

**NORTHEAST ILLINOIS REGIONAL COMMUTER RAILROAD CORPORATION**  
**D/B/A METRA**  
**INVITATION FOR BIDS**  
**METRA IFB NO. 13039A**

In order to be responsive, SEALED BIDS must be signed and received by the Northeast Illinois Regional Commuter Railroad Corporation D/B/A/ Metra at its office, 547 West Jackson Boulevard, 11<sup>th</sup> Floor East, Chicago, Illinois 60661, no later than 2:00 P.M., local prevailing time on July 10, 2018 at which time and place, all such bids will be opened publicly and read aloud for the following:

**(Re-Bid)** Contractor shall as an independent contractor and not as an agent of Metra provide all permits, labor, tools, equipment, insurance, transportation, facilities, etc. necessary for construction services to convert Metra's 95<sup>th</sup> Street existing tie station and Metra's Riverdale existing tie station into full traction power substations.

**Project No.(s) 4254**  
**CRD-2014-LSCII,CRD-2014A-LR4,CRD-2014-LSC2, IL-54-0002**

**NOTES:**

- 1. A pre-bid meeting will be held at 10:00 A.M. on June 18, 2018 at W. 141<sup>st</sup> Street and S. Atlantic Avenue in Riverdale, Illinois. After viewing this location, we will proceed to the 95<sup>th</sup> Street Substation location and meet on the southwest corner of 800 E. 95<sup>th</sup> Street in Chicago, Illinois.**
- 2. ALL ATTENDEES ARE REQUIRED TO WEAR A HARD HAT, ORANGE SAFETY VEST (CLASS II WITH REFLECTIVE STRIPING), SAFETY GLASSES (SIDE SHIELDS FOR PRESCRIPTION EYEWEAR), AND STEEL TOED SAFETY BOOTS AT THE PRE-BID MEETING.**
- 3. Questions regarding this IFB shall be submitted in writing to Steve Bauman, Sr. Contracting Agent via email at [sbauman@metrarr.com](mailto:sbauman@metrarr.com) before 3:00 p.m. on June 22, 2018.**
- 4. The Disadvantaged Business Enterprise (DBE) Goal for this project is 10%.**

This IFB may be downloaded at [www.metrarail.com](http://www.metrarail.com) under the About Metra Section, Metra & Business, Invitation for Bids. Company registration is required to download all bid packages.

All Bids must be only in the form prescribed by METRA and must be made in accordance with this Invitation for Bid, and other Contract documents, all of which are on file and available for examination at the office of METRA at the above address and are made part of this notice as though fully set forth herein. **Vendors may deliver bids to the Materials Management Department, Monday-Friday between the office hours of 8:00 A.M. and 4:00 P.M. (LPT).** Metra reserves the right to accept any Bid or any part thereof or reject any and all Bids.

Construction of the aforementioned is funded in major part by the Federal Transit Administration ("FTA"), the Regional Transportation Authority ("RTA") and the Illinois Department of Transportation ("IDOT"), pursuant to financial assistance Agreements with said agencies.

Each bid must be accompanied by a bid deposit of 5% of the total base bid price in the form of a cashier's check, certified check, bid bond. The successful bidder will be required to submit payment and performance bonds in an amount equal to the total value of the award.

Metra, reserves the right to accept any bid, any part or parts thereof, or to reject any and all bids. Acceptance of any bid is subject to the concurrence by the FTA, RTA and IDOT.

Metra, in accordance with Title VI of the Civil Rights Act of 1964, 78 Stat. 252, 42 U.S.C. 200d-4 and Title 49; Code of Federal Regulations, Subtitle A., Part 21 (Non-discrimination in Federally-Assisted Programs of the Department of Transportation) issued pursuant to said Act, hereby notifies all bidders that it will affirmatively ensure that in regard to any Contract entered into pursuant to this Invitation, minority business enterprises will be afforded full opportunity to submit bids in response to this Invitation and will not be discriminated against on the grounds of race, color, creed, sex, disability, or national origin in consideration for an award.

In order to be considered responsible all bidders will be required to certify that they are not on the Comptroller General's list of ineligible contractors.

Bidders should confirm that DBE firms are (IL UCP) certified by going to the websites of IDOT, City of Chicago, Metra, Pace and/or CTA.

Northeast Illinois Regional Commuter Railroad Corporation D/B/A/ Metra

Senior Contracting Agent: Steve Bauman

# INVITATION FOR BID

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**(Re-Bid) Construction Services to convert Metra's 95th Street Existing Tie Station and Metra's Riverdale Existing Tie Station into Full Traction Power Substations**

**IFB NO. 13039A**

**PRE-BID MEETING DATE: June 18, 2018 at 10:00 A.M. (LPT)**

**QUESTION DEADLINE DATE: June 22, 2018 at 3:00 P.M. (LPT)**

**IFB DUE DATE: July 10, 2018 at 2:00 P.M. (LPT)**

**Sr. Contracting Agent: Steve Bauman**

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NORTHEAST ILLINOIS REGIONAL COMMUTER RAILROAD CORPORATION D/B/A METRA  
PROFESSIONAL SERVICES/CONTRACTS  
547 WEST JACKSON BOULEVARD  
CHICAGO, IL 60661

# **BID ENVELOPE SUBMITTAL INSTRUCTIONS**

**Submit your bid or proposal in a SEALED envelope  
The SEALED envelope is to be labeled with the information as indicated below:**

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**Bidder Name:  
Bidder Address:**

**METRA RAILROAD  
Materials Management Department  
547 W. Jackson Boulevard, 11E  
Chicago, IL 60661**

**Item: (Re-Bid) 95<sup>th</sup> & Riverdale Substation  
SEALED BID NO.: 13039A  
OPENING DATE (Enter Date):  
Sr. Contracting Agent: Steve Bauman**

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# NO OFFER BID SHEET

**NO OFFER:** If not bid is to be submitted, detach this sheet from the Invitation for Bid, complete the information requested, fold, staple, affix postage, enter return address and mail.

**NO ENVELOPE NECESSARY**

**NO BID SUBMITTED FOR REASONS CHECKED:**

( ) CANNOT COMPLY WITH SPECIFICATIONS

( ) DO NOT PERFORM THIS SERVICE

( ) OTHER

(SPECIFY): \_\_\_\_\_  
\_\_\_\_\_

SIGNATURE AND TITLE: \_\_\_\_\_  
PRINT

COMPANY: \_\_\_\_\_

(FOLD ALONG DOTTED LINE)

-----  
FROM:

AFFIX POSTAGE

METRA RAILROAD  
MATERIALS MANAGEMENT DEPARTMENT  
547 W. JACKSON BOULEVARD, 11E  
CHICAGO, IL 60661

Item: (Re-Bid) 95th & Riverdale Substation  
SEALED BID NO.: 13039A  
Sr. Contracting Agent: Steve Bauman



**IFB NO. 13039A**

**NORTHEAST ILLINOIS REGIONAL COMMUTER RAILROAD CORPORATION, D/B/A  
METRA**

**547 West Jackson Boulevard  
Chicago, Illinois 60661**

**PROPOSAL/CONTRACT**

**This Contract is entered into by and between the Northeast Illinois Regional Commuter Railroad Corporation, D/B/A Metra a public corporation under the laws of the State of Illinois, and \_\_\_\_\_ a \_\_\_\_\_ organized and existing under the laws of the State of \_\_\_\_\_ (Contractor).**

**WITNESSETH:**

**ARTICLE I - SCOPE OF WORK**

**1.0 GENERAL.**

Contractor shall, as an independent contractor and not as an agent of METRA, provide all permits, labor, tools, equipment, insurance, transportation, and facilities, etc. necessary for **Construction Services to convert Metra's 95th Street existing tie station and Metra's Riverdale existing tie station into full traction power substations, per the attached plans and specifications.**

1.1 **EXHIBITS.**

The following Exhibits are attached hereto and incorporated herein by reference:

**BID SUBMITTAL CHECKLIST**

- EXHIBIT A -** Omitted by Metra
- EXHIBIT B -** Information For Bidders
- EXHIBIT C -** General Provisions
- EXHIBIT D -** FTA/IDOT Addendum for Construction Contracts
- EXHIBIT E -** Labor Provisions
- EXHIBIT F -** Civil Rights Requirements (Title VI Assurance)
- EXHIBIT G -** Construction Insurance Requirements
- EXHIBIT H -** Tax Exemption Authorization
- EXHIBIT I -** DOL - Equal Employment Opportunity Requirement
- EXHIBIT J -** Certification Regarding a Drug Free Workplace
- EXHIBIT K -** Metra Disadvantaged Business Compliance Requirements
- EXHIBIT L -** Affidavit/Certification
- EXHIBIT M -** Buy America Certificate
- EXHIBIT N -** Project Signs
- EXHIBIT O -** Standard Contractor Application and Certification for Payment
- EXHIBIT P -** Omitted by Metra
- EXHIBIT Q -** Omitted by Metra
- EXHIBIT R -** Metra Specification No. -1649-17, Traction Power Augmentation, 95<sup>th</sup> and Riverdale Tie Station Conversion, including Subsurface Exploration for 95<sup>th</sup> Street; and Subsurface Exploration for Riverdale
- EXHIBIT S -** Drawings - 95<sup>th</sup> Street Substation and Riverdale Substation
- EXHIBIT T -** Construction Safety Instructions
- EXHIBIT U -** Quality Management Program
- EXHIBIT V -** U.S. Department of Labor Wage Determinations
- EXHIBIT W -** U.S. Department of Transportation FTA Requirements, Contract Clauses
- EXHIBIT X -** Veterans Preference

**ARTICLE II - PERIOD OF PERFORMANCE.**

2.0 **PERIOD OF PERFORMANCE.** The Contractor shall complete the work within a duration period of 570 calendar days which starts from the award date (not the notice to proceed date) of this Contract. Actual work cannot begin until receipt of a written "Notice to Proceed" is given by Metra. A Notice to Proceed will be issued once the Contractor has submitted and Metra has approved the Contractor's necessary bonds, insurance and DBE subcontracts (if applicable). In addition, the Contractor must submit its approved Federal Railroad Administration (FRA Control of Alcohol and Drug Use (49 CFR Part 219) Railroad Contractor Compliance Plan along with the FRA's written approval of the Contractor's plan. Metra reserves the right to terminate the contract if these documents are not submitted to and approved by Metra within 30 calendar days from the award date of the contract.

**ARTICLE III - CONSIDERATION.**

3.0 **CONSIDERATION.** As consideration for the work under this Contract, the Contractor shall receive a fixed price sum of:

GRAND TOTAL NUMERIC NUMBER AND ALL APPLICABLE ALLOWANCES AS SET FORTH IN THIS IFB: \$\_\_\_\_\_.

Write in dollar amount: \_\_\_\_\_

3.1 **PROGRESS PAYMENTS.** Contractor shall submit certified estimates to Metra on or about the first day of each month during the progress of the work. Metra will pay on or about thirty (30) days from receipt of the certified estimates for the work installed per Metra's standard pay request application form #CP100097 attached as Exhibit O. Ten percent (10%) of the cost of the work will be retained until such time as 80% work provided for in this Contract is completed and accepted. The retainage will be reduced to 5% upon completion and acceptance of 80% of the work.

a. Contractor's application for payment is to be on a long form affidavit, itemizing Contractor's mobilization, general conditions, and all areas of construction not subcontracted, and will include profit and overhead, and all subcontractor contracts, supervision, bonds, and insurance.

b. Chicago Title & Trust type waivers (pink and blue forms) shall be included for the previous monthly draw. Metra may exercise its right to request photocopies of cancelled checks from the Contractor to his subcontractors, manufactures, & suppliers, etc. When Metra requires them, copies of these cancelled checks shall accompany each pay request. Upon Metra's request, cancelled checks shall be submitted for the month previous to the amount shown on the pay request minus retainage. As an example, Pay Request No. 3 should include waivers for Pay Request No. 2 and cancelled checks from Pay Request No. 1.

Contractor Acknowledgement Form

The Contractor is to complete and submit this form with its bid or within 2 business days of request by Metra. Failure to supply this information may result in your bid being rejected.

The Contractor hereby acknowledges that the PSE installed equipment to be furnished, and the ductbanks will comply with the dimensions shown on drawing numbers: 1050, and 1071 for both Riverdale and 95<sup>th</sup> Street Substations.

\_\_\_\_\_  
Contractor Signature

\_\_\_\_\_  
Date

The Contractor hereby acknowledges its compliance with Specification Section 16612 - IN-LINE TEST ON RECTIFICATION EQUIPMENT AND SURGE AND DESTRUCTIVE TEST ON DIODES.

\_\_\_\_\_  
Contractor Signature

\_\_\_\_\_  
Date

The Contractor will include with his first pay request a breakdown of how much of each pay item will be paid to each subcontractor and supplier.

- c. The Contractor must submit an initial draw request to Metra's project representative and project management consultant for approval prior to formal submittal.
- d. Upon Metra's request, invoices for progress payments must include supporting documentation such as packing slips, subcontractor's invoice and material invoices.

3.2 **INVOICING AND PAYMENT.** Payment terms shall be net thirty (30) days after receipt by Metra of invoice or completion of work. The Contractor shall submit schedule of values for approval using Metra Form No. CP10079, Exhibit O. Contractor shall submit its invoices to:

**Metra  
Accounts Payable, REF. Project No.  
547 West Jackson Boulevard  
Chicago, Illinois 60661**

Invoice should show:

Metra Account No. \_\_\_\_\_

Metra Contract No. \_\_\_\_\_

3.3 **CHANGES IN THE SCOPE OF WORK.** Changes in the contractual scope of work shall be preceded by a duly executed Change Order or Contract Modification Worksheet itemizing any change in the Contract sum or terms and conditions.

- a. Any change in the scope of work, Contract Modification, or Change Order amount must be submitted on Metra's Contract Modification Worksheet, and negotiated with Metra. All Change Orders must be approved by Metra prior to execution. Final authority will reside with the Executive Director.
- b. On Contracts less than \$1,000,000.00, the Contractor's profit added to the subcontractor's itemized statement cannot exceed five (5) percent and overhead cannot exceed ten (10) percent. On Contracts over \$1,000,000.00, the Contractor's profit added to the subcontractor's itemized statement cannot exceed five (5) percent and overhead cannot exceed five (5) percent.

- c. On work performed by the Contractor's own forces, the Contractor will be reimbursed for actual cost of labor, materials, use of tools, and use of equipment. Contractor's profit added to the direct costs cannot exceed five (5) percent overhead cannot exceed five (5) percent.
- d. On contracts less than \$1,000,000.00, subcontractors profit cannot exceed five (5) percent and overhead cannot exceed ten (10) percent. On contracts \$1,000,000.00 or greater, the subcontractors profit cannot exceed five (5) percent and overhead cannot exceed five (5) percent.
- e. Metra and/or designated construction Manager will be responsible to execute a standard Metra Change Order form describing the change in scope including justification for same.

**ARTICLE IV - SPECIAL CONDITIONS**

- 4.0 **LABOR PROVISION - CONSTRUCTION.** The Contractor and all DBE subcontractors shall furnish copies of their employment makeup as set forth in Exhibit E to:

Ms. Janice R. Thomas, Sr. Division Director, Office of Diversity and Civil Rights  
Metra - Office of Diversity and Civil Rights Division  
547 W. Jackson Boulevard - 5th Floor  
Chicago, IL 60661

- 4.1 **RESIDENT INSPECTOR.** Metra may have a resident inspector at the construction site to monitor progress and conduct such inspections and tests as are necessary to protect Metra's interests. Metra also reserves the right of source inspection at the Contractor's and its sub-contractors' places of manufacture or fabrication. Contractor shall provide office space for the resident inspector and permit his presence in the production and/or construction area at all reasonable times. Such office space shall be adequate, in the opinion of Metra, for the intended purpose, and shall be equipped with utilities supplied, furnished, maintained, cleaned, and protected with security as necessary by the Contractor in a manner equivalent to that provided by the Contractor for performing similar functions within his own shop and office facilities.

4.2 **DISADVANTAGED BUSINESS COMPLIANCE REQUIREMENTS.** As a condition of award, the Contractor must comply with the Disadvantaged Business Compliance Requirements contained in Exhibit K. Firms claiming to be minority/female owned and controlled must be certified by Metra. Applications for certification may be obtained from the Office of Bus. Div. and Civil Rights Department (312) 322-6323.

**\*Note: Some of these documents must be completed and submitted with the bid as a condition of responsiveness.**

4.3 **HEADINGS.** The article, section, paragraph, or other headings are for convenience and reference only and in no way define, limit, or describe the scope or intent of this Contract or its Exhibits.

4.4 **REFERENCES.** All references to Metra shall be construed as and shall be references to the Northeast Illinois Regional Commuter Railroad Corporation.

4.5 **ENTIRE AGREEMENTS.** This Contract, together with any other documents expressly incorporated into the foregoing, contain the entire agreement between the parties hereto and there are no prior or contemporaneous oral or written understandings or agreement binding on Metra affecting the subject matter of this Contract other than those expressly referred to therein. No other agreement, understanding, acknowledgment, invoice, or other form used by Contractor, in any way purporting to modify or alter the provisions of this Contract will be binding upon Metra unless made in writing and signed by Metra's authorized representative.

4.6 **JURISDICTION.** This Contract is made and shall be interpreted under the laws of the State of Illinois, and Contractor agrees and consents that only the Courts of Illinois, the United States District Court for the Northern District of Illinois and the Seventh Circuit shall have jurisdiction over controversies arising out of this Contract.

4.7 **AWARD.** Award of the Contract may be subject to FTA/IDOT approval.

4.8 **UTILITIES AND FEES.** All temporary utilities, including but not limited to heat, electricity, and water are to be paid by the Contractor. Any permit or tap fees are to be paid by the Contractor.

4.9 **LIQUIDATED DAMAGES.** Time is of the essence of this Contract. Should the Contractor neglect, refuse, or fail to complete the work under this Contract within the time agreed upon, and in view of the difficulty of estimating with exactness damages caused by such delay, Metra shall have the right to charge the Contractor the sum of \$3,560.00 per day for each and every calendar day that such work under this contract is delayed in its completion beyond the specified time, as liquidated damages and not a penalty.

4.10 **CONFLICT OF INTEREST.** No contract for the construction of a project shall be awarded to the firm, its subsidiaries, or affiliates that designed the project, except with the approval of Metra and/or the funding agencies or authorized representative.

4.11 **ADDENDA.** Contractor acknowledges receipt of the following addenda, attached hereto and made a part hereof:

**Addendum No.**

**Addendum Date**

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

4.12 **APPROPRIATION OF FUNDS**

If this Contract is for a period of longer than one year, it is subject to the appropriation of funds by Metra's Board of Directors for each year beyond the first year of this Contract.

**IN WITNESS WHEREOF**, the parties hereto have executed this Contract as of date of award shown below.

By execution below, bidder hereby offers to perform the construction services as indicated herein.

**Bidder/Contractor**

\_\_\_\_\_  
**Firm Name**

\_\_\_\_\_  
**Street Address**

\_\_\_\_\_  
**City State Zip**

\_\_\_\_\_  
**Print Name**

X  
\_\_\_\_\_  
**Signature of Authorized Signee**

\_\_\_\_\_  
**Title**

\_\_\_\_\_  
**Phone**

\_\_\_\_\_  
**FAX**

\_\_\_\_\_  
**Date**

**By execution below Northeast Illinois Regional Commuter Railroad Corporation, D/B/A Metra/Metropolitan Rail accepts offer as indicated above.**

\_\_\_\_\_  
**Signature**

\_\_\_\_\_  
**CEO/Executive Director**

\_\_\_\_\_  
**Date of Award**

**ATTENTION**

**ATTENTION**

## **BID SUBMITTAL CHECKLIST**

Use the following checklist to ensure completeness in assembling your bid. Failure to submit and/or complete all requested information may result in your bid being rejected as materially non-responsive.

CHECK BOX WHEN COMPLETED

- A.**  **Bid Envelope:** Properly addressed
- B.**  **Proposal/Contract:** All spaces filled in, the bid amount, paragraph 3.0 page 3, Page 3A – Contractor Acknowledgement Form; list addenda in paragraph 4.11 on page 7; the signature page 8 executed; two (2) sets of pages 1 thru 8 with original signatures on both copies
- C.**  **Exhibit J:** Certification Regarding a Drug Free Workplace  
- Executed
- D.**  **Exhibit K:** Metra Disadvantaged Business Compliance Requirements – Executed
- E.**  **Exhibit L:** Affidavit/Certification – Executed
- F.**  **Exhibit M:** Buy America Certificate: Executed
- G.**  **Bid Bond or Cashier's/Certified Check For 5% of the Bid Amount** - Enclosed
- H.**  **Additional Notes:**
  - Did your pricing take into consideration all applicable Specifications, Terms and Conditions used in this government procurement?
  - Bidders are cautioned *NOT* to qualify their bid by modifying the Contract documents, either by ALTERATION or by SUPPLEMENTAL STATEMENTS.
  - All bids are to be made in accordance with these specifications and Terms and Conditions. Bids which are *NOT* so made may be rejected as *NON-RESPONSIVE*.

OMITTED BY METRA

**Submission of Bid**

Bidder must submit two (2) complete, signed copies of the Contract and shall have entered the appropriate information in all blank spaces, in order to be responsive. In addition, as a condition of responsiveness, all Certificates and Affidavits must be completed and submitted with the submission of the bid.

Each bid must be submitted in a sealed envelope.

Once submitted, no bid may be withdrawn without Metra's consent, but it may be superseded by a subsequent timely bid. Any bid received after the time and date specified for opening, or any postponement thereof, will not be considered. Bids shall be irrevocable for a period of one hundred twenty (120) calendar days after Metra opens them.

Each bidder is responsible for reading the Contract Documents and for determining for itself that the Specification describes the work in sufficient detail. Failure of a bidder to do so shall not relieve the bidder of any obligation with respect to said bid. Bidders shall notify Metra of any inappropriate brand name, component, or equipment called for in the Specification by Metra. After bids have been opened, no bidder shall assert that there was a misunderstanding concerning the nature of the work to be done or the quantities and specifications of the equipment to be delivered, and no such claim shall relieve a bidder from its obligation to perform at the Contract Price.

The Contract Price shall include all permits, insurance, materials, plant facilities, work and expense necessary to perform the work in accordance with the Contract Documents at the Contract Price. The Contract Price shall not include any amount for sales or use taxes, or any other tax from which Metra is exempt.

Information (other than in the form of a written Addendum issued by Metra) from an officer, agent, or employee of Metra or any other person shall not affect the risks or obligations assumed by the bidder or relieve him from fulfilling any of the conditions and obligations set forth in the bid and other Contract Documents. Before the bids are opened, **ALL MODIFICATIONS OR ADDITIONS TO THE SPECIFICATIONS, GENERAL PROVISIONS, OR OTHER CONTRACT DOCUMENTS WILL BE MADE IN THE FORM OF A WRITTEN ADDENDUM ISSUED BY METRA.** Metra will send copies of any such Addendum (including notice of Approved Equals) not less than ten (10) calendar days before bids are opened to those persons who have received bid packages.

The Specifications describe the equipment and the standard of construction, and are not intended to describe a particular manufacturer's product. Brand names specified in the Specifications shall be deemed to include Approved Equals, but bidder must obtain Metra's approval of their proposed equal not less than ten (10) calendar days before bids are opened, and Metra will notify all bidders accordingly.

**Bid Deposit**

Each bid must be accompanied by a Bid Deposit, as earnest money, in the form of a bid bond, a certified or cashier's check, drawn on a responsible bank, made payable to the order of Metra for 5% of the total bid price amount including alternates. As soon as the bid prices have been compared, Metra will return the deposit of all except the three lowest bidders. When the Contract is executed, the deposits of the two remaining unsuccessful bidders will be returned. The Bid Deposit of the successful bidder will be retained until the Payment and Performance Bonds and Insurance Certificates have been received and approved, at which time it will be returned.

**Award, Payment/Performance Bond and Insurance**

The bidder, having executed the Contract signature page, understands and agrees Metra may enter into the Contract by executing said signature page and returning one copy of the Contract to the bidder. The Award Date of the Contract shall be that date on which the Contract is delivered to the successful bidder.

**BONDS, PAYMENT & PERFORMANCE**

Payment and Performance Bonds each in the amount of 100 percent of the Contract Price, with a corporation surety satisfactory to Metra, will be required to assure performance of the Contract. Any attorney-in-fact who signs any bond must attach to each bond an effective copy of his power of attorney, the date of the bond specifically including such date within the authority conferred thereby.

Acceptable Bond Form is the February 1970 Edition of AIA Document A311, Performance Bond and Labor and Material Payment Bond.

The Contractor shall furnish a performance bond, satisfactory to Metra, within thirty (30) calendar days of Contract award.

Payment bonds and performance bonds must be provided by a company listed in Federal Register Circular 570, latest revision, Surety Companies Acceptable on Federal Bonds, and a Financial Rating of V or better as published by Best's Key Rating Guide, latest edition. Additionally, the bonding firm must be registered to do business in Illinois by the State of Illinois Department of Insurance.

In case of failure of the bidder to timely provide the Payment and Performance Bonds and/or the Insurance Certificate to Metra, may at its option, declare the bidder in default of the Contract, in which case the Bid Deposit accompanying the proposal shall be forfeited to, and shall become the property of Metra. Metra may elect either to accept the next lowest responsible bid, or re-advertise for new bids and take such other actions as are provided for under the Default Termination Provisions of the Contract.

**EVALUATION OF BIDS/BIDDERS**

Metra may make such investigations as it deems necessary to determine the ability of the bidder to perform the work in conformity with the Contract Documents, and the bidder shall furnish to Metra all such information and data for this purpose as Metra may request.

Metra reserves the right to waive minor informalities or irregularities in the bids received, to accept any bid deemed advantageous to Metra, or to reject any and all bids submitted. Conditional bids, or those which take exception to the Contract Documents without prior written approval from Metra, may be considered nonresponsive and may be rejected.

If awarded, the Contract shall be awarded to the lowest responsive, responsible bidder. The low bid shall be calculated on the base bid, or the base bid plus one or more of any of the alternate bids, in any combination, solely as determined by Metra pursuant to its best interests. In determining the lowest responsive and responsible bid, consideration will be given to several factors, including but not limited to price, financial responsibility of the bidder, completion date, responsiveness to the specifications, suitability of the equipment offered for its intended use, and the experience of Metra and other purchasers with the bidders.

**EXHIBIT B**  
**INFORMATION FOR BIDDERS**

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Metra may conduct a price and/or cost analysis of the bid as set forth in FTA circular 4220.1F. A price analysis is the process of examining the bid and evaluating a proposed price without evaluating the separate cost elements. The price analysis, through comparison to other similar procurement's, will be based on established or competitive prices of the elements used in the comparison. The comparison will be made to a purchase of similar quantity and involving similar specifications. Where a difference exists, a detailed analysis will be made of this difference and costs attached to the difference.

Metra may, in addition to or in place of a price analysis, conduct a cost analysis of the bid price. A cost analysis is the process of verifying individual cost elements that make up the total cost proposed.

The price and/or cost analysis will be made by Metra in conjunction with this bid. If Metra cannot perform the needed analysis, Metra may obtain the services of a qualified firm to perform the cost analysis.

By submitting its bid, the bidder agrees to furnish, upon request from Metra, all information (including a list of subcontractors and suppliers and their prices) reasonably necessary for such analysis. Furthermore, Metra may request that the bidder show, in detail, the kinds, quantities, and prices of direct material and direct labor used to develop prices/costs submitted in the bid. In addition, Metra reserves the right to request and receive information explaining and estimating process, including the judgmental factors and methods used to project from known data, and the contingencies used. Metra may require the bidder to show how it computes and applies indirect costs, and to show trend and budgetary data.

Metra may also conduct a pre-award facility survey of the bidder. This survey may include, but is not limited to, determining if the bidder has the experience and capability and the necessary facilities and financial resources to complete the Contract in a satisfactory manner within the required time.

Metra award will be made within one hundred and twenty (120) days after the date of the bid opening, or any mutually agreed extension thereof.

Metra's bid protest procedures are available upon request. You have the right to protest this IFB or RFP. There are important time limits set forth in the procedures which are summarized here, but this paragraph is not meant to substitute the procedures. Any discrepancies between this paragraph and the bid protest procedures shall be decided by applying the procedures. If you wish to protest this solicitation, the protest must be filed in writing with Metra no later than five (5) days before the opening of bids. If you wish to protest the bid evaluation, the protest must be filed in writing with Metra no later than five (5) days after the bid opening. If you wish to protest award of the Contract, the protest must be filed, in writing with Metra, no later than five (5) days after Metra notifies bidders, in writing or orally, of the lowest responsive and responsible bidder. FTA will only review the protest regarding the alleged failure of the grantee to have written protest procedures or allege failure to follow such procedures. For more details concerning FTA's role in bid protests, bidders are referred to Metra's Bid Protest Procedures and FTA circular 4220.1F.

**EXHIBIT C**  
**GENERAL PROVISIONS (Construction)**

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<b>1.</b>	<b>GENERAL</b>	<b>PAGE</b>	<b>1</b>
<b>2.</b>	<b>PAYMENT</b>	<b>PAGE</b>	<b>1</b>
<b>3.</b>	<b>JOINT VENTURES AND SUBCONTRACTS</b>	<b>PAGE</b>	<b>2</b>
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**EXHIBIT C**  
**GENERAL PROVISIONS (Construction)**

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1. **GENERAL**

- A. The work called for herein is not part of the trade or business of Metra but is a part of the regular line of business and trade of the Contractor.
- B. Contractor shall at all times have a qualified representative acceptable to Metra available for consultation. Such representative shall have the authority to make field decisions, receive direction from Metra's representative, and direct, supervise, and schedule the Contractor's employees and subcontractors. The Contractor shall not lend its employees to Metra or request the loan of Metra employees for any purpose.
- C. It is understood that all materials furnished hereunder will be new, that workmanship and materials under this Contract are to be first quality in every respect, and that the complete job is subject to Metra inspection and approval before final payment is made.

2. **PAYMENT**

- A. Payments will be made as provided in the Contract unless otherwise authorized in writing by Metra, the items of work for which payment will be made shall be limited to those listed and enumerated in the Contract. The unit prices or lump sum price or prices stated in the Contract will be used in determining the amount to be paid and shall constitute full and final compensation for all work.
- B. There shall be no increase in the cost of any Fixed Price portion of this Contract except as provided for under the **CHANGES** clause of this Contract.
- C. Metra may withhold interim and/or final payments to Contractor, pending Contractor's submission (in accordance with Il. Rev. State. 1954, Chap. 82, Sec. 5) to Metra of a sworn statement, stating the names of all parties furnishing, or who have furnished, material and/or labor and the amounts due, or to become due to each.
- D. If any portion of this Contract is on other than a Fixed Price basis, and Contractor has reason to believe that the costs of the Non-Fixed Price portions(s) which it expects to incur thereunder in the next thirty (30) days, when added to the costs previously incurred, will exceed eighty-five percent (85%) of the estimated cost thereof, the Contractor shall notify Metra in writing to the effect giving a revised estimate of the total cost of performance of that portion(s) of the Contract.
  - i Metra shall not be obligated to pay the Contractor in excess of the estimated amount(s) for labor and materials or any Non-Fixed Price portion of this Contract, unless Metra notified the Contractor in writing that the estimated cost for same has been increased.
  - ii Contractor shall be reimbursed only for the actual amount paid to sub-contractors for materials under the Non-Fixed Price portion of this Contract. No payment of any kind shall be made to Contractor as a part of the material(s) cost for letting administrative handling or supervising the acquisition of the materials.
  - iii Metra and the Contractor must execute the Field Inspection Report, prior to Metra making payment(s) to the Contractor. When TIME AND MATERIAL AND/OR UNIT PRICE is provided in the Contract, Metra and Contractor must additionally execute, for said work each day, a "Daily Report", to permit payment for same.

**3. JOINT VENTURES AND SUBCONTRACTS**

**A. JOINT VENTURES**

A joint venture agreement of the parties must be submitted to Metra for Metra's approval at the time of bid/proposal due date. The joint venture agreement must be properly executed by authorized officers of each party in the joint venture.

The agreement must address the administrative, financial, and field responsibilities of each partner. The agreement, at a minimum, must define the portions of the work of the agreement and contract each partner is responsible for and whose share in the capital contribution, control, management, risks, and profits of the joint venture are commensurate with its ownership interest.

Prior to award of a contract, Metra reserves the right to request the parties of the joint venture to provide additional documentation to verify the legal, financial and corporate responsibilities of the joint venture.

**B. SUBCONTRACTS**

No part of the work covered under this Contract shall be sublet by the Contractor without prior approval from Metra. A list of proposed sub-contractors shall be submitted to Metra for approval, prior to start of work. In subletting any such work, the Contractor shall obtain the written agreement of each sub-contractor in terms substantially equivalent to the terms herein set forth, and shall require each sub-contractor to furnish certificates of insurance in compliance with Metra's insurance requirements in advance of commencing work, and provide proof of these requirements to Metra.

a.) Nothing contained in the Contract shall be construed as creating a Contractual relationship between any subcontractor and Metra. The divisions or sections of the specifications are not intended to control the Contractor in dividing the work among subcontractors, or to limit the work performed by any trade. The Contractor shall be responsible to Metra for acts and omissions of his own employees, subcontractors, and their employees. He shall solely be responsible for the coordination of the work of the trades, subcontractors, and suppliers. Metra will not undertake to settle any differences between or among the Contractor, subcontractors, or suppliers.

b.) Metra may undertake or award other Contracts for additional work at or near the site of the work under this Contract. The Contractor shall fully cooperate with the other Contractors and with Metra employees and shall carefully adapt scheduling and performing the work, heeding any direction that may be provided by the Metra's Project Manager or Metra's Contracting Officer. The Contractor shall not commit or permit any act that will interfere with the performance of work by any other Contractor or by employees.

**4. WARRANTY**

For a period of one (1) year from the date of completion, as evidenced by the date of Final Acceptance of the Work, the Contractor warrants that work performed under this Contract conforms to the Contract requirements and is free of any and all defects of equipment, material or workmanship performed by the Contractor or any of its subcontractors or suppliers. Under this warranty, the Contractor shall remedy at its own expense any such failure to conform or any defect. Nothing in the above intends or implies that this warranty shall apply to work which has been abused or neglected by Metra or other user. In the event that there are multiple warranty provisions, then the most stringent warranty shall prevail.

5. **MATERIALS AND EQUIPMENT**

- A. The Contractor at its own cost and expense shall provide all manner of materials, labor, tools, equipment cartage, and facilities necessary for the performance and completion of the work.
- B. The Contractor shall be solely responsible for its tools, equipment and materials and shall load, unload, and provide storage facilities for same, in an area specified by Metra and in such manner that traffic may be maintained in buildings, on roads, and railroads (as applicable) during and after working hours.

6. **PERMITS AND LICENSES**

Permits and licenses of any nature necessary for the prosecution of the work shall be secured and paid for by the Contractor. The Contractor shall give all notices required by and otherwise comply with all laws, ordinances, rules, and regulations, including the safety rules and regulations of Metra, bearing on the conduct of said Work.

7. **PROTECTION OF PROPERTY**

- A. The premises are to be kept in a neat and orderly condition, and unless otherwise specified in this Contract, title to all demolished materials and equipment, waste, excavated material, and rubbish is vested in Contractor and shall be disposed off the premises by Contractor, unless specified to the contrary elsewhere in the Contract.
- B. Any damage caused by the Contractor's performance of this Contract to structures, utilities, facilities, or property shall be promptly repaired or restored to its original condition by the Contractor at its own expense irrespective of fault, unless instructed to the contrary by Metra.
- C. Metra shall assume risk of loss of the work and materials only upon Final Acceptance. Prior to Final Acceptance, the Contractor shall have risk of loss of the work, including any damages sustained from any cause whatsoever.
- D. The Contractor shall lay out its work from the established ranges and gages indicated on the drawings and shall furnish at its own expense, all stakes, templates, platforms, equipment range markers, and labor as may be required for the execution of work to such lines and grades as may be established or indicated by Metra until authorized to remove them. If such marks are destroyed by the Contractor through its negligence prior to their authorized removal, they may be replaced by Metra at its discretion. The expense of replacement will be deducted from any amounts due, or to become due the Contractor.

8. **LIENS**

The Contractor shall not at any time suffer nor permit any lien or attachment or other encumbrance to be put or remain on said premises or the work to be constructed thereon for or on account of any work or materials furnished hereunder or by reason of any other claim or demand against the Contractor, and the Contractor shall not put any materials on said premises unless the Contractor has an unencumbered title thereto. Metra shall require waivers of lien prior to making final payment under this Contract.

9. **UTILITIES**

Contractor shall be responsible to provide, at its expense, all such utilities and sanitary, storage, office and other facilities as it may need during the performance of this Contract. Contractor shall maintain

these utilities and facilities in accordance with applicable laws, codes, and standards, and shall remove same upon completion of the work in a manner satisfactory to Metra.

10. **DRAWINGS AND SPECIFICATIONS**

The Contractor shall check all drawings and specifications, if any, furnished him immediately upon their receipt, and shall promptly notify Metra of any omissions, discrepancies, or variations from field conditions. The Contractor shall compare all drawings and verify the figures before laying out the work and will be responsible for any errors which may result therefrom. Omissions from the drawings or specifications, variations between drawings, specifications and field conditions, or the misdescription of details of work which are manifestly necessary to carry out the intent of the drawings and specifications, or which are customarily performed, shall not relieve the Contractor from performing such omitted or misdescribed details of work, but shall be performed as if fully and correctly set forth and described in the drawings and specifications. Work shown on drawings but not on specifications or work shown on specifications but not on drawings shall be performed as if on both drawings and specifications. The Contractor has an obligation to bring patent discrepancies to Metra's attention.

11. **SAFETY AND SECURITY**

- A. Contractor shall at all times be responsible to enforce strict discipline and good order among its employees and provide such items as flagmen, barricades, danger signs, etc., as are necessary for the protection of the property, its owners, employees, other Contractors, Metra, and the general public. In addition, the Contractor shall insure compliance with all safety codes laws and standards. Specific rules relative to the work site will be explained to the Contractor at pre-work safety conference, such as the limitation of the Contractor's employees to definitive area and routes of ingress and egress.
- B. Pursuant to Section 107 of the Contract Work Hours and Safety Standards Act and Department of Labor regulations, "Safety and Health Regulations for Construction," 29 C.F.R. 1926, no laborer or mechanic working on a construction Contract shall be required to work in surroundings or under working conditions that are unsanitary, hazardous, or dangerous to his or her health and safety as determined under construction and health standards promulgated by the Secretary of Labor.
- C. Contractor shall comply with Federal Railroad Administration requirements (49 CFR 214) Working On Railroad Bridges, described in the Metra Safety Rules H469, H470 and H471. Contractor shall be supplied with a copy of the written rules for inclusion in the Contractor's safety program.

12. **CONTRACTOR ACKNOWLEDGMENT**

The Contractor acknowledges that it has satisfied itself as to the nature and location of the work, the general and local conditions, particularly those bearing upon transportation, disposal, handling, and storage of materials, availability of labor, water, electric power, roads, and uncertainties of weather, river stages, tides, and similar physical conditions at the site, the conformation and conditions of the ground, the character of equipment and facilities needed preliminary to and during the prosecution of the work, and all other matters upon which information is reasonably obtainable and which can in any way affect the work or the cost thereof under this Contract. The Contractor further acknowledges that it has satisfied itself as to the character, quality and quantity of surface and subsurface materials to be encountered insofar as this information is reasonably ascertainable from an inspection of the site, including all exploratory work done by Metra, as well as from information presented by the drawing and

specifications made a part of this Contract. Any failure by the Contractor to acquaint itself with all available information shall not relieve it from responsibility for estimating properly the difficulty or cost of successfully performing the work.

Metra assumes no responsibility for any misunderstanding or representations made by any of its officers or agents during or prior to the execution of this Contract, unless (1) such understanding or representations are expressly stated in the Contract, and (2) the Contract expressly provides that the responsibility therefore is assumed by Metra. Representations made but not so expressly stated for which responsibility is not expressly assumed by Metra in the Contract shall be deemed only for the information of the Contractor.

13. **POSSESSION OF WORK**

Metra shall have the right to take possession of or use any completed or partially completed work. Such possession or use shall not be deemed an acceptance of any work not completed in accordance with the Contract. If such prior possession or use by Metra delays the progress of the work or causes additional expenses to the Contractor, an equitable adjustment in the Contract price and/or time of completion will be made and the Contract shall be modified in writing accordingly.

14. **TAXES**

- A. The contract price shall not include, and Contractor shall not add to the Contract Price, any amount in the nature of sales, transfer, service or use taxes, or any other tax from which Metra is exempt, with respect to the work performed hereunder or the transfer or delivery of any of the equipment to Metra. In the event any claim is made against Contractor for payment of any such taxes, Contractor shall promptly notify Metra and afford to it the opportunity, before payment of any such taxes, to contest said claim in the manner and to the extent it may elect and to settle or satisfy such claim.
- B. Contractor covenants and agrees to pay all foreign, federal, state, and municipal taxes, duties, imposts, assessments, and charges (except as otherwise provided in paragraph A directly above) arising out of or in connection with the performance of the work, or the furnishing or delivery of the Equipment.

15. **NOTICES**

Except as otherwise specified in the contract documents, all requests, notices, demands, authorizations, directions, consents or waivers or other documents required or permitted under this Contract shall be in writing and shall be delivered in person to, or deposited postage pre-paid in the mails of the United States addressed to Metra's Director Professional Services/Contracts at the above address.

16. **SEVERABILITY AND WAIVERS**

- A. The parties agree that if any provision of this Contract shall be held invalid for any reason whatsoever, the remaining provisions shall not be affected thereby if such remaining provision should then continue to conform with the purposes of this Contract, and the terms and requirements of law.
- B. Metra's failure to promptly enforce any of the conditions of this Contract shall not be deemed to be a waiver, and no waiver of any rights under this Contract shall constitute a waiver of any of Metra's other rights.

17. **PASS-THROUGH**

All rights, warranties, guarantees, privileges, remedies, or other benefits granted under the Contract shall pass-through to any organization to whom Metra may assign, lease, sell or otherwise transfer the use of the completed work procured hereunder.

18. **INDEMNIFICATION**

Contractor hereby binds itself, its successors, and assigns, to indemnify, defend, and hold harmless Metra from all loss, damage, or expense (including attorneys' fee) due to any claim brought against Metra for alleged infringement of United States Letters Patent, of the United States of State Trademark laws, or of the United States or State Copyright Laws, arising from any material or design specified in, or supplied pursuant to, this Contract.

In connection with the performance of this Contract, the Contractor agrees to assume all risk of injury to person (including death) and damage to property suffered by Contractor, Metra, and all other persons, firms, and corporations, and the Contractor agrees to indemnify, defend, and save harmless Metra and its officers, agents (including for the purpose of this Contract, any Construction Management Consultant), and employees from and against all loss, liability, cost, and expense (including all costs of litigation and all attorney's fees) which any of them may incur, sustain, or be subject to on account of all claims, including injury or death to persons, or damage to property suffered by Contractor, Metra, and all other persons, firms, and corporations which result from or arise out of the performance of this Contract by Contractor, its agents, servants, or employees. This indemnification is not intended to violate the provisions of 740 ILCS 35/0.01 et seq., or any amendments thereto, and this indemnification shall not imply nor is it intended to be an indemnification of Metra's own negligence or the negligence of Metra's employees.

The indemnification (along with the Construction Insurance Requirements Form) sets for the entire understanding between the parties regarding this subject. Any modification of these terms must be approved by Metra in writing. In addition, the Contractor is to do so in writing. Any attempt by the Contractor to define such terms in the specification shall be void unless Metra specifically and expressly approves of the terms in writing.

19. **CONSTRUCTION STANDARDS**

Construction plans must meet seismic standards of the region.

20. **NOTICE-TO-PROCEED**

The Contractor is required to start construction within 10 calendar days of the Notice-to-Proceed if so directed by Metra.

21. **GIFT BAN ACT**

State of Illinois Gift Ban Act: The Contractor (Consultant, Vendor, or as appropriate) shall comply with the applicable provisions of the State of Illinois Gift Ban Act, 5 ILCS 430/10- 10 et seq. as amended, and refrain from providing gifts to Metra's employees in violation of Metra's Gift Ban Policy.

22. **TRAINING**

If required by Metra, Contractor will provide training and support materials, approved by Metra's Training and Development Division, to assure:

- A. **Operator proficiency.** Metra's operators of the product, system or equipment must have the knowledge and ability to use the product according to Metra standards.

**EXHIBIT C**  
**GENERAL PROVISIONS (Construction)**

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- B. **Metra personnel proficiency.** Metra personnel must have the ability to diagnose and repair common and uncommon problems with the product, system or equipment. Applicable Metra personnel must be able to:
- Locate and identify all vendor components.
  - Use vendor-provided parts manuals.
  - Use specialized diagnostic tools required by the particular product, system or equipment.
  - Use detailed vendor-provided troubleshooting guides, which may include, but are not limited to:  
Flow Charts Symptom maps
- C. **Support.** Contractor will provide the following operation and maintenance support materials:
- Master parts list.
  - Recommended life cycles of systems and sub-systems.
  - Recommended overhaul schedules and procedures.
  - Preventative maintenance schedules.
- D. **Training support.** Contractor will assist Metra's Training and Development Division in providing necessary skills and knowledge to supervisors and other personnel who need to know some components of the product, system or equipment. This includes all manuals and guides identified above in paragraphs.

A, B, and C of this section and:

- Multimedia information about the product, system or equipment in professional quality beta video format, or other Metra approved format and standards.
- Material standards:
- All text and graphics from vendor produced manuals in electronic Metra- approved format.
- All text materials will be targeted to an 8th grade reading level and competency of GED level 3.
- All manuals and procedures will comply with Metra Training defined standards, as attached. (Equipment manuals, Procedure sheets).

EXHIBIT D  
FTA/IDOT ADDENDUM FOR CONSTRUCTION CONTRACTS

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U.S. DEPARTMENT OF TRANSPORTATION  
FEDERAL TRANSIT ADMINISTRATION (“FTA”) AND  
ILLINOIS DEPARTMENT OF TRANSPORTATION (“IDOT”)  
ADDENDUM FOR CONSTRUCTION CONTRACTS

1. **Parties Affected.** The Contractor agrees to take appropriate measures to ensure that his firm, employees, any subcontractors, or any additional parties contracted for work as a result of this Contract will be responsible for compliance with those Federal and State requirements described in this Contract.
2. **False or Fraudulent Statements or Claims.** The Contractor recognizes that the requirements of the Program Fraud Civil Remedies Act of 1986, as amended, 49 U.S.C. part 3801 et seq and US DOT regulations 49 C.F.R. Part 31 apply to its actions pertaining to this Contract. Accordingly, the Contractor certifies or affirms the truthfulness and accuracy of any statement it has made, it makes, or it may make pertaining to the Contract. In addition to other penalties that may be applicable, the Contractor also acknowledges that if it makes a false, fictitious, or fraudulent claim, statement, submission, or certification, the Federal Government reserves the right to impose the penalties of the Program Fraud Civil Remedies Act of 1986, as amended, on the Contractor to the extent the Federal Government deems appropriate. If applicable, the Federal Government reserves the right to impose on the Contractor the penalties of 18 U.S.C. Part 1001 and 49 U.S.C. Part No. 5307 (n) (1), to the extent the Federal Government deem appropriate.
3. **Approved Equals and Brand Names.** Where a feature, component, or item is specified by brand name in the Specifications, the words “or Approved Equal” are implied. All approvals and requests for approvals of proposed Approved Equals must be in writing. Specification by brand name of components or equipment in the Specification shall not relieve Contractor from its responsibility to design and construct the Equipment and perform the work in accordance with the general performance requirements of the Specifications and these General Provisions.
4. **Environmental Requirements.** The Contractor recognizes that many Federal and State laws imposing environmental and resource conservation requirements may apply to the Contract. Some, but not all, of the major Federal laws that may affect the Project include: the National Environmental Policy Act of 1969, as amended, 42 U.S.C. § 4321 et seq.; the Clean Air Act, as amended, 42 U.S.C. § 7401 et seq, and scattered sections of 29 U.S.C.; the Clean Water Act, as amended, scattered sections of 33 U.S.C. and 12 U.S.C.; the Resource Conservation and Recovery Act, as amended, 42 U.S.C. §§ 6901 et seq.; and the Comprehensive Environmental Response, Compensation, and Liability Act, as amended, 42 U.S.C. §§ 6901 et seq. The Contractor also recognizes that U.S., EPA, FHWA and other agencies of the Federal Government have issued and are expected in the future to issue regulations, guidelines, standards, orders, directives, or other requirements that may affect the Project. Thus, the Contractor agrees to adhere to, and impose on its subcontractors and any other parties at any tier, any such Federal requirements as the Federal Government may now or in the future promulgate. Listed below are requirements of particular concern to FTA, Metra, and the Contractor. The Contractor acknowledges that this list does not constitute the Contractor’s entire obligation to meet all Federal environmental and resource conservation requirements.

a. **Environmental Protection.**

The Contractor agrees to comply with the applicable requirements of the National Environmental Policy Act of 1969, as amended, 42 U.S.C. §§ 4321 et seq. in accordance with Executive Order No. 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," 59 Fed. Reg. 7629, Feb. 16, 1994; FTA statutory requirements on environmental matters at 49 U.S.C. §5324(b); Council on Environmental Quality regulations on compliance with the National Environmental Policy Act of 1969, as amended, 40 C.F.R. Part 1500 et seq.; and joint FHWA/FTA regulations, "Environmental Impact and Related Procedures," 23 C.F.R. Part 771 and 49 C.F.R. Part 622.

b. **Air Quality.** The Contractor agrees as follows:

1. The Contractor agrees to comply with all applicable standards, orders, or regulations issued pursuant to the Clean Air Act, as amended, 42 U.S.C. §§ 7401 et seq. Specifically:

a) The Contractor agrees to comply with all applicable requirements of U.S. EPA regulations, "Conformity to State or Federal Implementation Plans of Transportation Plans, Programs, and Projects Developed, Funded or Approved Under Title 23 U.S.C. or the Federal Transit Act," 40 C.F.R. Part 51, Subpart T; and "Determining Conformity of Federal Actions to State or Federal Implementation Plans," 40 C.F.R. Part 93. To support the requisite air quality conformity finding for the Project, the Contractor agrees to implement each air quality mitigation and control measure incorporated in the Project. The Contractor agrees that any Project identified in an applicable State Implementation Plan (SIP) as a Transportation Control Measure, will be wholly consistent with the description of the design concept and scope of the Project described in the SIP.

2. The Contractor agrees to comply with, and assures compliance by its subcontractors at any tier, with these requirements resulting from the project. The Contractor will report any violation by its own employees and subcontractors at any tier that may result in any violation of these requirements to Metra, the FTA, and to the appropriate U.S. EPA Regional Office.

c. **Clean Water.** The Contractor agrees as follows:

1) The Contractor agrees to comply with all applicable standards, orders, or regulations issued pursuant to the Federal Water Pollution Control Act, as amended, 33 U.S.C. §§1251 et seq.

2) The Contractor agrees to comply with, and assures compliance by its subcontractors at any tier, with these requirements resulting from the project. The Contractor will report any violation by its own employees and subcontractors at any tier that may result in any violation of these requirements to the FTA, Metra, and to the appropriate U.S. EPA Regional Office.

5. **Audit and Inspection of Records.** Contractor shall permit the authorized representatives of Metra to inspect all work Materials, payroll, and other data and records involving this Agreement and to audit the books, records, and accounts involving this Agreement.
6. **Disadvantaged Business Enterprise.** Contractor must take all such action as may be necessary and reasonable to assure that minority business enterprises have an equitable opportunity to compete in all subcontracting activities and shall cooperate with Metra in its program for the participation of disadvantaged enterprises.
7. **Employment.**
- 7.1 **Equal Employment Opportunity and Fair Employment Practices.** In connection with the execution and performance of this Contract, Contractor shall not discriminate against any employee or applicant for employment because of race, religion, color, sex, national origin, age or disability. Such action shall include but not be limited to the following: employment, upgrading, demotion, transfer, recruitment, recruitment advertising, layoff, termination, rates of pay or other forms of compensation, and selection for training, including apprenticeship.
- 7.2 **FTA Regulations.** Contractor for itself, its assignees and successors in interests, agrees that it will comply with the following regulations:
- a) **Compliance with Regulations.** Contractor shall comply with the Regulations relative to nondiscrimination in federally-assisted programs of the FTA Title 49, Code of Federal Regulations, Part 21, as they may be amended from time to time (hereinafter referred to as the Regulations), which are incorporated herein by reference and made a part of this Contract.
  - b) **Nondiscrimination.** Contractor, with regard to the work performed by it during this Contract, shall not discriminate on the grounds of race, religion, color, sex, national origin, age or disability in the selection and retention of subcontractors, including procurement of materials and lease of equipment. Contractor shall not participate either directly or indirectly, in the discrimination prohibited by Section 21.5 of the Regulations, including employment practices, when this Contract covers a program set forth in Appendix B of the Regulations.
  - c) **Solicitations for Subcontracts (including Procurements of Materials and Equipment).** In all solicitations either by competitive bidding or negotiation, made by Contractor for work to be performed under a subcontract, including procurement of materials or lease of equipment, each potential subcontractor or supplier shall be notified by Contractor of Contractor's obligations under the Contract and the regulations relative to nondiscrimination on the grounds of race, color, religion, national origin, age, disability, or sex.
  - d) **Information and Reports.** Contractor shall provide all information and reports required by the Regulations or directives issued pursuant thereto, and shall permit access to its books, records, accounts other sources of information, and its facilities as may be determined by Metra or FTA to be

pertinent to ascertain compliance with such Regulations, orders and instructions. Where any information required of Contractor is in the exclusive possession of another who fails or refuses to furnish information, Contractor shall so certify to Metra or FTA, as appropriate, and shall set forth what efforts it has made to obtain the information.

- e) **Sanctions for Noncompliance.** In the event Contractor's noncompliance with the nondiscrimination provisions of this Contract, Metra shall impose such Contract sanctions as it or FTA may determine to be appropriate including, but not limited to:
- (i) Withholding of payments to Contractor under this Contract until Contractor complies, and/or
  - (ii) Cancellation, termination or suspension of this Contract, in whole or in part.
- f) **Incorporation of Provisions.** Contractor shall include the paragraphs (a) through (f) of this Section 7.2 in every subcontract, including procurement of materials and lease of equipment, unless exempt by the Regulations, or directives issued pursuant hereto. Contractor shall take such action with respect to any subcontract or procurement as Metra or FTA may direct as a means of enforcing such provisions including sanctions for noncompliance; provided, however, that in the event Contractor becomes involved in, or is threatened with, litigation with a subcontractor or supplier as a result of such direction, Contractor may request Metra to enter into such litigation to protect the interest of Metra, and in addition, Contractor may request the United States to enter into such litigation to protect the interests of the United States.

7.3 **Equal Employment Opportunity.** Contractor shall comply with, and assure that each subcontractor complies with, the following regulations of the Illinois Department of Human Rights:

7.3.1 **Section 6.1.** In the event of the Contractor's noncompliance with any provisions of the Equal Opportunity Clause, the Contractor may be declared non-responsive and therefore ineligible for future Contracts or subcontracts with the State of Illinois or any of its political subdivisions or municipal corporations, and the Contract may be canceled or voided in whole or in part, and such other sanctions or penalties may be imposed or remedies invoked as provided by statute or regulations. During the performance of this Contract, the Contractor agrees as follows:

- 1) That it will not discriminate against any employee or applicant for employment because of race, religion, color, sex, national origin, disability, ancestry, physical or mental handicap unrelated to ability, or an unfavorable discharge from military service; and further that it will examine all job classifications to determine if minority persons or women are underutilized and will take appropriate affirmative action to rectify any such under-utilization.
- 2) That, if it hires additional employees in order to perform this Contract or any portion hereof, it will determine the availability (in accordance with the Department's Rules and

Regulations) of minorities and subcontractors, and further, it will promptly notify the Contracting agency and the Department in the event any subcontractor fails or refuses to comply therewith. In addition, no Contractor will utilize any subcontractor declared by the Department to be non-responsible and therefore, ineligible, for Contracts or subcontracts with the State of Illinois or any of its political subdivisions or municipal corporations.

7.3.2 **Section 6.3 Subcontracts.** Each Contractor and subcontract shall, in turn, include the Equal Employment Opportunity Clause set forth in Section 6.1 of these Rules and Regulations in each of its subcontracts verbatim or by reference, so that provisions of Paragraphs 1 through 7 of said clause will be binding upon subcontractors of every tier, provided, however, that only paragraphs 1, 5, 6, and 7 need be included in every subcontract as defined in Section 1.1 (17) (a) of these Rules and Regulations.

8. **Termination and Suspension.** Metra reserves the right to terminate this Contract at any time after the effective date of this Contract, with or without cause. The termination will be effective as provided in Sections 8.1 and 8.2 below.

8.1 **Termination for Default (or for Cause).**

a. Each of the following is an event of default:

- I. If Contractor fails to begin the work or abandons it;
- II. If the Contract is assigned or the work subcontracted otherwise than as permitted by the Contract documents.
- III. if Contractor unreasonably delays performance of the Contract without excuse hereunder;
- IV. if Contractor violates or breaches any of the provisions or covenants of the Contract documents or does not comply therewith in good faith;
- V. If the work or any part thereof is not completed within the delivery time prescribed in the Contract, or within the time to which such delivery is extended by Metra;
- VI. In view of the necessity for special skill and ample financial resources in the execution of work, if Contractor shall make an assignment for the benefit of creditors, take advantage of any insolvency statute, debtor or creditor law now or hereafter enacted or amended, or if its property or affairs shall be put in the hands of a receiver or receivers.

b. Upon the occurrence of any events of default, Metra, upon written notice to Contractor, shall have the following rights:

- I. The right to declare Contractor in default and the Contract abandoned and to take over and complete the work or any part thereof itself or through other Contractors, as agent for at the expense of Contractor; and

- II. The right to declare the Contractor in default and to terminate the Contract as to any work not yet completed.

In any event, Metra reserves its right to damages, liquidated or otherwise, arising out of any such default, and such other remedies as may be provided by the law, unless Contractor cures such default within seven (7) calendar days after receipt of written notification of default. In the event of cancellation or termination following the event of default, no cancellation charges shall be paid to Contractor.

- 8.2 **Termination without Default.** As stated before, Metra reserves the right to terminate this Contract, effective immediately, without cause, upon notice to the Contractor of termination in writing. Additionally, in the event FTA's or IDOT's financial assistance for Contract is, in whole or in part, suspended, abrogated, or terminated for any reason whatsoever, Metra shall have the right to terminate this Contract upon receipt of written notice by the Contractor, with no obligation other than payment to the Contractor of the following cancellation charges. In the event cancellation other than for Contractor's default, Metra agrees to pay, and Contractor agrees to accept as its sole remedy, cancellation charges equal to the cost (less salvage), if any, of materials, supplies, and labor then expended or irrevocably committed to the work, plus a reasonable profit (not greater than 10%) based on a proportionate allocation of the profit which would have been earned had the entire work been performed to the portion of the work then performed. Title to all property covered by such charges shall vest in Metra without additional charge. Payment of cancellation charges will be made within forty-five (45) calendar days after presentation of Contractor's invoice showing all cancellation charges accompanied by evidence substantiating each cost or expense claimed.

- 8.3 **Post-Termination Obligations.** After receipt of a notice of termination, and except as otherwise directed by Metra, the Contractor shall:

- a) stop work under the Contract on the date and to the extent specified in the notice of termination; and
- b) place no further orders or subcontracts for materials, services, or facilities, except as may be necessary for completion of such portion of this work under the Contract as is not terminated; and
- c) terminate all orders and subcontracts to the extent that they relate to the performance of work terminated by the notice of termination.

9. **Unavoidable Delays.** If completion of the work under this Contract should be unavoidably delayed, Metra shall extend the time for completion of this Contract for the determined number of days of excusable delay. A delay is unavoidable only if the delay was not reasonably expected to occur in connection with or during the Contractor's performance; was not caused directly or substantially by acts, omissions, negligence, or mistakes of the Contractor, the Contractor's suppliers, or their agents; was substantial and caused the Contractor to miss delivery dates; and the Contractor could not adequately have guarded against the delay by Contractual or legal means.

- 9.1 **Notification of Delay.** The Contractor shall notify Metra by telephone as soon as the Contractor has, or should have, knowledge that an event has occurred which will delay the work. Within five (5) calendar days, the Contractor shall confirm such notice in writing furnishing as much detail as is available.

9.2 **Request for Extension.** The Contractor agrees to supply, as soon as such data is available, any reasonable proof that is required by Metra to make a decision on any request for extension. Metra shall examine the request for extension and any documents supplied by the Contractor, and shall determine if the Contractor is entitled to an extension and the duration of such extension, or is subject to Liquidated Damages, or termination for default, as set forth elsewhere in the Contract. Metra shall notify the Contractor of the decision in writing.

It is expressly understood and agreed that the Contractor shall not be entitled to damages or compensation and shall not be reimbursed for losses on account of delays resulting from any cause under this provision.

10. **Modifications to Contract.**

10.1 **Written Change Orders.** Oral change orders are not permitted. No change in this Contract shall be made except in writing signed by an authorized representative. The Contractor shall be liable for all costs resulting from any specification change not properly ordered by written modification to the Contract and signed by Metra. In addition, the Contractor shall be responsible for correcting any specification change not properly ordered.

10.2 **Change Order Procedure.** The Contractor shall submit to Metra a written request for a Contract Modification with a detailed price and schedule breakdown for the work to be done on Metra's forms. This request shall be accepted or modified through negotiations between the Contractor and Metra. Upon agreement, detailed modifications shall be executed in writing by both parties. Disagreements that cannot be resolved within negotiations shall be resolved in accordance with the Contract Dispute Clause.

10.3 **Price Adjustment For Regulatory Changes.** If the price adjustment is set forth, either upward or downward, it shall be negotiated between Metra and the Contractor for changes that are mandatory as a result of legislation or regulations that are promulgated and become effective between the date of the bid opening and the date of manufacture. Such price adjustments may be audited, where required.

11. **Interest of Members of Congress.** No member of or delegate to the Congress of the United States, nor any member or delegate to the Illinois General Assembly, shall be admitted to any share or part of this Contract or to any benefit arising therefrom.

12. **Prohibited Interest.** No member, officer or employee of Metra, during his tenure shall have any interest, direct or indirect, in this Contract or the proceeds thereof.

13. **Financial Assistance Contracts.** This Contract is subject to the provisions of the financial assistance Contracts between Metra, FTA, IDOT, and other sponsoring agencies which are identified in the Invitation for Bids.

14. **Ineligible Contractors and Subcontractors.** Any name appearing upon the Controller General of the United States' list of ineligible Contractors for federally financed and assisted construction shall not be eligible to act as a Contractor or as a subcontractor for the Contractor pursuant to this Contract. In the event the Contractor or subcontractor is on the Comptroller General's list of ineligible Contractors for federally financed or assisted construction, this contract may be canceled, terminated, or suspended by Metra.

- 1) **Violation of Public Contracts.** Contractor and subcontractors are required to certify that they are not on the U.S. Comptroller's consolidated list of persons or firms currently debarred for violation of various public Contracts.
  
15. **Contract Changes.** Any proposed change in the Contract shall be submitted to Metra for its prior approval.
  
16. **Subcontracting Limitations.** The Contractor shall perform site work, with his own employees, equivalent to at least 30 (%) percent of the total pay items. Only pay items for direct labor and direct labor fringes for the Contractor's own employees and material purchased for installation by these employees will be used in computing the total amount and percentage of work. Work performed by the Contractor's employees shall mean actual on-site work. Pay items shall exclude all material purchases made by the Contractor that are installed by either subcontractor(s) of any tier, or material procured on behalf of Metra for installation by Metra's own workforces. Pay items shall also exclude all general conditions, including but not limited to, insurance, all bonding expenses, mobilization expenses, overhead expenses and profit. In order to be considered an employee of the Contractor, an employee must be listed on required federal and or state payroll tax returns, e.g. State of Illinois UC940 form.
  
17. **Copyright and Rights in Data.** This Agreement shall be subject to the U.S. Federal Transit Administration's (FTA) policy on copyrights and rights in data, with respect to research reports and other technical materials developed with program funds. That policy, as set forth in Section II B of the FTA External Operating Manual, permits the author or grantee to copyright the work, but FTA reserves a royalty-free nonexclusive and irrevocable license to reproduce, publish or otherwise use, and to authorize others to use, the work for Government purposes.

**Definition.** The term "subject data" used in this section means recorded information, whether or not copyrighted, that is delivered or specified to be delivered under the Grant Agreement or Cooperative Agreement. Examples include, but are not limited to: computer software, engineering drawings and associated lists, specifications, standards, process sheets, manuals, technical reports, catalog item identifications, and related information. The term "subject data" does not include financial reports, cost analyses, and similar information incidental to Project Administration.

**Federal Restrictions.** The following restrictions apply to all subject data first produced in the performance of the Grant Agreement or Cooperative Agreement:

- 1) Except for its own internal use, Metra may not publish or reproduce subject data in whole or part, or in any manner or form, nor may Metra authorize others to do so, without the written consent of the Federal Government, until such time as the Federal Government may have either released or approved the release of such data to the public.
  
- 2) The restrictions on publication of Subsection 19.b (1) of this Master Agreement, however, does not apply to an Agreement with an institution of higher learning.

In accordance with 49 C.F.R. Part 18.34 and 49 C.F.R. Part 19.36 the Federal Government reserve royalty-free, non-exclusive and irrevocable license to

reproduce, publish, or otherwise use, and to authorize use for Federal Government purposes the "subject data" described as follows:

- a. Any subject data developed under this Contract financed by FTA to Metra, whether or not a copyright has or has not been obtained by the Contractor; and
- b. Any rights of copyright to which a Contractor purchases ownership paid by Metra with Federal assistance.

18. **Cargo Preference - Use of United States - Flag Vessels and Flag Air Carriers**

The Contractor agrees--

- A. To utilize privately owned United States - flag commercial vessels to ship at least 50% of the gross tonnage (computed separately for dry bulk carriers, dry cargo lines, and tankers) involved, whenever shipping any equipment, materials, or commodities pursuant to this Contract, to the extent such vessels are available at fair and reasonable rates for United States-flag commercial vessels.
- B. To furnish within 20 days following the date of loading for shipment originating within the United States, or within 30 working days following the date of loading for shipments originating outside the United States, a legible copy of a rated, "on board" commercial ocean bill-of-lading in English for each shipment of cargo described in paragraph A above to the FTA Administrator and grantee through the prime Contractor in the case of subcontractor bill-of-lading and to the Division of National Cargo, Office of Market development, Maritime Administration, Washington, D.C. 20230.
- C. To utilize U.S. flag air carriers, to the extent service is available, for the international air transportation of any persons involved in this Contract or any property acquired for the Contract as required by the International Air Transportation Fair Competitive Practices Act of 1974, as amended, 49 U.S.C § 40118, in accordance with U.S. GAO regulations, "Uniform Standards and Procedures for Transportation," 40 C.F.R. Part 52, and U.S. GAO Guidelines for Implementation of the "Fly America Act," B-138942, 1981 U.S. Comp. Gen. LEXIS 2166, March 31, 1981.
- D. To insert the substance of the provisions of this clause in all subcontracts issued pursuant to this clause.

19. **Nondiscrimination.** Pursuant to Department of Labor regulations at 41 C.F.R. 60-1.4(b) (1) and 60-1.4(c):

- 1) The Recipient agrees that it will incorporate or cause to be incorporated into any Contract for construction work, or modification thereof, as defined in Department of Labor Regulations, "Office of Federal Contract Compliance Programs, Equal Opportunity, Department of Labor," 41 C.F.R. Chapter 60, that is paid for in whole or in part with federal funds obtained from the Federal Government or borrowed on the credit of Federal Government pursuant to a grant, cooperative Agreement, contract, loan, insurance, or guarantee, or

undertake pursuant to a Federal program involving the grant, Cooperative Agreement, contract, loan, insurance, or guarantee, the following equal opportunity clause:

DURING THE PERFORMANCE OF THIS CONTRACT, THE CONTRACTOR AGREES AS FOLLOWS:

- a) The Contractor will not discriminate against any employee or applicant for employment because of race, creed, color, or national origin. The Contractor will take affirmative action to ensure that applicants are employed and that employees are treated during employment, without regard to their race, religion, color, national origin, age, disability, or sex. Such action shall include, but not be limited to, the following: Employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this nondiscrimination clause.
- b) The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor; state that all qualified applicants will receive consideration for employment without regard to race, religion, color, age, sex, disability or national origin.
- c) The Contractor will send to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding, a notice to be provided advising the labor union or workers' representatives of the Contractor's commitments under section, 202 of Executive Order No. 11246 of September 24, 1965 and shall post copies of the notice in conspicuous places available to employees and applicants for employment.
- d) The Contractor will comply with all provisions of the Executive Order 11246 of September 24, 1965, and of the rules, regulations and relevant orders of the Secretary of Labor.
- e) The Contractor will furnish all information and reports required by Executive Order 11246 of September 24, 1965, and by the rules, regulations and orders of the Secretary of Labor, or pursuant thereto, and will permit access to its books, records and accounts by the Secretary of Labor and the FTA for purposes of investigation to ascertain compliance with such rules, regulations and orders.
- f) In the event of the Contractor's noncompliance with the nondiscrimination clauses of this Contract or with any of such rules, regulations, or orders, this Contract may be canceled, terminated, or suspended, in whole or in part, and the Contractor may be declared ineligible for further federal or federally assisted contracts in accordance with procedures authorized in Executive Order 11246 of September 24, 1965, and such other sanctions may be imposed and remedies invoked

as provided in Executive Order 11246 of September 24, 1965 or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.

- g) The Contractor will include the provisions of paragraphs (a) through (g) of this subsection in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary issued pursuant to Section 204 of Executive Order 11246 of September 24, 1965, so that provisions will be binding upon each subcontractor or vendor. The Contractor will take such action with respect to any subcontract or purchase order as the Secretary of Labor or the FTA may direct as a means of enforcing such provisions, including sanctions for noncompliance provided, however, that if a Contractor becomes involved in or is threatened with litigation with a subcontractor or vendor as a result of such direction, the Contractor may request the United States to enter into such litigation to protect the interest of the United States.
- 2) Standard Federal equal employment opportunity construction Contract specifications (Executive Order No. 11246):
1. As used in these specifications:
    - a) "Covered Area" means the geographical area described in the solicitation from which this Contract resulted;
    - b) "Director" means director, office of federal Contract compliance programs, United States Department of Labor, or any person to whom the director delegates authority;
    - c) "Employer Identification number" means the federal social security number used on the employer's quarterly federal tax return, U.S. Treasury Department Form 941;
    - d) "Minority" includes:
      - i. Black (all persons having origins in any of the Black African racial groups not of Hispanic origin);
      - ii. Hispanic (all persons of Mexico, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race);
      - iii. Asian and Pacific Islander (all persons having origins in any of the original people of the far east, South Asia, the Indian subcontinent, or the Pacific Islands); and
      - iv. American Indian or Alaskan Native (all persons having origins in any of the original people of North America and maintaining identifiable tribal affiliations through

membership and participation or community identification).

2. Whenever the Contractor, or any subcontractor at any tier, subcontracts a portion of the work involving any construction trade, it shall physically include in each subcontract in excess of \$10,000 the provisions of these specifications and the notice which contains the applicable goals for minority and female participation and which is set forth in the solicitations from which this Contract resulted.
3. If the Contractor is participating (pursuant to 41 C.F.R. § 60-4.5) in a hometown plan approved by the U.S. Department of Labor in the covered area, either individually or through an association, its affirmative action obligations on all work in the plan area (including goals and timetables) shall be in accordance with that plan for those trades which have unions participating in the plan. Contractors must be able to demonstrate their participation in and compliance with the provisions of any such hometown plan. Each Contractor or subcontractor participating in an approved plan is individually required to comply with its obligations under the EEO Clause, and to make a good faith effort to achieve each goal under the plan in each trade in which it has employees. The overall good faith performance by other Contractors or subcontractors toward a goal in an approved plan does not excuse any covered Contractor's or subcontractor's failure to make good faith efforts to achieve the plan goals and timetables.
4. The Contractor shall implement the specific affirmative action standards provided in paragraphs (7) (a) through (p) of these specifications. The goals set forth in the solicitation from which this Contract resulted are expressed as percentages of the total hours of employment and training of minority and female utilization the Contractor should reasonably be able to achieve in each construction trade in which it has employees in the covered area. Covered construction Contractors performing construction work in geographical areas where they do not have a federal or federally assisted construction Contract shall apply the minority and female goals established for the geographical area where the work is being performed. Goals are published periodically in the Federal Register in notice form, and such notices may be obtained from any office of federal Contract compliance programs office or from federal procurement contracting officers. The Contractor is expected to make substantially uniform progress toward its goal in each craft during the period specified.
5. Neither the provisions of any collective bargaining agreement, nor the failure by a union with whom the Contractor has a collective bargaining agreement, to refer either minorities or women shall excuse the Contractor's obligations under these specifications, Executive Order 11246 or the regulations promulgated pursuant thereto.
6. In order for the nonworking training hours of apprentices and trainees to be counted in meeting the goals, such apprentices and trainees must

be employed by the Contractor during the training period, and the Contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor.

7. The Contractor shall take specific affirmative actions to ensure equal employment opportunity. The evaluation of the Contractor's compliance with these specifications shall be based upon its effort to achieve maximum results from its actions. The Contractor shall document these efforts fully, and shall implement affirmative action steps at least as extensive as the following:
  - a) Ensure and maintain a working environment free of harassment, intimidation, and coercion at all sites, and in all facilities at which the Contractor's employees are assigned to work. The Contractor, where possible, will assign two or more women to each construction project. The Contractor shall specifically ensure that all foremen, superintendents, and other on-site supervisory personnel are aware of and carry out the Contractor's obligation to maintain such a working environment, with specific attention to minority or female individuals working at such sites or in such facilities.
  - b) Establish and maintain a current list of minority and female recruitment sources, provide written notice to minority and female recruitment sources and to community organizations when the Contractor or its unions have employment opportunities available, and maintain a record of the organizations' responses.
  - c) Maintain a current file of the names, addresses, and telephone numbers of each minority and female off-the-street applicant and minority or female referral from a union, a recruitment source, or community organization and of what action was taken with respect to each such individual. If such individual was sent to the union hiring hall for referral and was not referred back to the Contractor by the union or, if referred, not employed by the Contractor, this shall be documented in the file with the reason therefor, along with whatever additional actions the Contractor may have taken.
  - d) Provide immediate written notification to the Director when the union or unions with which the Contractor has a collective bargaining agreement has not referred to the Contractor a minority person or woman sent by the Contractor, or when the Contractor has other information that the union referral process has impeded the Contractor's efforts to meet its obligations.
  - e) Develop on-the-job training opportunities and/or participate in training programs for the area which expressly include minorities

and women, including upgrading programs and apprenticeship and trainee programs relevant to the Contractor's employment needs, especially those programs funded or approved by the Department of Labor. The Contractor shall provide notice of these programs to the sources compiled under (7) (b) above.

- f) Disseminate the Contractor's EEO policy by providing notice of the policy to unions and training programs and requesting their cooperation in assisting the Contractor in meeting its EEO obligations; by including it in a publicizing it in the company newspaper, annual report, etc.; by specific review of the policy with all management personnel and with all minority and female employees at least once a year; and by posting the company EEO policy on bulletin boards accessible to all employees at each location where construction work is performed.
- g) Review, at least annually, the company's EEO policy and affirmative action obligations under these specifications with all employees having responsibility for hiring, assignment, layoff, termination, or other employment decisions including specific review of these items with on-site supervisory personnel such as superintendents, general foreman, etc., prior to the initiation of construction Work at any job site. A written record shall be made and maintained identifying the time and place of these meetings, persons attending, subject matter discussed, and disposition of the subject matter.
- h) Disseminate the Contractor's EEO policy externally by including it in any advertising in the new media, specifically including minority and female news media, and providing written notification to and discussing the Contractor's EEO policy with other Contractors and subcontractors with whom the Contractor does or anticipates doing business.
- i) Direct recruitment efforts, both oral and written, to minority, female, and community organizations, to schools with minority and female students and to minority and female recruitment and training organizations serving the Contractor's recruitment area and employment needs. Not later than one month prior to the date for the acceptance of applications for apprenticeship or other training by any recruitment source, the Contractor shall send written notice to organizations such as the above, describing the openings, screening procedures, and tests to be used in the selection process.
- j) Encourage present minority and female employees to recruit other minority persons and woman, and where reasonable, provide after school, summer and vacation employment to minority and female youth, both on the site and in other areas of the Contractor's work force.

- k) Validate all test and other selection requirements where there is an obligation to do so under 41 C.F.R. part 60-3.
  - l) Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel for promotional opportunities and encourage these employees to seek or to prepare for, through appropriate training etc., such opportunities.
  - m) Ensure that seniority practices, job classifications, work assignments and other personnel practices do not have a discriminatory effect by continually monitoring all personnel and employment related activities to ensure that the EEO policy and the Contractor's obligations under these specifications are being carried out.
  - n) Ensure that all facilities and company activities are non-segregated except that separate or single-user toilet and necessary changing facilities shall be provided to assure privacy between sexes.
  - o) Document and maintain a record of all solicitations of offers for subcontracts from minority and female construction Contractors and suppliers, including circulation of solicitations to minority and female Contractor associations and other business associations.
  - p) Conduct a review, at least annually, of all supervisors' adherences to and performance under the Contractor's EEO policies and affirmative action obligations.
8. Contractors are encouraged to participate in voluntary associations that assist in fulfilling one or more of their affirmative action obligations set forth in paragraphs (7) (a) through (p). The efforts of a contractor association, joint contractor-union, contractor-community, or other similar group of which the Contractor is a member and participant, may be asserted as fulfilling any one or more of its obligations under paragraphs (7) (a) through (p) of these specification, provided that the Contractor actively participates in the group, makes every effort to assure that the group has a positive impact on the employment of minorities and women in the industry, ensures that the concrete benefits of the program are reflected in the Contractor's minority and female work force participation, makes a good faith effort to meet is individual goals and timetables, and can provide access to documentation that demonstrates the effectiveness of actions taken on behalf of the Contractor. The obligation to comply, however, is the Contractor's and failure of such a group to fulfill an obligation shall not be a defense for the Contractor's noncompliance.
9. A single goal for minorities and a separate goal for women have been established. The Contractor, however, is required to provide equal employment opportunity and to take affirmative action for all minority groups, both male and female, and all women, both minority and non-

minority. Consequently, the Contractor may be in violation of the Executive Order if a particular group is employed in a substantially disparate manner (even though the Contractor has achieved its goal for women generally, the Contractor may be in violation of the Executive Order if a specific minority group of women is under-utilized.

10. The Contractor shall not use the goals and timetables or affirmation action standards to discriminate against any person because of race, color, religion, sex or national origin.
11. The Contractor shall not enter into any subcontract with any person or firm debarred from government Contracts pursuant to Executive Order No. 11246.
12. The Contractor shall carry out such sanctions and penalties for violation of these specification and of the equal opportunity clause, including suspension, termination, and cancellation of existing subcontracts, as may be imposed or ordered pursuant to Executive Order No. 11246, as amended, and its implementing regulations, by the office of federal contract compliance programs. Any Contractor who fails to carry out such sanctions and penalties shall be in violation of these specifications and Executive Order No. 11246, as amended.
13. The Contractor, in fulfilling its obligations under these specifications, shall implement specific affirmative action steps, at least as extensive as those standards prescribed in paragraph (7) of these specifications, so as to achieve maximum results from its efforts to ensure equal employment opportunity. If the Contractor fails to comply with the requirements of the Executive Order, the implementing regulations, or these specifications, Metra Director shall proceed in accordance with 41 C.F.R. § 60-4.8.
14. The Contractor shall designate a responsible official to monitor all employment related activity to ensure that the company EEO policy is being carried out, to submit reports relating to the provisions hereof as may be required by the government, and to keep records. Records shall at least include for each employee the name, address, telephone numbers, construction trade, union affiliation if any, employee identification number when assigned, social security number, race, sex, status (e.g. mechanic, apprentice trainee, helper or laborer), dates of changes in status, hours worked per week in the indicated trade, rate of pay, and locations at which the work was performed. Records shall be maintained in an easily understandable and retrievable form; however, to the extent that existing records satisfy this requirement, Contractors shall not be required to maintain separate records.
15. Nothing herein provided shall be construed as a limitation upon the application of other laws that establish different standards of compliance or upon the application of requirements for the hiring of local or other area residents (e.g. those under the Public Works Employment Act of 1977 and the Community Development Block Grant Program).

- 20) **Assignment.** This Agreement shall be binding upon and inure to the benefit of the respective successor, assigns, heirs, and personal representatives of Metra and Contractor. Any successor to the Contractor's rights under this agreement must be approved by Metra.
- 21) **Government Inspection.** Representatives of the United States Government and of the State of Illinois shall have access to the site of construction and shall have the right to inspect all project works.
- 22) **Patent Infringement.** The Contractor shall defend any suit or proceeding brought against Metra that is based on claims of equipment patent infringement. The Contractor shall pay any damages and costs awarded therein, including incidental and consequential damages, against Metra. In case said equipment, or any part thereof in such suit, is held to constitute infringement and use of said equipment or part thereof is enjoined, the Contractor shall, at its own expense and option, either procure for Metra the right to continue using said equipment or part thereof, replace same with non-infringing equipment, or modify it so it becomes non-infringing.
- 23) **Disputes.**
- a) In the event the Contractor disagrees with a decision of Metra concerning any question or issue arising under the Contract prior to acceptance of the last work under the Contract, Contractor shall request arbitration by so advising Metra in writing within ten (10) business days after receiving notice of the decision of Metra with which it disagrees. When arbitration is requested by the Contractor, the parties shall attempt to agree upon the appointment of one impartial arbitrator out of five impartial arbitrators, all of whom shall be members of the National Academy of Arbitrators. Either party shall have the right to reject one entire list and to request a submission of another panel. Thereafter, the Contractor shall strike two names, Metra shall then strike two names and the name of the last person remaining on the list will be designated as the arbitrator, and his appointment and final decision shall be binding on both parties.
  - b) It is agreed, however, that the authority of an arbitrator shall be confined to the interpretation and application of the specific provisions of the contract documents. He shall have no right to add to, take from or modify any of the provisions thereof.
  - c) The cost and the expenses of arbitration shall be divided equally between Metra and the Contractor.
  - d) Pending final disposition of a dispute hereunder, the Contractor shall carry on the work unless otherwise agreed to by Metra and the Contractor in writing.
- 24) **Buy America.**
- a) The Contractor agrees to comply with 49 U.S.C. 5323 (j), FTA's Buy America regulations at 49 C.F.R. Part 661, and any amendments thereto, and any

implementing guidance issued by FTA, with respect to this Contract, when financed by Federal funds (Grant Agreement or Cooperative Agreement.)

- b) As a condition of responsiveness, the Contractor agrees to submit with its Bid submission, a completed Buy America Certificate.

25) **Required in Bidding Requirements.**

- a) In the event a single bid is received, Metra will conduct a price and/or cost analysis of the bid. A price analysis is the process of examining the bid and evaluating the separate cost elements. It should be recognized that a price analysis through comparison to other similar procurements must be based on an established or competitive price of the elements used in the comparison. The comparison must be made to a purchase of similar quantity and involving similar specifications. Where a difference exists, a detailed analysis must be made of this difference and costs attached hereto.
- b) Where it is impossible to obtain a valid price analysis, it may be necessary for Metra to conduct a cost analysis of the bid price with the bidder's full cooperation.
- c) The price and/or cost analysis will be made by competent and experienced auditors or Contract agents. An engineer's estimate or comparison of the prices involved in this Contract is insufficient.
- d) If Metra does not have the capabilities to perform the needed analysis, FTA will lend support in obtaining the services of the Defense Contract Audit Agency.

26) **Conservation.** Contractors shall recognize mandatory standards and policies relating to energy efficiency which are contained in the State energy conservation plan issued in compliance with the Energy Policy Conservation Act (42 UDC, Section 6321 et seq.).

27) **Changing Requirements.** To achieve compliance with changing Federal, State and Local requirements, Contractor is to recognize that the requirements may change and the changed requirements will apply to this project as required, unless the Federal, State and/or Local Government determines otherwise.

28) **Reporting, Record Retention and Access.** The Contractor agrees as follows:

- a) **Reports.** The Contractor agrees to provide Metra and if requested, to the FTA, those reports required by the Contract and as required by U.S. Dept. of Transportation's Grant Management rules or other reports the Federal Government may require.
- b) **Record Retention.** The Contractor agrees that, during the course of this Contract and for three (3) years thereafter it will maintain intact and readily accessible all data, documents, reports, records, contracts, and supporting materials relating to the Contract as Metra or the Federal Government may require to review.

- c) **Access to Records.** The Contractor agrees to permit the Secretary of Transportation and the Comptroller General of the United States, or their duly authorized representative, to inspect all work, materials, payrolls, and other data and records involving this Contract and to audit the books, records, and accounts of the Contractor involving this Contract. For those Contracts whose contract award is not based on competitive bidding procedures as defined by the Secretary of Transportation, the Contractor in accordance with 49 U.S.C. Part 5325(a), agrees to permit the Secretary of Transportation and the Comptroller General of the United States, or their duly authorized representative, to inspect all work, materials, payrolls, and other data and records involving this Contract and to audit the books, records, and accounts of the Contractor involving this Contract.
- 29) **Patent Rights.** If any invention, improvement, or discovery of the Contractor is conceived or first actually reduced to practice in the course of or under the Contract, and that invention, improvement, or discovery is patentable under the laws of the United States of America or any foreign country, the Contractor will notify Metra immediately and provide a detailed written report of same. In addition, unless the Federal Government makes a contrary determination in writing, the rights and responsibilities of the Contractor, Metra and the Federal Government pertaining to that invention, improvement, or discovery will be determined in accordance with applicable Federal laws, regulation, including any waivers thereof. Unless specified otherwise, the Contractor agrees it will transmit to the FTA those rights due the Federal Government in any invention resulting from the Contracts described in the U.S. Dept. of Commerce's Regulation, No. 37 C.F.R Part 401.
- 30) **Contract Hours and Safety Standards Act.** The Contractor agrees to comply and assure compliance with Sections 102 and 107 of the Contract Work Hours and Safety Standards Act, as amended, 40 U.S.C. Parts 327 through 333; and implements and complies with U.S. Department of Labor Regulation 29 C.F.R. Part 5; 29 C.F.R. Part 1926.
- 31) **Substance Abuse.** To the extent the Contractor, subcontractor, or any party contracted for work as a result of this Contract that performs a safety sensitive function, Contractor agrees to comply with, and assures their employees comply with the requirements of 49 U.S.C. Part 5331 and 49 C.F.R. Part 653 for Drug Abuse. To the extent the Contractor, subcontractor, or any party contracted for work as a result of this Contract that performs a safety sensitive function, agrees to comply with, and assures their employees comply with the requirements of 49 U.S.C. Part 5331, and 49 C.F.R. Part 654 for Alcohol Abuse.
- 32) **Access Requirement for Individuals with Disabilities.** The Contractor agrees to comply with, and assure that any subcontractor, at any tier under this Contract complies with all applicable requirements of the American with Disabilities Act of 1990 (ADA), 42 U.S.C. §§ 12101 et seq. and 49 U.S.C. § 322; Section 504 of the Rehabilitation Act of 1973, as amended, 29 U.S.C. § 794; Section 16 of the Federal Transit Act, as amended, 49 U.S.C. app. § 1612; and the following regulations and any amendments thereto:
- 1) U.S. DOT regulations, "Transportation Services for Individuals with Disabilities (ADA), "49 C.F.R. Part 37;

- 2) U.S. DOT regulations, "Nondiscrimination on the Basis of Handicap in Programs and Activities Receiving or Benefitting from Federal Financial Assistance," 49 C.F.R. Part 27;
  - 3) U.S. DOT regulations, "Americans with Disabilities (ADA) Accessibility Specifications for Transportation Vehicles," 49 C.F.R. Part 38;
  - 4) Department of Justice (DOJ) regulations, "Nondiscrimination on the Basis of Disability in State and Local Government Services," 28 C.F.R. Part 35;
  - 5) DOJ regulations, "Nondiscrimination on the Basis of Disability by Public Accommodations and in Commercial Facilities," 28 C.F.R. Part 36;
  - 6) General Services Administration regulations, "Construction and Alteration of Public Buildings," "Accommodations for the Physically Handicapped," 41 C.F.R. Part 101-19;
  - 7) Equal Employment Opportunity Commission (EEOC) "Regulations to Implement the Equal Employment Provisions of the Americans with Disabilities Act," 29 C.F.R. Part 1630;
  - 8) Federal Communication Commission regulations, "Telecommunications Relay Services and Related Customer Premises Equipment for the Hearing and Speech Disabled: 47 C.F.R. Part 64, Subpart F; and
  - 9) FTA regulations, "Transportation for Elderly and Handicapped Persons," 49 C.F.R. Part 609.
- 33) **Seismic Safety.** The Contractor agrees to comply with the requirements of U.S. DOT regulations applicable to seismic safety requirements for U.S. DOT assisted construction projects at 49 C.F.R., Part 41, (specifically, 49 C.F.R., para 41.117), and any implementing guidelines FTA may issue.
- 34) **Employee Benefits.** Contractor agrees to pay its employees all rightful salaries, medical benefits, pensions, and social security benefits pursuant to applicable labor agreements and Federal and State statutes, and Contractor further agrees to make all required withholdings and deposits therefore. In addition, Contractor agrees to require all subcontractors for this project to pay their employees all their rightful salaries, medical benefits, pensions and social security benefits pursuant to applicable labor agreements and Federal and State statutes, and to further require all subcontractors for this project to make all required withholdings and deposits therefore. Such requirements shall be included by the Contractor in all its contracts and agreements with subcontractors for this project.
- 35) **No Federal Government Obligations to Third Parties.** Absent the Federal Government's express written consent, the Federal Government shall not be subject to any obligations or liabilities to any sub-recipient, third party contractor, or any other person not a party to the Grant Agreement or Cooperative Agreement in connection with the performance of the Project. Notwithstanding any concurrence provided by the Federal Government in or approval of any solicitation, sub-

agreement, or third party contract, the Federal Government continues to have no obligations or liabilities to any party, including the sub-recipient and third party contractor.

- 36) **Privacy Act.** The following requirements apply to the Contractor and its employees that administer any system of records on behalf of the Federal Government and Metra under any contract.
- a) The Contractor agrees to comply with, and assures the compliance of its employees with, the information restrictions and other applicable requirements of the Privacy Act of 1974, 5 U.S.C. §552a. The Contractor agrees to obtain the express consent of the Federal Government and Metra before the Contractor or its employee operate a system of records on behalf of the Federal Government and Metra. The Contractor understands that the requirements of the Privacy Act, including the civil and criminal penalties for violation of that Act, apply to those individuals involved, and that failure to comply with the terms of the Privacy Act may result in termination of the underlying contract or purchase order.
  - b) The Contractor agrees to include these requirements in each subcontract to administer any system of records on behalf of the Federal Government and Metra financed in whole or in part with financial assistance provided by either FTA or Metra.
- 37) **Preference for Recycled Products.** If specified by Metra in the Invitation for Bid or Request for Proposal, and to the extent practicable and economically feasible, Metra agrees to accept by competitive preference, products and services that conserve natural resources, protect the environment and that are energy efficient. Examples of such products may include, but are not limited to products described in the U.S. Environmental Protection Agency guidelines at 40 C.F.R. parts 247-253, which implement section 6002 of the Resource Conservation and Recovery Act, as amended, 42 U.S.C. §6962.
- 38) **Employee Protections.** The Contractor agrees to comply with and assures compliance by its subcontractors at any tie, with applicable employee protection requirements for employees of section 102 of the Contract Work Hours and Safety Standards Act, as amended, 40 U.S.C. §327 through 332, and implementing U.S. DOL regulations, “Labor Standards Provisions Applicable to Contracts Governing Federally Financed and Assisted Contracts (also Labor Standard Provisions Applicable to Non-construction Contracts Subject to the Contract Work Hours and Safety Standards Act)”, 29 C.F.R. Part 5.
- 39) **Energy Conservation.** The Contractor agrees to comply with the mandatory energy efficiency standards and policies within applicable State energy conservation plans and/or guidelines issued in compliance with the Energy Policy and Conservation Act, 42 U.S.C. §6321 et seq.

**LABOR PROVISIONS – CONSTRUCTION**

**A. GENERAL INSTRUCTIONS FOR COMPLIANCE WITH THE LABOR PROVISIONS**

1. This Construction Project is subject to the Davis-Bacon and Related Acts.
2. The minimum wages as established by the U.S. Department of Labor to be paid on this Construction Project are contained in the attached Wage Determination.
3. All workers that are to be employed under this Contract shall be classified in conformance with the Wage Determination classifications. If a classification or a rate is not found in the attached Wage Determination, call or write Metra's Contracting Officer and request a classification or rate determination.
4. The Contract Wage Determination as well as a Davis-Bacon Poster must be prominently posted at the construction site.
5. Payroll data must be maintained by Contractors and subcontractors as required under 29 CFR 5.5.
6. Certified Payrolls must be submitted weekly by all contractors to Metra's Office of Diversity and Civil Rights through LCPtracker, Inc.'s Web based Certified Payroll database application.
7. Use of LCPtracker is free of charge to Metra construction contractors. Minimum system requirements for use are Internet access through any Web browser (Internet Explorer (V.9 or higher) or Google Chrome are preferred) and the latest version of Adobe Acrobat Reader.

**B. LABOR STANDARDS PROVISIONS APPLICABLE TO CONTRACTS COVERING  
FEDERALLY FINANCED AND ASSISTED CONSTRUCTION (ALSO LABOR  
STANDARDS PROVISIONS APPLICABLE TO NONCONSTRUCTION CONTRACTS  
SUBJECT TO THE CONTRACT WORK HOURS AND SAFETY STANDARDS ACT)**

Refer to Title 29 Labor Part 5

**1. Minimum Wages**

- a. All laborers and mechanics employed or working upon the site of the work (or under the United States Housing Act of 1937 or under the Housing Act of 1949 in the construction or development of the project), will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act, 29 C.F.R. Part 3), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the Contractor and such laborers and mechanics.

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Contributions made or costs reasonably anticipated for bona fide fringe benefits under Section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of 29 C.F.R. § 5.5 (a) (1) (iv); also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided at 29 C.F.R. § 5.5 (a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: *Provided*, That the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under 29 C.F.R. § 5.5 (a)(1)(ii) and the Davis-Bacon Poster (WH-1321) shall be posted at all times by the Contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

- b. 1.) The Contracting Officer shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and that is to be employed under the Contract shall be classified in conformance with the wage determination. The Contracting Officer shall approve an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:
  - a.) The work to be performed by the classification requested is not performed by a classification in the wage determination; and
  - b.) The classification is utilized in the area by the construction industry; and
  - c.) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.
- 2.) If the Contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the Contracting officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate) a report of the action taken shall be sent by the Contracting Officer to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, D.C. 20210. The Administrator, or an authorized representative, will approve, modify or disapprove every additional classification action within 30 days of receipt and so advise the Contracting Officer or will notify the Contracting Officer within the 30-day period that additional time is necessary.
- 3.) In the event the Contractor, the laborers or mechanics to be employed in the classification or their representatives, and the Contracting Officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the Contracting Officer shall refer the questions including the views of all interested parties and the recommendation of the Contracting Officer, to the Administrator for determination. The

## EXHIBIT E LABOR PROVISIONS

Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the Contracting Officer or will notify the Contracting Officer within the 30-day period that additional time is necessary.

- 4.) The wage rate (including fringe benefits where appropriate) determined pursuant to 29 C.F.R. § 5.5 (a)(1)(ii)(B) or (C), shall be paid to all workers performing work in the classification under this Contract from the first day on which work is performed in the classification.
- c. Whenever the minimum wage rate prescribed in the Contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the Contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.
- d. If the Contractor does not make payments to a trustee or other third person, the Contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, *PROVIDED* that the Secretary of Labor has found, upon the written request of the Contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the Contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

### 2. Withholding

The Federal Transit Administration (FTA) or Metra shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld from the Contractor under this Contract or any other Federal contract with the same Prime Contractor, or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same Prime Contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the Contractor or any subcontractor the full amount of wages required by the Contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work (or under the United States Housing Act of 1937 or under the Housing Act of 1949 in the construction or development of the project), all or part of the wages required by the Contract, the FTA may, after written notice to the Contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

### 3. Payrolls and Basic Records

- a. Payrolls and basic records relating thereto shall be maintained by the Contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work (or under the United States Housing Act of 1937, or under the Housing Act of 1949, in the construction or development of the project). Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in Section

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1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made, and actual wages paid. Whenever the Secretary of Labor has found under 29 C.F.R. § 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in Section 1(b)(2)(B) of the Davis-Bacon Act, the Contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual costs incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

- b. 1.) The Contractor shall submit weekly for each week in which any Contract work is performed a copy of all payrolls to the attention of Metra's DBE Director. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under 29 C.F.R. § 5.5 (a) (3) (i) except that full social security numbers and home addresses shall not be included on weekly transmittals. Instead the payrolls shall only need to include an individually identifying number for each employee (e.g., the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH-347 is available for this purpose from the Wage and Hour Division Web site at <http://www.dol.gov/esa/whd/forms/wh347instr.htm> or its successor site. The Prime Contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to Metra's DBE Director, the Prime Contractor, or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a Prime Contractor to require a subcontractor to provide addresses and social security numbers to the Prime Contractor for its own records, without weekly submission to Metra.
- 2.) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the Contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the Contract and shall certify the following:
  - a.) That the payroll for the payroll period contains the information required to be provided under §5.5 (a)(3)(ii) of Regulations, 29 CFR Part 5, the appropriate information is being maintained under §5.5 (a)(3)(i) of Regulations, 29 CFR Part 5, and that such information is correct and complete;
  - b.) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the Contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from

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the full wages earned, other than permissible deductions as set forth at 29 C.F.R. Part 3;

- c.) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the Contract.
- 3.) The weekly submission of a properly executed certification set forth on the reverse side of optional Form WH-347 shall satisfy the requirement for submission of the "statement of compliance" required by 29 C.F.R. § 5.5(a) (3) (ii) (B).
- 4.) The falsification of any of the above certifications may subject the Contractor or subcontractor to civil or criminal prosecution under 18 U.S.C. § 1001 and 31 U.S.C. § 231.
- c. The Contractor or subcontractor shall make the records required under 29 C.F.R. § 5.5 (a) (3) (i) available for inspection, copying, or transcription by authorized representatives of the FTA or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the Contractor or subcontractor fails to submit the required records or make them available, the FTA may, after written notice to the Contractor or Metra, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available, may be grounds for debarment action pursuant to 29 C.F.R. § 5.12.

#### 4. **Apprentices and Trainees**

##### a. **Apprentices**

Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the Contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than

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that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the Contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

### b. Trainees

Except as provided in 29 C.F.R. § 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits, listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work performed actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

### c. Equal Employment Opportunity

The utilization of apprentices, trainees and journeymen under 29 C.F.R. Part 5 shall be in conformity with the Equal Employment Opportunity requirements of Executive Order 11246, as amended, and 29 C.F.R. Part 30.

**5. Compliance with Copeland Act Requirements**

The Contractor shall comply with the requirements of 29 C.F.R. Part 3, which are incorporated by reference in this Contract.

**6. Contract Termination; Debarment**

A breach of the Contract clauses in 29 C.F.R. § 5.5 may be grounds for termination of the Contract, and for debarment as a Contractor and a subcontractor as provided in 29 C.F.R. § 5.12.

**7. Compliance with Davis-Bacon and Related Act Requirements**

All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 C.F.R. Parts 1, 3, and 5 are incorporated by reference in this Contract.

**8. Disputes Concerning Labor Standards**

Disputes arising out of the labor standards provisions of this Contract shall not be subject to the general disputes clause of this Contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 C.F.R. Parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the Contractor (or any of its subcontractors) and the Contracting agency, the U.S. Department of Labor, or the employees or their representatives.

**9. Certification of Eligibility.**

- a. By entering into this contract or a third party Contract financed under this contract, the Contractor certifies that neither it (nor he nor she) nor any person or firm that has an interest in the Contractor's firm is a person or firm ineligible to be awarded Government Contracts by virtue of section 3(a) of the Davis-Bacon Act of 29 C.F.R. § 5.12(a)(1).
- b. No part of this Contract shall be subcontracted to any person or firm ineligible for award of a Government Contract by virtue of section 3(a) of the Davis-Bacon Act or 29 C.F.R. § 5.12(a)(1).
- c. The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. § 1001.

**10. Compliance with Contract Work Hours  
And Safety Standards Act Requirements**

Any Contract in an amount in excess of \$100,000 is subject to the Overtime provisions of the Contract Work Hours and Safety Standards Act. As used in these provisions, the terms laborers and mechanics include watchmen and guards.

**a. Overtime Requirements**

No Contractor or subcontractor Contracting for any part of the Contract work which may require or involve the employment of laborers or mechanics shall require or

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permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

b. Violation; Liability for Unpaid Wages; Liquidated Damages.

In the event of any violation of the Overtime Requirements of 29 C.F.R. § 5.5 (b) (1), the Contractor and any subcontractor responsible therefor shall be liable for the unpaid wages. In addition, such Contractor and subcontractor shall be liable to the United States (in the case of work done under Contract for the District of Columbia or a territory, to such District or to such territory) for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of 29 C.F.R. § 5.5 (b)(1) in the sum of \$10 for each calendar day on which such individual was required or permitted to work in excess of the standard work week of forty hours without payment of the overtime wages required by 29 C.F.R. § 5.5 (b) (1).

c. Withholding for Unpaid Wages and Liquidated Damages.

The FTA or Metra shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the Contractor or subcontractor under any such Contract or any other federal Contract with the same Prime Contractor, or any other federally-assisted Contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same Prime Contractor, such sums as may be determined to be necessary to satisfy any liabilities of such Contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth at 29 C.F.R. § 5.5 (b) (2).

d. Payrolls and Basic Records for Contracts Subject Only to CWHSSA.

In any contract subject only to the Contract Work Hours and Safety Standards Act and not to any of the other statutes cited in §5.1, the Contractor or subcontractor shall maintain payrolls and basic payroll records during the course of the work and shall preserve them for a period of three years from the completion of the contract for all laborers and mechanics, including guards and watchmen, working on the contract. Such records shall contain the name and address of each such employee, social security number, correct classifications, hourly rates of wages paid, daily and weekly number of hours worked, deductions made, and actual wages paid. Further, the records to be maintained under this paragraph shall be made available by the Contractor or subcontractor for inspection, copying, or transcription by authorized representatives of the FTA, Metra, or the Department of Labor, and the Contractor or subcontractor will permit such representatives to interview employees during working hours on the job. Contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth at 29 C.F.R. § 5.5 (b) (2).

**11. Notice to the Public Body of Labor Disputes**

Whenever the Contractor has knowledge that any actual or potential labor dispute is delaying or threatens to delay the timely performance of this Contract, the Contractor shall immediately give notice thereof, including all relevant information with respect thereto, to Metra.

**12. Disputes Clause**

- a. All disputes concerning the payment of prevailing wage rates or classifications shall be promptly reported to Metra for decision or, at the option of Metra, referral to the Secretary of Labor. The decision of the Secretary of Labor shall be final.
- b. All questions relating to the application or interpretation of the Copeland Act, the Contract Work Hours and Safety Standards Act, the Davis-Bacon Act, or Section 13 of the Act shall be sent to Metra for referral to the Secretary of Labor for ruling or interpretation, and such ruling or interpretation shall be final.

**13. Convict Labor**

In connection with the performance of work under this Contract the Contractor agrees not to employ any person undergoing sentence of imprisonment at hard labor. This does not include convicts who are on parole or probation.

**14. Subcontracts**

The Contractor or subcontractor shall insert in any subcontracts the clauses 1 through 13 set forth in Group B of this exhibit and such other clauses as the FTA may by appropriate instructions require, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The Prime Contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses 1 through 13 set forth in Group B of this exhibit.

**15. Definitions**

- a. DOT means U.S. Department of Transportation.
- b. FTA means Federal Transit Administration
- c. Public Body means Northeast Illinois Regional Commuter Railroad Corporation d/b/a Metra.
- d. Sponsor means Northeast Illinois Regional Commuter Railroad Corporation D/B/A Metra.
- e. Contracting Officer shall mean the office so designated.
- f. Contractor shall mean the Contractor designated as such in this Contract.

**CIVIL RIGHTS REQUIREMENTS (TITLE VI ASSURANCE):**

The Contractor agrees to comply with and assures compliance by its sub-contractors at any tier with the following Civil Rights Requirements. The Contractor agrees to insure these requirements must be included within all contracts to its sub-contractors at any tier. Failure to implement or follow the provisions set forth in this Exhibit may result in the Contractor being placed in breach of the Contract terms and may result in Contract termination.

(1) Nondiscrimination - In accordance with Title VI of the Civil Rights Act, as amended, 42 U.S.C. § 2000d, section 303 of the Age Discrimination Act of 1975, as amended, 42 U.S.C. § 6102, section 202 of the Americans with Disabilities Act of 1990, 42 U.S.C. § 12132, and Federal transit Law 49 U.S.C. § 5332, the Contractor agrees that it will not discriminate against any employee or applicant for employment because of race, color, creed, national origin, sex, age, or disability. In addition, the Contractor agrees to comply with applicable Federal implementing regulations and other implementing requirements FTA may issue.

(2) Equal Employment Opportunity - The following equal employment opportunity requirements apply to the underlying contract:

(a) Race, Color, Creed, National Origin, Sex - In accordance with Title VII of the Civil Rights Act, as amended, 42 U.S.C. § 2000e, and Federal transit laws at 49 U.S.C. § 5332, the Contractor agrees to comply with all applicable equal employment opportunity requirements of U.S. Department of Labor (U.S. DOL) regulations, "Office of Federal Contract Compliance Programs, Equal Employment Opportunity, Department of Labor," 41 C.F.R. Parts 60 et seq., (which implement Executive Order No. 11246, "Equal Employment Opportunity" as amended by Executive Order No. 11375, "Amending Executive Order 11246 Relating to Equal Employment Opportunity," 42 U.S.C. § 2000e note), and with any applicable Federal statutes, executive orders, regulations, and Federal policies that may in the future affect construction activities undertaken in the course of the Project. The Contractor agrees to take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, creed, national origin, sex, or age. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer, recruitment or recruitment advertising, layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. In addition, the Contractor agrees to comply with any implementing requirements FTA may issue.

**EXHIBIT F**  
**CIVIL RIGHTS REQUIREMENTS**

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(b) Age - In accordance with section 4 of the Age Discrimination in Employment Act of 1967, as amended, 29 U.S.C. § 623, and Federal transit law at 49 U.S.C. § 5332, the Contractor agrees to refrain from discrimination against present and prospective employees for reason of age. In addition, the Contractor agrees to comply with any implementing requirements FTA may issue.

(c) Disabilities - In accordance with section 102 of the Americans with Disabilities Act, as amended, 42 U.S.C. § 12112, the Contractor agrees that it will comply with the requirements of U.S. Equal Employment Opportunity Commission, "Regulations to Implement the Equal Employment Provisions of the Americans with Disabilities Act," 29 C.F.R. Part 1630, pertaining to employment of persons with disabilities. In addition, the Contractor agrees to comply with any implementing requirements FTA may issue.

(3) The Contractor also agrees to include these requirements in each subcontract financed in whole or in part with Federal assistance provided by FTA, modified only if necessary to identify the affected parties.



**CONSTRUCTION INSURANCE REQUIREMENTS**

**Convert 95th & Riverdale Tie Stations to Full Traction Power Substations**

Effective concurrently with the commencement of the work, the contractor/vendor shall obtain and maintain throughout the life of the work, the insurance coverage as stated in the following pages. With the exception of Professional Liability, all coverage needs to be written on an occurrence form and with an insurer carrying a minimum AM Best rating of at least A-VIII. Should you have any questions, please call Marilyn Schiismann at 312-322-7093.

TYPE OF COVERAGE	AMOUNT REQUIRED
1. WORKERS' COMPENSATION: Coverage A - Statutory Coverage B - \$ 1,000,000	\$ <u>1,000,000</u> Limits of Liability
2. COMPREHENSIVE GENERAL LIABILITY (BROAD FORM): Bodily Injury Liability & Property Damage Liability (combined) 50 Foot Railroad Exclusion must be deleted from Definition of Insured Contract. Include Products/Completed Operations.	\$ <u>4,000,000</u> Each Occurrence \$ <u>6,000,000</u> Aggregate
3. EXCESS COMPREHENSIVE GENERAL LIABILITY-EXCESS OF PRIMARY LIMITS (2) and Auto (4) and (1) Employers' Liability Bodily Injury Liability & Property Damage Liability (combined)	\$ <u>4,000,000</u> Each Occurrence \$ <u>6,000,000</u> Aggregate
4. AUTOMOBILE LIABILITY: Bodily Injury Liability & Property Damage Liability (combined)	\$ <u>1,000,000</u> Combined Single Limit
5. CONTRACTOR'S POLLUTION LIABILITY: Bodily Injury Liability & Property Damage Liability (combined)	\$ <u>N/A</u> Each Occurrence \$ <u>N/A</u> Aggregate
6. RAILROAD PROTECTIVE LIABILITY: Bodily Injury Liability & Property Damage Liability (combined)  To be placed in Metra's Railroad Protective Liability Blanket Policy	\$ <u>Covered by Metra</u> Each Occurrence \$ <u>Covered by Metra</u> Aggregate
7. BUILDER'S RISK INSURANCE	<u>Full Value of Contract</u>
8. PERFORMANCE/PAYMENT BOND	<u>Full Value of Contract</u>
9. OTHER INSURANCE (Professional - Errors & Omissions)	\$ <u>n/a</u>

Additional Insureds shall be as follows: The Commuter Rail Division of the Regional Transportation Authority, a division of an Illinois municipal corporation, and its affiliated separate public corporation known as the Northeast Illinois Regional Commuter Railroad Corporation, both operating under the service mark Metra as now exists or may hereafter be constituted or acquired, the Regional Transportation Authority, an Illinois municipal corporation, and other railroads operating on Metra's property.

**METRA'S INSURANCE REQUIREMENTS APPLICABLE TO ALL POLICIES:**

-Include a waiver of subrogation, thereby waiving your rights of subrogation against Metra and any additional insureds.

-Include the Additional Insured Endorsement for all coverages including products and completed operations.

-Be primary and non-contributory on all coverages.

-All deductibles applicable to the insurance coverage shall be borne by the contractor/vendor. The certificate of insurance shall clearly state how defense costs (also known as "allocated loss adjustment expenses") shall apply in terms of the deductible and the insurance limits. (SIR programs are prohibited, unless approved by Metra's Risk Management Department.)

-All subcontractors retained or hired for the work shall be required to maintain limits and term equivalent to those required of the prime contractor.

-Should any of the above described policies be cancelled before the expiration date thereof, notice will be delivered in accordance with the policy provisions. Contractor/Vendor will immediately notify Metra of the cancellation, non-renewal, material change or reduction in coverage of any required insurance policy. Such notice shall be sent certified mail to Metra, care of Director of Risk Management, 547 W. Jackson, Suite 1500, Chicago, IL 60661.

-In no event, shall the failure by Metra to receive certificates of insurance required hereunder, or to receive them by the date(s) required hereunder, be construed as a waiver of the contractor/vendor's obligation to obtain the required insurance coverages. Failure by Metra to demand any certificate of insurance or other evidence of full compliance with the insurance requirements set forth herein, or failure by Metra to identify a deficiency in the evidence provided, shall not be construed as a waiver of the obligation to procure or maintain the insurance required hereunder. The acceptance of delivery by Metra of any certificate of insurance does not constitute approval or agreement that the insurance requirements have been met or that the insurance policies identified in the certificates of insurance are in compliance with such requirements.

**METRA'S INSURANCE REQUIREMENTS – SPECIFIC CONDITIONS**

**Commercial General Liability Insurance**

The CGL policy shall include the following coverage limits when limits are indicated:

\$4,000,000 per occurrence \$6,000,000 aggregate  
 \$4,000,000 aggregate for completed operations & products liability

**Automobile Liability Insurance**

The Automobile policy shall include the following additional coverage limits:

Include “any” auto (i.e. all autos owned by the contractor/vendor as well as hired and non-owned autos used by the contractor/vendor and autos used by the contractor/vendors’ employees while on Metra property).

\$1,000,000 for Property Damage (if not combined in single limit)

**Workers Compensation and Employers Liability Insurance**

Workers Compensation Insurance coverage should be at statutory limits.

As a minimum, the Employers Liability policy shall include coverage limits of:

\$1,000,000 for bodily injury by accident  
 \$1,000,000 for bodily injury by disease, each employee  
 \$1,000,000 aggregate liability

**List Metra as an additional insured shall be as follows:** The Commuter Rail Division of the Regional Transportation Authority, a division of an Illinois municipal corporation and its affiliated separate public corporation known as the Northeast Illinois Regional Commuter Railroad Corporation, both operating under the service mark Metra as now exists or may hereafter be constituted or acquired, and The Regional Transportation Authority, an Illinois municipal corporation.



**Illinois Department of Revenue**

Office of Local Government Services  
Sales Tax Exemption Section, 3-520  
101 W. Jefferson Street  
Springfield, IL 62702  
217 782-8881

8 JUN 15 4:01

—LAW ENFORCE—

EXHIBIT H

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\_\_\_\_\_  
\_\_\_\_\_

January 2, 2015

NORTHEAST IL REGIONAL COMMUTER RAILROAD CORPORATION  
SUE ANN ROSEN  
547 WEST JACKSON BOULEVARD  
CHICAGO IL 60661

Effective January 1, 2015, we have renewed your governmental exemption from payment of the Retailers' Occupation Tax, the Service Occupation Tax (both state and local), the Use Tax, and the Service Use Tax, as required by Illinois law.

We have issued the following new tax exemption identification number:

E9975-7850-07

to

NORTHEAST IL REGIONAL COMMUTER RAILROAD CORPORATION  
of  
CHICAGO, IL

The terms and conditions governing use of your exemption number remain unchanged.

Office of Local Government Services  
Illinois Department of Revenue

**EXHIBIT I**  
**DOL - EQUAL EMPLOYMENT OPPORTUNITY REQUIREMENTS**

The following notice shall be included in, and shall be a part of, all solicitations for offers and bids on all Federal and federally assisted construction contracts or subcontracts in excess of \$10,000 to be performed in geographical areas designated by the Director pursuant to §60-4.6 of this part (see 41 CFR 60-4.2(a)):

Notice of Requirement for Affirmative Action to Ensure Equal Employment Opportunity  
(Executive Order 11246)

1. The Offeror's or Bidder's attention is called to the "Equal Opportunity Clause" and the "Standard Federal Equal Employment Specifications" set forth herein.
2. The goals and timetables for minority and female participation, expressed in percentage terms for the Contractor's aggregate workforce in each trade on all construction work in the covered area, are as follows:

Time- tables	Goals for minority participation for each trade	Goals for female participation in each trade
	19.6% for each year	6.9% for each year.

These goals are applicable to all the Contractor's construction work (whether or not it is Federal or federally assisted) performed in the covered area. If the contractor performs construction work in a geographical area located outside of the covered area, it shall apply the goals established for such geographical area where the work is actually performed. With regard to this second area, the contractor also is subject to the goals for both its federally involved and nonfederally involved construction.

The Contractor's compliance with the Executive Order and the regulations in 41 CFR part 60-4 shall be based on its implementation of the Equal Opportunity Clause, specific affirmative action obligations required by the specifications set forth in 41 CFR 60-4.3(a), and its efforts to meet the goals. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade, and the contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from Contractor to Contractor or from project to project for the sole purpose of meeting the Contractor's goals shall be a violation of the contract, the Executive Order and the regulations in 41 CFR part 60-4. Compliance with the goals will be measured against the total work hours performed.

3. The Contractor shall provide written notification to the Director of the Office of Federal Contract Compliance Programs within 10 working days of award of any construction subcontract in excess of \$10,000 at any tier for construction work under the contract resulting from this solicitation. The notification shall list the name, address and telephone number of the subcontractor; employer identification number of the subcontractor; estimated dollar amount of the subcontract; estimated starting and completion dates of the subcontract; and the geographical area in which the subcontract is to be performed.
4. As used in this Notice, and in the Contract resulting from this solicitation, the "covered area" for the Standard Metropolitan Statistical area (SMSA) is Chicago, IL.

**EXHIBIT I**

**DOL - EQUAL EMPLOYMENT OPPORTUNITY REQUIREMENTS**

**Equal Opportunity Clause**

During the performance of this Contract, the Contractor agrees to abide by all conditions set forth in the Equal Opportunity Clause as detailed in 41 CFR Part 60, including:

Standard Federal Equal Employment Opportunity Construction Contract Specifications (Executive Order 11246)

1. As used in these specifications:
  - a. "Covered area" means the geographical area described in the solicitation from which this contract resulted;
  - b. "Director" means Director, Office of Federal Contract Compliance Programs, United States Department of Labor, or any person to whom the Director delegates authority;
  - c. "Employer identification number" means the Federal Social Security number used on the Employer's Quarterly Federal Tax Return, U.S. Treasury Department Form 941.
  - d. "Minority" includes:
    - (i) Black (all persons having origins in any of the Black African racial groups not of Hispanic origin);
    - (ii) Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South American or other Spanish Culture or origin, regardless of race);
    - (iii) Asian and Pacific Islander (all persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands); and
    - (iv) American Indian or Alaskan Native (all persons having origins in any of the original peoples of North America and maintaining identifiable tribal affiliations through membership and participation or community identification).
2. Whenever the Contractor, or any Subcontractor at any tier, subcontracts a portion of the work involving any construction trade, it shall physically include in each subcontract in excess of \$10,000 the provisions of these specifications and the Notice which contains the applicable goals for minority and female participation and which is set forth in the solicitations from which this contract resulted.
3. If the Contractor is participating (pursuant to 41 CFR 60-4.5) in a Hometown Plan approved by the U.S. Department of Labor in the covered area either individually or through an association, its affirmative action obligations on all work in the Plan area (including goals and timetables) shall be in accordance with that Plan for those trades which have unions participating in the Plan. Contractors must be able to demonstrate their participation in and compliance with the provisions of any such Hometown Plan. Each Contractor or Subcontractor participating in an approved Plan is individually required to comply with its obligations under the EEO clause, and to make a good faith effort to achieve each goal under the Plan in each trade in which it has employees. The overall good faith performance by other Contractors or Subcontractors toward a goal in

**EXHIBIT I**

**DOL - EQUAL EMPLOYMENT OPPORTUNITY REQUIREMENTS**

an approved Plan does not excuse any covered Contractor's or Subcontractor's failure to take good faith efforts to achieve the Plan goals and timetables.

4. The Contractor shall implement the specific affirmative action standards provided in paragraphs 7 a through p of these specifications. The goals set forth in the solicitation from which this contract resulted are expressed as percentages of the total hours of employment and training of minority and female utilization the Contractor should reasonably be able to achieve in each construction trade in which it has employees in the covered area. Covered Construction contractors performing construction work in geographical areas where they do not have a Federal or federally assisted construction contract shall apply the minority and female goals established for the geographical area where the work is being performed. Goals are published periodically in the Federal Register in notice form, and such notices may be obtained from any Office of Federal Contract Compliance Programs office or from Federal procurement contracting officers. The Contractor is expected to make substantially uniform progress in meeting its goals in each craft during the period specified.
5. Neither the provisions of any collective bargaining agreement, nor the failure by a union with whom the Contractor has a collective bargaining agreement, to refer either minorities or women shall excuse the Contractor's obligations under these specifications, Executive Order 11246, or the regulations promulgated pursuant thereto.
6. In order for the nonworking training hours of apprentices and trainees to be counted in meeting the goals, such apprentices and trainees must be employed by the Contractor during the training period, and the Contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor.
7. The Contractor shall take specific affirmative actions to ensure equal employment opportunity. The evaluation of the Contractor's compliance with these specifications shall be based upon its effort to achieve maximum results from its actions. The Contractor shall document these efforts fully, and shall implement affirmative action steps at least as extensive as the following:
  - a. Ensure and maintain a working environment free of harassment, intimidation, and coercion at all sites, and in all facilities at which the Contractor's employees are assigned to work. The Contractor, where possible, will assign two or more women to each construction project. The Contractor shall specifically ensure that all foremen, superintendents, and other on-site supervisory personnel are aware of and carry out the Contractor's obligation to maintain such a working environment, with specific attention to minority or female individuals working at such sites or in such facilities.
  - b. Establish and maintain a current list of minority and female recruitment sources, provide written notification to minority and female recruitment sources and to community organizations when the Contractor or its unions have employment opportunities available, and maintain a record of the organizations' responses.
  - c. Maintain a current file of the names, addresses and telephone numbers of each minority and female off-the-street applicant and minority or female referral from a union, a recruitment source or community organization and of what action was taken

**EXHIBIT I**

**DOL - EQUAL EMPLOYMENT OPPORTUNITY REQUIREMENTS**

with respect to each such individual. If such individual was sent to the union hiring hall for referral and was not referred back to the Contractor by the union or, if referred, not employed by the Contractor, this shall be documented in the file with the reason therefor, along with whatever additional actions the Contractor may have taken.

- d. Provide immediate written notification to the Director when the union or unions with which the Contractor has a collective bargaining agreement has not referred to the Contractor a minority person or woman sent by the Contractor, or when the Contractor has other information that the union referral process has impeded the Contractor's efforts to meet its obligations.
- e. Develop on-the-job training opportunities and/or participate in training programs for the area which expressly include minorities and women, including upgrading programs and apprenticeship and trainee programs relevant to the Contractor's employment needs, especially those programs funded or approved by the Department of Labor. The Contractor shall provide notice of these programs to the sources compiled under 7b above.
- f. Disseminate the Contractor's EEO policy by providing notice of the policy to unions and training programs and requesting their cooperation in assisting the Contractor in meeting its EEO obligations; by including it in any policy manual and collective bargaining agreement; by publicizing it in the company newspaper, annual report, etc.; by specific review of the policy with all management personnel and with all minority and female employees at least once a year; and by posting the company EEO policy on bulletin boards accessible to all employees at each location where construction work is performed.
- g. Review, at least annually, the company's EEO policy and affirmative action obligations under these specifications with all employees having any responsibility for hiring, assignment, layoff, termination or other employment decisions including specific review of these items with onsite supervisory personnel such as Superintendents, General Foremen, etc., prior to the initiation of construction work at any job site. A written record shall be made and maintained identifying the time and place of these meetings, persons attending, subject matter discussed, and disposition of the subject matter.
- h. Disseminate the Contractor's EEO policy externally by including it in any advertising in the news media, specifically including minority and female news media, and providing written notification to and discussing the Contractor's EEO policy with other Contractors and Subcontractors with whom the Contractor does or anticipates doing business.
- i. Direct its recruitment efforts, both oral and written, to minority, female and community organizations, to schools with minority and female students and to minority and female recruitment and training organizations serving the Contractor's recruitment area and employment needs. Not later than one month prior to the date for the acceptance of applications for apprenticeship or other training by any recruitment source, the Contractor shall send written notification to organizations such as the above, describing the openings, screening procedures, and tests to be used in the selection process.

**EXHIBIT I**

**DOL - EQUAL EMPLOYMENT OPPORTUNITY REQUIREMENTS**

- j. Encourage present minority and female employees to recruit other minority persons and women and, where reasonable, provide after school, summer and vacation employment to minority and female youth both on the site and in other areas of a Contractor's work force.
  - k. Validate all tests and other selection requirements where there is an obligation to do so under 41 CFR part 60-3.
  - l. Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel for promotional opportunities and encourage these employees to seek or to prepare for, through appropriate training, etc., such opportunities.
  - m. Ensure that seniority practices, job classifications, work assignments and other personnel practices, do not have a discriminatory effect by continually monitoring all personnel and employment related activities to ensure that the EEO policy and the Contractor's obligations under these specifications are being carried out.
  - n. Ensure that all facilities and company activities are nonsegregated except that separate or single-user toilet and necessary changing facilities shall be provided to assure privacy between the sexes.
  - o. Document and maintain a record of all solicitations of offers for subcontracts from minority and female construction contractors and suppliers, including circulation of solicitations to minority and female contractor associations and other business associations.
  - p. Conduct a review, at least annually, of all supervisors' adherence to and performance under the Contractor's EEO policies and affirmative action obligations.
8. Contractors are encouraged to participate in voluntary associations which assist in fulfilling one or more of their affirmative action obligations (7a through p). The efforts of a contractor association, joint contractor-union, contractor-community, or other similar group of which the contractor is a member and participant, may be asserted as fulfilling any one or more of its obligations under 7a through p of these Specifications provided that the contractor actively participates in the group, makes every effort to assure that the group has a positive impact on the employment of minorities and women in the industry, ensures that the concrete benefits of the program are reflected in the Contractor's minority and female workforce participation, makes a good faith effort to meet its individual goals and timetables, and can provide access to documentation which demonstrates the effectiveness of actions taken on behalf of the Contractor. The obligation to comply, however, is the Contractor's and failure of such a group to fulfill an obligation shall not be a defense for the Contractor's noncompliance.
9. A single goal for minorities and a separate single goal for women have been established. The Contractor, however, is required to provide equal employment opportunity and to take affirmative action for all minority groups, both male and female, and all women, both minority and non-minority. Consequently, the Contractor may be in violation of the Executive Order if a particular group is employed in a substantially disparate manner (for example, even though the Contractor has achieved its goals for women generally, the

**EXHIBIT I**

**DOL - EQUAL EMPLOYMENT OPPORTUNITY REQUIREMENTS**

Contractor may be in violation of the Executive Order if a specific minority group of women is underutilized).

10. The Contractor shall not use the goals and timetables or affirmative action standards to discriminate against any person because of race, color, religion, sex, sexual orientation, gender identity, or national origin.
11. The Contractor shall not enter into any Subcontract with any person or firm debarred from Government contracts pursuant to Executive Order 11246.
12. The Contractor shall carry out such sanctions and penalties for violation of these specifications and of the Equal Opportunity Clause, including suspension, termination and cancellation of existing subcontracts as may be imposed or ordered pursuant to Executive Order 11246, as amended, and its implementing regulations, by the Office of Federal Contract Compliance Programs. Any Contractor who fails to carry out such sanctions and penalties shall be in violation of these specifications and Executive Order 11246, as amended.
13. The Contractor, in fulfilling its obligations under these specifications, shall implement specific affirmative action steps, at least as extensive as those standards prescribed in paragraph 7 of these specifications, so as to achieve maximum results from its efforts to ensure equal employment opportunity. If the Contractor fails to comply with the requirements of the Executive Order, the implementing regulations, or these specifications, the Director shall proceed in accordance with 41 CFR 60-4.8.
14. The Contractor shall designate a responsible official to monitor all employment related activity to ensure that the company EEO policy is being carried out, to submit reports relating to the provisions hereof as may be required by the Government and to keep records. Records shall at least include for each employee the name, address, telephone numbers, construction trade, union affiliation if any, employee identification number when assigned, social security number, race, sex, status (e.g., mechanic, apprentice trainee, helper, or laborer), dates of changes in status, hours worked per week in the indicated trade, rate of pay, and locations at which the work was performed. Records shall be maintained in an easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, contractors shall not be required to maintain separate records.
15. Nothing herein provided shall be construed as a limitation upon the application of other laws which establish different standards of compliance or upon the application of requirements for the hiring of local or other area residents (e.g., those under the Public Works Employment Act of 1977 and the Community Development Block Grant Program).

**CERTIFICATION REGARDING A DRUG FREE WORKPLACE**

Pursuant to the definitions regarding a Drug Free Workplace provided in the Drug-Free Workplace Act of 1988, the Illinois Drug Free Workplace Act, 30 ILCS 580/1 *et seq.*, the Federal Acquisition Regulation System (“FAR”), Procedures for Transportation Workplace Drug & Alcohol Testing Programs, 49 CFR 40, Prevention of Alcohol Misuse & Prohibited Drug Use in Transit Operation, 49 CFR 655, Federal Railroad Administration (“FRA”) Control of Alcohol and Drug Use (49 CFR Part 219) Model Part 219 Railroad Contractor Compliance Plan, \_\_\_\_\_ (“Contractor”) certifies to the best of its knowledge and belief that it and its principals:

1. Maintain a workplace(s) (i.e. the site(s) for the performance of work done by the Contractor in connection with this contract) safe and free from “controlled substances” as described in the Controlled Substances Act (21 U.S.C. 812) and as further described in regulations 21 CFR 1308.11 – 1308.15.
2. Have neither been convicted, including entering a plea of ‘nolo contendere,’ nor had sentence imposed by any judicial body charged with the responsibility to determine violations of Federal or State criminal drug statutes.
3. Publish and give notice to its employees and sub-contractors that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the Contractor’s workplace, and also that actions will be taken against any and all employees and sub-contractors found to be violation of same.
4. Provide that all employees engaged in the performance of the contract receive a copy of the above statement, that the employee will abide by the terms of this statement, and that the employee will notify the employer in writing of the employee’s conviction no later than five (5) calendar days after such conviction.
5. Provide for appropriate action against an employee for violation of any and all of these rules and that an employee convicted of drug abuse must satisfactorily participate in a drug abuse assistance or rehabilitation program approved for such purposes by Federal, State, or local health or law enforcement or other appropriate agency.
6. Comply with all drug and alcohol policies, testing programs and reporting requirements set forth in 49 CFR 40 and 49 CFR 655 whenever the Contractor, its employees, or sub-contractor(s) perform one or more of the following functions considered “safety-sensitive”, as defined in 49 CFR 655:
  - (1) Operating a revenue service vehicle, including when not in revenue service;
  - (2) Operating a non-revenue service vehicle, when required to be operated by a holder of a Commercial Driver’s License;
  - (3) Controlling dispatch or movement of a revenue service vehicle;
  - (4) Maintaining (including repairs, overhaul and rebuilding) a revenue service vehicle or equipment used in revenue service; or
  - (5) Carrying a firearm for security purposes.
7. Comply with all statutes and regulations administered by the FRA in implementing the required 49 CFR Part 219 Drug and Alcohol Program.
8. Will otherwise comply with all drug and alcohol policies set forth in applicable Federal, State and local laws and regulations, including, but not limited to the Drug-Free Workplace Act of 1988, FAR, Illinois Drug Free Workplace Act, 49 CFR 40 and 49 CFR 655, FRA Control of Alcohol and Drug Use (49 CFR Part 219) Model Part 219 Railroad Contractor Compliance Plan in such version, prior or subsequent to amendment or revision, as is currently enforced or enforceable at and during the execution and performance of this Contract.

In addition to other remedies, the Contractor’s failure to comply with any part of the requirements of the Drug-Free Workplace Act of 1988, FAR, Illinois Drug Free Workplace Act, 49 CFR 40 or 49 CFR 655, FRA Control of Alcohol and Drug Use (49 CFR Part 219) Model Part 219 Railroad Contractor Compliance Plan, may render the Contractor subject to any or all of the following: suspension of payments, termination of contract for default, suspension or debarment.

\_\_\_\_\_  
Signature and Title of Authorized Official

\_\_\_\_\_  
Date

**METRA  
DISADVANTAGED BUSINESS ENTERPRISE (DBE)  
COMPLIANCE REQUIREMENTS**

The Northeast Illinois Regional Commuter Railroad Corporation, d/b/a Metra, is required to take all necessary and reasonable steps to ensure non-discrimination in the award and administration of contracts. Therefore, the federal regulatory provisions of 49 CFR Part 26 apply to this Contract.

**I. CONTRACT GOAL**

Metra has established a contract DBE goal of \_\_\_\_\_%.

**NOTE:**

*For bid/proposal responsiveness purposes only, DBE credit toward the contract DBE goal is measured solely against the base bid, initial proposal, bid total or grand total, not on allowance, alternative bid amounts or master purchase agreement total dollar limitation.*

**II. BID/PROPOSAL RESPONSIVENESS REQUIREMENTS**

**In order to be responsive, a bidder/proposer must make good faith efforts to meet the contract goal** for Disadvantaged Business Enterprise (DBE) participation in this contract. A bidder can accomplish this in either of two ways:

- A.** First, the bidder/proposer can commit to meet the goal with enough participation by DBEs that are certified, at the time of bid, by the Illinois Unified Certification Program (IL UCP), providing properly completed and signed Schedules of this Exhibit - Schedule A or Schedule D (if a joint venture) as well as Schedule C(s), written confirmation from the DBE(s) participating in the contract as provided in Schedule A. Schedule A or D must list the name, description of DBE work scope, the North American Industry Classification System (NAICS) Code and dollar amount of participation of each, and only each, DBE that will participate in this Contract. (If the bidder/proposer is itself a DBE, the DBE bidder/proposer must indicate on Schedule A what scope of work its forces will actually perform outside of the work of any subcontractor, and the dollar amount of that work. If this amount does not satisfy the DBE goal, the DBE bidder/proposer must list the additional DBE subcontractor(s) that will satisfy the DBE goal, along with their work scope and agreed price).

Bidders/Proposers/Contractors shall utilize the specific DBE participant(s) listed on the Schedule A or D to perform the work and supply the materials for which each is listed unless prior written approval is obtained from Metra's Senior Division Director.

The Bidder/Proposer/Contractor shall not be entitled to any payment for work or material unless it is performed or supplied by the listed DBE; **or**

- B.** Second, if the bidder/proposer cannot meet the goal with enough participation by DBEs, the bidder/proposer must provide properly completed and signed Schedule A or D and Schedule C(s) to the extent it will utilize DBE participation, and submit detailed and corroborating documentation evidencing its good faith efforts to achieve the contract goal.

The bidder/proposer must comply with A or B of Section II, and submit all documentation prior to or with submittal of the bid/proposal. If the bidder/proposer fails to do so, its bid/proposal will be deemed non-responsive. **Any DBE(s) listed on Schedule A and/or D must be certified by the IL UCP at the time of the bid/proposal due date.**

LOCATING DBE FIRMS

The IL UCP DBE Directory can be viewed via Metra's Website, [www.metrarail.com](http://www.metrarail.com). Or, a directory can be provided upon request by calling Metra's Senior Division Director at (312) 322- 6323.

**III. GOOD FAITH EFFORTS**

Metra's Senior Division Director is responsible for determining whether a bidder/proposer met the DBE Responsiveness Requirements. Metra's Senior Division Director determines whether a bidder/proposer has properly committed to meet the contract goal and whether a bidder/proposer who has not committed to meeting the goal has documented good faith efforts in order to be responsive. The documentation of good faith efforts must include copies of each DBE and non-DBE subcontractor quote submitted to the bidder when a non-DBE subcontractor was selected over a DBE for work on the contract. Metra must be satisfied that all information is complete and accurate, and adequately documents the bidder's/proposer's good faith efforts before Metra commits to the performance of the contract by the successful bidder/proposer.

A bidder's/proposer's documented good faith efforts to meet the contract goal must demonstrate that the bidder/proposer took *all necessary and reasonable steps* which, by their scope, intensity, and appropriateness to the objective, could reasonably be expected to obtain sufficient DBE participation, even if the bidder/proposer was not fully successful. Metra will make a fair and reasonable judgment whether a bidder/proposer that did not meet the goal made adequate good faith efforts. Metra will consider the quality, quantity, and intensity of the different kinds of efforts that the bidder/proposer made. The efforts employed by the bidder/proposer should be those that one would reasonably expect a bidder/proposer to take if the bidder/proposer were actively and aggressively trying to obtain DBE participation sufficient to meet the DBE contract goal. Mere *pro forma* efforts are not good faith efforts to meet the DBE contract requirements.

Metra will also take into account the performance of other bidders/proposers in meeting the contract goal. For example, when the apparent successful bidder/proposer fails to commit to the contract goal, but others commit to the goal, Metra will raise the question of whether, with additional reasonable efforts, the apparent successful bidder/proposer could have committed to the goal.

If the apparent successful bidder/proposer fails to commit to the goal, but meets or exceeds the average DBE participation obtained by other bidders/proposers, Metra may view this, in conjunction with other factors, as evidence that the apparent successful bidder/proposer made good faith efforts.

The following is a list of types of actions that Metra will consider as part of the evaluation of the bidder's/proposer's good faith efforts to obtain DBE participation. It is not intended to be a mandatory check list, or to be exclusive or exhaustive. Other factors or types of efforts

may be relevant in appropriate cases:

- A. Soliciting through all reasonable and available means (e.g., attendance at pre-bid/pre-proposal meetings, if applicable, advertising, and/or written notices) the interest of all certified DBEs who have the capability to perform the work of the contract. The bidder/proposer must solicit this interest within sufficient time to allow the DBEs to respond to the solicitation. The bidder/proposer must determine with certainty if the DBEs are interested by taking appropriate steps to follow up initial solicitations.
- B. Selecting portions of the work to be performed by DBEs in order to increase the likelihood that the DBE goals will be achieved. This includes, where appropriate, breaking out contract work items into economically feasible units to facilitate DBE participation, even when the bidder/proposer might otherwise prefer to perform these work items with its own forces.
- C. Providing interested DBEs with adequate information about the plans, specifications, and requirements of the contract in a timely manner to assist them in responding to a solicitation.
  - 1. Negotiating in good faith with interested DBEs. It is the bidder's/proposer's responsibility to make a portion of the work available to DBE subcontractors and suppliers and to select those portions of the work or material needs consistent with the available DBE subcontractors and suppliers, so as to facilitate DBE participation. Evidence of such negotiation includes the names, addresses, and telephone numbers of DBEs that were considered; a description of the information provided regarding the plans and specifications for the work selected for subcontracting; and evidence as to why additional agreements could not be reached for DBEs to perform the work.
  - 2. A bidder/proposer using good business judgment would consider a number of factors in negotiating with subcontractors, including DBE subcontractors, and would take into consideration a firm's price and capabilities, as well as contract goals. The fact that there may be some additional costs involved in finding and using DBEs, however, is not in itself sufficient reason for a bidder's/proposer's failure to meet the contract DBE goal, as long as such costs are reasonable. Also, the ability or desire of a bidder/proposer to perform the work of a contract with its own organization does not relieve the bidder/proposer of the responsibility to make good faith efforts. Bidders/Proposers are not, however, required to accept high quotes from DBEs if the price difference is excessive or unreasonable.
- D. Not rejecting DBEs as being unqualified without sound reasons based on a thorough investigation of their capabilities. The bidder's/proposer's standing within the industry, membership in specific groups, organizations, or associations and political or social affiliations (for example, union vs. non-union employee status) are not legitimate causes for the rejection or non-solicitation of bids/proposals in the bidder's/proposer's efforts to meet the project goal.
- E. Making efforts to assist interested DBEs in obtaining bonding, lines of credit, or insurance as required by Metra or the bidder/proposer.
- F. Making efforts to assist interested DBEs in obtaining necessary equipment, supplies, materials, or related assistance or services.
- G. Effectively using the services of available minority/women community organizations; minority/women contractors' groups; local, state, and federal minority/women business assistance offices; and other organizations as allowed on a case-by-case basis to provide assistance in the recruitment and placement of DBEs.

**IV. COUNTING DBE PARTICIPATION**

Schedules A or D and C are reviewed to evaluate and determine DBE credit for proposed DBE participation. The Schedules must be completely filled out and the Description of Work clearly defined, in detail to establish that the identified DBE participant(s) would be providing a commercially useful function as per USDOT Regulation 49 CFR 26.55 (c). Description(s) of Work and associated Amount(s) provided on Schedules A or D and C must be in agreement.

Metra will only count credit for:

- Participation by DBEs Certified by the Illinois Unified Certification Program (IL UCP) at the time of the bid/proposal due date;
- Participation by DBEs directly related to this procurement.

As per 49 CFR. Part 26, Metra counts DBE participation toward overall and contract goals as follows:

- A. When a DBE participates in a contract, Metra counts only the value of the work actually performed by the DBE toward the DBE goal. Participation will only be credited in the DBE’s area of specialization. Credit for work in other areas requires additional support documentation for each of those areas.
- B. Metra counts the entire amount of that portion of a contract that is performed by the DBE’s own forces. This includes the cost of supplies and materials obtained by the DBE for the work of the contract, including supplies purchased or equipment leased by the DBE (except supplies and equipment the DBE subcontractor purchases or leases from the prime contractor or its affiliate).
- C. Metra counts the entire amount of fees or commissions charged by a DBE firm for providing a bona fide service, such as professional, technical, consultant, or managerial services, or for providing bonds or insurance specifically required for the performance of a DOT-assisted contract, toward DBE goals, provided Metra determines the fee to be reasonable and not excessive as compared with fees customarily allowed for similar services.
- D. When a DBE subcontracts part of the work of its contract to another firm, the value of the subcontracted work may be counted toward DBE goals only if the DBE’s subcontractor is itself a DBE. Work that a DBE subcontracts to a non-DBE firm does not count toward DBE goals.
- E. When a DBE performs as a participant in a joint venture, Metra counts a portion of the total dollar value of the contract equal to the distinct, clearly defined portion of the work of the contract that the DBE performs with its own forces toward DBE goals.
- F. Metra counts expenditures to a DBE toward DBE goals only if the DBE is performing a commercially useful function on this Contract.

- 1. A DBE performs a commercially useful function when it is responsible for execution of the work of the contract and is carrying out its responsibilities by actually performing, managing, and supervising the work involved. To perform a commercially useful function, the DBE must also be responsible, with respect to materials and supplies used on the contract, for negotiating price, determining quality and quantity, ordering the material, and installing (where applicable) and paying for the material itself. To determine whether a DBE is performing a commercially useful function, Metra must evaluate the amount of work subcontracted, industry practices, whether the amount the firm is to be paid under the contract is commensurate with the work it is actually performing and the DBE credit claimed for its performance of work, and other relevant factors.
- 2. A DBE does not perform a commercially useful function if its role is limited to that of an

extra participant in a transaction, contract, or project through which funds are passed in order to obtain the appearance of DBE participation. In determining whether a DBE is such an extra participant, Metra must examine similar transactions, particularly those in which DBEs do not participate.

3. If a DBE firm acting as a prime contractor and/or as a subcontractor under this Contract does not perform or exercise responsibility for at least thirty percent (30%) of the total cost of its contract with its own work force, or the DBE subcontracts a greater portion of the work of a contract than would be expected on the basis of normal industry practice for the type of work involved, Metra must presume that it is not performing a commercially useful function.
4. Metra uses the following factors in determining whether a DBE trucking company is performing a commercially useful function:
  - a. The DBE must be responsible for the management and supervision of the entire trucking operation for which it is responsible on a particular contract, and there cannot be a contrived arrangement for the purpose of meeting DBE goals;
  - b. The DBE must itself own and operate at least one fully licensed, insured, and operational truck used on the contract;
  - c. The DBE receives credit for the total value of the transportation services it provides on the contract using trucks it owns, insures, and operates using drivers it employs;
  - d. The DBE may lease trucks from another DBE firm, including an owner-operator who is certified as a DBE. The DBE who leases trucks from another DBE receives credit for the total value of the transportation services the lessee DBE provides on the contract;
  - e. The DBE may also lease trucks from a non-DBE firm, including from an owner-operator. The DBE who leases trucks from a non-DBE is entitled to credit for the total value of transportation services provided by non-DBE lessees not to exceed the value of transportation services provided by DBE-owned trucks on the contract. Additional participation by non-DBE lessees receives credit only for the fee or commission it receives as a result of the lease arrangement.

*Example to paragraph (d)(5):* DBE Firm X uses two of its own trucks on a contract. It leases two trucks from DBE Firm Y and six trucks from non-DBE Firm Z. DBE credit would be awarded for the total value of transportation services provided by Firm X and Firm Y, and may also be awarded for the total value of transportation services provided by four of the six trucks provided by Firm Z. In all, full credit would be allowed for the participation of eight trucks. With respect to the other two trucks provided by Firm Z, DBE credit could be awarded only for the fees or commissions pertaining to those trucks Firm X receives as a result of the lease with Firm Z.

- f. The DBE may lease trucks without drivers from a non-DBE truck leasing company. If the DBE leases trucks from a non-DBE truck leasing company and uses its own employees as drivers, it is entitled to credit for the total value of these hauling services.
- g. For purposes of this subparagraph (d), a lease must indicate that the DBE has exclusive use of and control over the truck. This does not preclude the leased truck from working for others during the term of the lease with the consent of the DBE, so long as the lease gives the DBE absolute priority for use of the leased truck. Leased trucks must display the name and identification number of the DBE; and
- h. If DBE credit is to be counted for this contract, the contractor must submit to Metra's Senior Division Director a Monthly DBE Trucking Report (*see attached pgs.*

*15 & 16*) of trucks used on the project that are owned and/or leased by the DBE participants as described above.

5. If a DBE is presumed not to be performing a commercially useful function as provided in these requirements, the DBE may present evidence to rebut this presumption. Metra may determine that the firm is performing a commercially useful function given the type of work involved and normal industry practices.
6. Metra's decisions on commercially useful function matters are subject to review by the Federal Transit Administration, but are not administratively appealable to United States Department of Transportation.
7. **Metra counts** expenditures with DBEs for **materials or supplies** toward DBE goals as provided in the following:
  - a. If the materials or supplies are obtained from a DBE **manufacturer**, Metra counts one hundred percent (**100%**) of the cost of the materials or supplies toward DBE goals.
  - b. For purposes of these requirements, a manufacturer is **a firm that operates or maintains a factory or establishment that produces, on the premises, the materials, supplies, articles, or equipment required under the contract and of the general character described by the specifications.**
  - c. If materials or supplies are purchased from a DBE **regular dealer**, Metra counts sixty percent (**60%**) of the cost of the materials or supplies toward DBE goals.
  - d. For purposes of these requirements, a regular dealer is **a firm that owns, operates, or maintains a store, warehouse, or other establishment in which the materials, supplies, articles or equipment of the general character described by the specifications and required under the contract are bought, kept in stock, and regularly sold or leased to the public in the usual course of business.**
    - (1) To be a regular dealer, the firm must be an established, regular business that engages, as its principal business and under its own name, in the purchase and sale or lease of the products in question.
    - (2) A person may be a regular dealer in such bulk items as petroleum products, steel, cement, gravel, stone, or asphalt without owning, operating, or maintaining a place of business as provided in this paragraph if the persons both owns and operates distribution equipment for the products. Any supplementing of regular dealers' own distribution equipment shall be by a long-term lease agreement and not on an ad hoc or contract-by-contract basis.
    - (3) Packagers, brokers, manufacturers' representatives, or other persons who arrange or expedite transactions are not regular dealers within the meaning of this paragraph.
    - (4) With respect to materials or supplies purchased from a DBE which is neither a manufacturer nor a regular dealer, Metra counts the entire amount of fees or commissions charged for assistance in the procurement of the materials and supplies, or fees or transportation charges for the delivery of materials or supplies required on a job site, toward DBE goals, provided Metra determines the fees to be reasonable and not excessive as compared with fees customarily allowed for similar service. Metra will not count any portion of the cost of the materials and supplies themselves toward DBE goals, however.

8. Metra will not count toward its overall goal the dollar value of work performed under a contract by a firm after it has ceased to be certified.
9. Metra will not count the participation of a DBE subcontractor toward the prime contractor's DBE achievements or Metra's overall goal until the amount being counted toward the goal has been paid to the DBE.

**V. RECONSIDERATION**

If Metra determines that a bidder/proposer is not responsive because it has not committed to meeting the contract goal or documented sufficient good faith efforts, the bidder/proposer has five (5) days to request administrative reconsideration. The bidder/proposer must make this request in writing to:

Executive Director/CEO  
Metra  
547 West Jackson Boulevard  
Chicago, Illinois 60661-5717  
(312) 322-6979

The Reconsideration Official, or designee, will not have played any role in the original determination that the bidder/proposer did not document sufficient good faith efforts.

As part of this Reconsideration, the bidder/proposer will have the opportunity to provide written documentation or argument concerning the issue of whether it committed to meeting the contract goal or made adequate good faith efforts to do so. The bidder/proposer will have the opportunity to meet in person with Metra's Reconsideration Official, or designee, to discuss these issues. Metra will send the bidder/proposer a written decision after its reconsideration, explaining Metra's basis for finding that the bidder/proposer did or did not meet the goal or made adequate good faith efforts to do so. The result of this reconsideration process is not administratively appealable to the United States Department of Transportation.

**VI. RESPONSIBILITY REQUIREMENTS**

**A. Joint Ventures**

If the bidder/proposer is a DBE joint venture, a signed joint venture agreement must be submitted to Metra for Metra's approval at the time of bid/proposal due date. This agreement must address the administrative, financial, and field responsibilities of each partner. The DBE participation must meet the criteria as set forth in the following definition per 49 CFR 26.5:

*Joint Venture* means an association of a DBE firm and one or more other firms to carry out a single, for-profit business enterprise, for which the parties combine their property, capital, efforts, skills and knowledge, and in which the DBE is responsible for a distinct, clearly defined portion of the work of the contract and whose share in the capital contribution, control, management, risks, and profits of the joint venture are commensurate with its ownership interest.

**B. Substitutions**

A bidder/proposer cannot substitute any DBEs listed on Schedule A or D without prior written approval from Metra's Senior Division Director (See Section VII [F]).

**VII. CONTRACT PERFORMANCE**

**A.** Upon award of a Metra *contract*, a Contractor's good faith efforts to achieve the contract DBE goal and DBE credit are monitored, evaluated and measured against the entire awarded contract value, including alternates, allowance work, amendments change orders, and options.

1. *If the award includes an alternate bid*, Metra expects any DBE listed on the Schedule A or D to perform the same or similar subcontractor work contained in the alternate bid. Revised Schedules A or D and C will be required to document additional DBE commitment.
2. *If the award is a negotiated amount*, Metra expects any DBE listed on the Schedule A or D to perform the same or similar subcontractor work contained in the initial bid or proposal. Revised Schedules A or D and C will be required to document the negotiated amount DBE commitment.
3. In addition, Metra expects any DBE listed on the Schedule A or D to perform the same or similar subcontractor *work authorized under the allowance or under release by a master purchase agreement* as necessary to meet the established contract DBE goal.
4. The Contractor is required to notify Metra's Senior Division Director immediately to address a revised "Commitment to DBE Participation" in a situation where the DBE's work scope has changed as a result of actions taken by Metra.

**B. Subcontracts (Prior to Notice to Proceed)**

1. A Metra Notice to Proceed will not be issued to the prime Contractor until signed DBE Subcontracts are provided to the Metra's Senior Division Director. **Within thirty (30) calendar days after the Notice of Award** of the contract, the Prime Contractor must provide copies of **Signed contracts** between the prime Contractor and the DBEs to Metra's Senior Division Director.
2. **Failure to provide the DBE subcontracts to Metra's Senior Division Director within the time required shall constitute a breach of this Contract**, and upon such breach, Metra may terminate this Contract and/or exercise other sanctions, penalties, or remedies as allowed by law or equity, and as Metra deems appropriate.

**C. Contract Invoices/Payments**

The Contractor must submit to Metra's Senior Division Director of the Office of Business Diversity & Civil Rights:

1. Two (2) copies of contract invoices, including support documentation, at the same time the

- originals are submitted to Metra's Accounts Payable; and concurrently
2. Copies proof of subcontractor/supplier payment(s) in the form of canceled checks (both sides) or other proof of payment.

**D. Prompt Payment**

The Contractor agrees to pay each subcontractor for satisfactory performance of its subcontract no later than fifteen (15) calendar days from the receipt of such payment that the Contractor receives from Metra. The Contractor agrees further to return funds it has retained to each subcontractor within fifteen (15) calendar days after the subcontractors work is satisfactorily completed.

The Contractor agrees to complete the prompt payment log, included in the payment application form (or provided by Metra's Senior Division Director), documenting dates and amounts of payments made to subcontractors.

Any failure to comply with this Section will be in material breach of this Contract, and Metra reserves all its rights in law and equity for such breach. In addition, such breach will be taken into consideration for the Contractor's responsibility status for future contracts with Metra. This clause applies to both DBE and non-DBE prime contractors and subcontractors.

**E. DBE Participation**

Metra's office of the Senior Division Director may make on-site visits from time to time during the course of this Contract to ensure compliance with the requirements set forth herein, and may require verification of any commitment represented to us in connection with the Contractor's use of DBE businesses in the performance of this Contract.

**Further, if problems should arise with respect to the Contractor's subcontract with any DBEs, please contact Metra's Senior Division Director immediately so that Metra may be apprised and lend whatever assistance Metra can in solving the problem.**

**F. Substitution of DBE Firms**

The Contractor must obtain prior written approval from Metra in order to substitute any DBE, which Metra has approved for participation in this Contract.

The Contractor cannot terminate for convenience any DBE listed on Schedule A (or an approved substitute DBE firm), and then perform the work of the terminated subcontract with its own forces or those of an affiliate or substitute firm, without Metra's prior written consent.

The Contractor is required to notify Metra's Senior Division Director immediately and provide reasonable documentation of any DBE's inability or unwillingness to perform its subcontract.

Before transmitting to Metra a request to terminate and/or substitute any DBE, the Contractor must give notice in writing to the DBE, with a copy to Metra, of its intent to request to terminate and/or substitute, and the reason for the request.

The Contractor must give the DBE five days to respond to the Contractor's notice and advise Metra and the contractor of the reasons, if any, why it objects to the proposed termination of its subcontract and why you should not approve the Contractor's action.

The Contractor is required to make good faith efforts to replace any DBE that is terminated, or whose work scope has changed, or has otherwise failed to complete its work on this Contract with another certified DBE, to the extent needed to meet the Contract goal.

The Contractor must provide a copy of the new subcontract with the substitute DBE, or documentation of good faith efforts to substitute the initial DBE with another DBE.

The Contractor is required to notify Metra's Senior Division Director immediately to address a revised "Commitment to DBE Participation" in a situation where the DBE's work scope has changed as a result of actions taken by Metra.

**G. Records**

A record of all activities to demonstrate good faith efforts must be kept by the Contractor and made available to Metra upon request.

**H. Contract Assurance**

The Contractor makes the following assurance and agrees to include the assurance in each subcontract that the Contractor signs with a subcontractor:

The Contractor or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this Contract. The Contractor shall carry out applicable requirements of 49 CFR Part 26 in the award and administration of federally assisted contracts. Failure by the Contractor to carry out these requirements is a material breach of this

Contract, which may result in the termination of this Contract or other such remedy, as Metra deems appropriate, which may include, but is not limited to:

1. Withholding monthly progress payments;
2. Assessing sanctions;
3. Liquidated damages; and/or
4. Disqualifying the contractor from future bidding as non-responsible.

**I. Breach of Contract**

Failure to abide by any of the DBE participation requirements in this Contract or any requirements set forth in 49 CFR Part 26 shall constitute a breach of this Contract, and upon such breach, Metra may terminate this Contract and/or exercise other sanctions, penalties, or remedies as allowed by law or equity and as Metra deems appropriate.

**VIII. REFERENCES**

All references to Metra's Senior Division Director mean:

Janice R. Thomas, Senior Division Director  
Metra Office of Diversity and Civil Rights  
547 West Jackson Boulevard  
Chicago, Illinois 60661-5717

## SCHEDULE A

### BIDDER/PROPOSER/CONTRACTOR COMMITMENT TO DBE SUBCONTRACT PARTICIPATION

NAME OF BIDDER/PROPOSER OR  
CONTRACTOR: \_\_\_\_\_

METRA IFB/RFP/CONTRACT (TASK) NO.: \_\_\_\_\_  
NAME OF PROJECT: \_\_\_\_\_

**NOTE:**

- Bidder/Proposer/Contractor Must COMPLETE, SIGN AND RETURN THIS FORM along with Completed, Signed Schedule Cs from Each listed DBE.
- If the BIDDER/PROPOSER/CONTRACTOR is itself a DBE, the DBE BIDDER/PROPOSER/CONTRACTOR must indicate the scope of work it will perform with its own forces (independent of the work of any subcontractor) and the dollar amount of that work.
- Any DBE listed on this Schedule A must be certified by the IL UCP at the time of Bid/Proposal submittal (view IL UCP DBE Directory @ [www.MetraRail.com](http://www.MetraRail.com)).

NAME and ADDRESS OF DBE FIRM	DBE SCOPE OF WORK (TO BE PERFORMED FOR THIS PROJECT)* and NORTH AMERICAN INDUSTRY CLASSIFICATION SYSTEM (NAICS) CODE	AGREED AMOUNT
		\$
		\$
		\$
		\$
<b>TOTAL DBE COMMITMENT</b>		\$

\*If space is not sufficient provide detail on attached page.

**For bid/proposal responsiveness purposes only, DBE credit for Total DBE Commitment is measured solely against the base bid, initial proposal, bid total, or grand total, not on allowance, alternative bid amounts or master purchase agreement total dollar limitation.** However, in the event Metra awards a contract, Metra expects any DBE listed on the Schedule A to perform the same or similar subcontractor work under the allowance. *If the award includes an alternate*, Metra expects any DBE listed on the Schedule A to perform the same or similar subcontractor work contained in the alternate. *If the award is a negotiated amount*, Metra expects any DBE listed on the Schedule A to perform the same or similar subcontractor work contained in the initial bid or proposal. In addition, Metra expects any DBE listed on the Schedule A to perform the same or similar subcontractor work authorized under the allowance or under release by a master purchase agreement as necessary to meet the established contract DBE goal.

Bidder/Proposer/Contractor cannot substitute any DBE without prior approval of the Senior Division Director. Bidder/Proposer/Contractor cannot terminate for convenience any DBE listed and then perform the work with its own forces without prior approval of the Senior Division Director.

I hereby certify that arrangements have been made for the foregoing work with the listed DBE subcontractor(s). I further understand that any willful falsification, fraudulent statement, or misrepresentation will result in appropriate sanctions, which may include debarment and/or prosecution under applicable State and Federal Laws.

\_\_\_\_\_  
Printed Name and Title of Bidder/Proposer/Contractor Authorized Signee

\_\_\_\_\_  
Signature of Bidder/Proposer/Contractor Authorized Signee

\_\_\_\_\_  
Date

**SCHEDULE C**  
**CONFIRMATION OF DBE COMMITMENT**

**NAME OF BIDDER/PROPOSER OR CONTRACTOR:** \_\_\_\_\_

**METRA IFB/RFP/CONTRACT (TASK) NO.:** \_\_\_\_\_  
**NAME OF PROJECT:** \_\_\_\_\_

**NOTE:**

- Bidder/Proposer/Contractor Must **SUBMIT THIS FORM** from each listed DBE at the time of Bid/Proposal Along With its Schedule A.
- If the **BIDDER/PROPOSER/CONTRACTOR** is itself a DBE, the **DBE BIDDER/PROPOSER/CONTRACTOR** must indicate the scope of work it will perform with its own forces (independent of the work of any subcontractor) and the dollar amount of that work.
- Any DBE listed on Schedule A and/or D must be certified by the IL UCP at the time of Bid/Proposal submittal (view IL UCP DBE Directory @ [www.MetraRail.com](http://www.MetraRail.com)).

**NAME OF DBE FIRM:** \_\_\_\_\_

**ADDRESS OF DBE FIRM:** \_\_\_\_\_

hereby certifies that it is participating in the referenced Metra project in the agreed amount of \$ \_\_\_\_\_ performing

and as shown on Schedule A of \_\_\_\_\_ 's bid/proposal/contract.  
Name of Prime Bidder/Proposer/Contractor

PLEASE COMPLETE THE FOLLOWING (Trucking Firms Complete Both Columns):					
			TRUCKING FIRMS ONLY		
The above DBE work will be further subcontracted:			The above DBE work will be supplemented with leased trucks:		
Check One	Yes	No	Check One	Yes	No
If Yes, indicate the % of the Schedule A and C Agreed Amount that is to be further subcontracted to a DBE and/or Non-DBE firm. Provide additional Schedule C(s) if further subcontracted to a DBE.			If Yes, indicate the % of the Schedule A and C Agreed Amount that will be expended for the lease of another DBE and/or Non-DBE firm's trucks. Provide additional Schedule C(s) if leased from a DBE.		
If No, enter "0%" on both lines below.			If No, enter "0%" on both lines below.		
_____% of DBE's work will be further subcontracted to another DBE.			_____% of DBE's work will be supplemented with leased trucks from another DBE.		
_____% of DBE's work will be further subcontracted to a Non-DBE.			_____% of DBE's work will be supplemented with leased trucks from a Non-DBE.		

I further understand that any willful falsification, fraudulent statement, or misrepresentation will result in appropriate sanctions, which may include debarment and/or prosecution under applicable State and Federal Laws.

\_\_\_\_\_  
**Printed Name and Title** of DBE Firm Authorized Signee

\_\_\_\_\_  
**Signature** of DBE Firm Authorized Signee

\_\_\_\_\_  
**Date**

**SCHEDULE D**  
**COMMITMENT TO DBE JOINT VENTURE**

NAME OF BIDDER/PROPOSER OR  
CONTRACTOR: \_\_\_\_\_

METRA IFB/RFP/CONTRACT (TASK) NO.: \_\_\_\_\_  
NAME OF PROJECT: \_\_\_\_\_

**NOTE:**

- A FORMAL JOINT VENTURE AGREEMENT MUST BE SUBMITTED FOR APPROVAL AT THE TIME BID/PROPOSAL IS DUE, ALONG WITH SCHEDULES D AND C.
- When a DBE performs as a participant in a joint venture, Metra counts a portion of the total dollar value of the contract equal to the distinct, clearly defined portion of the work of the contract that the DBE performs with its own forces toward DBE goals.
- Any DBE listed on Schedule D must be certified by the IL UCP at the time of Bid/Proposal submittal (view IL UCP DBE Directory @ [www.metrail.com](http://www.metrail.com)).

NAME and ADDRESS OF DBE FIRM	DBE SCOPE OF WORK (TO BE PERFORMED FOR THIS PROJECT)* and NORTH AMERICAN INDUSTRY CLASSIFICATION SYSTEM (NAICS) CODE	AGREED AMOUNT
		\$
		\$
		\$
		\$
<b>*If space is not sufficient provide detail on attached page.</b>		<b>TOTAL DBE COMMITMENT</b> \$

*For bid/proposal responsiveness purposes only, DBE credit for Total DBE Commitment is measured solely against the base bid, initial proposal, bid total or grand total, not on allowance, alternative bid amounts or master purchase agreement total dollar limitation. However, in the event Metra awards a contract, Metra expects any DBE listed on the Schedule A to perform the same or similar subcontractor work under the allowance. If the award includes an alternate, Metra expects any DBE listed on the Schedule A to perform the same or similar subcontractor work contained in the alternate. If the award is a negotiated amount, Metra expects any DBE listed on the Schedule A to perform the same or similar subcontractor work contained in the initial bid or proposal. In addition, Metra expects any DBE listed on the Schedule A to perform the same or similar subcontractor work authorized under the allowance or under release by a master purchase agreement as necessary to meet the established contract DBE goal.*

Bidder/Proposer/Contractor cannot substitute any DBE without prior approval of the Senior Division Director. Bidder/Proposer/Contractor cannot terminate for convenience any DBE listed and then perform the work with its own forces without prior approval of the Senior Division Director.

I hereby certify that arrangements have been made for the foregoing work with the listed DBE subcontractor(s). I further understand that any willful falsification, fraudulent statement, or misrepresentation will result in appropriate sanctions, which may include debarment and/or prosecution under applicable State and Federal Laws.

\_\_\_\_\_  
Printed Name and Title of Joint Venture Authorized Signee

\_\_\_\_\_  
Signature of Joint Venture Authorized Signee

\_\_\_\_\_  
Date

\_\_\_\_\_  
Printed Name and Title of Joint Venture Authorized Signee

\_\_\_\_\_  
Signature of Joint Venture Authorized Signee

\_\_\_\_\_  
Date



# Monthly DBE Trucking Report

Month: \_\_\_\_\_ Year: \_\_\_\_\_

Date: \_\_\_\_\_

**Contractor Information:**

Name: \_\_\_\_\_  
 Address: \_\_\_\_\_  
 City, \_\_\_\_\_ State: \_\_\_\_  
 Zip: \_\_\_\_\_

**Contract Information:**

Metra Contract No.: \_\_\_\_\_  
 Project Name: \_\_\_\_\_  
 Location: \_\_\_\_\_

Please provide the following information:

	Name of Trucking Company	DBE (Y/N)	Owner/Operator (Y/N)	License Plate # on Truck	Name on Truck and Truck Number	List The Date(s) of Trucking Activities	Commission or Amount Paid	Date Paid	Lease Arrangement* (if applicable)**
1.							\$		Lease agreement <input type="checkbox"/> With Non-DBE <input type="checkbox"/> With DBE <input type="checkbox"/>
2.							\$		Lease agreement <input type="checkbox"/> With Non-DBE <input type="checkbox"/> With DBE <input type="checkbox"/>
3.							\$		Lease agreement <input type="checkbox"/> With Non-DBE <input type="checkbox"/> With DBE <input type="checkbox"/>
4.							\$		Lease agreement <input type="checkbox"/> With Non-DBE <input type="checkbox"/> With DBE <input type="checkbox"/>
5.							\$		Lease agreement <input type="checkbox"/> With Non-DBE <input type="checkbox"/> With DBE <input type="checkbox"/>
<b>Total Amount Paid:</b>							\$		

\_\_\_\_\_  
 Prime Contractor Signature (Required)

\_\_\_\_\_  
 Metra Representative Signature (Required)

*\*Upon request all Lease Agreements should be made available, in accordance with 49 CFR 26.55(d)(7).*



# Monthly DBE Trucking Report

Comments: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

## MONTHLY DBE TRUCKING REPORT – INSTRUCTIONS:

The right top of the form contains boxes to put in the Date the report is submitted, the Metra Contract Number, Project Name, and Project Location.

The left top of the form contains boxes to put in the Month of the reporting period and the Year of the reporting period. The form also requires the Contractor Information.

The Contractor must submit the form on a monthly basis to Metra’s Senior Division Director. The report must show the dollar amount paid to the DBE trucking company(s) for trucking work performed by certified DBE trucks and for fees or commissions of non-DBE trucks utilized each month on the project. The amount paid to each trucking company is to be entered in the column called “*Commission or Amount Paid.*” The total figure of the “*Commission or Amount Paid*” is to be placed under the box labeled “*Total Amount Paid.*”

All columns are required. Use additional pages if necessary.

The Contractor receives DBE credit for trucking based on the following factors (see 49 CFR 26.55(d)(1-7)):

- 1) 100% for the trucking services provided by the DBE using trucks it owns, insures, and operates using drivers it employs.
- 2) 100% for the trucking services provided by the trucks leased from other DBE firms.
- 3) The DBE that leases trucks equipped with drivers from a non-DBE is entitled to credit for the total value of transportation services provided by non-DBE leased trucks equipped with drivers not to exceed the value of transportation services on the contract provided by DBE-owned trucks or leased trucks with DBE employee drivers (49 CFR 26.55(d)(5)). Additional participation by non-DBE owned trucks equipped with drivers receives credit only for the fee or commission it receives as a result of the lease arrangement (49 CFR 26.55(d)(5)).

***\*\*A lease must indicate that the DBE has exclusive use of and control over the truck. This does not preclude the leased truck from working for others during the term of the lease with the consent of the DBE, so long as the lease gives the DBE absolute priority for use of the leased truck. Leased trucks must display the name and identification number of the DBE (49 CFR 26.55(d)(7)).***

**AFFIDAVITS /CERTIFICATIONS FOR CONTRACTORS**

**FILL IN THE BLANKS AND SUBMIT THIS FORM WITH BID. HAVE APPLICABLE SIGNATURES NOTARIZED.**

STATE OF \_\_\_\_\_

COUNTY OF \_\_\_\_\_

The Undersigned represents that s/he is \_\_\_\_\_ (“Undersigned”) the  
(Print Name)

\_\_\_\_\_ of \_\_\_\_\_  
(Print President or Other Proper Title) Print name of Entity)

(“Company” or “Undersigned”) and is authorized to attest on behalf of himself/herself and said Company by stating as follows:

**A. PROHIBITED INTERESTS AND CONFLICTS OF INTEREST**

**1. PUBLIC OFFICER PROHIBITED ACTIVITIES ACT AFFIDAVIT**

The Company is the bidder submitting this bid and that the proposer is in compliance with Provisions set forth in the Public Officer Prohibited Activities Act, 50 ILCS 105/0.01, et seq., and to the best of its knowledge and belief, no person holding office, either by election or appointment under the laws or constitution of this State, is in any manner interested, either directly or indirectly, in his/her own name or in the name of any other person, association, trust, or corporation, in this contract or the performance of any work/services under this contract which such officer has been or may be called upon to act or vote.

**2. METRA'S CONFLICTS OF INTEREST ORDINANCE**

Pursuant to §4.03 of Metra's Bidding Regulations:

Members of the Board, officers, and employees of Metra, their spouses, their children, their parents, their brothers and sisters and their children, are prohibited from having or acquiring any contract or any direct pecuniary interest in any contract which will be wholly or partially performed by the payment of funds or the transfer of property of the Metra. Any firm, partnership, association, or corporation from which any member of the Board, officer, or employee of the Metra is entitled to receive more than seven and one half percent (7-1/2%) of the total distributable income, is prohibited from having or acquiring any contract or direct pecuniary interest in any contract which will be performed in whole or in part by payment of funds or the transfer of property of Metra.

Any firm, partnership, association, or corporation from which members of the Board, officers, employees of Metra, their spouses, their children, their parents, their brothers and sisters and their children, are entitled to receive in the aggregate more than fifteen percent (15%) of the total distributable income, is prohibited from having or acquiring any contract or direct pecuniary interest in any contract which will be performed in whole or in part by the payment of funds or the transfer of property of Metra.

Board members and employees are prohibited from participating in the selection, award, or administration of a contract supported by Metra funds, federal funds, or any other grant funds if a real conflict of interest or, to his or her knowledge, an apparent conflict of interest would be involved. A real or apparent conflict of interest would arise when any of the following has an interest in the entity selected for award: (a) an employee, officer, board member, or agent; (b) any member of his or her immediate family (as listed above in the first paragraph); (c) his or her business partner; or (d) an organization that employs; or intends to employ, any of the above. "Apparent" is defined under this paragraph as being one in which a person is an officer or director of an entity, or has an interest in the ownership or profits of an entity, and such interest appears substantial to a reasonable person. "Interest" is defined under this paragraph as a direct or indirect entitlement to receive any of the entity's profits.

In addition, Undersigned states that no officer of Metra has represented, either as an agent or otherwise, the proposer with respect to this application or bid for contract. Finally, Undersigned states that to best of its knowledge and belief, no officer of Metra has received or been offered from any person on behalf of the proposer, either directly or indirectly, any money or other thing of value as a gift, bribe, or means of influencing any vote or action in any official's capacity. Furthermore, Undersigned certifies that, to the best of its knowledge, it is in compliance with Metra's Bidding Regulations and is unaware of any of the foregoing persons having an interest prohibited by Section 4.03 of the Bidding Regulations.

## **B. NON-COLLUSION AFFIDAVIT**

The Company is the bidder submitting this bid and that such bid was not made in the interest of or on behalf of any undisclosed person, partnership, company, organization or corporation; that such bid is genuine and not collusive or a sham and that said proposer has not been a party to any agreement or collusion among bidders/proposers or prospective bidders/proposers in restraint of freedom of competition by agreement to bid a fixed price or other-wise, or to refrain from proposing, and has not, directly or indirectly, by agreement, communication, or conference with anyone, attempted to induce action prejudicial to the interest of Metra, or of any proposer or anyone else interested in the proposed contract.

## **C. CERTIFICATE FOR BID**

As a part of its offer to contract for services to Metra, the Undersigned hereby certifies that neither the Company nor any of its principals are barred from proposing on the aforementioned contract as a result of a violation of either Section 33E-3 or 33E-4 of 720 ILCS 5/33E.

**D. CERTIFICATE OF DEBARMENT**

As the potential contractor for a primary contract, or subcontractor to a primary contractor for subcontracts over \$25,000.00, the Undersigned certifies to the best of its knowledge and belief, the Company and its principals:

1. Are not included on the U.S. Comptroller General's Consolidated List of Persons or Firms Debarred from federal contracts for violations of various public contracts incorporating labor standard provisions;
2. Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any federal, state, or local government entity;
3. (a) have not been convicted under the laws of Illinois or any other state of bribery or attempting to bribe any government officer or employee or have made an admission of guilt of that conduct that is a matter of record but has not been prosecuted for that conduct. No business shall be barred from contracting with Metra as a result of a conviction under this Section of any employee or agent of the business if the employee or agent is no longer employed by the business and: i) the business has been finally adjudicated not guilty; or ii) the business demonstrates to Metra, and Metra finds that the commission of the offense was not authorized, requested, commanded, or performed by a director, officer, or high managerial agent on behalf of the business as provided in paragraph (2) of subsection (a) of Section 5-4 of the Criminal Code of 1961. For purposes of this Subsection (a), when an official, agent, or employee of a business committed the bribery or attempted bribery on behalf of the business and in accordance with the direction or authorization of a responsible official of the business, the business shall be chargeable with the conduct. Contractor hereby certifies that the contractor and its subcontractors are not barred from being awarded a contract or subcontract under this Section.  
  
(b) Are not convicted of a felony. No person or business shall do business with Metra from the date of conviction until 5 years after the date of completion of the sentence for that felony, unless no person held responsible by a prosecutorial office for the facts upon which the conviction was based continues to have any involvement with the business. Contractor hereby certifies the Contractor is not barred from being awarded a contract under this Section.
4. Are not presently indicted for, or otherwise criminally or civilly charged by a government entity (federal, state or local) for any reason; or
5. Have not, within a three-year period preceding this bid, had one or more public transactions (federal, state or local) terminated for cause or default.

(If the Undersigned is unable to certify to any of the statements in this certification, the Undersigned shall attach an explanation).

**THE UNDERSIGNED CERTIFIES OR AFFIRMS THE TRUTHFULNESS AND ACCURACY OF THE CONTENTS OF THE STATEMENTS SUBMITTED ON OR WITH THIS CERTIFICATION AND UNDERSTANDS THAT THE PROVISIONS OF THE FEDERAL FALSE CLAIMS ACT ARE APPLICABLE THERETO.**

**E. CERTIFICATION OF RESTRICTIONS ON LOBBYING**

This certification is required to be completed with the solicitation if the bid exceeds \$100,000.00. Failure to return this certification with the solicitation may result in a determination that the offer is non-responsive or non-responsible.

The Undersigned certifies to the best of its knowledge or belief that:

1. No federal appropriated funds have been paid or will be paid, by or on behalf of the Undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any federal contract, the making of any federal grant, the making of an federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any federal contract, grant, loan, or cooperative agreement.
2. If any funds other than federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee or any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of federal contact, grant, loan, or cooperative agreement, the Undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying", in accordance with its instructions.
3. The Undersigned shall require that the language of this certification be included in the award document for all sub-awards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements), and that all subrecipients shall certify and disclose accordingly.

**F. REVOLVING DOOR PROHIBITION**

The Undersigned has reviewed its list of employees (and subcontractors) involved in this procurement and it has no knowledge of any former Metra employee being involved in the solicitation process in violation of Section 4.05 of Metra's Bidding Regulations.

Section 4.05 states that all Metra Board members and non-contract personnel in specified positions are expressly prohibited, for a period of one (1) year after terminating employment with Metra, from engaging in any procurement activity with Metra. A "specified position" is one that is non-contract, is held for a period of six (6) months preceding such termination, is at a Grade P12 or above (including M Grades), and is not merely clerical or ministerial in nature. The prohibition includes, but is not limited to: lobbying the procurement process; specifying;

bidding; or proposing bid, proposal, or contract documents on the part of the former employee or Board member, or in association with the former employee or Board member by or on behalf of any firm, partnership, association, or corporation affiliated with the former employee or Board member. The Undersigned certifies that the award and/or execution of a contract would not cause any violation of Section 4.05.

**G. CONTINUING OBLIGATION TO INFORM METRA**

If Company acquires information after executing this certification that there may be an actual or apparent violation of any of the above Company shall promptly bring such information to the attention of Metra's Procurement Officer. Company shall thereafter cooperate with Metra's review and investigation of such information, and comply with any instruction it receives from Metra in regard to remedying the situation.

**H. ILLINOIS WAGE ACT/DAVIS-BACON ACT CERTIFICATION**

To the extent applicable, the Undersigned hereby certifies that the wage rate paid by said Undersigned will be no less than the wage rates set forth by the State of Illinois and the Federal Davis-Bacon Act. Labor classifications and current wage rates are available for review at Metra's headquarters upon written request.

**I. PENALTIES**

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into the Contract pursuant to Metra's regulations and 31 U.S.C. §1352. A Company who makes a false statement, materials to the certification, is subject to termination for cause.

**PRIME CONTRACTOR SIGNATURES REQUIRED ON NEXT PAGE**

The undersigned certifies or affirms the truthfulness and accuracy of each statement of its certification and disclosure, if any. In addition, the Company understands and agrees that the provisions of 31 U.S.C. §3801, et seq., apply to this certification and disclosure.

\_\_\_\_\_  
(Print) Name of Company

By: \_\_\_\_\_ Date: \_\_\_\_\_  
Signature of Person Making Affidavit (Undersigned listed above)

\_\_\_\_\_  
(Print) Title of Person Making Affidavit

**NOTARIZE HERE**  
Subscribed and sworn to before me  
This \_\_\_\_\_ day of \_\_\_\_\_ 20\_\_\_\_\_.

\_\_\_\_\_  
Notary Public

**CERTAIN SUBCONTRACTOR SIGNATURES REQUIRED ON NEXT PAGE**

**SUBCONTRACTOR  
DEBARMENT CERTIFICATION**

**NOTE: PRIMARY CONTRACTOR IS RESPONSIBLE FOR THIS FORM BEING SUBMITTED PRIOR TO AWARD. SUBCONTRACTOR(S) WITH SUBCONTRACTS OVER \$25,000.00 MUST ALSO COMPLETE AND SIGN THE FOLLOWING:**

STATE OF \_\_\_\_\_

COUNTY OF \_\_\_\_\_

The Undersigned represents that s/he is \_\_\_\_\_ (“Undersigned Subcontractor”) (Print Name)

The \_\_\_\_\_ of \_\_\_\_\_ (Print “President” or Other Proper Title) (Print name of Subcontractor Entity)

(“Subcontractor” or “Undersigned Subcontractor”) and is authorized to attest on behalf of himself/herself and Subcontractor Entity by stating as follows:

- 1. As a subcontractor to a primary contractor for subcontracts over \$25,000.00, the undersigned Subcontractor certified to the best of its knowledge and belief that the debarment statements in Section D above are truthful and accurate.
- 2. If Undersigned Subcontractor acquires information after executing this certification that there may be an actual or apparent violation of any of the above, Subcontractor shall promptly bring such information to the attention of Metra’s Procurement Officer.
- 3. The provisions of Section 1 above are applicable.

\_\_\_\_\_

(Print) Name of Subcontractor Entity

By: \_\_\_\_\_  
Signature of Person Making Affidavit (Undersigned listed above)

Date: \_\_\_\_\_

\_\_\_\_\_ (Print) Title of Person Making Affidavit

**NOTARIZE HERE**

Subscribed and sworn to before me  
This \_\_\_\_\_ day of \_\_\_\_\_ 20\_\_\_\_\_.

\_\_\_\_\_  
Notary Public

# NON ROLLING STOCK

## BUY AMERICA CERTIFICATE

The Bidder hereby certifies that it will comply with the requirement of Section 165a of the Surface Transportation Assistance Act of 1982 as amended, and the regulations of 49 CFR 661.

### **Certification requirement for procurement of steel, iron, or manufactured products.**

#### *Certificate of Compliance with 49 U.S.C. 5323 (j)(1)*

The bidder or offeror hereby certifies that it will meet the requirements of 49 U.S.C. 5323 (j)(1) and the applicable regulations in 49 CFR Part 661.5.

Date \_\_\_\_\_

Signature \_\_\_\_\_

Company Name \_\_\_\_\_

Title \_\_\_\_\_

OR

#### *Certificate of Non-Compliance with 49 U.S.C. 5323 (j)(1)*

The bidder or offeror hereby certifies that it cannot comply with the requirements of 49 U.S.C. 5323 (j) (1) and 49 C.F.R. 661.5, but it may qualify for an exception pursuant to 49 U.S.C. 5323 (j)(2)(A), 5323 (j)(2)(B), or 5323 (j)(2)(D), and 49 C.F.R. 661.7.

Date \_\_\_\_\_

Signature \_\_\_\_\_

Company Name \_\_\_\_\_

Title \_\_\_\_\_

**Note:** The U.S./Canadian Free Trade Agreement does not supersede the Buy American Requirement.

Bidders must sign that either they "will comply" or, "cannot comply" with the Buy America Certificate. If bidder signs both compliance and non-compliance to the Buy America Certificate bidder will be deemed non-responsive.

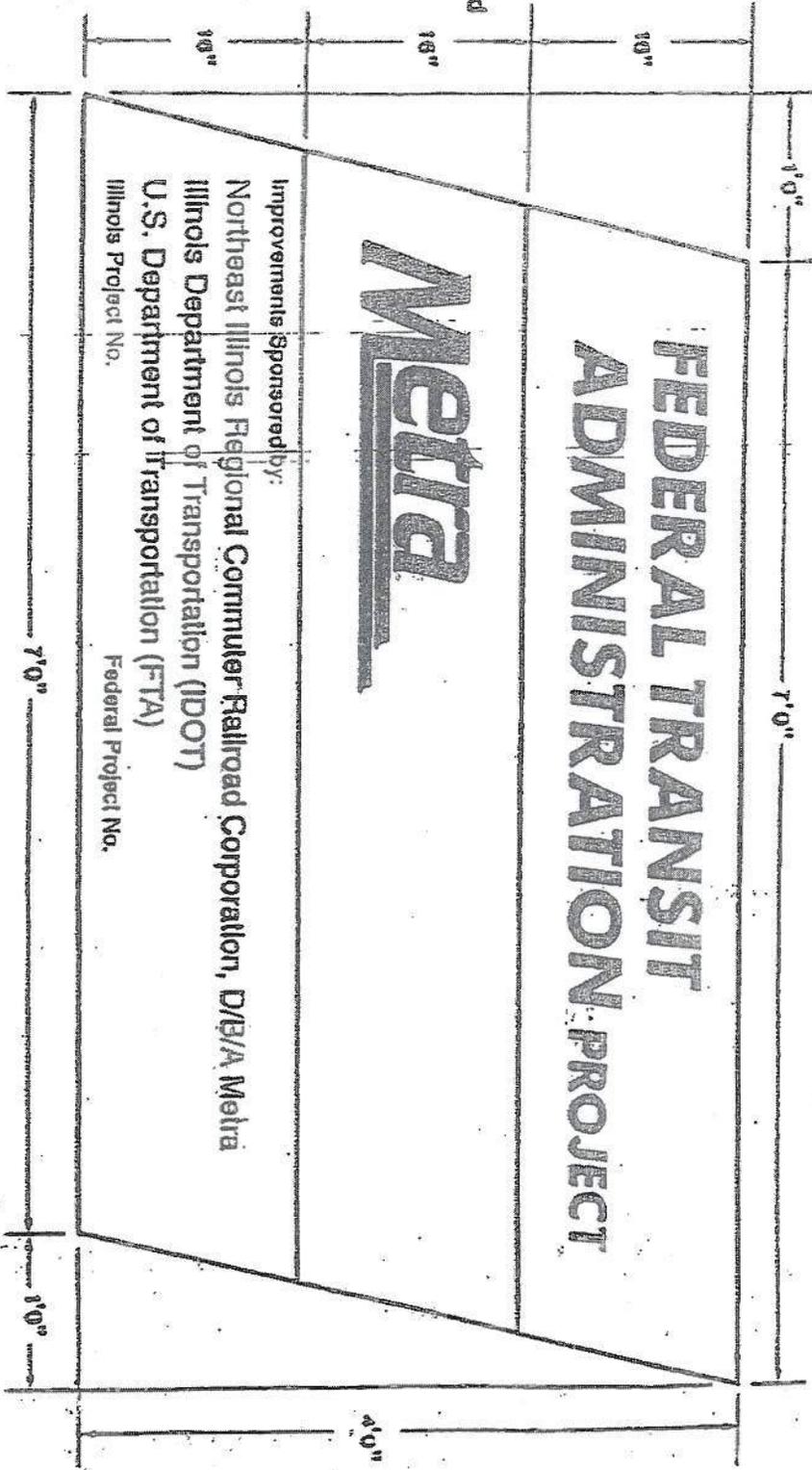
**PROJECT SIGNS - FTA/IDOT**

1. One sign shall be erected at each major entrance to the project for maximum public identification of the work, and shall be maintained in good condition until completion of the project. Upon project completion, the signs shall be removed.
2. Signs are to cut from standard 4' x 8' waterproof plywood sheets, or other suitable material, and shall meet the design standards shown in the drawing below. The supports for the signs shall be furnished by the contractor and approved by the Engineer.
3. The sign may be varied to meet special requirements of the situation, but proportions shall be maintained.
4. The center white panel will indicate briefly the nature of the project, such as "KEATING BUS GARAGE AND TERMINAL". Avoid maps or lengthy descriptions. Copy should be limited to two lines, if possible.
5. No information shall be included on the project signs except that stipulated in the above paragraphs or the drawing below.
6. Lettering and colors shall have a minimum life of five years.
7. Back of sign to be painted white and edges to be painted white.
8. Notify Metra for inspection before shipment.
9. Signs to have face protection for shipment.
10. Signs will be promptly replaced or repaired, at no additional cost to Metra, if it is damaged, vandalized or stolen.

RED background  
WHITE lettering  
(Italics)

WHITE background  
BLUE lettering

BLUE background  
WHITE lettering



Lettering: Futura Bold Italic (top)  
 Futura Bold (center)  
 Futura Demi Bold (bottom)

FTA Logo: Black circle, reversed  
 white letters



**CONTRACTOR APPLICATION FOR PAYMENT  
AND SUMMARY OF DBE PARTICIPATION**

EXHIBIT O

CONTRACTOR:	CONTRACT NO. Note 1	PROJECT NAME:	PROJECT NO. Note 2	APPLICATION NO.	DATE:	Note 3
Address:	Note 7	METRA PROJ. MGR.:	Note 8	APPLICATION PERIOD:	START:	Note 9
PROJECT MANAGER:	Note 10	CONSTRUCTION MGR:	Note 11	AMOUNT DUE:	END:	Note 12
CONTRACT AMOUNT:	\$0.00	RESIDENT ENGINEER:	Note 13	ACCOUNT CODES:	Note 15	
CONTRACT MODIFICATIONS	Note 14					
ORIGINAL CONTRACT INCL. ALLOWANCE:	Note 16					
END DATE:	Note 17					

**METRA APPROVAL BOX**

**SWORN STATEMENT**

*Contractor's Application for Payment*

The undersigned Contractor certifies that the work covered by this Application has been completed in accordance with the Contract Documents, that all amounts have been paid by him for Work for which the previous Certificates for Payment were issued and payments received by Owner, and the payment shown herein is now due. I agree to furnish waivers of lien and copies of cancelled checks for all materials and labor under my contract as required. In addition, the undersigned Contractor certifies that the wage rates paid by said Contractor and all subcontractors have been and will be no less than the wage rates set forth by the State of Illinois and the Federal Davis Bacon Act.

By: Note 18 My Commission expires: \_\_\_\_\_  
 Title: Note 19 Subscribed and sworn to Note 21  
 Date: Note 20 before me this date: \_\_\_\_\_

County of: Note 22  
 State: Note 23

TOTAL AMOUNT EARNED	Note 24	In accordance with the Contract Documents, based on-site observations and the data comprising the above application,	
% OF GENERAL CONTRACTOR WORK	Note 25	that the Work has progressed to the point indicated, to the best of my knowledge, information and belief, the quality of the Work	METRA CONSTRUCTION INSPECTOR *
% OF DBE EXPENDED	Note 26	is in accordance with the Contract Documents; and the Contractor	APPROVAL/DATE: _____
% OF WORK COMPLETE LAST PERIOD	Note 27	is entitled to payment of the AMOUNT CERTIFIED.	_____ *(Resident Engineer representing Metra)
% OF WORK COMPLETE THIS PERIOD	Note 28		
% OF WORK COMPLETE TO DATE	Note 29		

**\*\*CONTRACTOR MUST USE FIRST PAGE OF METRA APPLICATION FORM. APPROVED BACKUP PAGES MAY BE SUBSTITUTED WITH ALL OF THE REQUIRED INFORMATION INCLUDED IN THE CONTRACTOR FORM**



OMITTED BY METRA

OMITTED BY METRA



**METRA SPECIFICATION NO. – 1649-17**

**TRACTION POWER AUGMENTATION**

**95<sup>TH</sup> AND RIVERDALE TIE STATION CONVERSION**

**PREPARED FOR METRA BY:**

**LTK ENGINEERING SERVICES  
LARAMORE, DOUGLASS & POPHAM, INC.  
KALTSOUNI MEHDI, INC.**

**METRA/MED/PROJECT NO. 4254**

**CONSTRUCTION PACKAGE  
Issued for Bid Revised 06/2018  
06/08/2018**

METRA  
ISSUED FOR BID Revised 06/2018

**METRA SPECIFICATION NO: 1649-17**

**95<sup>TH</sup> and RIVERDALE TIE STATION CONVERSION**

**CONSTRUCTION PACKAGE**

**SECTION 00 00 10**

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METRA

ISSUED FOR BID Revised 06/2018

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METRA  
ISSUED FOR BID Revised 06/2018

**METRA SPECIFICATION NO: 1649-17**

**95<sup>TH</sup> and RIVERDALE TIE STATION CONVERSION**

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**01. CONTRACTOR'S RESPONSIBILITIES**

A. Review of Contract Documents and Field Conditions Supervision and Construction Procedures

1. Pre-construction Conference

- a. After award of the contract and prior to performance of the work, METRA Engineering Construction will schedule a Pre-Construction Meeting. The following items will be reviewed and discussed: introduction of METRA's and the Contractor's key personnel assigned to the project, scheduling time/date for weekly field progress meetings, construction procedures, construction schedules, pay application procedures, shop drawing procedures.

B. Supervision and Construction Procedures

1. See Specification Section 01 35 13 – Special Project Procedures.

C. Labor and Materials

1. Unless otherwise stated in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for the proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work. See Specification Section 01 50 00 for Temporary Facilities and Controls.
2. METRA will not be responsible for damaged materials stored at the site, whether caused by Acts of God, vandalism, or due to other causes.
3. All materials, products, and other items furnished under this Contract shall be new and of current production. Discontinued products, model numbers, or other out of

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production items are not acceptable. See Specification Section 01 25 00 for Substitutions and Product Options.

4. Deliver manufactured materials in original packages bearing the brand name of the manufacturer. Seals shall be unbroken and labels intact until the time of use by the Contractor and observation by METRA's Construction Manager. Store materials and equipment off of the ground in such a manner as to prevent the intrusion of moisture or foreign matter and damage of any kind, until ready for installation. Remove damaged or deteriorated materials from the premises.
5. METRA will not pay for Contractor stored materials prior to installation.
6. The Contractor shall enforce strict discipline and good order among their employees and other persons carrying out the Work. The Contractor shall not permit employment of unfit individuals or individuals not properly skilled in the tasks assigned to them.
7. Labor shall be performed in the best, most workmanlike manner by employees skilled in their respective trades. Standards of work required throughout shall be of such grade as will bring first class results only.
8. Mechanics whose work is unsatisfactory to METRA's Construction Manager, or considered by METRA's Construction Manager to be careless, incompetent, unskilled, or otherwise objectionable, shall be dismissed from work upon written notice to do so by METRA.

**D. Permits/Law Compliance**

1. The Contractor must obtain all permits required for the complete performance of the Work, as described in the Contract Documents. Submit two (2) copies of the permits to METRA's Construction Manager prior to starting work related thereto.
2. Furnish and install a weatherproof, glass enclosed, outdoor bulletin board and mount the same near the construction office (or on the exterior wall of the construction office), for the purpose of posting all valid permits.
3. Permits must remain posted in an exterior "visible" location, during the entire construction period.
4. The Contractor must immediately notify METRA's Construction Manager of the requirements in these Specifications and/or on the Drawings, which do not strictly comply with the applicable laws, ordinances, and rules governing the Work, before proceeding with that part of the Work. Failure of the Contractor to do so must be understood as an agreement on the part of the Contractor to guarantee compliance with the requirements for Work covered by this Contract.

**E. Superintendent**

1. The Contractor shall employ a competent Superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. The
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Superintendent shall represent the Contractor, and communications given to the Superintendent shall be as binding as if given to the Contractor.

2. It is required that the Contractor's Field Superintendent be at the construction site during all normal working hours for a minimum of forty (40) hours per week and during all special operations regardless of when performed. The Field Superintendent must always be present when Subcontractors perform work at the site. The Field Superintendent is to be a "non-working" Superintendent.

**F. Construction Schedules**

1. See Specification Section 01 32 00 - Construction Schedules.

**G. Progress Meetings**

1. METRA will schedule and administer Progress Meetings each week throughout the duration of the Work. Minutes will be written and issued by METRA's Construction Manager, which will form part of the permanent construction records.
2. The Contractor must make physical arrangements for meetings and prepare an agenda with copies for all participants.
3. Attendance: Contractor's Field Superintendent; subcontractors and manufacturers, as well as suppliers or fabricators, when requested by Metra; METRA's Construction Manager; and METRA personnel as appropriate to the agenda topics for each meeting.
4. Suggested Agenda: Review of previous meeting minutes, review of work progress, status of the progress schedule and adjustments thereto, delivery schedules, submittals, maintenance of quality standards, pending changes and substitutions, and other items affecting the progress of the Work.

**H. Project Data and Records**

1. Books and accounts kept by the Contractor in connection with the Contract shall be open to the inspection of METRA's Construction Manager. Promptly following the preparation of periodic payrolls of the Contractor and each of its subcontractors, the Contractor shall furnish METRA's Construction Manager with the number of certified copies required of such payrolls.
2. The Contractor and each subcontractor shall also keep an accurate record showing the names and occupation of all laborers, workmen, and mechanics employed by them in connection with the Work, and also showing the actual hourly wages paid to each of their workers. This record shall be open at all reasonable hours to the inspection of METRA.
3. The Contractor shall, when required, furnish to METRA's Construction Manager a written statement, verified by affidavit, giving the names and addresses of all persons, firms, and corporations who have up to the date thereof furnished labor or material in or about the performance of the Contract, and the amounts due or to become due to said parties.

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**I. Submittals**

1. See Specification Section 01 33 00 – Submittal Procedures.

**J. Progress Photos**

1. Digital high resolution color photos of the Work must be taken from different viewpoints on the last day of each calendar month or on the first day that a request for payment is made; and thereafter on the day of each succeeding request for payment until completion of the Work has been accomplished as determined by METRA's Construction Manager.
2. The Contractor will arrange for photos to be taken from location points designated by METRA's Construction Manager.
3. Photos of each view shall be submitted with monthly pay requests.

**K. Use of Site**

1. The Contractor will so confine their plant and equipment, the storage of materials, and the operation of their workmen to the limits of the Work and the area designated and approved by METRA's Construction Manager.
2. No Contractor or material supplier will erect signs or advertising media of any nature on the premises without explicit written approval from METRA's Construction Manager.
3. METRA is an operating transportation agency and must therefore maintain operations at all times during the construction of this Project. The Contractor must take special care to conduct operations in such a manner so as not to cause damage to equipment, or interrupt service operations.
4. The Contractor must maintain adequate protection of all work and protect METRA's property from injury or loss arising in connection with the Contract; pay for damage, injury, death, or loss which may occur; and adequately protect all public and private property and all persons that may be affected directly or indirectly by the work performed under the Contract.

**L. Cutting and Patching**

1. All cutting and patching of concrete, masonry, carpentry, steel, ironwork, and finished surfaces must be done by the Contractor at their own expense, in order that the work may be properly installed. All disturbed construction or finished areas must be made good by the Contractor using skilled craftsmen, as approved by METRA's Construction Manager. Under no conditions may structural work be cut, except upon written approval by METRA's Construction Manager.
2. In general, cutting through slabs and walls is to be avoided and only where absolutely necessary will the same be permitted. When this is necessary, the same

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must be done by the Contractor in a careful manner and the openings filled around all pipes as directed and approved by METRA's Construction Manager.

3. The Contractor is cautioned to not do any cutting or disturbing of finished walls or similar work unless absolutely necessary.
4. All masonry, wood, steel, ironwork, or other finishes damaged or cut into during the installation of the Work must be restored to the original condition by skilled labor experienced in that particular building trade.

**M. Utilities**

1. The Contractor must arrange, in writing, for the proper connection of the utility services serving the site, and must be responsible for all costs related thereto. The Contractor must submit three (3) copies of such notifications and arrangements to METRA's Construction Manager. The Contractor must include in their pricing, all Public Utility Service costs related to the provision of the utility(s) serving the site, both temporary and permanent.
2. The Contractor is advised to make all arrangements and to take and exercise such necessary precautions to prevent interference with, damage to, and/or destruction of utility services in the construction area. See Specification Section 01 71 35 for Damage to Utilities.

**N. Access to Work**

1. The Contractor shall provide METRA and METRA's Construction Manager with access to the Work in preparation and progress wherever located.

**02. CHANGES IN THE WORK**

- A. See Specification Section 01 26 00 - Contract Modification/Change Order Procedure.

**03. CONTRACT TIME****A. Delays and Time Extensions**

1. The Contractor shall not be entitled to an extension of time for changes in the Work required due to the Contractor's own fault, or which extends beyond the time extension provided in a Change Order.
2. When a change occurs due to unforeseen causes, beyond the control and without fault or negligence of the Contractor, including, but not restricted to acts of God, acts of the Public Enemy, governmental acts, fires, floods, epidemics, strikes (except those caused by improper acts or omissions of the Contractor), extraordinary delays in delivery of materials caused by strikes, lockouts, wrecks, freight embargoes, or governmental acts, the time of completion shall be extended in whatever amount as determined by METRA to be equitable. The time extension shall be based on an analysis of the Construction Schedules prepared by the Contractor and submitted for review along with the request for a time extension.

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3. An "Act of God" means an earthquake, flood, cloudburst, cyclone, or other cataclysmic phenomenon of nature beyond the power of the Contractor to foresee or to make preparations in defense against it. A rain, windstorm, or other phenomenon of normal intensity, based on National Weather Bureau Reports, for the particular locality and for the particular season of the year in which the work is being performed, shall not be construed as an "Act of God" and no extension of time will be granted for the delays resulting. No extensions of time will be granted for a delay or suspension of the work due to the fault of the Contractor.
4. No extension of time on account of a delay due to unforeseen causes will be granted unless written application is immediately filed with METRA's Construction Manager. After each unforeseen delay is filed, METRA shall review the request and give the Contractor written notice of an extension to the contract date, or hold the request for later consideration.
5. In the event of an inexcusable delay by the Contractor, METRA may direct that the Work be accelerated by means of overtime, additional crews or additional shifts, or re-sequencing of the Work. The cost of overtime must be included in the Contract lump sum price. No additional payments will be made because of overtime Work required.

**04. PROGRESS PAYMENTS AND COMPLETION****A. General Requirements**

1. METRA may withhold any payment to the Contractor for unsatisfactory work, if and for so long as the Contractor fails to perform any of its material obligations hereunder, or otherwise is in default under any of the provisions of the Contract Documents, subject to the requirements of applicable law.

**B. Schedule of Values**

1. The Contractor shall submit to METRA's Construction Manager, before the first Application for Payment, a schedule of values allocating the entire Contract Sum to the various portions of the Work and prepared in such form and supported by such data to substantiate its accuracy as required. This schedule shall be used as a basis for reviewing the Contractor's Application for Payment.

**C. Applications for Payment**

1. Payment to the Contractor is to be made monthly and is to be based upon an estimate of work accomplished as determined and approved by METRA's Construction Manager. At least ten (10) days before the date established for each progress payment, the Contractor shall submit to METRA's Construction Manager an itemized Application for Payment prepared in accordance with the Schedule of Values for completed portions of the Work. Such application shall be notarized and supported by such data substantiating the Contractor's right to payment, such as requisitions from subcontractors and material suppliers.
  2. Metra, under no circumstances, will advance payments to the Contractor. The progress payment method described herein, shall be adhered to in all instances.
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**D. Inspection of Work**

1. See Specification Section 01 77 00 - Project Closeout.

**E. Final Completion and Final Payment**

1. Upon receipt of the Contractor's written notice that the Work is ready for final inspection and acceptance and upon receipt of the final Application for Payment, METRA's Construction Manager will promptly make such inspection, and when METRA's Construction Manager finds the Work acceptable under the Contract Documents and the Contract fully performed, METRA's Construction Manager will promptly issue a final Certificate for Payment stating that to the best of their knowledge, information, and belief, and on the basis of their on-site visits and inspections, the Work has been completed in accordance with the terms and conditions of the Contract Documents and that the entire balance found to be due to the Contractor and noted in the final Certificate is payable. Also, once a final Certificate for Payment has been issued, the Contractor should sign and issue a release to METRA, releasing the Agency from any and all further claims by the Contractor.

**05. PROTECTION OF PERSONS AND PROPERTY****A. Safety**

1. See Specification Section 01 35 23 - Safety and Loss Prevention.

**B. Site Security**

1. The Contractor must secure the site at all times. The Contractor is solely responsible for the protection of their equipment and belongings on the site. METRA provides protection only for its own facilities and METRA will not be responsible for site security.

**C. Fire Protection**

1. Fire protection must comply with local fire regulations and with the specific regulations of METRA.
2. Provide an ample number of suitable fire extinguishers rated for the specific potential fire hazards present on the site.
3. Combustible materials must be removed from areas in which welding or cutting is to take place, and flameproof tarpaulins and dry chemical extinguishers must be readily available.
4. Not more than one day's supply of flammable liquids including oil, gasoline, paint, or solvent must be brought onto the site at one time. Liquids with a flash point of 140° F (or below), must be confined to UL approved safety cans. Bulk supplies of flammable liquids must be well removed from structures and storage yards.

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5. No open fires will be permitted.
6. The burning of refuse shall not be permitted.

**D. Flagging**

1. Road: See Specification Section 01 55 26 - Traffic Control and Protection.

**E. Hazardous Materials**

1. The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents, and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance encountered on the site by the Contractor, including but not limited to asbestos or polychlorinated biphenyl (PCB), the Contractor shall immediately stop Work in the affected area upon recognizing the condition and report the condition to both METRA and METRA's Construction Manager in writing.
2. Except as may be required by the Contract Documents, the Contractor agrees that it shall not transport to, use, generate, dispose of, or install at the Project site any hazardous substance, except in accordance with applicable Environmental Laws. Further, in performing the Work, the Contractor shall not cause any release of hazardous substances into, or contamination of, the environment including the soil, atmosphere, and any water course or ground water, except in accordance with the applicable Environmental Laws or as required by the Contract Documents.
3. For the purposes of this Contract, the term "hazardous substance" shall mean and include, but shall not be limited to, any element, constituent, chemical, substance, compound, or mixtures, which are defined in or included under or regulated by any local, state, or federal law, rule, ordinance, by-law, or regulation pertaining to environmental contamination, clean-up, or disclosure.

**F. Environmental Protection**

1. The Contractor shall comply with all Federal, State, and Local Regulations to provide for the abatement and prevention of pollution by regulating and controlling the quantity and quality of stormwater runoff and wastes admitted to or discharged into jurisdictional waters. The Contractor shall also comply with the water pollution regulations of Illinois, established by the State of Illinois Pollution Control Board and with the U.S. Environmental Protection Agency's Federal Water Pollution Control act, and all amendments thereof.
2. Compliance with air pollution requirements established by local agencies, the State of Illinois Pollution Control Board, and the U.S. Environmental Protection Agency is also the Contractor's responsibility.
3. Noise pollution due to the work performed under this Contract shall be within the limits established by Local, State, and Federal Agencies.

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**06. INSURANCE AND BONDS**

- A. The Contractor is required to meet all insurance requirements as set out in the Agreement. See Specification Section 00 70 00 for METRA's General Conditions.

**07. CORRECTION OF WORK**

- A. The Contractor shall promptly correct Work rejected by METRA's Construction Manager or METRA, or Work failing to conform to the requirements of the Contract Documents, whether discovered before or after sufficient Completion and whether or not fabricated, installed, or completed. Costs of correcting such rejected work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for METRA's Construction Manager's services and expenses made necessary thereby, shall be at the Contractor's expense.
- B. The Contractor shall bear the cost of correcting destroyed or damaged construction, whether completed or partially completed, by METRA or separate contractors caused by the Contractor's correction or removal of Work that is defective, or otherwise, not in accordance with the requirements of the Contract Documents.
- C. If METRA prefers to accept Work that is not in accordance with the requirements of the Contract Documents, METRA may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. The Contractor shall pay all costs and expenses incurred by METRA in the evaluation of and determination to accept such defective Work, as well as the amount by which the value of the Work is diminished by the defect.

**08. MISCELLANEOUS PROVISIONS**

A. Tests and Inspections

1. See Specification Section 01 40 00 - Testing and Inspection.

B. Quality Management Program

1. See Exhibit U - Quality Management Plans in the Invitation for Bid (IFB).

**END OF SECTION**

SECTION 00 70 00

GENERAL CONDITIONS

**PART 1: GENERAL**

1.01 DESCRIPTION OF WORK

- A. This section specifies the requirements for METRA's General Conditions. The work shall consist of the administration, supervision, utilities, overhead, and other like items necessary to support the operation of the Contract.

1.02 RELATED WORK

- |                                      |                  |
|--------------------------------------|------------------|
| A. Supplementary Conditions          | Section 00 10 00 |
| B. Temporary Facilities and Controls | Section 01 50 00 |
| C. Project Record Documents          | Section 01 78 39 |

**PART 2: PRODUCTS (NOT USED)**

**PART 3: EXECUTION (NOT USED)**

**PART 4: MEASUREMENT AND PAYMENT**

4.01 MEASUREMENT

- A. Measurement will be based on the percentage of work completed and dependent on the Engineer's monthly review of Project Record Drawings and Specifications. Project Record Drawings must be maintained current with construction operations, and all changes must be documented in accordance with Specification Section 01 78 39. The Contractor will provide the drawings for review on site prior to the approval of each monthly pay request.

4.02 PAYMENT

- A. The work covered under this section shall be paid for at the Contract lump sum price, as shown in the Schedule of Values for General Conditions.
- B. The amount that the Contractor will receive payment for will be limited to two percent (2%) of the amount computed from the total contract bid less the cost of insurance and bonds.

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- C. Partial payment of the lump sum amount bid for General Conditions, not exceeding two percent (2%), will be made over the life of the contract in payments proportional to the percentage of completion based on the Contractor's approved monthly invoice. Progress payments will be contingent upon the Engineer's review and acceptance of the Project Record Drawings and Specifications.

**4.03 INSURANCE AND BOND**

- A. Payment for insurance and bond will be made as a lump sum amount against the invoices and certificates presented by the Contractor from the insurance and bonding companies.

**END OF SECTION**

**SECTION 01 11 00**  
**SUMMARY OF WORK**

**PART 1 - GENERAL**

1.01 SUMMARY OF WORK

- A. This Section includes a general summary of work to be performed by the Contractor under this Contract.
- B. Work described in the Contract Documents is to be performed in such a manner as to not disrupt or interfere with the day-to-day operations, equipment, or services of the rail line. The Contractor's requirements for work space access and maintaining the work schedule are to be worked out and coordinated with Metra.
- C. The Contractor is responsible for all of the Work required to provide the complete design and construction of the following items as shown on the plans, or as specified in these detailed specifications:
  - 1. The Contractor shall provide for all design services, labor, materials, testing, and commissioning; and for all equipment, tools, instruments, and incidentals necessary to perform all work as indicated in the Contract Documents.
  - 2. Contractor shall comply with all applicable codes, ordinances, rules, regulations, orders and legal requirements.
  - 3. Contractor shall obtain and pay for all applicable permits and fees. Under no circumstances shall the Contractor be entitled to any time extension or monetary damages due to any delay in issuing any permits.
  - 4. Contractor shall provide all required mobilization, traffic control and protection. Contractor shall inspect the site and verify all existing conditions, dimensions, access and obstructions.

1.02 DEFINITIONS

- A. The following terms are used throughout the Contract Documents. The work will be governed in accordance with these definitions:
  - 1. Fabricated: "Fabricated" pertains to items specifically assembled or made of selected materials or components in order to meet individual design requirements.
  - 2. Manufactured: "Manufactured" means standard units, usually mass produced by an established manufacturer of the respective item.
  - 3. Provide: "Provide" means to furnish and install.

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4. Shop Fabricated or Shop Made: "Shop Fabricated or Shop Made" refers to items made by a Contractor or subcontractor in its own shop.

**1.03 PROJECT DESCRIPTION****A. General**

1. Building new Traction Power Substations in Metra's right-of-way near or adjacent to existing tie stations at the following locations:
  - a. Riverdale - 141 South Highlawn, Riverdale, Illinois,
  - b. 95th Street - 9500 South Cottage Grove Chicago, Illinois
2. The work under this Contract is to convert existing Tie Breaker Stations into full-fledged Traction Power Substations
3. All equipment for each new substation shall be housed in a pre-packaged, modular, thermally-insulated electrical grade enclosure. Equipment includes the following major traction power equipment and auxiliaries:
  - a. One (1) 15 kV AC Switchgear Line-Up
  - b. Two (2) Dry-Type Copper-Winding Traction Power Transformers
  - c. Two (2) Sets of Anode Bus Ducts
  - d. Two (2) 3000 kW, 1500 Vdc Silicon Diode Rectifiers
  - e. One (1) 1500 Vdc Switchgear Line-Up, consisting of two cathode breakers, one each for two rectifiers.
  - f. Two (2) auxiliary transformers
  - g. One Set of Batteries, Battery Charger, AC and DC Distribution Panels and Auxiliaries Required for the Operation of Traction Power Substation.
  - h. Station Control Equipment and SCADA to Interface with existing equipment and SCADA system.
4. The Contractor shall furnish all equipment in a pre-packaged enclosure and perform all work integral to the final design, construction and testing of the new traction power substation. The work shall include obtaining all necessary permits, site improvements, landscaping, and foundations for pre-packaged modular enclosures with all equipment furnished installed and connected including HVAC, LED lighting, and underground utilities, as shown on the Contract Drawings or as specified.

**B. The work includes but is not limited to the following:**

1. Reinforced cast-in-place concrete foundations, manholes and underground duct banks.
2. All activities associated with subsurface work including, but not limited to excavation, earthwork, shoring, temporary support of existing structures, excavation support systems, removal of clean and contaminated soil, backfill, trench backfill, granular backfill, grading, drainage and the relocation and protection of existing utilities.

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3. Equipment foundations including, but not limited to, reinforced, cast-in-place concrete footings, foundation walls, slabs, pits and pads.
4. Site work and improvements including, but not limited to paving, curbs and gutters, fencing and guard rails.
5. Fabrication and installation of pre-packaged equipment housing containing substation equipment furnished, installed, and wired including, but not limited to the following:
  - a. AC switchgear line-up
  - b. Rectifier transformers
  - c. Rectifiers
  - d. Bus ducts
  - e. DC switchgear line-up
  - f. SCADA
  - g. Power and control interconnections
  - h. Electrical and mechanical auxiliaries, such as the following:
    - 1) Auxiliary transformers
    - 2) Automatic transfer switches
    - 3) AC and dc distribution panels
    - 4) Batteries
    - 5) Battery charger
    - 6) Conduits
    - 7) Cables and grounding
    - 8) Lighting
    - 9) Heating and air conditioning
    - 10) Communication equipment
    - 11) Fiber optic
    - 12) Fiber switches
    - 13) Copper cables
    - 14) Fire alarms
    - 15) Receptacles
6. Grounding system including rods, insulated ground cable, ground bus, and non-insulated ground cable in the trays.
7. Underground ductbank from ComEd Service entrance manhole to the incoming cubicles of the ac switchgear line-ups and the utility drainage.
8. ComEd wireless smart metering system.
9. Underground ductbank from the new substation building to the existing tie breaker building for providing interconnecting tie between the existing dc switchgear lineup and the new dc switchgear lineup, as well as for interconnection of control and SCADA circuits.
10. Dielectric floor installation.
11. Traction power equipment and wiring for 15 kV ac switchgear, rectifier transformers, 1500 Vdc silicon rectifiers and 1500 Vdc switchgear cubicles.

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12. Positive feeder cables from the new dc switchgear cubicles to a new knife switch located in an outdoor fiberglass enclosure for installation on the outside wall of the existing tie breaker building. From the switch, a dc bus connection to the existing dc switchgear line-up. All cables between the new switchgear cubicles to the knife switch shall be installed in an underground ductbank.
13. Negative feeder cables from the negative of rectifiers in the substation to the negative bus located in an enclosure mounted on the top of the manhole. Negative feeder cables from the enclosure via negative manhole to the risers between each of the four incoming and outgoing tracks for connections to the running rails. All negative cables shall be installed in underground ductbanks. The ductbanks under the tracks shall be installed by means of directional boring in horizontally bored casings.
14. Any temporary work necessary during construction to maintain transit operations and safety, including, but not limited to signage, railings, fencing, lighting, etc.
15. Any temporary work necessary to maintain the existing signal, communication and traction power system during construction.
16. A horizontal and vertical survey of all the areas to be reconstructed. Location of all underground utilities prior to excavation. A revised design to correct any deviations found.
17. Contractor must be responsible to locate all underground public and private utilities, obtain and pay for all permits, easements, licenses, and inspections along with any other approvals required to perform and complete the work.
18. Maintenance of traffic control and protection, temporary pavement and markings including all traffic and pedestrian barriers. Restoration in a timely manner of all streets, sidewalks, alleys, markings, signage, fencing, etc. disturbed by construction.
19. Abatement and disposal of hazardous and special waste materials in accordance with all applicable standards and regulations. Metra has no prior knowledge if any hazardous or special waste materials are present on the site or within existing buildings.
20. Substation furniture and accessories.
21. Substation maintenance equipment.
22. All incidentals and collateral work required to complete the project as indicated on the Drawings and as covered by all Contract Documents. Restoration of site and adjacent properties to their pre-construction condition.
23. Completion of all punchlist items.

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24. The new Substation must be fully integrated into the existing SCADA System previously provided by QEI.

**1.04 PROJECT MILESTONE LIST**

- A. The Contractor must achieve the milestones listed below. Metra will be unable to provide support for testing in multiple locations at the same time. Deviations from the milestones below will require Metra's written approval.
- B. The Milestones must be integrated and clearly shown in the Contractor's Project Schedule.

<b>Calendar Days After NTP</b>			
		<b>Riverdale</b>	<b>95th</b>
1	NTP	0	0
2	Submit Basic Design	30	30
3	Design Review Conference	45	45
4	Resubmit Basic Design	60	60
5	Basic Design Approved	90	90
6	Submit Shop Drawings	120	120
7	Shop Drawings Approved	150	150
8	Release Manufacturing	150	150
9	Submit Test Procedures (Factory/Field)	180	180
10	Integrated FAT Test at Equipment Manufacturer Complete	330	450
11	Installation Onsite Complete	360	480
12	Commissioning Complete/Substation energized	390	510
13	Site Demobilized	410	530

- C. Milestones 10 – 13 must be staggered as shown in the Milestone List above to ensure availability of METRA's Resources. METRA will not allow the Start of Testing activities for 95<sup>th</sup> street TPS unless Riverdale TPS is fully commissioned and online.

**1.05 GENERAL REQUIREMENTS**

- A. The Contractor shall limit the use of Metra property and facilities to the construction activities indicated in the Contract Documents.
- B. The Contractor shall not interfere with, block, or in any way encumber public right-of-way or personal property without proper permission of the person, business or agency having jurisdiction. Proof of authorization and copies of required permits shall be submitted to the Metra's Authorized Representative prior to blocking or using the property or public right-of-way.
- C. The Contractor shall provide reasonable access to the site and shall not prohibit nor interfere with lawfully conducted inspections or site visits by properly identified representatives of Metra, regulatory agencies, or collective bargaining units.
- D. The Contractor shall perform preparation work such as temporary pavement marking, barriers, etc., and provide and maintain traffic control and protection. Upon completion of all construction at each street, restripe the pavement and remove all traffic control and protection associated with the construction of the Project.

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- E. Perform clean-up routinely at the end of each work day. It is the Contractor's responsibility to make sure each trade cleans up after their work and that each work zone is cleaned daily; otherwise, the Contractor shall perform the clean-up for them.
- F. The Contractor shall obtain all permits and pay for all fees, rent or other expense for easement, for access to the work area or for storage of materials, equipment or construction operations. The Contractor shall submit proposed access plans including for additional areas, for Metra's approval.
- G. The Contractor is responsible to provide temporary power for all site activities as well as temporary Power Supply to the Substation Building to support all testing activities as well as temporary heating and cooling.

**1.06 SITE EXAMINATION**

- A. Verify measurements for finished work. Do not scale drawings.
- B. Prior to mobilization, the Contractor shall record on DVD format and photographs, the existing condition of all areas that are to be occupied, worked on, restored or affected in any way by the Project. Include conditions of adjacent buildings, structures and site improvements, including finished surfaces that may be misconstrued as damaged caused by construction or demolition operations. Submit reports, DVD format, and photographs of existing conditions to Metra's Authorized Representative prior to mobilization of any site. The same is to occur after area or storage of the work is completed.
- C. The Contractor shall notify Metra's Authorized Representative at least 48 hours in advance before videoing and taking photographs to afford Metra the opportunity to accompany the Contractor while performing this work.
- D. The Contractor shall be responsible for and must repair or replace any portions of such buildings, structures and site improvements caused by its acts, whether negligent or otherwise, and shall leave existing conditions in as good as existed prior to commencement of the Work.
- E. The Contractor is responsible to issue and regularly distribute clear, updated and accurate field construction progress to be included in the meeting minutes for the duration of the Contract, from beginning to end.

**1.07 FIELD CONDITIONS, PERSONNEL AND SERVICES**

- A. Field Conditions: Examine the site of the work and adjacent premises and the various means of access; storing of materials and equipment; facilities for delivery; installing and operating the necessary construction work, and any other difficulties that may be encountered in the execution of the work.
- B. Personnel: Furnish the services of a competent superintendent at the construction sites during all working hours together with foremen and all skilled and common labor required to complete the work. The labor employed will be subject to the approval of Metra's Authorized Representative, which will have the power to require the removal of any person, or persons, if in Metra's judgment it

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would be in the interest of the work that such, person, or persons, be removed from the project.

- C. Provide all temporary heat required for prevention of damage of work and materials by freezing as found necessary to carry on construction operations, or for any reason as directed by Metra's Authorized Representative.
- D. Confine plant and equipment, the storage of materials, and the operations of workers to the limits of the site. In no way interfere with the work of others adjacent to the site.
- E. The Contractor shall protect the Authority's property and adjacent properties. The Contractor shall take all necessary precautions for the safety of the employees near the work.
- F. The Contractor shall secure all Contractor-owned, or Contractor-used equipment, left on the project site during hours of non-work to prevent the unauthorized use of that equipment for any purposes.
- G. Remove snow, ice, and construction debris from work zones as required.

**1.08 CONTRACTOR USE OF PREMISES**

- A. Limit use of the premises to construction activities within the limits of the proposed improvements (Contract limits).
- B. Confine operations to areas within Contract limits. Portions of the site beyond areas where construction operations are indicated are not to be disturbed.
- C. Keep driveways and entrances serving the premises clear and available to the Authority and the public at all times. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on site.
- D. Furnish, install and maintain temporary access locations for the Contractor's access to the work sites. Temporary access sites shall be approved by Metra's Authorized Representative prior to use.
- E. Furnish and install temporary protection for existing equipment to permit continued operation of the existing equipment without interruption.

**1.09 STORAGE OF MATERIALS**

- A. The Contractor shall not store any material on Metra property or structures at any time unless approved by the Authority. All materials shall be delivered to the work site in quantities only large enough to perform the necessary tasks for each day.
- B. The Contractor assumes full responsibility for protection and security of all materials stored on the site. Materials shall be maintained by the Contractor in "as-new" condition, including immediate removal of any graffiti or posters at no additional cost to Metra.

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- C. The Contractor shall obtain and pay for the use of all storage areas required for its execution of the Contract. If it becomes necessary in the opinion of Metra to move materials which are temporarily stored at a location, the Contractor shall move such materials to other locations as directed by Metra at no additional cost.

**1.10 CONSTRUCTION CONSTRAINTS**

- A. Contractor shall submit the location and extent of areas for materials staging use for approval by the Authority.
- B. Flagging personnel shall be required during hours the Line is operational.
- C. Provide construction barriers for the safety of trains, and the general public during demolition and construction.
- D. Maintain traction power, signal, and communication systems for operation of trains at all times during the construction period.

**1.11 REGULATORY REQUIREMENTS**

- A. The Contractor shall immediately notify Metra's Authorized Representative of requirements in these specifications and/or drawings, which do not strictly comply with the applicable laws, ordinances, and rules governing the work, before proceeding with that part of the work. Failure of the Contractor to do so shall be understood as an agreement on the part of the Contractor to guarantee compliance with the requirements of work covered by this Contract.

**PART 2 - PRODUCTS**

2.01 NOT USED

**PART 3 - EXECUTION**

3.01 NOT USED

**END OF SECTION**

**SECTION 01 14 33**  
**RAILROAD FLAGGING**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section includes the requirements for Railroad Flagging. The work under this Section shall include the use of Railroad Flagmen in conjunction with construction performed adjacent to in-service railroad tracks, as required by Metra and approved by Metra's Authorized Representative.
- B. Flagmen and associated flagging equipment are furnished by the railroad.

1.02 RELATED WORK

- A. Section 011500, Metra Requirements
- B. Section 015526, Traffic Control

1.03 AVAILABILITY OF FLAGGERS

- A. Metra will provide flagging personnel as required at no cost to the Contractor, except as specified otherwise. The number of flagmen to be provided by Metra will depend on railroad operations.
- B. There are a limited number of flagmen available. Every reasonable effort will be made to furnish the Contractor with a railroad flagman.
- C. If a railroad flagman is not present as requested, the appropriate railroad official must be notified BEFORE WORK IS TO BEGIN. AT NO TIME MAY THE CONTRACTOR WORK WITHIN 25 FEET OF THE TRACK WITHOUT A FLAGMAN.
- D. No extension of Contract time will be awarded due to the unavailability of Flagging Personnel.

**PART 2 - PRODUCTS**

2.01 NOT USED

**PART 3 - EXECUTION**

3.01 FLAGMEN

- A. If work is performed within 25 feet of the center of the nearest set of rails, flagmen will be necessary. Flagmen may also be required as the Railroad deems necessary.

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- B. Flagmen must be ordered with a two-working-day notice to the Railroad. When notice is given, the Contractor shall be prepared to provide the approximate duration and nature of its work to be performed. The appropriate contact information for arranging flagging will be provided to the Contractor by Metra's Authorized Representative.
- C. The final decision for the need for Railroad Flagmen will be with Metra and subject to the approval of Metra's Authorized Representative.
- D. Cancellations shall be made by 2:00 P.M. of the prior working day. The Contractor shall assume the cost of requested flagging that is not used and not canceled.
- E. Flagmen are generally personnel from the Railroad who act as warning devices for the approach of on-coming trains. They cannot authorize any deviations to the Drawings and Specifications, or approve or inspect work.
- F. Railroad Flagmen shall not be used as on-street flagmen. Any on-street flagmen needed are the responsibility of the Contractor and shall be furnished in accordance with Section 015526, Traffic Control.
- G. Flagmen may work a maximum of 12 hours a day, although in most cases in the suburban territory, curfews exist that do not allow work during rush hour periods. The length of the working day must be established with the Railroad before work is started. (See Section 011500, Metra Requirements, regarding work curfews).
- H. Men and equipment may not be present at track level, Monday through Friday during rush hour. Rush hour is typically between the hours of 5:45 A.M. to 9:15 A.M. and between 3:30 P.M. to 7:00 P.M. However, these times are subject to change and working windows shall be approved by the Metra's Authorized Representative.
- I. Obey all signals and directions given by flagmen and take whatever actions are necessary to ensure compliance with signals and directions given. If signals and directions are not obeyed, a Stop Work Order may be issued.
- J. When a railroad flagman informs the Contractor's foreman that a train is approaching, ALL WORK MUST CEASE AND OPERATORS CLEAR THE TRACKS and dismount machines. If this is not done, the flagman will not allow the train to pass. Any train delays of this type will not be tolerated and damages may be assessed to the Contractor for these types of train delays.

**3.02 EQUIPMENT NEAR TRACKS**

- A. Equipment or materials allowed by Metra's Authorized Representative to remain at track level outside of the above mentioned times, shall be stored not less than 25 feet away from the centerline of the nearest active track.
- B. At no time will machinery be allowed to cross the tracks or set up on the tracks without prior permission from the Railroad's authorized representative. This type of work will require special protection and should be avoided.

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**PART 4 - MEASUREMENT AND PAYMENT**

4.01 MEASUREMENT

- A. Railroad flagging will not be measured for payment.

4.02 PAYMENT

- A. All costs associated with Railroad Flagging will be borne by others, except that the Contractor will assume the cost of requested flagging that is not used and not canceled.

**END OF SECTION**

**SECTION 01 15 00**  
**METRA REQUIREMENTS**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section includes requirements for the following:
  - 1. Railroad flagman
  - 2. Work curfew
  - 3. Passenger/pedestrian protection
  - 4. Work scheduling and notifications
  - 5. Weekend, holiday, and night work
  - 6. Safety

1.02 RELATED WORK

- A. Section 011433, Railroad Flagging
- B. Section 013523, Safety and Loss Prevention

1.03 RAILROAD COORDINATION

- A. Railroad Flagman Requirements
  - 1. See Section 011433, Railroad Flagging.
- B. Work Curfew:
  - 1. No work (within 25 feet of the track) may be performed during morning and evening rush hours. See the General Notes in the Plan Set for the specific hours that this entails. The exact curfew for each location MUST be established with the Railroad/Operating Department before the Work is started.
  - 2. If adequate separate temporary facilities are established then the work curfew may not apply.
  - 3. Men and equipment may not be present at track level, Monday through Friday during rush hour. Rush hour is typically between the hours of 5:45 A.M. to 9:15 A.M. and between 3:30 P.M. to 7:00 P.M. However, these times are subject to change and working windows shall be approved by the Metra's Authorized Representative.

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- C. Passenger/Pedestrian Protection:
1. All work shall be protected by a barricade system and proper signage, as required by Metra's Authorized Representative. This protection shall be provided by the Contractor at its own cost. No barricading can be placed closer than 10'-0" to the centerline of the nearest track. Excavations shall be covered or completely surrounded with a positive barrier.
- D. Work Scheduling and Notifications:
1. Work shall be scheduled and progressed in such a manner as to reduce the impact on the commuting public.
  2. All requests to close portions of a station platform shall be scheduled in advance and permission granted by Metra's Authorized Representative.
  3. A copy of the weekly schedule of activities shall be presented to Metra's Representative prior to that week's activities.
  4. A clear understanding must be obtained of the Contractor's activities and permission to proceed with construction work that will impact commuters.
  5. Only a portion of a platform may be taken out of service at any given time for reconstruction.
- E. Failure to Comply:
1. If there is any violation of these restrictions, a Stop Work Order will be issued and all work shall cease until Metra and its railroading partners are satisfied that all problems have been resolved and the requirements of the Specifications are met. No costs of a work stoppage may be passed on to Metra, its railroading partners, or the communities affected by the Project.
  2. See Section 013523, Safety and Loss Prevention, for the steps that will occur when a Stop Work Order is issued.
- F. Weekend, Holiday, and Night Work:
1. The Contractor may be allowed to work weekends, holidays, or after hours at night.
  2. All arrangements shall be made three days in advance for site access, station security, and lock-up. All work must be approved in advance and coordinated with Metra (or its railroad partner's) operations.

**1.04 SAFETY INSTRUCTIONS**

- A. See Section 013523, Safety and Loss Prevention.
- B. In addition, adhere to the following:
1. If, in the opinion of Metra's Authorized Representative, any of the Contractor's (or its subcontractor's) equipment is unsafe for use on

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railroad right-of-way, the Contractor, at the request of Metra's Authorized Representative, shall remove such equipment from the railroad right-of-way.

2. If Metra's Authorized Representative has given the Contractor permission to use certain equipment on any track at the job site, the Contractor shall ensure that each and all of its employees responsible for operating such equipment are trained:
  - a. Equipment includes any motive power, including (without limitation), any hi-rail equipment ("Motive Power") on any track of the railroad's.
  - b. Training requires employees to know, understand, and comply with Metra's operating rules applicable to the operation and use of such Motive Power.
3. If the Contractor's employees use any such Motive Power to move rail cars or other rail-bound equipment equipped with air brakes, the Contractor shall further ensure that the employees are trained accordingly:
  - a. Training requires employees to know, understand, and comply with Metra's rules for handling such Motive Power, cars, and equipment.
  - b. Contractor's employees shall perform all required tests of the operating system of any Motive Power, cars, and other equipment before and after movement.
  - c. The Contractor shall acknowledge receipt of Metra's applicable rules governing:
    - 1) The operation and use of Motive Power, cars, and other equipment and the movement of such Motive Power, cars, and equipment by rail.
    - 2) The operation and use of any hi-rail vehicles off of the railroad.

**PART 2 - PRODUCTS**

2.01 NOT USED

**PART 3 - EXECUTION**

3.01 NOT USED

**END OF SECTION**

**SECTION 01 20 00**  
**PRICE AND PAYMENT PROCEDURES**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section includes:
1. Administrative and procedural requirements governing the handling, coordination, and processing of measurement and payment.
  2. Requirements for pay requests.

1.02 GENERAL PROCEDURES

- A. The Contract is a lump sum contract divided into lump sum items of work, as listed on the Schedule of Values.
- B. Lump Sum payment for items of work will be full compensation for completing the work in compliance with the Contract Documents, inclusive of furnishing all manpower, equipment, materials, and performance of all operations relative to the construction of this project. Payment will be made on a percent complete basis.
- C. In order to determine the work percent complete, work items may be measured using appropriate units or by other determinations as necessary. Metra's Authorized Representative will verify the Contractor's measurement and percent complete status indicated on each Application for Payment. Metra's Authorized Representative's decisions with respect to percent complete status of the work will be final after three working days, if the Contractor does not submit a written notice as defined in the following paragraph.
- D. If the Contractor differs with Metra's Authorized Representative on the determination of quantities and percent complete status, it must notify Metra in writing within three working days from the time that the Contractor is informed of the decision by Metra's Authorized Representative. Otherwise, Metra will not consider any such difference as a claim for payment.
- E. Work items that are required but whose quantities are not shown on the Contract Drawings will not be measured, but will be considered incidental to the Contract or incidental to the specified items on the Schedule of Values as noted. No additional compensation will be allowed.
- F. Note that the repair of utilities, surface features, existing structures, etc., which is required due to damage resulting from construction activities that is beyond the limits of work or payment as defined on the Contract Drawings or herein, shall be performed by the Contractor at no cost to Metra.

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- G. All quantities shown in the Contract Documents are furnished for information only. The Contractor is responsible for verifying all quantities to estimate and complete the work in accordance with the Contract Documents.
- H. Metra reserves the right to alter the Drawings, Specifications, modify incidental work as may be necessary, and increase or decrease the quantities of work to be performed. Changes in the work shall not be considered as a waiver of any conditions of the Contract nor invalidate any provisions thereof. When changes result in revisions in the quantities of work to be performed, the Contractor may utilize unit prices shown on Contractor's schedule of values as they basis for negotiating changes in scope.
- I. The Contractor shall take no advantage of any apparent deviation in the Contract Drawings or Specifications, and Metra's Authorized Representative shall be permitted to make corrections and interpretations as may be deemed necessary for fulfillment of the intent of the Contract Documents.

**1.03 PAY REQUESTS**

- A. Each pay request shall include photocopies of canceled checks from the Contractor to its subcontractors, manufacturers, suppliers, etc. The cancelled checks shall be submitted for the month previous to the waiver and shall be for the amount shown on the pay request minus retainage. That is, with Pay Request No. 3, submit waivers for Pay Request No. 2 and cancelled checks from Pay Request No. 1.
- B. The Contractor shall furnish with its first pay request a breakdown of how much of each pay item will be paid to each subcontractor, such that Metra's Authorized Representative can track the furnished waivers.
- C. All pay requests shall be submitted using the Contractor Application for Payment Form found in Metra's CCQMP.

**PART 2 - PRODUCTS****2.01 NOT USED****PART 3 - EXECUTION****3.01 GENERAL**

- A. The Contractor shall maintain daily records as back-up material, for the measurement of work completed and/or material stored. The Contractor shall present daily records upon the request of Metra's Authorized Representative.

**END OF SECTION**

**SECTION 01 25 00**  
**SUBSTITUTION PROCEDURES**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. Section includes administrative and procedural requirements for handling requests for substitutions made after award of the Contract.

1.02 DEFINITIONS

- A. Request for Substitutions: Request for change in product, material, equipment, and methods of construction required by the Contract Documents, proposed by the Contractor after contract award. The following are not considered substitutions:

1. Substitutions requested by Bidders during the bidding period, and accepted prior to award of the Contract, are included in the Contract Documents and are not subject to the requirements specified in this Section.
2. Revisions to the Contract Documents requested by Metra's Authorized Representative.
3. Specified options of products and construction methods included in the Contract Documents.
4. The Contractor's determination of and compliance with governing regulations and lawful orders issued by governing authorities, except as provided for in the Contract Documents.

- B. Revisions to the Contract Documents, where required by Metra's Authorized Representative are "changes" not "substitutions."

- C. "Or Approved Equal": Where named products, materials, or methods are accompanied by "or approved equal" or other language of the same effect, the Contractor's requests to use unnamed products, materials, or methods are considered requests for substitutions, and are subject to the specified requirements.

1.03 PRODUCT REQUIREMENTS

- A. Products are generally specified by ASTM, IEEE, or other reference standard, and/or by manufacturers' names and model numbers or trade names in order to establish standards of quality and performances and not for the purpose of limiting competition.

1. When specified only by reference standard, select any product meeting the standard, by any manufacturer, subject to written approval with a certification of compliance.

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2. When several products or manufacturers are specified, the Contractor has the option of using a product by any of the manufacturers that fully complies with the specified materials and established performance standards. The listing of a manufacturer's name, brand name, or serial numbers shall not relieve the Contractor from furnishing products that comply with the detailed requirements of the Specifications.
- B. The materials specified are the basis of the Contract. However, substitutions may be submitted to Metra's Authorized Representative for approval, subject to compliance with all requirements in this Section and the Contract. Only Metra's Authorized Representative will determine whether or not the substitution is an approved equal.

**1.04 SUBSTITUTION PROCEDURE**

- A. Prepare requests for substitution in writing accompanied by all pertinent technical and cost data.
1. Include complete data on the proposed substitution substantiating that the product is equal in quality, workmanship, and serviceability to the specified product and its use will not affect the time schedule or project cost of this and other Contracts.
  2. Each request of this kind shall include the name of the material or equipment for which it is to be substituted, as well as a complete description of the proposed substitute including the following:
    - a. Complete product identification and description;
    - b. Manufacturer's literature;
    - c. Background on the manufacturer and the product's performance record or test data (including installing where it is specified to be by the manufacturer's representative);
    - d. Drawings and a sample cost comparison to the original product that was specified (including the dollar value of the credit back to Metra);
    - e. Any other information necessary for a proper evaluation; and
    - f. A statement setting forth any changes in other materials, equipment, or other work that the incorporation of the substitute would require.
  3. The burden of proof as to the merit of the proposed substitute is upon the proposer.
- B. Requests for substitutions when forwarded to Metra's authorized Representative are understood to mean all of the following:
1. The proposed substitution has been personally investigated by the Contractor.
  2. The substitute carries the same or better guarantee as the specified item.

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3. The cost data presented is complete and includes all related costs under this Contract and that all claims are waived for additional costs related to the substitution that subsequently become apparent.
  4. The installation of the approved substitute will be coordinated with all related trades and that such changes as may be required will be made so that the work is complete in all respects.
- C. After award of Contract, substitutions will be considered only under one or more of the following conditions:
1. Required for compliance with subsequent interpretation of code requirements.
  2. Unavailability of specified products, through no fault of the Contractor.
  3. Subsequent information discloses inability of specified products to perform properly or to fit in designated space.
  4. Manufacturer/fabricator refuses to certify or guarantee performance of specified product as required.
  5. When it is clearly seen in the judgment of Metra's Authorized Representative that a substitution would be substantially in Metra's best interests in terms of cost, time or other considerations.

**1.05 METRA RESPONSE TO SUBSTITUTION REQUEST**

- A. Notification: Metra's Authorized Representative will notify the Contractor of either the acceptance or rejection of a proposed substitute. Metra's Authorized Representative shall solely determine whether or not the substituted product is equal to those originally specified in quality, performance, design, and suitability for the intended use and life expectancy of the equipment and/or systems. Metra's Authorized Representative's decisions are final.
- B. Acceptance: Will be in the form of a written response from Metra's Authorized Representative.
- C. Substitution requests will not to be considered and shall be promptly returned to the Contractor due to the following:
1. The request is not accompanied by sufficient substantiating data.
  2. Substitutions are indicated or implied in shop drawing submittals without a formal request.
  3. For their implementation, they require substantial revisions to the Contract Documents in order to accommodate their use.
  4. They materially affect the work or schedule of other contractors.
  5. They do not comply with the specified equipment/material standards in every respect.

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6. Submittals are not made in writing with a formal transmittal letter.

**PART 2 - PRODUCTS**

2.01 NOT USED

**PART 3 - EXECUTION**

3.01 NOT USED

**END OF SECTION**

**SECTION 01 26 00**  
**CONTRACT MODIFICATION PROCEDURES**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section includes requirements for Contract modifications, whether by Metra or the Contractor, after execution of the Contract.

1.02 REQUEST FOR CONTRACT MODIFICATION

- A. Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order or a Contract Modification.
- B. If the construction change provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:
1. Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
  2. Unit prices stated in the Contract Documents or subsequently agreed upon; or
  3. A cost to be determined in a manner agreed upon by the parties and a mutually accepted fixed or percentage fee.
- C. A request for a Contract Modification can be initiated by Metra, Metra's Authorized Representative, or the Contractor to immediately authorize any changes in the Work, Contract Sum, or Contract Time. The document is signed by both Metra and the Contractor. All Contract Modifications are later formalized and shall be incorporated into a Contract Change Order towards the end of the Project.
- D. Metra will approve prepared Contract Modifications as required, in cooperation with and based on the recommendation of Metra's Authorized Representative. All costs for Contract Modification additions or deletions shall be based upon the latest edition of R. S. MEANS Co. Inc. books.
- E. All proposals for a change involving an increase or decrease in the amount of the Contract Sum shall be submitted by the Contractor in a completely itemized breakdown form, which shall include but not be limited to the following: Material quantities and input prices, labor costs, construction equipment costs, and any general conditions.
- F. Contract Modifications will be approved when an unforeseen field condition arises on the construction site and action is required to maintain job progress. They will also be approved when changes in time schedules or budgets are required. No work can proceed without proper authorization.

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- G. In all cases, Metra shall prepare and issue the formal Contract Change Order as is appropriate to each project. A Change Order is a written instrument signed by both Metra and the Contractor stating their agreement upon all of the following: the Change in Work; the amount of the adjustment, if any, in the Contract Sum; and the extent of the adjustment, if any, to the Contract Time. Information, sketches, revised drawings, proposals, cost analysis, and supporting back-up shall be furnished by the Contractor.

**1.03 GENERAL PROCEDURES**

- A. If a Contract Modification is required by the Contractor, the Contractor shall send the request, complete with all pertinent drawings, prospectus, and cost data to Metra's Authorized Representative.
- B. If a Contract Modification is initiated by Metra's Authorized Representative or Metra, the Contractor will be informed if the requested change affects work scheduled to commence before the approved Contract Modification can be issued.
- C. Metra's Authorized Representative will review all Contract Modification requests and forward them to Metra with recommendations.
- D. If, in the opinion of Metra, a formal Contract Change Order is appropriate, Metra will prepare and issue the Contract Change Order.
- E. Metra's review time will generally be fifteen (15) working days from the time of receipt; however, this time cannot be guaranteed.
- F. Submittals by regular U.S. mail are at the Contractor's own risk. Metra will not be responsible for time losses and costs due to lost submittals or transmittal delay problems.
- G. The Contractor shall not proceed with fabrication or installation of equipment for material affected by any requested Contract Modification until the request has been formally rejected or approved.
- H. All Contract Modifications shall be resolved within 30 working days.

**PART 2 - PRODUCTS**

2.01 NOT USED

**PART 3 - EXECUTION**

3.01 NOT USED

**END OF SECTION**

**SECTION 01 32 00**  
**CONSTRUCTION SCHEDULES**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section includes requirements for the preparation and submittal of construction schedules.

1.02 SUBMITTALS

- A. The Contractor shall submit the following schedules:
1. Preliminary Project Schedule:
  2. Updated Progress Schedules
  3. Schedule of Submittals
  4. Major Products Delivery Schedule
  5. Narrative Reports
  6. Work Schedule for the following two-week period in a format acceptable to Metra, at regularly scheduled project meetings.
- B. Submittal Schedule:
1. Within 15 days after Notice to Proceed, submit the following:
    - a. Preliminary Project Schedule
    - b. Narrative Report
  2. After Metra review, submit the following within 15 calendar days, modified to accommodate revisions recommended by Metra's Authorized Representative:
    - a. Revised Preliminary Project Schedule
    - b. Schedule of Submittals
    - c. Major Products Delivery Schedule
    - d. Narrative Report
  3. On a monthly basis, submit the following, indicating changes occurring since the previous submission, revised projections of progress and completion, and other identifiable changes:
    - a. Updated progress schedules, including the following
      - 1) Master Project Schedule
      - 2) Schedule of Submittals
      - 3) Major Products Delivery Schedule

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## 4) Narrative Report

- b. Progress Schedules must show the approved Preliminary Project Schedule dates directly above the actual start and finish dates for the work performed.
- c. Failure to furnish when requested is cause to delay progress payments.

## 1.03 FORMAT

- A. Prepare a network analysis system using the critical path method.
- B. The system shall consist of diagrams and accompanying mathematical analysis.
- C. In addition to the critical path method chart, the Contractor shall submit a bar chart covering all construction activities.

## 1.04 CONTENT

- A. The network shall show the order and interdependence of activities and the sequence in which the Work is to be accomplished as planned by the Contractor. The basic concept of a network analysis diagram shall be followed to show how the start of a given activity is dependent on the completion of preceding activities and its completion restricts the start of following activities.
- B. The detailed network activities shall include the following, in addition to construction activities:
  - 1. The submittal and approval of samples of materials and shop drawings.
  - 2. The procurement of critical materials and equipment.
  - 3. Fabrication of special material and their installation and testing.
  - 4. All activities of Metra and Metra's Authorized Representative that affect progress.
  - 5. Contract required dates for completion of all or parts of the Work.
- C. The selection and number of activities shall be subject to Metra's Authorized Representative's approval, but shall not be less than a minimum of 20 activities.
  - 1. Identify each activity by major Specification section number.
  - 2. Identify work of separate stages, type of work, and other logically grouped activities.
- D. Activity Schedule Tabulation:
  - 1. The following information shall be furnished as a minimum for each activity.
    - a. Preceding and Following (i,j) Event Number
    - b. Activity Description
    - c. Estimated Duration of Activities in Calendar Days

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- d. Earliest Start Date (by Calendar Date)
  - e. Earliest Finish Date (by Calendar Date)
  - f. Actual Start Date (by Calendar Date)
  - g. Actual Finish Date (by Calendar Date)
  - h. Latest Start Date (by Calendar Date)
  - i. Latest Finish Date (by Calendar Date)
  - j. Slack or Float
  - k. Percentage of Activity Completed
2. The activity schedule shall list the activities in sorts or groups as follows:
    - a. By the preceding event number from lowest to highest and then in the order of the following event number.
    - b. By the amount of slack, then in order of preceding event number.
    - c. By responsibility in order of earliest allowable start dates.
    - d. In order of latest allowable start dates and then in order of preceding event numbers and then in order of succeeding event numbers.
- E. Detailed Network Arrow Diagram:
1. Detailed network diagrams shall be time scaled and shall be drafted to show a continuous flow from left to right with no arrows from right to left.
  2. Related activities shall be grouped on the network.
  3. The critical path shall be plotted generally along the center of the sheet with paths of increasing float placed towards the top and/or bottom.
  4. Clearly indicate, by symbol (or other means) the critical path of the project.
  5. The following information shall be shown on the diagram for each activity:
    - a. Event Numbers
    - b. Activity Description
    - c. Group, Stage, or Area Identification
    - d. Activity Duration
  6. Weekends and holidays shall be indicated.
  7. Allowance for inclement weather during the construction season (mid-March to mid-November) shall be included on the basis of an average of one rain day for each eleven working days. Allowance for winter working and the activities the Contractor intends to complete during the winter months (mid-November to mid-March) shall also be included. Metra's Authorized Representative reserves the right of Approval to the Contractor's allowance for winter working. No sheeting or excavation adjacent to track shall be performed during the winter.
  8. Metra's Authorized Representative must approve the detailed arrow diagram prior to the Contractor's first payment submittal and approval.

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9. Subsequent review and approval of the Detailed Network Arrow Diagram shall be done on a basis as directed by Metra's Authorized Representative and Metra.
- F. Schedule of Submittals:
1. List all required submittals in sorts or groups as follows:
    - a. By Specifications section number from lowest to highest, then in order of earliest start date, and then in order of i, j event number.
    - b. By order of earliest start date and then in order of i, j event numbers.
- G. Major Products Delivery Schedule:
1. List all delivery dates of major products, equipment and materials in sorts or groups as follows:
    - a. By Specification section number from lowest to highest.
    - b. Then in order of earliest start (delivery date) date.
    - c. Then in order of earliest start (delivery date) date, and then in order of i, j event number

**1.05 REVISIONS TO SCHEDULES**

- A. Indicate progress of each activity to date of submittal, and projected completion date of each activity.
- B. Identify activities modified since previous submittal, major changes in scope, and other identifiable changes.
1. Inclusion in the network and use of revised logic and/or duration time estimates for updating, whether furnished by the Contractor or by Metra's Authorized Representative, shall not be construed as extensions of time to the dates required in the Contract.
  2. Extensions of time are to be granted by Contract Modification or Change Order only.
- C. The Contractor shall submit a narrative report along with the updated schedules as required which shall include:
1. Description of problem areas.
  2. Current and anticipated delaying factors and their impact.
  3. An explanation of corrective actions taken or proposed.
  4. The total percentage of all work completed as of the report date.
  5. Progress along the critical path in terms of days ahead or behind the allowable dates.

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- 6. An explanation of how the Contractor plans to get the project back on schedule and meet the completion date.
- D. If Metra's Authorized Representative finds the proposed schedule not acceptable, he may require the Contractor to submit a new schedule. If a satisfactory plan is not agreed upon, Metra's Authorized Representative may direct the Contractor to increase its work force, construction equipment or number of work shifts without additional cost to Metra.
- E. Failure to Meet Schedule:
  - 1. Failure of the Contractor to comply with the approved construction schedule shall be considered grounds for determination by Metra that the Contractor is failing to prosecute the Work with such diligence as will ensure its completion within the Contract time.
  - 2. A delay of 30 calendar days or more, based on the construction schedule critical path shall be sufficient cause for Metra to notify the Contractor's bonding firm and other involved parties.
- F. Extensions of Time:
- G. Extensions of time will be granted by Contract Modification or Change Order only. All requests by the Contractor for extensions of time shall be submitted to Metra's Authorized Representative for review and approval. All pertinent supporting data shall accompany requests for extension of time.

**1.06 SCHEDULING AND OPERATING RESTRICTIONS**

- A. A horizontal construction clearance of 10'-0" from the centerline of any active track in the area shall be maintained.
- B. Additional scheduling restrictions must be complied with when noted on the plans.
- C. The Contractor must comply with scheduling restrictions relating to work permits and work hour restrictions by governing authorities, at no additional cost to Metra.
- D. Violations of scheduling restrictions related to Metra's track operations shall be subject to a penalty.

**PART 2 - PRODUCTS**

2.01 NOT USED

**PART 3 - EXECUTION**

3.01 NOT USED

**END OF SECTION**

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**SECTION 01 33 00**  
**SUBMITTAL PROCEDURES**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section includes administrative and procedural requirements for submittals required for performance of the Work, including the following:
  - 1. Submittal schedule.
  - 2. Product data, shop drawings, samples, and supporting data as requested in the technical sections.
- B. For non-work related, administrative submittals, see other parts of the Contract Documents.

1.02 RELATED SECTIONS

- A. Section 013200, Construction Schedules
- B. Section 017839, Project Record Documents

1.03 SUBMITTALS

- A. Submit a complete schedule of all required work-related submittals to Metra's Authorized Representative. The submittals will be reviewed at the Pre-Construction Conference. Revise the schedule as directed by Metra's Authorized Representative and resubmit for final approval.

1.04 SUBMITTAL PROCEDURES

- A. A separate submittal shall be prepared for each material type and/or system.
- B. Prepare and transmit submittals sufficiently in advance of performing related work to allow time for review and possible resubmittal. No extension of time will be authorized due to the Contractor's failure to prepare or transmit submittals sufficiently in advance of the work.
- C. A submittal shall be made for all required work, whether or not a submittal is specifically indicated.
- D. Every cover sheet, page, drawing or sample of all submittals shall be marked with a permanent, tamper proof identification that includes the following (as applicable):
  - 1. Specification Number
  - 2. Contract Number
  - 3. Contractor - date approved

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4. Subcontractor - date approved
  5. Sub-subcontractor - date approved
  6. Supplier/Manufacturer - prepared (mailed)
  7. State Specification Division, Section, Subsection and Paragraph(s) Involved
  8. Specify related drawings and details
- E. All submittals shall be accompanied by a transmittal letter plus two copies of the letter.
- F. The transmittal letter shall include all identification information marked on the submittal and the Contractor's certification that all information is in compliance with the Contract Documents.
- G. Minor variations from the Contract Documents shall also be indicated and each submittal made to highlight such deviations.
- H. All submittals shall have a minimum of 2-in x 3-in clear area for approval stamps and signatures.
- I. Submittals shall be packaged appropriately and sent by U.S. registered mail or delivered to Metra's Authorized Representative. Metra will not be responsible for time losses and extra costs due to lost submittal for transmittal delays.
- J. Work shall not proceed in a manner that necessitates later revisions of a submittal that has been transmitted.

**1.05 REQUIREMENTS FOR ELECTRONIC SUBMITTALS**

- A. All diagrams, drawings and instruction material shall be prepared using the latest version of MicroStation® in English language and U.S. Standard system of weights and measures. All drawings and reproducible tracings shall be 24 inches x 36 inches overall. The equipment layout drawing shall be drawn to 1/4 inch = 1 foot-0 inch scale. A bar chart (graphic scale) shall be provided on all equipment layout drawings. All drawings must follow Metra's CAD standards and Metra's Electrical Color Code.
- B. Submit as Adobe (Portable Document Format) pdf document(s). Describe each submittal or submittal group under cover of an electronic transmittal.
- C. Provide bookmarks for each product within a single submittal when it contains multiple products.
- D. Documents shall be created directly from the native format; scanned documents are not permitted.
- E. Electronic product data submittals shall not be locked or password protected.

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**1.06 SCHEDULE OF SUBMITTALS**

- A. Furnish a complete schedule of Work-related submittals to be made to Metra's Authorized Representative, in accordance with the requirements of Section 013200, Construction Schedules.
  - 1. The schedule for submittal shall be coordinated with the construction schedule.
  - 2. The submittal schedule will be reviewed at the pre-construction meeting. The Contractor shall revise schedule as directed by Metra's Authorized Representative and resubmit for final approval prior to first payment request.

**1.07 QUANTITIES OF SUBMITTALS**

- A. Initial Submittals: The number of copies, the manner of submittal, and the Contractor's options for certain categories of initial submittals shall be as specified in other Sections or in this Section.
- B. Final Distribution Copies:
  - 1. Except as otherwise indicated in other Sections, submit the following quantities for each type to Metra's Authorized Representative for submittal, resubmittal use, or other distribution as specified.
  - 2. Quantities do not include copies for the Contractor's record and distribution to subcontractors, suppliers, fabricators, installers, governing authorities, and others involved in the performance of the work, which the Contractor may need to provide with submittal copies in order to receive Metra's Authorized Representative's action markings.
- C. Shop Drawings:
  - 1. Six hard-copies and one electronic pdf format file.
  - 2. Submit four full size prints of all final drawings
- D. Product Data: Six hard-copy sets and one electronic pdf format file.
- E. Book of Plans: Three hard-copy sets and one electronic pdf format file.
- F. Samples: Six sets.
- G. Qualifying and Certifying Reports: Six copies
- H. Test Reports and Certificates: Six copies
- I. Instruction and Service Manuals: Three preliminary hard copies, six final hard-copies, and one electronic pdf format file.
- J. The Contractor shall submit final As-Built drawings to Metra as specified in Section 017839, Project Record Documents.

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- K. Warranties, Bonds and Maintenance Agreements: Where specifically prepared or executed for the project, provide six hard-copies and one electronic copy in a USB drive; additional copies to be furnished to meet requirements of submittal of Maintenance Manuals.

**1.08 PRODUCT DATA**

- A. Modify product data and installation instructions to delete information which is not applicable to the work.
- B. Supplement standard information to provide information specifically applicable to the Work.
  - 1. Transmittal shall constitute the Contractor's certification that the submittal has been reviewed and is proposed for incorporation into the work.
  - 2. Product data submittals shall be sufficiently edited and/or annotated to clearly indicate the intended product, marked catalog number including of size(s), color(s), and selection of available accessories and options to be included, as appropriate.
- C. Brochures, catalog cuts, and other product data which do not clearly indicate specific products intended will be rejected.

**1.09 SHOP DRAWINGS**

- A. Prepare shop drawings that establish the actual detail of the work:
  - 1. Indicate proper relation to adjoining work.
  - 2. Amplify design details of all general, civil and structural items in proper relation to verified physical items.
  - 3. Incorporate minor changes of design or construction to suit actual conditions.
  - 4. Fully describe all material and equipment to be incorporated into the project.
  - 5. Include manufacturer's specifications and special detailed information.
- B. Shop drawings shall include plans, full flow diagrams, control diagrams, specifications, equipment schedules and sequences of operations, when applicable.
- C. Drawings shall be made under the direction and supervision of the Contractor and shall show all work dimensioned exactly as installed. Major equipment and apparatus shall be shown to scale and properly located.
- D. The drawing shall include plan layouts drawn at a scale (or scales) as required; minimum scale shall be 1/8" equal to 1'-0". It is intended that construction drawings of each trade be the same scale(s) in order to permit respective plans to be superimposed upon all others of each trade.

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- E. In addition to the floor plans, the layouts of all congested areas such as mechanical and electrical equipment rooms, and all functionally critical areas shall be drawn at a minimum scale of  $\frac{1}{4}'' = 1'-0''$  with all details of construction shown.
- F. Metra's Authorized Representative may request additional drawings if, in his opinion, they are required too properly coordinate the project.
- G. The Contractor shall be responsible for the coordination of all work with the work of all trades and shall, in preparing the drawings, continually check the work of all other trades (inclusive of that indicated by shop drawings) in order to avoid possible installation conflict. It shall be understood that the work shown on the drawings has been so coordinated. In the event of conflicts or interference that cannot be resolved in the field, the Contractor shall request a written clarification from Metra's Authorized Representative.
- H. Final shop drawings shall be the same size as the Contract Drawings and printed on Metra's standard borders, with the Contractor's name added.
  - 1. See Metra's Engineering CADD Manual for Metra standard border.
  - 2. At a minimum, the shop drawing title block must indicate:
    - a. Project Name
    - b. Project Number
    - c. Contract Number
    - d. Revision
    - e. Date.

**1.10 SAMPLES**

- A. Samples shall be sufficient size to show general visual effect. When samples must show range of color, texture, finish graining or other properties, submit in sets of six showing the full scope of this range. Each sample shall bear identifying labels stating project name, material, manufacturer and location of project.

**1.11 CALCULATIONS**

- A. When specified in individual Sections, submit calculations.
- B. Submit calculations bearing seal and signature of professional engineer responsible for design, registered in State of Illinois.

**1.12 INFORMATIONAL SUBMITTALS**

- A. Informational submittals upon which Metra's Authorized Representative is not expected to take responsive action may be so identified in Contract Documents. When professional certification of performance criteria of materials, systems, or equipment is required by Contract Documents, Metra's Authorized Representative shall be entitled to rely upon accuracy and completeness of such certifications.

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- B. Types of Informational Submittals:**
1. Design data: Submit with shop drawings.
  2. Test reports: Submit within two weeks of testing.
  3. Certifications:
    - a. Submit certifications when specified in individual Specification sections.
    - b. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
    - c. Certifications may be recent or previous test results on material or product, but must be acceptable to Metra's Authorized Representative.
    - d. Submit welder certifications with shop drawings.
    - e. Submit manufacturer or fabricator certifications with product data.
    - f. Submit certificates of compliance within two weeks following approval or acceptance by authority having jurisdiction.
    - g. Submit installation certifications within two weeks following completion of product installation.
  4. Engineering Certifications:
    - a. Submit certified statement, signed and sealed by professional engineer responsible for design attesting to the following:
      - 1) Conformity to applicable governing codes.
      - 2) Conformity to criteria in Contract Documents.
      - 3) Component parts were designed or selected for locale and application intended.
    - b. Submit with shop drawings. Submit prior to fabrication if shop drawings are not required by individual specification sections.
  5. Qualification Data:
    - a. When specified in individual Sections, submit manufacturer's, fabricator's, and installer's qualifications verifying years of experience with traction power equipment manufacturing.
    - b. Include list of completed projects having similar scope of Work identified by name, location, date, reference names, and phone numbers.
    - c. Submit manufacturer qualification data with proposed products list.
  6. Manufacturer's Instructions:
    - a. When specified in individual Specification sections, submit manufacturer's printed instructions for delivery, storage, assembly, installation, adjusting, finishing, and other pertinent data.

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- b. Identify conflicts between manufacturer's instructions and Contract Documents and how the Contractor intends to resolve them.
  - c. Identify conflicts between manufacturer's instructions and Contract Documents and how the Contractor intends to resolve them.
  - d. Submit with product data.
- C. Quantity: Submit in quantities specified for product data.

**1.13 INCOMPLETE AND PARTIAL SUBMITTALS**

- A. Incomplete Submittal: Submittal not complying with specified submittal requirements.
- B. Partial Submittal: Submittal subdivided into components as indicated in submittal schedule and each component submitted separately.
- C. Any submittal not in compliance with the specified requirements will be returned to the Contractor without review.

**1.14 CONTRACTOR REVIEW**

- A. All submittals shall be fully reviewed for compliance with the Contract Documents and approved before transmittal by the Contractor and, if applicable, by the subcontractor(s) involved.
- B. Stamp, sign or initial, and date each submittal to certify compliance with requirements of Contract Documents. Contractor's stamp shall bear the words as follows: REVIEWED AND APPROVED FOR CONFORMANCE WITH CONTRACT DOCUMENTS.
- C. All Submittals sent for construction shall clearly mark "Issue for Construction" on the title block. Submittals not in compliance with the Contract Documents will be returned for resubmittal.
- D. No work may commence until the installation drawings are reviewed by Metra's Authorized Representative and returned without comments.

**1.15 METRA'S AUTHORIZED REPRESENTATIVE'S REVIEW**

- A. Review time will be 15 working days from the date of receipt. The Contractor shall be advised promptly when it is determined that a submittal being reviewed must be delayed for coordination.
- B. Review Procedure: All submittals in compliance with these requirements will be reviewed by Metra's Authorized Representative for compliance with the Contract Documents, stamped, signed and distributed.
  - 1. Submittals stamped REVISE AND RESUBMIT or REJECTED shall be corrected by the Contractor, as requested, and resubmitted to Metra's Authorized Representative within 14 calendar days. No work related to the submittal may begin until approval is given.
  - 2. Submittals stamped COMMENTS AS NOTED shall be corrected by the Contractor, as requested, and resubmitted to Metra's Authorized

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Representative within 14 calendar days. Work may begin upon receipt of conditional approval from Metra's Authorized Representative if in compliance with the requested changes. Commencement of work on a COMMENTS AS NOTED submittal in no way relieves the Contractor of its responsibility to resubmit for final acceptance.

3. Submittal marked NO EXCEPTIONS TAKEN constitute an acceptable submittal and acceptance is final.
- C. Metra's Authorized Representative's review is not a complete check of the method of assembly, erection, or construction. Review shall in no way be construed as:
1. Permitting any departure whatsoever from the Contract Documents.
  2. Relieving the Contractor of its responsibility for any error in quantity, quality of materials, details, omissions or otherwise that may exist.
  3. Relieving the Contractor of its responsibility for adequate field connections, erection techniques, and measurements and quantities required.
  4. Relieving the Contractor of its responsibility for satisfactory performance of all work and coordination with the work of all subcontractors and other contractors.
  5. Permitting departure from additional details or instructions furnished by Metra's Authorized Representative.
- D. Distribution of reviewed and stamped submittals shall be as follows:
1. One to Metra's Field Office.
  2. Two retained for Metra's Authorized Representative's file.
  3. Original and one additional to the Contractor
- E. Additional copies of samples are returned to the Contractor when marked COMMENTS AS NOTED, REVISE AND RESUBMIT, or REJECTED, or are otherwise sent to Metra's Authorized Representative.
- F. Samples will not be returned to the Contractor and shall not be incorporated into the Work.
- G. Only such shop and working drawings, product data, etc., as has been signed and stamped with approval of Metra's Authorized Representative shall be allowed on the site.

**1.16 RESUBMITTALS**

- A. The Contractor shall make corrections required by Metra's Authorized Representative and shall resubmit as often as necessary.

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- B. The Contractor shall direct specific attention in writing, or on the resubmitted shop drawing or other type of submittal, to revisions other than the corrections requested by Metra's Authorized Representative on previous submissions.
- C. Re-submittals must be accompanied with a statement letter indicating the approach taken to bring them into compliance with the Specifications, and shall be documented on the submittals log.
- D. Review of Contractor Resubmittals:
  - 1. Metra will permit two reviews of each submittal by Metra's Authorized Representative, consisting of a review of the original submittal, and if necessary, review of one resubmittal at no expense to the Contractor.
  - 2. Metra will charge the Contractor 1.5 times the costs incurred by the Metra's Authorized Representative for each subsequent review of each submittal after review of the original submittal and one resubmittal.

**PART 2 - PRODUCTS**

2.01 NOT USED

**PART 3 - EXECUTION**

3.01 NOT USED

**END OF SECTION**

**SECTION 01 35 13**  
**SPECIAL PROJECT PROCEDURES**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section includes general requirements for prosecution of construction and requirements to submit work plans.

1.02 SUBMITTALS

- A. Submit detailed work plans for major operations that affect Metra commuters using Metra rail service. As directed by Metra's Authorized Representative or listed elsewhere in the Specifications, submit plans showing barricades, signage, etc. At least one week notification is required for changes to commuter access.

**PART 2 - PRODUCTS**

2.01 NOT USED

**PART 3 - EXECUTION**

3.01 GENERAL REQUIREMENTS

- A. It is imperative that the Contractor complete all construction operations as shown on the Drawings and specified in the Specifications, without interruption to Metra commuter service or any freight service operating on this line.
- B. The roadways in the vicinity of the project must be kept open to pedestrians and street traffic in each direction at all times, except as otherwise specified in the Contract Documents.
- C. The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for, and have control over, the construction means, methods, techniques, sequences, and procedures, as well as for coordinating all portions of the Work under the Contract, unless the Contract Documents give other specific instructions concerning these matters.
- D. As work progresses, changes or modifications in such procedures, methods, and equipment may be required. In such an event, further work shall be performed only in accordance with such changes or modifications as submitted to and approved by Metra's Authorized Representative in writing.
- E. In general, follow the procedure and sequence of operations as specified in the Contract Documents for the construction of the Work. The order in which the various operations or stages are specified is based on the requirement that

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railroad and vehicular traffic must be maintained at all times with a minimum amount of inconvenience or interference to train and vehicle movements. Only the principal items of work to be performed are listed or shown, and it shall be understood that it is not the intention to mention every detail of the work or to enumerate all of the items of the Contract that may be required for its completion.

- F. Obtain from the affected Municipality and the Illinois Department of Transportation (IDOT) any permission and permits for street closures necessary to complete the Work. A minimum of one week advanced notice must be given to the Municipality prior to any closure.
- G. Regardless of the order in which the construction operations are listed, the Contractor shall concurrently proceed with as many construction operations as possible in order to expedite the completion of the Contract.
- H. Prior to the Contractor starting work, a joint conference will be held among all interested parties, at which time a final schedule of operations shall be adopted. After this schedule has been adopted, no deviations by the Contractor will be allowed without written approval from Metra's Authorized Representative. No work shall be performed before a notice to proceed is given by Metra's Authorized Representative and Metra.
- I. The materials and labor required to perform the work in each stage shall be furnished by the one performing the work, unless specified otherwise.
- J. The Contractor shall ensure that all material suppliers and subcontractors, their agents, and employees adhere to the Contract Documents, and that they order materials on time, taking into account the current market and delivery conditions, so that materials are provided as needed per the schedule. The Contractor shall be responsible for the space requirements, locations, and routing of all materials and equipment required under this Agreement.
- K. If at any time before the commencement or during the progress of the Work the materials and equipment used or to be used appear to Metra's Authorized Representative as insufficient or improper for securing the quality of work required or the required rate of progress, Metra's Authorized Representative may order the Contractor to increase its efficiency or to improve the character of its equipment, and the Contractor shall conform to such order. However, the failure of Metra's Authorized Representative to demand an increase of efficiency or improvement shall not release the Contractor from its obligation to secure the quality of work or rate of progress required under this Contract.
- L. The Contractor shall be responsible to Metra for acts and omissions of its employees, subcontractors and their employees, and other persons or entities performing portions of the Work for, or on behalf of, the Contractor or any of its subcontractors.
- M. All employees and subcontractors of the Contractor shall be qualified by both training and experience to perform their assigned tasks.

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- N. The Contractor shall not permit at any time alcohol, controlled substances, or firearms to be present at the Project Site.

**END OF SECTION**

**SECTION 01 35 23**  
**SAFETY AND LOSS PREVENTION**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section includes requirements for the development and execution of safety and loss prevention procedures by the Contractor as applicable to the execution of the Work.

1.02 SUBMITTALS

- A. The Contractor must furnish a copy of its own, and its subcontractors Safety and Loss Prevention Program to Metra's Authorized Representative for review.

1.03 REQUIREMENTS OF REGULATORY AGENCIES

- A. Codes and Standards: The Contractor shall comply with the requirements of all laws and regulations of all authorities having jurisdiction over the work.
- B. 29 CFR 1910, Occupational Safety and Health Standards
- C. FRA Regulations:
  - 1. 49 CFR 213, Track Safety Standards
  - 2. 49 CFR 214, Railroad Workplace Safety.

1.04 PROTECTIVE MEASURES

- A. The Contractor shall take thorough precautions at all times for the protection of persons and property, and shall be liable for damage to persons or property, either on or off the site, that occurs as a result of its prosecution of the Work.

1.05 PERMITS

- A. The Contractor shall obtain permits for installing and maintaining barricades, walkways, fences, railings and whatever other safeguards that may be necessary to protect persons and property from damage as a result of the construction under this Contract.

1.06 SAFETY AND LOSS PREVENTION PROGRAM

- A. The Contractor shall be responsible for maintaining a safety and loss prevention program covering all work performed by the Contractor and its subcontractors.
  - 1. The Contractor shall designate a responsible member of its organization whose duties shall include loss and accident prevention, and who shall have the responsibility and full authority to enforce the program.

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2. The person shall hold meetings with the representatives of the various trades employed to ensure that all employees understand and comply with the program.
- B. The Contractor shall cooperate fully with Metra and all insurance carriers and loss prevention engineers on loss and accident prevention.
  - C. The Contractor, subcontractors and material men shall cooperate fully with all interested parties on accident prevention and claim handling procedures.
  - D. The Contractor must promptly report in writing to Metra all accidents arising out of, or in connection with the performance of the Work. The Contractor shall report whether the accident took place on or off of the project site, if it resulted in death, personal injury, or property damage, and give full details and statements of witnesses.
    1. If death, serious injuries or serious damages are caused, the accident shall be reported immediately by telephone or messenger.
    2. If any claim is made against the Contractor or any of its subcontractors on account of the accident, the Contractor shall promptly report the facts, in writing, to Metra, giving full details of the claim.

**1.07 OBSERVATION**

- A. During periodic visits to the job site, Metra's Authorized Representative will observe the job site for safety on an information basis only, not as an official agent. If Metra's Authorized Representative observes a condition considered to be unsafe, the Contractor's superintendent will be advised verbally of the observed condition, and the condition will be recorded in Metra's Authorized Representative's Log Report.
- B. If the condition represents an imminent danger, in the opinion of Metra's Authorized Representative, to persons or property, and the Contractor, after being verbally notified, does not immediately correct the condition, the observer will contact Metra:  
547 West Jackson Boulevard,  
Chicago, Illinois, 60661.  
A call must be supplemented by a written, signed statement.

**1.08 OBSERVANCE OF GENERAL CODE OF OPERATING RULES**

- A. The Contractor shall comply with all rules and regulations contained in the General Code of Operating Rules, adopted by Metra with particular emphasis on Rule G, which prohibits use of alcoholic beverages, drugs, etc. on Metra property. Any violation of this will result in permanent removal from the project.
- B. Workers must wear hard hats, eye protection, and safety boots when working on Metra property. The Contractor shall also furnish hard hats for visitors to the site.

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**1.09 WORKER SAFETY**

- A. The Contractor shall follow all the regulations issued under Federal Railway Administration (FRA) regulations 49 CFR 213 and 49 CFR 214.
- B. No employee will be allowed to begin work on railroad property each day until a daily job briefing is held with the Railroad's Employee in Charge (EIC).

**1.10 PENALTIES FOR NON-COMPLIANCE**

- A. Compliance with these Safety and Loss Prevention conditions is considered by Metra to be of primary importance. Therefore, Metra's Authorized Representative will take the following steps if the Contractor fails to comply with these Safety and Loss Prevention conditions:
  - 1. Minor Infractions of the Safety and Loss Prevention Conditions:
    - a. Minor infractions will be verbally brought to the attention of the Contractor's Superintendent by Metra's Authorized Representative.
    - b. It is expected that the Superintendent will promptly take the necessary steps to correct these infractions.
  - 2. Repeated Minor Infractions of the Safety and Loss Prevention Conditions or Failure of the Superintendent to Promptly Correct Minor Infractions Pointed Out by Metra's Authorized Representative:
    - a. These infractions will result in the Contractor being advised in writing by Metra's Authorized Representative of such violations and shall require the Contractor to respond in writing as to what steps will be taken in order to correct the infractions.
    - b. The Contractor shall then take immediate corrective action.
    - c. It is required that all corrective actions are completed as described and detailed in writing.
    - d. These infractions will be discussed and documented at Weekly Progress Meetings.
  - 3. Serious Violations of the Safety and Loss Prevention Conditions or Failure by the Contractor to Take the Corrective Actions Outlined in Paragraph 2 of the Penalties for Non-Compliance Above:
    - a. These infractions will result in Metra's Senior Director of Engineering issuing the Superintendent a written "Stop Work Order" that will require the Contractor and all of its subcontractors to immediately cease work activities on the project, and for all non-supervisory personnel of the Contractor and its subcontractors to immediately vacate Metra's premises.
    - b. The serious violations referenced in Paragraph 3 include, but are not limited to the following acts by the Contractor or any of its subcontractor's personnel:
      - 1) Failure to comply with FRA or Metra's Requirements for Fall Protection while working on bridges.

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- 2) Failure to comply with FRA or Metra's Requirements for On Track Safety and/or Roadway Worker Protection.
  - 3) Refusal to obey the signals and directions given to them by Metra's Flagman.
  - 4) Performing work at track level, or within 25 feet of any track, outside of the hours specified in the Specifications.
  - 5) Performing work at track level, or within 25 feet of any track, at any time without a Metra Flagman being present.
  - 6) Performing work on Metra property after the issuance of a "Stop Work Order".
  - 7) Failure to maintain the premises of Metra in a secure condition, which could potentially result in an accident or damage to Railroad property or equipment.
  - 8) Assault on a Metra employee.
  - 9) Any activity that causes, or directly contributes, to an FRA Reportable Injury to any on-duty employee of Metra.
  - 10) Intentional return of an individual barred under the conditions described in Section 1.08, A to the Project and/or premises of Metra.
  - 11) Any activity that causes or directly contributes to a derailment or any other train accident.
- c. After issuance of a Stop Work Order, Metra's Senior Director of Engineering will immediately meet on-site with Metra's Authorized Representative and the Contractor's Superintendent to discuss what steps will be taken to resume construction activity on the Project.
- 1) The Superintendent will be issued a written set of instructions by Metra's Senior Director of Engineering detailing what work must be done to bring the Project back into compliance with the Safety and Loss Prevention conditions.
  - 2) Any work activity by the Contractor or its subcontractors at this time will be limited to the corrective action required for bringing the Project back into compliance with these conditions.
- d. At this time, Metra's Senior director of Engineering may require that one or more employees of the Contractor or its subcontractors be prohibited from working on the Project or occupying Metra's property. The Superintendent will then be required to furnish Metra's Chief Engineering Officer with the names of those individuals.
- e. When the corrective action has been completed, and the Project has been brought back into compliance with the Safety and Loss Prevention conditions, Metra's Senior director of Engineering will issue a written Resume Work Order to the Superintendent.

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4. ANY Additional Serious Violations of the Safety and Loss Prevention Conditions:
    - a. If the Contractor or any of its subcontractors seriously violates the Safety and Loss Prevention conditions again, a written Stop Work Order will be issued to the Superintendent by Metra. All work on the Project will immediately cease and all employees of the Contractor and its subcontractors will immediately vacate the premises of Metra.
    - b. After issuance of a second and subsequent Stop Work Order(s), the President, Chief Executive Officer, or equivalent of the Contractor must contact Metra's Deputy Executive Director - Operations, in writing, to request that a hearing be held to discuss what steps must be taken by the Contractor in order to resume work on the Project. A hearing will be scheduled at the earliest opportunity by Metra's Deputy Executive Director - Operations, at 547 West Jackson Boulevard in Chicago, Illinois.
    - c. At the hearing, it will be the responsibility of the President, Chief Executive Officer, or equivalent of the Contractor to make a presentation to Metra detailing what steps will be taken by the Contractor, in order to bring the Project back into compliance with the Safety and Loss Prevention conditions of the Contract, as well as what steps will be taken by the Contractor to ensure that no additional violations of the conditions of this Section will occur. Acceptance or denial of the presentation will be at the discretion of Metra's Deputy Executive Director - Operations.
    - d. When Metra's Deputy Executive Director - Operations has been satisfied that the proper corrective measures will be taken by the Contractor, the Contractor will be issued written instructions regarding what steps it must take, prior to receiving a written Resume Work Order. All activity by the Contractor and its subcontractors on the premises of Metra during this time will be limited to corrective measures that will bring the Project back into compliance with the Safety and Loss Prevention conditions.
    - e. When all corrective work has been completed, the Contractor will be issued a written Resume Work Order by Metra.
  5. Any additional serious violations will be handled in the same manner as detailed in Paragraph 4 above.
- B. Any time lost by the Contractor resulting from the enforcement by Metra of "Penalties for Non-Compliance" will count as Contract days. Any requests by the Contractor for a Contract Extension will be denied.

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**PART 2 - PRODUCTS**

2.01 NOT USED

**PART 3 - EXECUTION**

3.01 NOT USED

**END OF SECTION**

**SECTION 01 40 00**  
**TESTING AND INSPECTION**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section includes administrative and procedural requirements for testing and inspection of materials to be incorporated into the Work.

1.02 RELATED SECTIONS

- A. Section 013300, Submittal Procedures

1.03 REFERENCES

- A. This Section incorporates by reference the latest revisions of the following documents:
- B. ASTM International (ASTM)
  - 1. ASTM E329, Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection

1.04 TESTING AND INSPECTION AGENCIES

- A. Contractor's Obligations:
  - 1. Contractor is responsible for testing and inspection as required in the Contract Drawings and Specifications.
  - 2. Contractor shall bear cost of testing materials that fail to conform to Specification requirements. Employment of a Testing and Inspection Agency by Metra shall in no way relieve Contractor's obligations to perform the specified Work of the Contract.
  - 3. Testing Agencies: As submitted to and approved acceptable for use by Metra's Authorized Representative.

1.05 CONTRACTOR'S TESTING AND INSPECTION AGENCY:

- A. The Contractor shall provide and pay for structural steel and weld tests and inspections to show that requirements of the Specifications have been fulfilled and for all tests required by law, ordinances, rules and regulations governing the Work, unless otherwise stated under the applicable section.
- B. Should any material or work be found after testing to be defective or inferior, such material and/or work shall be removed and replaced with new, sound materials and/or work. Removal and replacement shall be at the Contractor's own expense.

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- C. Contractor shall submit certified copies of each test result and/or report within 14 days, in accordance with Section 013300 Submittal Procedures, to Metra's Authorized Representative.
- D. Facilities Inspection Report: Submit to Metra's Authorized Representative a copy of the Inspection Report of the Testing and Inspection Agency employed by Contractor during its tour of inspection, with memorandum of remedies of any deficiencies reported by the inspection.
- E. Tests shall be required on all equipment to show compliance with the Contract Documents, whether or not they are specifically indicated.

**1.06 QUALIFICATIONS OF CONTRACTOR'S TESTING AND INSPECTION AGENCIES**

- A. Agencies shall meet "Recommended Requirements for Independent Laboratory Qualification" published by the American Council of Independent Laboratories.
- B. Agencies shall meet the basic requirements of ASTM E329.
- C. Agencies shall be authorized to operate in the State where the material is being manufactured or fabricated.
- D. Testing Equipment: Shall be calibrated at reasonable intervals by devices of accuracy traceable to either:
  - 1. National Institute of Standards and Technology
  - 2. Accepted values of natural physical constants.

**1.07 DUTIES OF CONTRACTOR'S TESTING AND INSPECTION AGENCIES:**

- A. The duties of the Contractor's Testing and Inspection Agency include the following:
  - 1. Cooperate and comply with the requirements of Metra's Authorized Representative and Contractor.
  - 2. Perform specified inspections, sampling, and testing of materials and methods of construction as directed by Metra's Authorized Representative to ascertain compliance of materials and workmanship with requirements of Contract Documents.
  - 3. Promptly notify in writing to Metra's Authorized Representative and Contractor observed irregularities or deficiencies of the work or products.
  - 4. Promptly submit certified copies of written report of test and inspection results to Metra's Authorized Representative in accordance with Section 013300, Submittal Procedures. Each report shall include, among other items:
    - a. Date issued
    - b. Project name and number
    - c. Testing and Inspection Agency name, address and telephone number

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- d. Name and signature of inspector
  - e. Date and time of sampling or inspection
  - f. Record of temperature and weather conditions
  - g. Date of test
  - h. Identification of products and Specifications Section
  - i. Location of sample or test in the Project
  - j. Type of inspection or test
  - k. Results of tests and compliance with Contract Documents
  - l. Interpretation of test results
5. Perform additional tests as required and directed by Metra's Authorized Representative.
- B. Inspection, sampling, and testing is required for, but is not restricted to, the following:
- 1. Cast-In-Place Concrete.
  - 2. Structural Steel.
- 1.08 CONTRACTOR'S RESPONSIBILITIES:
- A. Cooperation: Contractor shall cooperate with the Testing and Inspection Agency with regard to its determination of the Contractor's compliance with the Contract requirements and shall provide access to the work.
  - B. Secure and deliver to the laboratory adequate quantities of representational samples of materials proposed to be used that require testing.
  - C. Submit to the Testing and Inspection Agency the design mix proposed to be used for concrete and other Specification requirements that require testing and control by the Contractor.
  - D. Furnish copies of Products Test Reports as required.
  - E. Furnish incidental labor and facilities:
    - 1. To provide access to work to be tested.
    - 2. To obtain, mark and handle samples at the project site or at the source of the product to be tested.
    - 3. To facilitate inspections and tests.
    - 4. For the storage and curing of test samples.
    - 5. Notify the Testing and Inspection Agencies sufficiently in advance of operations to allow for assignment of their personnel and scheduling of tests.
  - F. Employ and pay for the services of a separate, equally qualified, independent testing and inspection laboratory to perform additional inspections, sampling and testing required when initial tests indicate work does not comply with Contract Documents.

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- G. Contractor shall pay for all costs related to products and/or material testing, in accordance with established requirements and as specified.
- H. Contractor shall submit names of the Testing and Inspection Agencies, which it intends to use. Metra's Authorized Representative will approve the agency(s). Approval of the Contractor testing and inspection agency(s) by Metra's Authorized Representative must be accomplished prior to Contractor's first payment submittal and approval.

**1.09 METRA'S AUTHORIZED REPRESENTATIVE'S RESPONSIBILITIES:**

- A. Metra, through its Authorized Representative, will perform all on-site testing of soils and concrete.
- B. The Authorized Representative will perform periodic shop inspections of steel fabrication.
- C. The Authorized Representative will witness and interpret the Contractor's Fabricator testing of welds in the Fabricator's shop.
- D. The Authorized Representative will perform periodic shop inspections of structural steel framing facilities.

**PART 2 - PRODUCTS**

2.01 NOT USED

**PART 3 - EXECUTION**

3.01 NOT USED

**END OF SECTION**

## SECTION 01 41 17

### VOLATILE ORGANIC COMPOUND (VOC) CONTENT RESTRICTIONS

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. This Section includes VOC restrictions for the product categories listed in the Definitions section, below.
- B. All products of each category that are installed as a part of this Project must comply. Metra's project goals do not allow for partial compliance.

##### 1.02 RELATED REQUIREMENTS

- A. Section 013300, Submittal Procedures

##### 1.03 DEFINITIONS

- A. Volatile organic compound (VOC): Any compound of carbon, excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate, which participates in atmospheric photochemical reactions.
- B. VOC-Restricted Products: All products of each of the following categories when installed or applied on-site in the building's interior:
  - 1. Adhesives, sealants, and sealer coatings.
  - 2. Paints and coatings.
  - 3. Composite wood and agrifiber products used either alone or as a part of another product.
  - 4. Other products when specifically stated in the Specifications.
- C. Interior of a Building: Anywhere inside of the exterior weather barrier.
- D. Adhesives: All gunnable, trowelable, liquid-applied, and aerosol adhesives, whether specified or not, including flooring adhesives, resilient base adhesives, and pipe jointing adhesives.
- E. Sealants: All gunnable, trowelable, and liquid-applied joint sealants and sealant primers, whether specified or not, including firestopping sealants and duct joint sealers.

##### 1.04 REFERENCES

- A. This Section incorporates by reference the latest revisions of the following documents:

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- B. Code of Federal Regulations (CFR)
  - 1. 40 CFR 59, Subpart D, National Volatile Organic Compound Emission Standards for Architectural Coatings
  - 2. 40 CFR 60, Appendix A-7, Test Methods 19 through 25E, EPA Method 24, Determination of volatile matter content, water content, density, volume solids, and weight solids of surface coatings
- C. Green Seal, Inc. (GS)
  - 1. GS-36, Adhesives for Commercial Use

**1.05 SUBMITTALS**

- A. Procedures: Section 013300, Submittal Procedures.
- B. Evidence of Compliance: Submit this for each different product in each applicable category.
- C. Product Data: For each VOC-restricted product used in this Project, submit product data showing compliance, except when another type of evidence of compliance is required.
- D. Installer Certifications for Accessory Materials: Require each installer of any type of product (not just the products for which VOC restrictions are specified) to certify that either:
  - 1. No adhesives, joint sealants, paints, coatings, composite wood, or agrifiber products have been used in the installation of its products; or
  - 2. That such products used comply with these requirements.

**1.06 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: Shall be an independent firm specializing in performing testing and inspections on the product types specified in this Section.

**PART 2 - PRODUCTS****2.01 MATERIALS**

- A. VOC-Restricted Products:
  - 1. Provide products having VOC content of types and volumes such that they comply with requirements for GREENGUARD or SCS certification.
    - a. GREENGUARD Certified Products at the GREENGUARD Environmental Institute; current listings at [www.greenguard.org](http://www.greenguard.org).
    - b. SCS Global Services - Certified Products; current listings at [www.scscertified.com](http://www.scscertified.com).

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2. Evidence of Compliance: Acceptable types of evidence are:
    - a. Current GREENGUARD certification.
    - b. Current SCS certification.
    - c. Current certification by other proposed certifiers as approved by Metra's Authorized Representative.
    - d. Report of laboratory testing performed in accordance with the specified certifying companies. The report must include a statement from the laboratory that the product meets the specified criteria.
  3. Product data submittals showing VOC content are NOT acceptable forms of evidence.
- B. Adhesives and Joint Sealants:
1. Provide only products having VOC content not greater than what is permitted by GS-36.
  2. Evidence of Compliance: Any reports of laboratory testing performed in accordance with the requirements of Green Seal are considered acceptable types of evidence.
- C. Aerosol Adhesives:
1. Provide only products having volatile organic compound (VOC) content not greater than those permitted by GS-36.
  2. Evidence of Compliance: Current Green Seal Certifications are acceptable evidence.
- D. Paints and Coatings:
1. Provide coatings that comply with the most stringent requirements specified in the following:
    - a. 40 CFR 59, Subpart D.
    - b. Architectural coating VOC limits of the State of Illinois.
  2. Determination of VOC Content: Testing and calculations in accordance with 40 CFR 59, Subpart D and 40 CFR 60, Appendix A-7, EPA Method 24, exclusive of colorants added to a tint base and water added at the project site; or other methods acceptable to the authorities having jurisdiction.
  3. Evidence of Compliance: Any reports of laboratory testing called out above are considered acceptable types of evidence.
- E. Composite Wood and Agrifiber Products and Adhesives Used for Laminating them:
1. Provide products having no added urea-formaldehyde resins.

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2. Evidence of Compliance: Published product data showing compliance with these requirements are considered acceptable types of evidence.

**PART 3 - EXECUTION****3.01 FIELD QUALITY CONTROL**

- A. Metra reserves the right to reject non-compliant products, whether installed or not, and require their removal and replacement with compliant products at no additional cost to Metra
- B. All additional costs to restore indoor air quality due to the installation of non-compliant products shall be borne by the Contractor.

**END OF SECTION**

## SECTION 01 41 18

### AMERICANS WITH DISABILITIES (ADA) COMPLIANCE

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. This Section includes requirements for meeting the Americans with Disabilities Act (ADA) and current standards for Sidewalks, Curb Ramps, Crosswalks, Driveways, Alley Returns, and other items governed by these standards.
- B. The work under this Section includes furnishing all labor, materials, and equipment necessary to construct stations and facilities that meet ADA standards. All new construction and alterations must follow the ADA Standards for Accessible Design and the latest edition of the Illinois Accessibility Code, as applicable.
- C. Except as modified herein, the work must be in accordance with the standards and details specified. Also, within the City of Chicago, CDOT's Regulations for Openings, Construction, and Repair in the Public Way shall be adhered to. This is a comprehensive manual for contractors, trades, utilities, agencies, and other professionals to plan and execute construction and restoration in Chicago's public way.

##### 1.02 RELATED WORK:

- A. Division 2, Sitework

##### 1.03 REFERENCES

- A. This Section incorporates by reference the latest revisions of the following documents:
- B. Illinois Department of Transportation (IDOT)
  - 1. IDOT Standard Specifications for Road and Bridge Construction
  - 2. IDOT Supplemental Specifications and Recurring Special Provisions

##### 1.04 SUBMITTALS:

- A. Submit detailed sidewalk and curb ramp design plans and calculations, sealed by a licensed professional engineer in the State of Illinois, to Metra's Authorized Representative for approval. The plans shall meet the standards called out in the Specifications.
- B. If the project involves a tactile detectable warning surface system, the Contractor must submit the following for approval by Metra's Authorized Representative:
  - 1. Samples: Two, minimum 12 inches square, of the tile type proposed for the work.

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2. Product Data: Submit the manufacturer's specifications describing products, installation procedures, and routine maintenance procedures.
3. Maintenance Instructions: Submit copies of the manufacturer's specified maintenance practices for each type of tactile detectable warning system and accessories, as required.

**PART 2 - PRODUCTS****2.01 MATERIALS**

- A. Tactile detectable warning systems shall be in accordance with IDOT's latest Standards and Specifications, and in accordance with the Americans with Disabilities Act. The Tactile Warning System must be produced by an approved manufacturer and installed by an experienced installer, who is certified in writing by the manufacturer as qualified for performing the installation and who has successfully completed other similar installations to the Project.
- B. The adjustment of frames and grates shall be in accordance with Sections 602 and 603 of IDOT Standard Specifications.
- C. Metra's bituminous concrete platform shall be constructed in accordance with Division 2, Sitework.
- D. Any asphalt concrete paving shall be done in accordance with Division 2, Sitework.
- E. Any 6" thick tactile for Metra at-grade boarding platform systems shall be constructed in accordance with Division 2, Sitework.
- F. Any Portland cement concrete sidewalks shall be construction in accordance with Division 2, Sitework.

**PART 3 - EXECUTION****3.01 CONSTRUCTION REQUIREMENTS**

- A. All proposed items shall be constructed in accordance with the sections in Division 2, Sitework.
- B. As required by ADA, sidewalks may need to be thickened at curb ramp locations in order to meet their requirements.
- C. Tactile detectable warning system installations shall be performed in accordance with the manufacturer's recommendations.
- D. Proposed items shall be constructed to the grades, elevations, and limits shown on the approved ADA plans and calculations.
- E. Any earth excavation or embankment required to meet the proposed grades shall be included in this work.

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- F. Any adjustments to the frames and grates of existing structures must be performed as outlined in Section 2.01, Materials, above.

**PART 4 - MEASUREMENT AND PAYMENT****4.01 MEASUREMENT**

- A. No separate measurement will be made for this Section.
- B. This Section shall include all of the items required to meet current ADA Standards, including but not limited to, developing approved ADA plans and calculations, sidewalk placement, curb and gutter placement, bituminous pavement placement, utility adjustments, and tactile detectible warning system installations.

**4.02 PAYMENT**

- A. The work covered under this Section will be paid for at the Contract Lump Sum Price as shown in the Schedule of Values for Americans with Disabilities (ADA) Compliance.
- B. This work will be paid based on the percentage of work completed, as approved by Metra's Authorized Representative.

**END OF SECTION**

## SECTION 01 42 00

### REFERENCE STANDARDS AND DEFINITIONS

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. Various standards are referenced throughout the Contract Documents. This Section includes the following:
  - 1. Applicability of Reference Standards.
  - 2. Provision of Reference Standards at the Site.
  - 3. Acronyms used in the Contract Documents for Reference Standards.
  - 4. Source of Reference Standards.
- B. Certain terms used in the Contract Documents are defined in this Section.

##### 1.02 DEFINITIONS

- A. Wherever in the Contract Documents the following terms, or pronouns in place of them, or their abbreviations are used, the intent and meaning shall be interpreted as follows:
  - 1. Addenda: Addenda are written or graphic instruments issued by Metra that modify or interpret the Bidding Documents by additions, deletions, clarifications, or corrections.
  - 2. Alternate: An Alternate Bid (or Alternate) is an amount stated in the Bid to be added to or deducted from the amount of the Base Bid, if the corresponding change in the work as described in the Bidding Documents, is accepted.
  - 3. Approved: This term, when used in conjunction with Metra's Authorized Representative's action on the Contractor's submittals, applications, and requests, is limited to Metra's Authorized Representative's duties and responsibilities as stated in the Conditions of the Contract.
  - 4. Authority: This term shall mean the Northeast Illinois Regional Commuter Railroad Corporation (Metra).
  - 5. Base Bid: The Base Bid is the sum stated in the Bid for which the Bidder offers to perform the work described in the Bidding Documents as the base, to which work may be added to or from which work may be omitted, for sums stated in Alternate Additives and Deductions.
  - 6. Bid: A Bid is a complete and properly signed proposal to do the work, or designated portion thereof, for the sums stipulated therein, submitted in

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accordance with the requirements of the Bidding Documents. The term Bid is used interchangeably with proposal.

7. Bidder: A Bidder is a person or entity who submits a Bid.
8. Bidding Documents: Bidding Documents include the Invitation to Bid, Instructions to Bidders, the Bid Form, other sample bidding and contract forms, and the proposed Contract Documents including Addenda issued prior to the date for receipt of bids.
9. Calendar Day: Shall mean every day shown on the calendar.
10. Consultant: Shall mean the firm of an Architectural/Engineering Company or their duly authorized representative.
11. Contract Documents: The Contract Documents proposed for the work consist of the Proposal/Contract, the Conditions of the Contract (General, Supplementary, and other Conditions), the Drawings, the Specifications, all Addenda issued prior to the date for receipt of bids, and all Modifications issued after execution of the Contract.
12. Contract Sum: The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable by Metra to the Contractor for performance of the Work under the Contract Documents.
13. Contractor: Shall mean the individual, firm, partnership, or corporation directly contracting with Metra for performance of the prescribed Work.
14. Drawings: The approved plans, profiles, typical cross sections, elevations, and details, or addenda thereto, which show the location, character, dimensions, and details of the work to be performed. The term Drawings is used interchangeably with Plans.
15. Engineer/Architect: Shall mean Metra's Authorized Representative as defined below.
16. Equal: Where the words "equal", "or equal", "approved", "satisfactory", and other words of like importance are used, determination and approval by Metra's Authorized Representative is intended, unless otherwise specified, and is so understood.
17. Directed: Terms such as "directed", "requested", "authorized", "selected", "approved", "required", and "permitted" mean "directed by Metra's Authorized Representative", "requested by Metra's Authorized Representative", and similar phrases.
18. Furnish: This term means to supply and deliver to project site, ready for installation.
19. General Requirements: The provisions or requirements of Division 01 Sections. General Requirements apply to the entire work of the Contract

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and, where so indicated, to other elements that are included in the Project.

20. IDOT: Illinois Department of Transportation
21. Include: Shall mean that the items specified thereafter may or may not be all of the constituents, components, or subordinate parts of the whole.
22. Indicated: This term is a cross-reference to graphics, notes, or schedules on the Drawings, to other paragraphs or schedules in the Specifications, and to similar means of recording requirements in the Contract Documents. Where terms such as shown, noted, scheduled, and specified are used in lieu of "indicated", it is for the purpose of helping the reader locate cross-references.
23. Install: Shall mean to receive, inspect, handle, unload, unpack, assemble, erect, place, anchor, apply, finish, protect, clean, and similar operations complete and ready for use, including connections, adjustments, and testing.
24. Installer: The entity (person or firm) engaged by the Contractor or its subcontractor or sub-subcontractor for the performance of a particular unit of work at the project site, including installation, erection, application, and similar required operations. It is a general requirement that such entities (Installers) be an expert in the operations that they are engaged to perform.
  - a. Experienced: This term, when used with the term Installer, means having a minimum of five previous traction power projects similar in size and scope to this Project, being familiar with the special requirements indicated, and having complied with requirements of the authority having jurisdiction.
  - b. Trades: Using terms such as carpentry does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as carpenter. It also does not imply that requirements specified apply exclusively to tradespersons of the corresponding generic name.
  - c. Assigning Specialists:
    - 1) Certain sections of the Specifications require that specific construction activities shall be performed by specialists who are recognized experts in those operations.
    - 2) The specialists must be engaged for those activities, and their assignments are requirements over which the Contractor has no option. However, the ultimate responsibility for fulfilling Contract requirements remains with the Contractor.
    - 3) This requirement shall not be interpreted to conflict with enforcing building codes and similar regulations governing the Work. It is also not intended to interfere with local trade union jurisdictional settlements and similar conventions.

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25. Joint-Venture: Shall mean a licensed business consisting of two or more persons, firms, or corporations, all of which shall have a valid license to perform the type of work proposed by the Joint Venture.
26. Metra: This term is the registered service mark for the Northeast Illinois Regional Commuter Railroad Corporation.
27. Metra's Authorized Representative: Any employee, agent, consultant, or representative of Metra duly authorized by Metra, to represent Metra in an engineering capacity and/or to make decisions for Metra with respect to the Work in an engineering capacity, or any party acting directly or through such employee, agent, consultant, or representative. The Contractor will be advised by Metra, in writing, of the identity and authority of Metra's Authorized Representative.
28. Owner: Shall mean "Metra" as defined in the Requirements for Bidding and instructions to Bidders.
29. Product Data: Illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.
30. Project: The total construction of which the Work performed under the Contract Documents may be the whole or a part of. The Project may include construction by Metra or separate contractors.
31. Project Site: The space available for performance of the Work. The extent of the project site is contained within the area bounded by temporary chain link fence, and may not be identical with the description of land upon which the project is to be built.
32. Provide or Provision: Shall mean to furnish and install, complete and ready for the intended use.
33. Regulations: This term includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.
34. Samples: Are physical examples that illustrate materials, equipment, or workmanship and establish standards by which the Work will be judged.
35. Shop Drawings: Are drawings, diagrams, schedules, and other data specially prepared for the Work by the Contractor or one of its subcontractors, sub-subcontractors, manufacturers, suppliers, or distributors to illustrate some portion of the Work. These are also sometimes referred to as Installation Drawings.
36. Specifications: The Specifications are the portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards, and workmanship for the Work and the performance of related services.

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37. Standard Specifications: IDOT's "Standard Specifications for Road and Bridge Construction," adopted April 1, 2016, and their "Supplemental Specifications and Recurring Special Provisions," adopted January 1, 2015.
38. Sub-Bidder: A Sub-Bidder is a person or entity which submits a bid to a Bidder for materials or labor, which is a portion of the work.
39. Subcontractor: Shall mean a person, firm, or corporation which has a contract with the Contractor to provide labor, materials, equipment, and services for work included in the Contract.
40. Testing Laboratory: An independent entity engaged to perform specific inspections or tests of the Work, either at the Project Site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.
41. UPRR: Union Pacific Railroad
42. Union Pacific Railroad Specifications: Shall be construed to mean the "Union Pacific Engineering Project Specifications," as found online at <http://www.up.com/customers/ind-dev/operations/specs/>.
43. Unit Price: An amount stated in the Bid as a price per unit of measurement for materials or services, as described in the Bidding Documents and/or in the proposed Contract Documents.
44. Working Day: Shall mean any calendar day except Saturdays, Sundays, or observed holidays in the State of Illinois.
45. Work: Shall mean all materials, labor, and services required to execute the requirements of the Contract Documents.

## 1.03 SUBMITTALS

- A. Permits, Licenses, and Certificates: For Metra's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, and similar documents, as well as correspondence and records established in conjunction with standards and regulations compliance.

## 1.04 SPECIFICATION FORMAT AND CONTENT EXPLANATION

- A. Specification Format: These Specifications are organized into Divisions and Sections based on the Construction Specifications Institute (CSI) 16-Division format and MasterFormat® numbering system. However, Division 1, General Requirements, is based on the CSI expanded 50-Division format and the MasterFormat® six-digit numbering system.

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- B. Specification Content: The Specifications use certain conventions regarding the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations or circumstances. These conventions are explained as follows:
1. Abbreviated Language: Language used in Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be interpolated as the sense requires. Singular words will be interpreted as plural and plural words interpreted as singular where applicable as the context of the Contract Documents indicates.
  2. Imperative and streamlined language is used generally in the Specifications. Requirements expressed in the imperative mood are to be performed by the Contractor. At certain locations in the text, subjective language is used for clarity to describe responsibilities that must be fulfilled indirectly by the Contractor, or by others when so noted.
  3. The words "shall be" are implied wherever a colon (:) is used within a sentence or phase.

**1.05 INDUSTRY STANDARDS**

- A. Applicability of Standards: Except where the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with the standards in effect as of the date of the Contract Documents.
- C. Conflicting Requirements: Where compliance with two or more standards is specified and where the standards may establish different or conflicting requirements for minimum quantities or quality levels, refer requirements that are different but apparently equal and uncertainties to Metra's Authorized Representative for a decision before proceeding.
- D. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of the requirements. Refer uncertainties to Metra's Authorized Representative for a decision before proceeding.
- E. Copies of Standards: Each entity engaged in construction on the Project is required to be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
- F. Where copies of standards are needed to perform a required construction activity, the Contractor shall obtain copies directly from the publication source.

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- G. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. Where such acronyms or abbreviations are used in the Specifications or other Contract Documents, they mean the recognized name of the trade association, standards-generating organization, authority having jurisdiction, or other entity applicable to the context of the text provision. Refer to the "Encyclopedia of Associations," published by Gale Research Co., available in most libraries for any uncertainties.

**1.06 GOVERNING REGULATIONS/AUTHORITIES**

- A. The procedure followed by Metra's Third Party Consultant has been to contact governing authorities where necessary to obtain information needed for the purpose of preparing the Contract Documents, recognizing that such information may or may not be of significance in relation to the Contractor's responsibilities for performing the work. The Contractor shall contact governing authorities directly for any necessary information and decisions having a bearing on the performance of the work.

**PART 2 - PRODUCTS**

2.01 NOT USED

**PART 3 - EXECUTION**

3.01 NOT USED

**END OF SECTION**

## SECTION 01 50 00

### TEMPORARY FACILITIES AND CONTROLS

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. This Section includes requirements for temporary facilities and controls.
- B. The work under this Section shall include furnishing all labor, materials, equipment, and tools required to install, maintain, and remove temporary facilities, as well as to maintain, protect, or restore existing and new facilities affected by the Contractor's means and methods for performing the Work.

##### 1.02 REFERENCES

- A. Illinois Department of Transportation (IDOT)
  - 1. IDOT Standard Specifications

##### 1.03 TEMPORARY ACCESS ROADS AND PARKING

- A. Provide temporary access roads and parking areas within the site as required, for the convenience of the Contractor and Metra, and necessity during progress of the Work, subject to the approval of Metra's Authorized Representative.
- B. If required, provide staging areas as warranted by means and methods for completing the Work. Protection and restoration of Metra, agency, corporate, private, and utility property shall be in accordance with the applicable sections of Articles 107.19 and 107.26 of IDOT Standard Specifications. Obtaining, maintaining, and restoring staging and work areas shall be included in the Contract Lump Sum Price and shall be at no additional cost to Metra.

##### 1.04 TRUCKING

- A. The Contractor's vehicles leaving the site at any time shall be hosed and washed clean of mud and dirt clinging to the wheels and exterior body surfaces.
- B. Load all trucks leaving the site in a manner that will prevent dropping materials on streets and, when necessary, provide suitable tarpaulins fastened over the load before trucks enter surrounding paved streets. Trucks bringing materials over paved streets to the site shall be similarly loaded and covered.
- C. Cleaning trucks is prohibited in areas where removed debris will foul track ballast or plug drainage structures.

##### 1.05 STREET CLEANING

- A. Maintain adjacent streets continually free of dirt and debris resulting from Work operations, and provide street cleaning as necessary or as directed by Metra's Authorized Representative. Payment will not be made for costs related to this

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operation. If street cleaning is not performed, Metra may do such cleaning and charge the cost to the Contractor.

**1.06 RUBBISH REMOVAL**

- A. Remove all rubbish as it occurs, but not less than weekly, and legally dispose of such rubbish off of the site. Obtain, in advance, releases from property owners where rubbish is to be disposed. Furnish copies of these releases to Metra. No removal shall occur until releases are received.
- B. Remove all surplus or rejected material, refuse, tools, and debris that may accumulate on the premises during the construction period from time to time, as may be directed by Metra's Authorized Representative. On completion of the Work, all debris shall be removed and the premises thoroughly broom cleaned.
- C. Remove all rubbish occasioned by the Work. If rubbish is not properly removed and the premises not cleaned, Metra may do such cleaning and charge the cost to the Contractor.
- D. Obtain approval for the locations of dumpsters in writing. Dumpsters are to be dropped off each morning and picked-up each night.

**1.07 TEMPORARY TOOL AND STORAGE AREA**

- A. Provide temporary tool and storage facilities as required for the Work. Locate and limit such facilities and storage of materials as approved by Metra's Authorized Representative.
- B. No materials, supplies, or equipment shall be stored within 15 feet of the centerline of any track, measured at right angles to the track.
- C. Coordinate, supervise, and control material storage and field office space for the various trades, subcontractors, and suppliers.
- D. Storage areas shall be neatly maintained and always kept clean and orderly by the Contractor. Equipment not being used on the work shall not be allowed to remain on the property.
- E. Store and handle materials and equipment so as to prevent the inclusion of foreign substances and to prevent damage from weather. Remove damaged or rejected materials from the premises and furnish new materials of proper quality and type before proceeding with the Work, at no additional cost to Metra.
- F. Metra is not responsible for damaged materials or equipment stored at the site, whether caused by acts of God, vandalism, or due to other causes.

**1.08 TEMPORARY PROTECTION**

- A. Provide temporary measures necessary to carry on the Work on schedule during inclement weather.
- B. Protect materials stored at the site from weather and theft. Contractor is responsible for losses of its materials.

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- C. Protect work in place, including that of other contractors, against damage from operations. Contractor is responsible for repair or replacement of work damaged by its operations.
- D. Employ watchmen or watch services as necessary to safeguard work covered by this Contract.

**1.09 TEMPORARY WATER**

- A. Provide temporary potable water supply lines temporary facilities as required. Obtain necessary permit(s) and pay for permits and water use costs during the entire construction period up to the final project acceptance date.

**1.10 TEMPORARY TOILETS**

- A. Provide portable chemical toilet facilities for workers employed on the project as soon as operations commence.
- B. Toilet facilities shall be serviced twice weekly, which shall include draining the tank, refilling and disinfecting the interior of each toilet unit, and keeping each unit stocked with toilet paper.
- C. Toilet facilities shall be maintained during the term of the construction period and removed upon completion of the work. The Contractor shall pay all costs for temporary toilets for its workers.

**1.11 TEMPORARY POWER AND LIGHT**

- A. Provide temporary power for the Work and for all temporary facilities. Obtain necessary permits from the municipality and pay for all permit costs.
- B. Provide electrical equipment, NEMA enclosure type, material, labor, and testing in accordance with applicable codes.
- C. Provide minimum temporary power for the collective use of all employees and subcontractors. Provide whatever accessories are necessary to adapt electric power for Work operations. Provide the following:
  - 1. Adequate power center and service for miscellaneous tools and equipment.
  - 2. Adequate number of weatherproof distribution boxes with breaker protected circuits and grounded outlets, in locations as directed by Metra's Authorized Representative.
  - 3. Equipment grounding continuity for the entire system.
  - 4. Grounded UL approved extension cords from the power center.
  - 5. Power for temporary lighting, heating, and ventilating.
  - 6. Power for welding and other special equipment.

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7. Power for testing and checking equipment of the same capacity as the permanent system.
- D. Provide minimum temporary lighting for general work and safety of 5 foot candles; finish and detail work shall provide 20 foot candles.
- E. Pay the electric utility company for all temporary service charges and energy costs for the temporary power, light, and heat provided during the entire construction period and up to the final project acceptance date.

**1.12 EXISTING STREETS, SIDEWALKS, CURBS AND LANDSCAPED AREAS**

- A. Where the Contractor excavates existing streets, sidewalks, curbs, and other areas outside of the site limits, or removes or damages streets, sidewalks, or curbs it shall, as a part of this Contract, replace all such cement, concrete, asphalt, brick, stone, grass, or cinders of the same thickness and manner as the original pavement sidewalk, curb, or landscaped areas, and in a manner approved and accepted by Metra's Authorized Representative.
- B. Where the Contractor hauls material over existing streets, sidewalks, curbs, or landscaped areas, and where it is necessary to drive trucks or equipment over such areas, it shall protect these areas from damage. Where such streets, sidewalks, curbs, or landscaped areas have been damaged, the Contractor shall remove and replace damaged areas with new cement, concrete, asphalt, brick, stone, or materials of the same thickness and manner as the original, unless otherwise directed by Metra's Authorized Representative.
- C. Install temporary bridging over trenches or near excavation, capable of sustaining the weight of buses and trucks and their cargoes that are normally dispatched in that particular area.
- D. When necessary, in the opinion of Metra's Authorized Representative, make arrangements for the diversion of traffic, provide all materials and signs, and perform all work necessary for the construction and maintenance of roadways while diverting traffic.
- E. Furnish necessary barricades, signs, lights, danger signals, and watchmen, and take other precautionary measures as necessary for the protection of persons or property at or near the construction site, in accordance with the requirements of the municipality, at no additional expense to Metra.

**1.13 WAYS, ETC.**

- A. Provide and maintain temporary covered walkways, ladders, ramps, scaffolds, runways, derricks, crane(s), and hoists required for the proper execution of the Work and protection of the workers and public.
- B. It shall be the Contractor's responsibility that such apparatus, equipment, and construction meet the requirements of the laws of the State of Illinois, and the municipality, concerning the protection of its employees and labor with adequate scaffolding and other safety precautions and safeguards, and any and all rules, regulations, and directions of Metra and other authorities having jurisdiction.

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**1.14 EXISTING UTILITIES**

- A. It shall be understood by the Contractor that it may make no use whatsoever of the existing utilities on the property for its own use or use in connection with the Work, including electric power, lighting, gas, water, sewer, and toilet facilities, without prior authorization from Metra's authorized Representative.

**1.15 SIGNS**

- A. There shall be no advertising signs on the premises, unless specifically approved by Metra's Authorized Representative.

**1.16 WELDING**

- A. No welding, flame cutting, or other operations involving the use of flames, arcs, or sparking devices is permitted without adequate protection and the permission of Metra's Authorized Representative.
- B. Combustible or flammable material shall be removed from the immediate working area. If removal is impossible, such materials shall be protected with a suitable non-combustible shield.
- C. Provide the necessary personnel and equipment to control fires resulting from welding, flame cutting, or other sources involving the use of flame, electrical arc, or sparking devices. Provide, at all times, acceptable fire extinguishers or other protection within 10 feet of the operation.

**PART 2 - PRODUCTS**

2.01 NOT USED

**PART 3 - EXECUTION**

3.01 NOT USED

**END OF SECTION**

**SECTION 01 52 00**  
**ENGINEER'S FIELD OFFICE, TYPE A**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section includes furnishing all labor, materials, tools, equipment and incidentals necessary to install, maintain and remove the Engineer's Field Office.
- B. The work also includes but is not limited to utility costs, cleaning, maintenance and all other appurtenant work as specified, and as directed by Metra's Authorized Representative.

1.02 REFERENCES

- A. IDOT Standard Specifications for Road and Bridge Construction.

1.03 METRA'S AUTHORIZED REPRESENTATIVE'S APPROVAL

- A. Metra's Authorized Representative shall approve the Engineer's Field Office, furnishings and equipment, before being accepted and moved to the site.
- B. The Engineer's Field Office may be provided in the form of a store front location in lieu of a combination of mobile spaces. The location and facility will be subject to the approval of Metra's Authorized Representative.

1.04 CLEANING SERVICE

- A. The Contractor shall provide or pay for weekly cleaning services to be performed throughout the duration of the Contract. The Contractor shall pay for all installation charges and all periodic fees for the temporary office and office furnishings.

**PART 2 - PRODUCTS**

2.01 GENERAL

- A. The items and equipment specified within this Section shall be rented or purchased by the contractor and must be made available to METRA for the duration of the project. All Cost associated with the Rental, Placement and Rental or Procurement cost as well as Removal shall be part of the overall contract price.
- B. Office size: Approximately 250 square feet of floor space. One area shall be of sufficient size to be used as a meeting room with a table and 15 chairs.
- C. Provide an electronic security system as follows:
  - 1. It shall have battery backup

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2. It shall have an on-site alarm
3. It shall include as a minimum what is described below:
  - a. Honeywell Vista 20p control panel
  - b. Honeywell 6160RF LCD keypad
  - c. 12 Vdc & 7ah battery such as Yuasa YA-NP712
  - d. Honeywell 5808LST smoke/heat detectors
  - e. Honeywell 5804-2 two-button control
  - f. Honeywell 943WH mini surface contacts
  - g. Excelsus Inc. IE-ZA431PJ3X alarm filter
  - h. Or approved equal.
- D. Provide security bars or steel heavy wire mesh screens covering the exterior of all windows and doors.
- E. Door locks: All exterior doors of the office shall be equipped with both cylinder and dead bolt locks, compatible with BEST seven-pin keys/cylinders.
- F. Provide a Portable-John type toilet outside of the trailer. Waste removal shall be scheduled once a week.
- G. Provide the following furniture:
  1. One desk with two file drawers and a pencil drawer.
  2. One 2-ft x 3-ft weatherproof notice board.
  3. One conference table that will accommodate 15 chairs.
  4. 15 padded steel folding chairs.
- H. Provide the following equipment:
  1. One fire extinguisher UL 2A: 10-BC. McMaster-Carr, Model No. 6430T16.
  2. One lockable, pilfer-resistant tool chest (Knaak box) 48-in L x 30-in D x 30-in H (25 cu ft) fabricated of 16-gauge steel and finished with tan enamel.
  3. One portable plan rack capable of storing a minimum of three 1-in sets of 36-in x 48-in drawings.
  4. One refrigerator with 20 cu ft capacity.
  5. One electric water cooler dispenser:
    - a. Water dispenser shall produce both hot and cold water,
    - b. Bottled water shall be supplied by Hinckley Schmidt or an approved equal.
  6. One first-aid cabinet:
    - a. It must be a 50-person kit of first-aid materials packed in a sturdy steel case.

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- b. The kit shall contain a wide variety of American Medical Association approved materials for virtually any first-aid need.
  - c. The materials shall include a first-aid manual and a contents sheet for checking.
- 7. One microwave oven, minimum 1000 watts.
- 8. One business machine, as follows:
  - a. Ricoh Aficio MP 4000 business machine with printing, faxing, scanning and e-mail capabilities.
  - b. The machine shall be capable of copying, collating, and stapling documents up to and including 11-in x 17-in at the approximate rate of 40 copies per minute with the first copy produced in approximately 10 seconds.
  - c. The copier shall accommodate letter, legal, or 11-in x17-in, white or colored, letterhead or preprinted.
  - d. The machine shall use standard 115 volts, 60 hertz electrical power.
  - e. Maintain at all times an adequate supply of white paper in all three sizes (letter, legal and 11-in x 17-in), toner and other consumables with the machine.
  - f. Provide a three-year repair, maintenance, and service agreement/contract for the copier including installation and set-up.
- I. Provide the following electronics:
  - 1. One standard PC or lap-top computer with printer for Metra's Authorized Representative's use, and an Internet account and Wi-Fi service with downstream speed of 30.0 Mbps and upstream speed of 6.0 Mbps.
  - 2. One digital camera with 20 megapixel minimum resolution, batteries charger, USB cable, minimum 16 GB memory card and digital camera case.
- J. Provide the following communication equipment:
  - 1. Total quantity of five communications lines.
    - a. Two lines shall be dedicated for telephone usage.
    - b. One line shall be for the security system.
    - c. One line shall be for the Ethernet computer modem.
    - d. One line shall be for the business machine.
  - 2. Telephones as follows:
    - a. Provide a wireless phone system with digital answering system, two separate lines and three handheld receivers.
    - b. Provide an additional phone with speaker capability, manufactured by Polycom, of the type that can be set on a conference table and equipped with Sound Station EX with extended microphones.

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- K. The Contractor shall be responsible for replacing any and all items stolen from the Engineer's Field Office, regardless of the circumstances. This is to include, but not to be limited to, specified items, testing equipment, and items such as calculators, cameras, coveralls, etc.
- L. The Engineer's Field Office, including all furnishings, shall be covered under the Contractor's Builder's Risk Insurance.

**2.02 FIELD OFFICE SITE**

- A. Grade the area for the trailer and parking spaces, and construct a 6-inch Aggregate Surface Course (Type A), meeting the applicable requirements of IDOT Standard Specifications for Road and Bridge Construction, Section 402, Aggregate Surface Course.
- B. After the Contract is complete, remove the Aggregate Surface Course and fencing and restore the area to its original condition or as approved by Metra's Authorized Representative.
- C. Provide temporary power 208/120 V to the site office.
- D. The trailer shall be grounded per NEC. Due to proximity of the ac distribution line and 1500 Vdc traction power, stray currents are very likely in the area.
- E. The enclosure shall be illuminated by approved security lights in each corner of the rectangle.
- F. The Field Office will be located close to the 95<sup>th</sup> Street TPS Site.

**PART 3 - EXECUTION****3.01 NOT USED****PART 4 - MEASUREMENT AND PAYMENT****4.01 MEASUREMENT**

- A. No separate measurement shall be made for the ENGINEER'S FIELD OFFICE.

**4.02 PAYMENT**

- A. Payment will be made at the Contract Lump Sum price as shown in the Schedule of Values for renting the ENGINEER'S FIELD OFFICE. Further, this price shall include all utility costs (alarm, water, telephone, and electric) and maintenance costs.

**END OF SECTION**

**SECTION 01 55 26**  
**TRAFFIC CONTROL**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. The work in this Section includes the furnishing, installation, maintenance, relocation, and subsequent removal of all signs, signals, markings, traffic cones, barricades, warning lights, flaggers, and other devices that are to be used for the purpose of regulating, warning, or guiding traffic during the Work.
- B. When traffic is to be directed over a detour route, the Contractor shall furnish, erect, maintain, and remove all applicable traffic control devices along the detour route according to the details shown in the plans.

1.02 REFERENCES

- A. This Section incorporates by reference the latest revisions of the following documents:
- B. Illinois Department of Transportation (IDOT)
  - 1. IDOT Standard Specifications for Road and Bridge Construction
  - 2. IDOT Supplemental Specifications and Recurring Special Provisions
  - 3. Illinois Supplement to the National Manual on Uniform Traffic Control Devices

1.03 GENERAL REQUIREMENTS

- A. Standards: Traffic Control will be in accordance with the applicable sections of the following:
  - 1. IDOT Standard Specifications
  - 2. Applicable guidelines contained in the Illinois Supplement to the National Manual on Uniform Traffic Control Devices,
  - 3. The Special Provisions
  - 4. Interim Special Provisions
  - 5. Special Details and Highway Standards specified or indicated in the Contract Drawings.
- B. At the pre-construction meeting the Contractor shall furnish the name of the individual in its direct employ who is responsible for the installation and maintenance of traffic control items for this project. IDOT will provide to the Contractor the name of its representative who is responsible for the administration of the Traffic Control Plan.

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- C. The Contractor shall notify the IDOT District One Bureau of Traffic 72 hours before commencing construction for changing traffic flow.
- D. The Contractor shall be responsible for the proper location, installation, and arrangement of all traffic control devices as shown on the Drawings, or as directed by Metra's Authorized Representative. Special attention must be given to advance guide signs during these operations, in order to keep barricade placement consistent with lane assignment. The Contractor shall cover all traffic control devices that may be inconsistent with traffic patterns during transfer from one construction stage to another.
- E. Contractor vehicles shall always move with and not against or across the flow of traffic. These vehicles shall enter or leave work areas in a manner that is not hazardous to and does not interfere with normal traffic, and shall not park or stop except within designated work areas. Personal vehicles are prohibited from parking within the right-of-way except in specific areas designated by the Metra's Authorized Representative.
- F. The Contractor shall immediately furnish a certified flagger or flaggers, if in the opinion of Metra's Authorized Representative, the Contractor's construction means or methods warrant it.
  - 1. No additional compensation will be made for flaggers.
  - 2. If no flaggers are available, the Contractor will cease operations until they become available.
- G. All signs, signals, markings, traffic cones, barricades, warning lights, flaggers, and other traffic control devices must conform to the Drawings, Specifications, special provisions, and the "Illinois Supplement to the National Manual on Uniform Traffic Control Devices."
  - 1. The Contractor shall obtain, erect, maintain, and remove all traffic control devices in accordance with IDOT Standard Specifications, Article 107.14, Maintenance of Traffic.
  - 2. Placement and maintenance of all traffic control devices shall be as directed by Metra's Authorized Representative., who will be the sole judge as to the acceptability of placement and maintenance of the traffic control devices prescribed in the appropriate standards.
- H. The Contractor shall ensure that all barricades, signs, lights, and other devices installed by its forces are operational every day, including Sundays and holidays. In the event of severe weather conditions, the Contractor must furnish any additional personnel required to properly maintain all traffic control devices as directed by Metra's Authorized Representative.
- I. At the completion of each stage of construction, or whenever operations indicate that a relocation of a proposed or existing traffic control device is advisable as determined by Metra's Authorized Representative, the Contractor shall remove all traffic control devices that were furnished, installed, and maintained by its forces under this Contract, and such devices will remain the property of the Contractor. All traffic control devices must remain in place until specific

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authorization for the relocation or removal of it is received from Metra's Authorized Representative.

- J. The Contractor must be aware of the requirements for the coordination of all work in this project and adjoining or overlapping projects, and for the coordination of barricade placement necessary to provide a uniform traffic detour pattern. The Contractor will not be permitted to erect, change, or remove its detour barricade system without prior approval from Metra's Authorized Representative.
- K. The placement of barricades and warning signs for the required lane closures shall be as specified, and shall proceed in the direction of the flow of traffic. The removal of all signs and barricades shall begin at the end of the construction areas and proceed toward oncoming traffic.
- L. Revisions to the staging of construction, requested by the Contractor, may require traffic control devices to be installed according to standards and/or designs other than those included in the Drawings.
  - 1. Revisions or modifications to the traffic control plans shown in the Contract shall be submitted by the Contractor for the approval of the Metra's Authorized Representative.
  - 2. Any requested revisions, as approved by Metra's Authorized Representative, shall not be at any additional cost to the Contract and is considered to be included in the contract lump sum price for Traffic Control and Protection.
- M. Delays to the Contractor caused by complying with these requirements are considered included in the cost of Traffic Control and Protection, and no additional compensation will be paid.
- N. Changeable message boards shall be provided by the Contractor at the locations shown on the Drawings. This item and work shall be completed according to IDOT Standard Specifications, Section 701, Work Zone Traffic Control and Protection.

**PART 2 - PRODUCTS**

2.01 NOT USED

**PART 3 - EXECUTION**

3.01 NOT USED

**END OF SECTION**

**SECTION 01 60 00**  
**PRODUCT REQUIREMENTS**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section includes general requirements for products.

**PART 2 - PRODUCTS**

2.01 PRODUCT REQUIREMENTS

- A. Provide new products unless used products are specifically required or permitted by the Contract Documents.
- B. Materials and Equipment incorporated into the Work:
1. No material or product shall be delivered to, provided for, or installed on this project that contains asbestos or asbestos-containing materials.
  2. Conform to project Specifications and standards.
- C. Manufactured and fabricated products:
1. Design, fabricate, and assemble in accordance with best engineering and shop practices.
  2. Manufacture like parts of duplicate units to standard sizes and gauges, in order to be interchangeable.
  3. Two or more items of the same kind shall be identical from the same manufacturer.
  4. All parts of systems shall be from the same manufacturer to the greatest extent possible.
  5. Adhere to equipment capacities, sizes, and dimensions shown or specified unless variations are specifically approved by a Change Order.

**PART 3 - EXECUTION**

3.01 NOT USED

**END OF SECTION**

**SECTION 01 71 13**  
**FIELD ENGINEERING**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section specifies the administrative and procedural requirements for field engineering services, including but not necessarily limited to the following:
  - 1. Land survey work,
  - 2. Civil engineering services,
  - 3. Structural engineering services
  - 4. Electrical engineering services.
- B. The work under this Section includes furnishing all labor, materials, and equipment for the following:
  - 1. Maintaining existing survey control points;
  - 2. Locating, establishing, and laying out lines, levels, and grades required for the proper installation of the work;
  - 3. Surveying and preparing as-built plans;
  - 4. Final survey; property line survey;
  - 5. Installing permanent survey markers;
  - 6. Other appurtenant services required for the proper installation of the work.

1.02 RELATED WORK

- A. Section 017839, Project Record Documents

1.03 QUALITY ASSURANCE

- A. Employ a Land Surveyor registered in the State of Illinois and acceptable to Metra's Authorized Representative. Ultimate responsibility for all layouts rests with the Contractor.
- B. Engage a Professional Engineer of the discipline required, registered in the State of Illinois, to perform any required engineering services.

1.04 SUBMITTALS

- A. Submit the name, address, and telephone number of the Surveyor and Engineers before starting any survey and engineering work.

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- B. Upon request, submit documentation verifying the accuracy of the survey work.
- C. Submit a certificate signed by the Land Surveyor that the elevations and locations of the Work are in conformance with the Contract Documents.

**1.05 CLOSEOUT SUBMITTALS**

- A. Project Record Documents
  - 1. Maintain a complete and accurate log of all control and survey work as it progresses.
  - 2. Submit Project Record Documents per the provisions of Section 017839, Project Record Documents.

**PART 2 - PRODUCTS****2.01 NOT USED****PART 3 - EXECUTION****3.01 EXAMINATION**

- A. Verify the locations of survey control points prior to starting any work.
- B. Promptly notify Metra's Authorized Representative of any discrepancies discovered.

**3.02 SURVEY REFERENCE POINTS:**

- A. Locate and protect survey control and reference points.
- B. The control datum for the survey shall be indicated on the Drawings.
- C. Take lateral and vertical readings at the tops of sheet piling, at the walers, and at ground level immediately after ground anchors have been installed, tested, and accepted as specified in Division 02 of the Specifications.
- D. Protect survey control points prior to starting any site work and preserve permanent reference points (Bench Marks) during construction.
- E. Promptly report to Metra's Authorized Representative the loss or destruction of any reference points, or relocation required because of changes in grades or other reasons.
- F. Replace dislocated survey control points and permanent reference points based on the original survey control. Do not make any changes without prior written notice to Metra's Authorized Representative.
- G. Install permanent survey markers as specified in Division 02 of the Specifications.

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**3.03 SURVEY REQUIREMENTS:**

- A. Provide field engineering services and use recognized engineering survey practices.
- B. Establish elevations, lines, and levels. Locate, and lay out by instrumentation and other similar appropriate means, the following:
  - 1. Site improvements, including pavement, curbing, and sidewalks; stakes for grading, sub-ballast, fill, and topsoil placement; and utility locations, slopes, top of grate, and invert elevations.
  - 2. Structural improvements, including all bridges and retaining walls.
- C. Periodically verify layouts by similar means.

**END OF SECTION**

**SECTION 01 71 23**  
**MOBILIZATION**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section specifies requirements for Mobilization.
- B. The work under this section shall include the furnishing of all labor, materials, and equipment necessary for preparatory work; the movement of personnel, equipment, supplies, and incidentals to the project site; the establishment of offices, buildings, and other facilities necessary to work on the project; and for all other work or operations that must be performed, or costs which must be incurred, when beginning work on the project.

1.02 RELATED WORK

- A. Section 015200, Engineer's Field Office, Type A

**PART 2 - PRODUCTS**

2.01 NOT USED

**PART 3 - EXECUTION**

3.01 NOT USED

**PART 4 - MEASUREMENT AND PAYMENT**

4.01 MEASUREMENT

- A. No separate measurement shall be made for Mobilization.

4.02 PAYMENT

- A. The work covered under this Section shall be paid for at the Contract lump sum price as shown in the Schedule of Values for Mobilization.

4.03 PAYMENT SCHEDULE

- A. The amount that the Contractor will receive payment for, in accordance with the following schedule, will be limited to 4% of the total Contract bid, less the cost of bonds and insurance.

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- B. Partial payment of the bid lump sum amount for Mobilization, not exceeding 4% of the total Contract bid less the cost of bonds and insurance, will be made in accordance with the following schedule:
1. With the Contractor's first pay request and upon furnishing the Engineer's Field Office, per Specification Section 015200, Engineer's Field Office, Type A, 10% of this item will be paid with the Contractor's first monthly invoice.
  2. When 5% or more of the original Contract amount is earned, not including bonds and insurance, an additional 15% of this item will be paid.
  3. When 15% or more of the original Contract amount is earned, not including bonds and insurance, an additional 10% of this item will be paid.
  4. When 25% or more of the original Contract amount is earned, not including bonds and insurance, an additional 15% of this item will be paid.
  5. The balance of the bid lump sum amount for Mobilization, and not exceeding 4% of the total Contract bid less the cost of bonds and insurance, will be paid over the duration of the Contract in payments proportional to the percentage of completion, based on the Contractor's approved monthly invoice.
- C. Nothing in this Section shall be construed to limit or preclude partial payments for other items as provided for by the Contract.

**END OF SECTION**

**SECTION 01 71 35**  
**PROTECTION OF UTILITIES**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section includes requirements related to damage to utilities.
- B. The Work under this Section shall include furnishing all labor, materials, tools and equipment required to repair any damages caused by the Contractor at its own expense.

1.02 UTILITY COORDINATION

- A. The Contractor shall cooperate with the utilities whenever any Work that is required under any utility agreements must be performed in conjunction with the construction that is required under the Contract.
- B. It is suggested that the Contractor first contact JULIE (800-892-0123) for work in Illinois to expedite utility notification.
- C. The Contractor shall contact each individual utility that is not a part of the JULIE system that may be affected by the work to determine whether interference exists, and for any other requirements relating to Work involving any utility facilities prior to submitting its bid proposal.
- D. The Contractor shall not interfere with, cause damage to, or interrupt any facilities of any utility, whether or not it is the subject of a utility agreement.

1.03 PERMITS AND LICENSES

- A. The Contractor shall procure all permits and licenses, pay all charges and fees, and give all notices necessary and incident to the due and lawful prosecution of the Work, including such permits and licenses as may be required in connection with the transportation of materials or equipment over haul roads, streets, highways or railroads.

1.04 UTILITY LOCATIONS

- A. The Contractor shall contact the appropriate Metra Division Engineering Office, BNSF, or UP to schedule a site utility marking with electrical, signal, and water services. The Contractor must be present at this utility marking. Any damaged railroad utilities will be retained by the Railroad and all costs will be paid for by the Contractor.
- B. All efforts on Metra's part will be given to advise the Contractor of the locations of underground cables. However, it shall be understood that such efforts by Metra do not relieve the Contractor of any of its responsibilities for restoring damaged utilities resulting from the activities of an employee, subcontractor, agent, or representative of the Contractor.

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- C. The Contractor is responsible for notifying owners of cables and underground facilities that may be jeopardized by the Contractor's operations in the same manner as required for giving notice to Metra.
- D. It is understood and agreed that the Contractor has taken into account in its proposal all utility facilities in their present and relocated positions, and all utility adjustment and relocation work, which will affect its progress and performance of the Work. No damages or additional compensation will be allowed to the Contractor for any delays or inconvenience sustained by it, due to interference from utility facilities or utility adjustments or relocation work.

**1.05 DAMAGE TO UTILITIES**

- A. If the Contractor interferes with, causes damage to, or interrupts facilities of any utility, the Contractor shall immediately inform the affected utility and give written notice to Metra.
- B. The Contractor shall cooperate with the utility company in the prompt repair and restoration of such utility facility and shall be responsible to the utility company for the cost of such repairs and restoration work.
- C. The Contractor is responsible for maintaining its performance of the Contract and completing the Project by the completion date, despite the Contractor's interference with or interruption of facilities of any utility.

**PART 2 - PRODUCTS**

2.01 NOT USED

**PART 3 - EXECUTION****3.01 INSTALLATION OF POSTS**

- A. Posts that are to be located near or over buried cables shall be installed by first digging a hole by hand, and then installing the post and back-filling the hole.
- B. No posts shall be driven under such conditions.
- C. Care shall be taken while digging by hand, so as not to damage the cable(s).

**END OF SECTION**

## SECTION 01 74 19

### CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. This Section includes the following:
  - 1. Requirements for management and disposal of construction waste.
  - 2. Requirements for submittal and implementation of a Waste Management Plan.

##### 1.02 RELATED SECTIONS

- A. Section 013300, Submittal Procedures
- B. Section 013513, Special Project Procedures
- C. Section 015000, Temporary Facilities and Controls

##### 1.03 DEFINITIONS

- A. Clean: Untreated and unpainted. Not contaminated with oils, solvents, caulk, or the like.
- B. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair, and demolition operations.
- C. Hazardous: Exhibiting the characteristics of hazardous substances (i.e., ignitibility, corrosivity, toxicity, or reactivity).
- D. Nonhazardous: Exhibiting none of the characteristics of hazardous substances (i.e., ignitibility, corrosivity, toxicity, or reactivity).
- E. Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.
- F. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.
- G. Recycle: To remove a waste material from the project site to another site, in order to remanufacture it into a new product for reuse by others.
- H. Recycling: The process of sorting, cleansing, treating, and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- I. Return: To give back reusable items or unused products to vendors for credit.

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- J. Reuse: To reuse a construction waste material in some manner on the project site.
- K. Salvage: To remove a waste material from the project site to another site for resale or reuse by others.
- L. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.
- M. Source Separation: The act of keeping different types of waste materials separate, beginning from the first time that they become waste.
- N. Toxic: Poisonous to humans either immediately or after a long period of exposure.
- O. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.
- P. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

**1.04 SUBMITTALS**

- A. Procedures: Section 013300, Submittal Procedures
- B. Submit a Waste Management Plan within 10 calendar days after receiving a Notice to Proceed, or prior to any trash or waste removal, whichever occurs first. Submit a projection of all trash and waste that will require disposal and alternatives to landfilling.
- C. Waste Disposal Reports: Submit at specified intervals, with details of quantities of trash and waste, the means of disposal or reuse and all associated costs. Show both totals to date and since the last report.
  - 1. Submit an updated Report with each application for progress payment. Failure to submit this Report will delay payment.
  - 2. Submit the Report on a form acceptable to Metra.
  - 3. Landfill Disposal: Include the following information:
    - a. Identification of material.
    - b. Amount (in tons or cubic yards) of trash/waste material from the Project disposed of in landfills.
    - c. State the identity of landfills, total amount of tipping fees paid to each landfill, and the total disposal cost.
    - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.

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4. Recycled and Salvaged Materials: Include the following information for each:
  - a. The identification of materials, including those retrieved by the installer for use on other projects.
  - b. Amount (in tons or cubic yards), the date removed from the project site, and the receiving party.
  - c. Transportation costs, the amount paid or received for the material, and the net total cost or savings of salvaging or recycling each material.
  - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
  - e. Certification from the receiving party that materials will not be disposed of in landfills or by incineration.
5. Material Reused on the Project: Include the following information for each:
  - a. Identification of material and how it was used in the Project.
  - b. Amount (in tons or cubic yards).
  - c. Include weight tickets as evidence of quantity.
6. Other Disposal Methods: Include information similar to that described above as appropriate, regarding the disposal method being used.

**1.05 WASTE MANAGEMENT REQUIREMENTS**

- A. Metra requires that this Project generate the least amount of trash and waste possible.
- B. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.
- C. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.
- D. Required Recycling, Salvage, and Reuse: The following may not be disposed of in landfills or by incineration:
  1. Aluminum and plastic beverage containers.
  2. Corrugated cardboard.
  3. Wood pallets.
  4. Clean dimensional wood: May be used as blocking or furring.
  5. Concrete: May be crushed and used as riprap, aggregate, sub-base material, or fill.
  6. Bricks: May be used on the Project if whole or crushed, and used as landscape cover, sub-base material, or fill.

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7. Metals: Including packaging banding, metal studs, sheet metal, structural steel, piping, reinforcing bars, door frames, and other items made of steel, iron, galvanized steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze.
  8. Glass.
  9. Plastic buckets.
  10. Paint.
  11. Plastic sheeting.
  12. Rigid foam insulation.
  13. Windows, doors, and door hardware.
- E. The Contractor shall submit periodic Waste Disposal Reports. All landfill disposals, recycling, salvage, and reuse must be reported regardless of to whom the cost or savings accrues. Use the same units of measure on all reports.
- F. The following methods of trash/waste disposal are prohibited:
1. Burning on the project site.
  2. Burying on the project site.
  3. Dumping or burying on other property, whether public or private.
  4. Other illegal dumping or burying.
  5. Incineration, either on- or off-site.

**1.06 REGULATORY REQUIREMENTS**

- A. The Contractor is responsible for knowing and complying with all regulatory requirements, including but not limited to, all federal, state and local requirements pertaining to the legal disposal of construction and demolition waste materials.

**1.07 WASTE MANAGEMENT ADMINISTRATION**

- A. Manager: Designate an on-site person or persons responsible for instructing workers and overseeing and documenting the results of the Waste Management Plan.
- B. Communication: Distribute copies of the Waste Management Plan to the job site foreman, each subcontractor, Metra, and Metra's Authorized Representative.
- C. Instruction: Provide on-site instruction on the appropriate separation, handling, recycling, salvaging, reuse, and return methods to be used by all parties at each stage of the Project.

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- D. Meetings: Discuss trash/waste management goals and issues at project meetings:
  - 1. Pre-construction meeting.
  - 2. Regular job-site progress meetings.
- E. See Section 013513, Special Project Procedures, for additional requirements.
- F. See Section 015000, Temporary Facilities and Controls, for additional requirements related to trash/waste collection and the removal of facilities and services.

**PART 2 - PRODUCTS**

2.01 NOT USED

**PART 3 - EXECUTION**

3.01 WASTE MANAGEMENT PLAN IMPLEMENTATION

- A. Facilities: Provide specific facilities for the separation and storage of materials for recycling, salvaging, reuse, returning, and trash disposal, for use by all contractors and installers.
  - 1. At a minimum, provide the following:
    - a. A separate area for the storage of materials to be reused on-site, such as wood cut-offs for blocking.
    - b. Separate dumpsters for each category of recyclables.
    - c. Recycling bins at worker lunch areas.
  - 2. Provide containers (as required).
  - 3. Provide temporary enclosures around piles of separated materials that are to be recycled or salvaged.
  - 4. Provide materials for barriers and enclosures that are nonhazardous, recyclable, or reusable to the maximum extent possible. Reuse project construction waste materials, if possible.
  - 5. Locate enclosures out of the way of construction traffic.
  - 6. Provide adequate space for pick-up and delivery, as well as for convenience to subcontractors.
  - 7. If an enclosed area is not provided, clearly layout and label a specific area on-site.
  - 8. Keep recycling and trash/waste bin areas neat and clean and clearly marked, in order to avoid the contamination of materials.

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- B. Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to all applicable regulations.
- C. Recycling: Separate, store, protect, and handle at the site all identified recyclable waste products in order to prevent the contamination of materials and to maximize the recyclability of identified materials. Arrange for timely pickups from the site or deliveries to a recycling facility, in order to prevent the contamination of recyclable materials.
- D. Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.
- E. Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

**END OF SECTION**

**SECTION 01 77 00**  
**CLOSEOUT PROCEDURES**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section includes closeout requirements. Closeout shall refer to the general requirements near the end of each phase or stage in preparation for final acceptance.

1.02 RELATED SECTIONS

- A. Section 017839, Project Record Documents

1.03 SUBMITTALS

- A. Prior to final payment, submit to Metra's Authorized Representative six bound sets of prints and electronic files showing the "Project Record" conditions, as well as any related and otherwise modified systems.
  1. Metra will make available to the Contractor the original drawings in order for the Contractor to reproduce one set of transparencies.
  2. The Contractor shall be responsible, and pay all costs involved, for the transfer and recording of all changes/deviations to a reproducible set of drawings, clearly marked "PROJECT RECORD" for Metra's permanent records.
  3. The Contractor shall exhibit their seal and sign the reproducible set of drawings.
  4. See Section 017839, Project Record Documents, for additional information.

1.04 CONTRACTOR'S RESPONSIBILITIES

- A. The Contractor is responsible for providing proper and safe access to Metra's Authorized Representative, for inspection of the Work.
- B. The Contractor is responsible for notifying all Municipal authorities and other agencies having jurisdiction in the area, in order to secure the necessary inspections and approvals as the work progresses. Failure to do so will be at the Contractor's own risk.
- C. The Contractor shall formally request pre-final inspections from Metra's Authorized Representative as specified in this Section. All requests shall be transmitted in writing.

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- D. Prior to requesting a pre-final inspection, the Contractor must complete all Contract work. The Contractor shall also submit a statement showing accounting of changes to the Contract sum.
- E. After the pre-final inspection, the Contractor shall receive from Metra's Authorized Representative a punch list of items/work to be completed prior to final inspection.
- F. Prior to requesting a final inspection for certification of final acceptance and final payment, the Contractor shall complete the following list of known exceptions.
  - 1. Submit a final payment request with final releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for projects and complete operations where required.
  - 2. Submit certified copy of Metra's Authorized Representative's final punch list of itemized work to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance.
  - 3. Submit record drawings, maintenance manuals, and similar final record information.
  - 4. Submit specific warranties, final certifications, and similar documents. Comply with other requirements covered in other divisions of the Specifications.
  - 5. Submit consent of surety.
  - 6. Correct faulty materials and faulty workmanship.
  - 7. Complete final clean-up requirements, including touch-up of marred surfaces.
  - 8. Submit certificates of inspection required for occupancy.
  - 9. Submit a guarantee of the completed Work.
  - 10. Submit copies of all test reports not previously submitted, as specified in other sections of the Specifications.
- G. After submitting the request for the final inspection, Metra's Authorized Representative will arrange a pre-final follow-up inspection, after which a final punch list will be submitted to the Contractor. The Contractor shall complete all items/work on this list, then submit a certified copy of the list stating that each item has been completed or otherwise resolved for acceptance.
- H. The Contractor shall be present at all inspections.

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**1.05 METRA'S AUTHORIZED REPRESENTATIVE'S RESPONSIBILITIES****A. Pre-final Inspection:**

1. Upon receipt of the Contractor's request for a pre-final inspection, Metra's Authorized Representative will check that all prerequisites for the inspection have been met.
  - a. If any prerequisites have not been met, Metra's Authorized Representative will notify the Contractor, in writing, within five working days from date of receipt.
  - b. If the request is in order, Metra's Authorized Representative will notify the Contractor of date(s) for the inspection.
  - c. The inspection will be held within 10 working days from receipt of a valid request for inspection.
2. Following the pre-final inspection, Metra's Authorized Representative will prepare a punch list stating all items/work to be completed or corrected by the Contractor prior to the final inspection.
  - a. All punch list items will be approved by Metra's Authorized Representative.
  - b. Transmittal will be in writing; the Contractor shall not accept the transmittal by any other means nor from any party other than Metra's Authorized Representative. The Contractor's failure to comply shall be at its own risk and expense.

**B. Pre-Final Follow-Up Inspection:**

1. Upon receipt of the Contractor's request for a final inspection, Metra's Authorized Representative will check that all prerequisites for the inspection have been met.
  - a. If any prerequisites have not been met, Metra's Authorized Representative will notify the Contractor in writing within five working days from the date of receipt
  - b. If the request is in order, Metra's Authorized Representative will notify the Contractor of the date(s) for a pre-final follow-up inspection.
  - c. The pre-final follow-up inspection will be held within 10 working days from receipt of a valid request.
2. Following the pre-final follow-up inspection, Metra's Authorized Representative will prepare a final punch list stating all items/work to be completed or corrected by the Contractor prior to the final inspection. Procedures for this list will be as outlined previously.

**C. Final Inspection:**

1. Upon receipt of the Contractor's written notice that all final punch list items have been completed, Metra's Authorized Representative will notify the Contractor of date(s) for the final inspection.

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2. The Contractor is advised that the final inspection will take place only after completion of all punch list items. Metra will issue a certificate of final acceptance only after successful completion of the final inspection.

**1.06 FINAL CLEAN-UP**

- A. The Contractor shall remove and legally dispose of all construction debris resulting from its operations from the site. The building shall be thoroughly cleaned, windows washed and floors waxed. The Contractor shall restore and repair all surfaces soiled by its construction operations.
- B. Removal of Protection: Except as otherwise indicated or requested by Metra's Authorized Representative, remove temporary protection devices and facilities which are installed during the course of the Work to protect previously completed work during remainder of project construction periods.
- C. The Contractor shall pay for all costs related to site cleaning. Cleaning shall be performed on driveway, curbing and sidewalk areas where hose washing may be permitted.
- D. The requirements of refuse removal, cleaning and other related work as specified, shall be completed prior to the final inspection and constitute one condition of Final Acceptance.

**1.07 GUARANTEE**

- A. The Contractor and its sureties shall unconditionally guarantee all work to be performed and all materials to be furnished under the Contract against defects in materials or workmanship for a period of one year from date of Final Acceptance by Metra's Authorized Representative. If a longer guarantee period is specified, the longer guarantee period shall apply.
- B. Where guarantees are required for work performed by subcontractors, secure guarantees from the subcontractors addressed to and in favor of Metra.
- C. Delivery of these guarantees shall not relieve the Contractor or its sureties from any obligations assumed under other provisions of the Contract Documents.
- D. If defects develop in any work within periods specified in the Contract Documents due to faults in materials and/or workmanship, make repairs and do necessary work to correct defective work so that it fully complies with the Contract Documents to the satisfaction of Metra's Authorized Representative.
  1. Perform such repairs, corrective work, including replacing of other work damaged by or otherwise affected by making of repairs or corrections, or which may have been damaged by defective work, without extra costs to Metra, starting within 10 days after written notice to the Contractor by Metra.
  2. Complete such repairs or corrective work as rapidly as possible.
- E. In case the Contractor or its surety fails to do work so ordered, Metra's Authorized Representative may have work done and charge the cost thereof

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against moneys retained, as provided for in the Contract Documents. If said moneys are insufficient to pay such cost, or if no money is available, the Contractor and its surety agree to pay to Metra such an amount as will fully reimburse Metra for such work.

- F. Guarantees required by the Contract Documents shall be delivered to Metra before the final voucher when the Contract is issued. They shall state that the time of guarantees shall begin to run on the date of Final Acceptance, even though guarantees are delivered prior thereto.

**PART 2 - PRODUCTS**

2.01 NOT USED

**PART 3 - EXECUTION**

3.01 NOT USED

**END OF SECTION**

**SECTION 01 78 39**  
**PROJECT RECORD DOCUMENTS**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section includes requirements for as-built drawings and specifications.

1.02 DEFINITIONS

- A. Record Copies: Shall mean documents or copies relating directly to performance of the Work, which Contractor is required to prepare or maintain for Metra's records, recording the work as actually performed.
1. In particular, record copies shall show changes in the Work in a manner similar to that shown and specified by original Contract Documents; and show additional information of value to Metra's records, but not indicated by original Contract Documents.
  2. Record copies include newly prepared drawings (if any are specified), marked-up product data specifications, addenda and change orders, marked-up product data submittals, record samples, field records for variable and concealed conditions such as excavations, and miscellaneous record information on work which is otherwise recorded only schematically or not at all.
  3. Certain individual sections may include specific record-copy requirements which extend requirements of this Section.

1.03 SUBMITTALS

- A. At Contract close-out, deliver the record documents to Metra's Authorized Representative:
1. Contractor shall submit all required record documents for Metra's Authorized Representative's review and approval.
  2. Revise and resubmit as directed until approved.
  3. The Contractor's request for final payment shall not be submitted and will not be accepted until all final and approved record documents have been received by Metra's Authorized Representative.
- B. Review of final drawings: Prior to copying and distributing, submit correct CAD drawings to Metra's Authorized Representative for review and acceptance. When acceptable, Metra's Authorized Representative will return to Contractor for organizing into sets, printing, binding and final submittal.

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- C. Furnish to Metra's Authorized Representative, at the time of Contract Close-out, one record copy error free of the following:
  - 1. Drawings
  - 2. Specifications
  - 3. O/M manuals for the Project with all the manufacturers' shop drawings and the cut sheets
  - 4. Addenda
  - 5. Change Orders and other modifications to the Contract.
  - 6. Field Test Records
- D. Accompany submittal with a transmittal letter stating the following:
  - 1. Date
  - 2. Project Title and Number
  - 3. Contractor's Name and Address
  - 4. Title and Number of Each Record Document Transmitted
  - 5. Signature of Contractor or its duly authorized representative
- E. Copies of Record Drawings:
  - 1. Upon completion of the CAD record drawings, prepare six blue-line or black-line prints of each drawing, regardless of whether changes and additional information were recorded on them or not.
  - 2. Organize each of the six copies into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates and other forms of identification on cover of each set.
  - 3. Organize and bind marked-up sets of prints (maintained during the construction period) in same manner.
  - 4. Submit marked-up sets and copy sets to Metra's Authorized Representative.
  - 5. In addition, electronic files (PDFs and native files like CADD, Word, Excel, etc.) of all Project Record Drawings and Specifications shall be organized in a similar fashion and must be submitted at Project Closeout, on a USB drive, to Metra's Authorized Representative at no additional cost. All PDFs shall be of a high resolution if there are any scans being submitted.

**1.04 AS-BUILT DRAWINGS**

- A. The Contractor shall be responsible for recording all changes and revisions during construction of the project.

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- B. Prior to final payment, the Contractor shall furnish Metra's Authorized Representative with as-built drawings for Metra's records as follows:
1. Use Metra's title block
  2. Sets shall follow the drawing list
  3. Format shall be MicroStation® CAD and PDF format. All drawings for subassemblies used on this project (e.g. HVAC, DIO Modules, FACP, intrusion alarm panels, etc.) must be converted into MicroStation®. Cross References and Interconnection Information must be added. An integrated Book of Plans shall be submitted.
  4. Drawings shall reflect all changes to the original Contract Drawings.
  5. All as-built drawings and programs shall start with Revision zero.
- C. Metra will make available to the Contractor the original Contract Drawings and the CAD standard manual in order for the Contractor to reproduce one set of electronic files. Contactor must follow the standards and the color code shall apply to specific terminal points when submitting drawings to Metra.
- D. The Contractor shall be responsible for all costs involved for the transfer and recording electronically of all changes/deviations to as-built drawings for providing permanent records to Metra. The Contractor shall electronically seal and sign all As-Built Drawings.
- E. Electrical Color Code:

LEGEND

COL . 0	⊙	TERMINAL POINT AT 1500 V D.C. SWITCHGEAR
COL . 3	⊗	TERMINAL POINT AT 12.4 KV A.C. SWITCHGEAR
COL . 53	⊠	TERMINAL POINT AT 4 KV A.C. SWITCHGEAR
COL . 17	⊡	TERMINAL POINT AT RECTIFIER CONTROL PANEL
COL . 2	△	TERMINAL POINT AT TRANSFORMER CONTROL PANEL
COL . 5	⊞	TERMINAL POINT AT TRANSFER TRIP & LBB SWITCHBOARD
COL . 78	⊕	TERMINAL POINT AT SUPERVISORY CONTROL CABINET
COL . 7	⊞	TERMINAL POINT AT BUS FAULT RELAY PANEL OR CONTROL SWITCHBOARD OR OTHER MISC. PANELS.

## 1.05 MAINTENANCE OF DOCUMENTS

- A. Store documents for Metra apart from documents used in construction.

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- B. Maintain documents in a clean, dry, legible condition and in good order. Do not record documents for construction purposes.
- C. Make documents available at all times for inspection by Metra's Authorized Representative.

**1.06 PROJECT RECORDS**

- A. Label each document "PROJECT RECORD" in neat, large-printed letters.
- B. The Contractor must create and maintain a Drawing Log, listing each sheet, with the current revision as listed in the title block and the date revised.
- C. Mark-up Procedure for Drawings:
  - 1. Record information concurrently with construction progress. Do not conceal any work until required information is recorded.
  - 2. During progress of the Work, maintain a white-print set (blue-line or black-line) of Contract Drawings and shop drawings, with mark-up of actual installations that vary substantially from the work as originally shown.
  - 3. Mark whatever drawing is most capable of showing actual physical condition, fully and accurately.
  - 4. Where shop drawings are marked up, mark cross-reference on Contract Drawings at corresponding location. Mark with erasable colored pencil, using separate colors where feasible to distinguish between changes for different categories of work at same general location.
  - 5. Mark-up important additional information that was either shown schematically or omitted from original drawings. Give particular attention to information on work concealed, which would be difficult to identify or measure and record at a later date.
  - 6. All changes shall be "bubbled" and cross referenced with documentation of the change.
  - 7. The drawing revision shall be maintained on each drawing with the date and source for all new sheets.
  - 8. Final submittals shall be dated and marked "PROJECT RECORD".
  - 9. Note alternative numbers, change order numbers and similar identification. Require each person preparing mark-up to initial and date mark-up and indicate the name of his firm.
  - 10. Include the following information:
    - a. Horizontal and vertical locations of underground utilities and appurtenances encountered during the work of the Contract, referenced to permanent surface utilities.
    - b. Field changes of dimensions and details.
    - c. Changes made by Field Order or by Change Order.

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- d. Details not on original Contract Drawings.
- D. Superseded Sheets: If new sheets are issued, the new sheet must reference the source of the change (RFI, ROCC, CM, etc.) and the superseded sheet, if any. Superseded sheets must also be kept in the project record set, with the word "Superseded" stamped clearly in the center of the sheet. Both new sheets and superseded sheets must be maintained in the Drawing Log.
- E. Shop Drawings: The PROJECT RECORD DRAWING set shall include approved shop drawings for the following work items: Structural steel, Electrical, Plumbing, Mechanical, project specific systems as determined by Metra's Authorized Representative (ex. Elevator shop drawing, snow melt system, overhead crane, etc.). All included shop drawings shall be incorporated into the Drawing Log.
- F. Preparation of CAD drawings:
  - 1. In preparation for certification of substantial completion of last major portion of the Work, review completed mark-up of record drawings with Metra's Authorized Representative.
  - 2. When authorized, proceed with preparation of a full set of corrected CAD drawings for Contract Drawings and shop drawings.
  - 3. Incorporate changes and additional information previously marked-up on print sets by erasing and redrawing where applicable, and by adding details and notations where applicable; refer instances of uncertainty to Metra's Authorized Representative for determination. Identify and date each update drawing.
- G. Printing Arrangements and Costs:
  - 1. Printing of original Drawings and costs to produce the CAD and other prints as specified shall be Contractor's responsibility.
  - 2. Metra's Authorized Representative will make original Contract Drawings, electronic copies, or reproduces available to Contractor for the reproduction.
  - 3. Contractor shall return original Drawings to Metra's Authorized Representative as soon as possible.
- H. Mark-up Procedure for Specifications:
  - 1. During progress of the work, maintain one copy of Specifications, including addenda, change orders and similar modifications issued in printed form during construction, and mark-up variations (of substance) in actual work in comparison with text of Specifications and modifications as issued.
  - 2. Give particular attention to substitutions, selection of options, and similar information on work where it is concealed or cannot otherwise be readily discerned at a later date by direct observation.

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3. Mark all changes made by RFI, ROCC, Contract Modification, and NCR, including a reference number.
  4. Where feasible, mark-up variation on blank left-hand pages of the Specification, facing printed right-hand pages containing original text affected by variation.
  5. The final submittal at Project completion will be listed as "PROJECT RECORD" in the title block, with a submittal date.
  6. Upon completion of mark-up, submit the specifications to Metra's Authorized Representative for Metra's records.
- I. Record Product Data:
1. During progress of the Work, maintain one copy of each product data submittal, and mark up significant variations in the actual work in comparison with submitted information.
  2. Include both variations in product as delivered to site, and variations from manufacturer's instructions and recommendations for installation. Give particular attention to concealed products and portions of the work which cannot otherwise be readily discerned at a later date by direct observation.
  3. Note related change orders and related mark-up of record drawings and specifications.
  4. Upon completion of mark-up, submit complete set to Metra's Authorized Representative for Metra's records.
- J. Record Sample Submittal:
1. Immediately prior to date(s) of the pre-final inspection, Metra's Authorized Representative (and including other Metra personnel where desired) shall meet with Contractor at site, to determine which submitted samples maintained by Contractor during progress of the work are to be transmitted to Metra for record purposes.
  2. Comply with Metra's Authorized Representative 's instructions for packaging, identification marking, and delivery to Metra's sample storage space.
  3. Dispose of other samples in manner specified for disposal of surplus and waste materials, unless otherwise indicated or directed by Metra's Authorized Representative.
- K. Miscellaneous Record Submittals:
1. Refer to other sections of the Specifications for requirements of miscellaneous record keeping and submittals in connection with actual performance of the Work.

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2. Immediately prior to date(s) of the pre-final inspection, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for continued use and reference by Metra, and submit them to Metra's Authorized Representative for Metra's records.
3. Categories of requirements resulting in miscellaneous work-records are recognized to include, but not necessarily limited to, the following:
  - a. Required field records on excavations, foundations, underground construction, wells and similar work.
  - b. Material certification for all permanent materials on the Project.
  - c. Operation & Maintenance Manuals.
  - d. Accurate survey showing locations and elevations of underground lines, including invert elevations of drainage piping.
  - e. Surveys establishing lines and levels of buildings.
  - f. Authorized measurements using unit prices or unit allowances.
  - g. Chemical treatment records (wood, soil, etc.).
  - h. Ambient and substrate condition tests.
  - i. Testing and qualification of installation firms.
  - j. Documented qualification of installation firms.
  - k. Load/performance testing.
  - l. Inspections and certifications by governing authorities, and Testing Laboratory.
    - 1) Final inspection and correction procedures.
    - 2) Statements of application.

**1.07 NEW RECORD DRAWINGS**

- A. Prepare new drawings in lieu of the specified procedures for preparation of final drawings where changes were specified by change order in response to alternatives, substitutions, or other modifications or additions to the Work, and where neither original Contract Drawings nor shop drawings are suitable for correction to show actual work.
- B. Consult Metra's Authorized Representative for scale and scope of detailing and notations required to record actual physical condition of work and its relation to other work. When completed and accepted, integrate newly-prepared drawings into general procedure specified for organizing, copying, binding and submittal of record drawings.

**PART 2 - PRODUCTS**

2.01 NOT USED

**PART 3 - EXECUTION**

3.01 NOT USED

**END OF SECTION**

## SECTION 02040 – EXISTING UTILITIES

### 1 GENERAL

#### 1.1 SCOPE OF WORK

##### 1.1.1 General

- 1.1.1.1 This Section specifies the requirements for locating and protecting existing utilities. Work under this Section is subject to the requirements of the Contract Documents, including the Supplementary Conditions.

### 2 PRODUCTS

#### 2.1 DESCRIPTION

- 2.1.1 All products used to repair damaged utilities shall be new and shall match the existing damaged material, subject to the approval of the Engineer.

### 3 EXECUTION

#### 3.1 UTILITY CONTACTS

- 3.1.1 The Contractor shall call JULIE (800-892-0123) and/or DIGGER (312-744-7000) in the City of Chicago and contact the various utility owners prior to any construction activities. The Contractor shall request a site visit to locate the various utilities. The Contractor shall advise the Metra's authorized representative of any utilities, which will require relocation for the proposed construction.
- 3.1.2 Most known data from the agencies has been incorporated into the plans. It is, however, the Contractor's responsibility to confirm or establish the existence of all utility facilities and their exact locations, whether contained in the data submitted by these agencies or not, and to safely schedule all utility relocations.
- 3.1.3 The Contractor shall also contact the METRA Engineering Department prior to any excavation on Railroad R.O.W. so that vital systems can be protected or avoided.

#### 3.2 UTILITY LOCATION

- 3.2.1 The Contractor must be responsible to locate all public and private underground utilities and shall make his own investigation to determine the existence, nature and exact location of all utility lines and appurtenances within the limits of the improvements. The cost of this Work shall be included in the bid.

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- 3.2.2 Where exploration trench is indicated on the drawings or required to locate the utility, a trench shall be constructed in accordance with Section 213 of the Standard Specification.
- 3.3 **DAMAGE DURING CONSTRUCTION**
- 3.3.1 Due care should be exercised by the Contractor to avoid damaging any power, telephone, gas, signal/communication and water or sewer lines near the construction operations. Any utility damaged by the Contractor during construction of the improvement shall be repaired at the Contractor's expense and to the satisfaction of the utility company(s) and the Metra's authorized representative.

**END OF SECTION 02040**

## SECTION 02080 – BEDDING AND TRENCH BACKFILL

### 1 GENERAL

#### 1.1 SCOPE OF WORK

##### 1.1.1 General

1.1.1.1 Work under this Section is subject to the requirements of the Contract Documents, including the Supplementary Conditions.

##### 1.1.2 Furnish, Install and Transport

1.1.2.1 This Work shall consist of furnishing and transporting fine aggregate for backfilling and course aggregate for bedding material for all trenches made in the subgrade of the proposed improvement, and all trenches outside of the subgrade where the inner edge of the trench is closer than 2 feet to the edge of the proposed pavement or curb. This item also includes the disposal of the surplus excavated material, which is replaced by the bedding and/or backfill.

##### 1.1.3 Related Work

1.1.3.1 Except as modified herein, the work shall be performed in accordance with the applicable requirements of Section 208 and Articles 550.04 and 550.07 of the Standard Specifications and according to the Typical Storm Sewer Trench Detail, as shown on the Drawings.

### 2 PRODUCTS

#### 2.1 BEDDING

2.1.1 Course aggregate gradation CA 11 or CA 13 shall be used as bedding and shall meet the requirements of Article 1004.01 of the Standard Specifications.

#### 2.2 TRENCH BACKFILL

2.2.1 Fine aggregate gradation FA 6 shall be used as trench backfill and shall meet the requirements of Article 1003.04 of the Standard Specifications.

### 3 EXECUTION

#### 3.1 DISPOSAL OF SURPLUS EXCAVATED MATERIAL

3.1.1 Disposal shall be made according to Article 202.03 of the Standard Specifications.

**END OF SECTION 02080**

## SECTION 02110 – SITE CLEARING / REMOVAL

### 1 GENERAL

#### 1.1 SCOPE OF WORK

##### 1.1.1 General

1.1.1.1 Contract Work under this Section is subject to the requirements of the Documents, including the Supplementary Conditions.

##### 1.1.2 Furnish and Install

1.1.2.1 Provide all labor, materials and equipment required for all demolition, removal, and disposal of items indicated on the drawings and/or as directed by the Metra's authorized representative, including but not limited to the following:

- 1.1.2.1.1 Existing buildings, foundations and concrete pads within proposed improvement areas.
- 1.1.2.1.2 Bituminous pavements, concrete sidewalks, concrete curbs, gutters, combination curbs and gutters other foundations and building pads.
- 1.1.2.1.3 Platforms and apparatus.
- 1.1.2.1.4 Fences and signage.
- 1.1.2.1.5 Abandoned underground sewer pipes, conduits and duct banks interfering with the new construction.
- 1.1.2.1.6 Lighting, power poles, wiring, other utilities as shown on plans and/or as directed by the Metra's authorized representative.
- 1.1.2.1.7 All other demolition work shown or noted on drawings, or as directed by the Engineer, to facilitate new construction work.

#### 1.2 SPECIAL REQUIREMENTS

1.2.1 The contractor shall be held responsible to have visited the site and fully determined to his own satisfaction all physical conditions; site characteristics; means of egress and access from and to the site; or any other peculiarities of access from and to the existing site which may influence or effect the cost(s) of this work in any way.

1.2.2 The Contractor shall be responsible for and shall protect adjoining properties and existing thoroughfares from damage due to his operations. The Contractor shall provide and maintain all barricades, lights, and all other protective devices necessary to

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fulfill the intent of this work, including requirements of all Federal, State or Municipal laws or ordinances. Barricades, lights and other protective devices shall be relocated as construction work progresses, and removed upon completion and acceptance of the work, or when so directed by the Metra's authorized representative.

**1.2.3 Utilities and Services:**

- 1.2.3.1 The Contractor shall carefully examine all public records and data available regarding public utilities and services and confer where necessary with the respective departments of the local agencies having jurisdiction. Contractor shall also confer with the respective private service of utility agencies to fully determine the location of all underground utilities and services.

**2 PRODUCTS****2.1 NOT USED****3 EXECUTION****3.1 GENERAL**

- 3.1.1 No demolition shall be commenced until a program of operations schedule has been coordinated with Metra, except that preparatory work may be started if specifically approved by and coordinated with the Metra's authorized representative.
- 3.1.2 Demolition work shall be done in such manner as to avoid hazards to persons and property and interference with the use of adjacent areas or interruption of free passage to and from such areas. Care shall be taken to prevent the spread of dust and flying particles.
- 3.1.3 Demolition and removal work shall be executed in careful and orderly manner. Accumulation of rubbish will not be permitted.
- 3.1.4 After work is started it shall be continued to completion at a rate that will allow the balance of the work to be completed within the time specified. If extra shifts are necessary beyond regular working hours, the work shall proceed with a minimum of nuisance to surrounding properties, and railroad operations.
- 3.1.5 Exact extent of demolition to be done may not be fully indicated by the drawings. The Contractor shall determine the nature and extent of demolition that will be necessary by comparing the drawings with the existing field conditions. It is expressly understood that this Contract includes all work of a demolition nature that may be required or necessary for a full and complete execution of the work, whether particularly referred to herein or not.

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- 3.1.6 Portions of existing sidewalks, which interfere with new construction work, shall be removed as shown on the plans, or as directed by the Metra's authorized representative. In removing sidewalk, provisions shall be made for satisfactory transition between replacements and the portion remaining in place. The Contractor shall saw cut to a minimum depth of 3 inches with a concrete sawing machine to prevent the surface from spalling when the concrete is broken out. This work shall be done in such a manner that a straight joint will be ensured.
- 3.1.7 Portions of existing concrete curb, gutter, combination curb and gutter, which interfere with new construction work, shall be removed as shown on the plans, or as directed by the Metra's authorized representative. In removing concrete curb, gutter, combination curb and gutter, provisions shall be made for satisfactory transition between replacements and the portion remaining in place. The Contractor shall saw cut to a minimum depth of 3 inches with a concrete sawing machine to prevent the surface from spalling when the concrete is broken out. This work shall be done in a manner that a straight joint will be ensured.
- 3.1.8 Existing bituminous paving, including any existing concrete slab or granite pavers under the existing bituminous paving, shall be removed as shown on the drawings, or as directed by the Metra's authorized representative. Saw cut bituminous paving to a minimum depth of 3 inches, using equipment and procedure to ensure a straight line along saw cut and to make proper transition between existing paving and new construction. Contractor shall verify whether a concrete slab or granite pavers may exist under the existing bituminous paving. In the event there is a concrete slab under the existing bituminous paving, saw cut concrete slab to a depth of 3 inches with a concrete sawing machine to prevent the surface from spalling when the concrete is broken out.
- 3.1.9 Removal of abandoned improvements as designated in Paragraph 1.1.2.1.5 above.
- 3.2 DISPOSAL
- 3.2.1 Except as otherwise specified, the Contractor shall be entitled to all salvageable materials resulting from the demolition work.
- 3.2.2 Remove all wrecked materials, debris and rubbish from the site, under no circumstances shall debris or rubbish be allowed to accumulate on the premises.
- 3.3 CLEANING
- 3.3.1 On completion of the demolition and removal work, clean the areas affected, including areas outside the limits of the Contractor's work area where permission to work has been granted. Remove existing poles lines which are no longer in use. Remove surplus construction material or debris resulting from the demolition work and dispose of legally off the site.

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- 3.3.2 Access routes to and from the site shall be kept clean of debris resulting from the work.
- 3.3.3 Burning of rubbish or debris on or near the premises will not be permitted.

**END OF SECTION 02110**

## SECTION 02190 – EROSION CONTROL

### 1 GENERAL

#### 1.1 SCOPE OF WORK

##### 1.1.1 General

1.1.1.1 Work under this Section is subject to the requirements of the Contract Documents, including the Supplementary Conditions.

##### 1.1.2 Furnish and Install

1.1.2.1 The work under this section includes furnishing all labor, materials, tools, equipment, and incidentals necessary for constructing temporary erosion control system within limits of project and right of way as described in Section 280 of Standard Specifications.

##### 1.1.3 Related Work

1.1.3.1 Except as modified herein, the work shall be in accordance with the applicable portions Standard Specifications, Section 280 and shall include:

1.1.3.1.1 Sediment control, Perimeter silt fence.

1.1.3.1.2 Inlet and pipe protection.

1.1.3.1.3 Erosion control maintenance.

1.1.3.1.4 Temporary erosion control seeding.

1.1.3.2 Section 02901 – Seeding and Sodding.

1.1.4 Compliance with all applicable Codes and Permits for the project.

### 2 PRODUCTS

#### 2.1 EROSION CONTROL MATERIALS

2.1.1 Materials shall meet the requirements of Section 280.02 of Standard Specifications.

### 3 EXECUTION

#### 3.1 PERIMETER SILT FENCE

3.1.1 Perimeter silt fence shall be placed in accordance with the Standard Specifications Article 280.04 at locations indicated on the plan drawings and as directed by the Metra's authorized representative.

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**3.2 INLET PROTECTION**

- 3.2.1 Inlet Protection shall be installed in compliance with section 280.04 at locations indicated on the plans or as required by the Metra's authorized representative. Inlet filters shall be installed either directly on the drainage structure or under the grate of the drainage structure resting on the lip of the frame. The fabric bag shall hang down into the drainage structure. Prior to ordering materials, the Contractor shall determine the size and shape of the various drainage structures being protected.

**3.3 EROSION CONTROL MAINTENANCE**

- 3.3.1 Erosion Control Maintenance shall conform to the Standard Specifications Article 280.05, except as follows:
- 3.3.1.1 The Contractor shall inspect erosion control measures at least once every week and immediately following a rainfall greater than one half inch. Any damaged or otherwise non-functional erosion control measures shall be repaired or replaced immediately by the Contractor.

**3.4 PERMIT**

- 3.4.1 The Contractor shall prepare Storm Water Pollution Prevention Plan and obtain all permits required by authorities having jurisdiction.

**END OF SECTION 02190**

## SECTION 02200 – EXCAVATION

### 1 GENERAL

#### 1.1 SCOPE OF WORK

##### 1.1.1 General

1.1.1.1 Work under this Section is subject to the requirements of the Contract Documents, including the Supplementary Conditions.

##### 1.1.2 Furnish and Install

1.1.2.1 all excavation trenching and backfill indicated on the drawings and specified herein, including but not limited to the following:

1.1.2.1.1 The work under this section includes the furnishing of all labor, materials, equipment, tools, transportation and services, to perform all the excavation, including all general machine or hand excavating trenching and backfilling; compacting and rough grading; stone fill under sidewalks, platforms and concrete slabs on grade and related items as required for and incidental to the completion of the work, as indicated on the drawings and specified herein.

1.1.2.1.2 Excavating, filling and backfilling shall include but is not limited to the following:

1.1.2.1.2.1 Excavating for footings and foundations walls, platforms, and stock piling of excavated material that may be approved for use as backfill and rough grading.

1.1.2.1.2.2 Excavating, trenching and backfilling as required for plumbing, heating and electrical work installed underground, including pits, conduits duct banks, sewers, drain tile, manholes, catch basins and other below grade structures specified in pertinent specifications and drawings sections.

1.1.2.1.2.3 Removing and disposing of all unsuitable material encountered within the limits of the excavation for the proposed footings, foundations, walkways, and pavements.

1.1.2.1.2.4 Placing engineered backfill and compacting to achieve minimum bearing capacity of 2000 pounds per square foot or as specified on drawings, whichever is greater.

1.1.2.1.2.5 Providing, placing and compacting to required grade approved backfill material obtained from excavation or from off-site (borrow excavated material).

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1.1.2.1.2.6 Top of compacted sub-grade shall allow for the placement of paving, plus the compacted stone base or other type, base as shown or specified.

1.1.2.1.2.7 Removing all subsurface obstructions as required to perform all excavating, backfilling and grading work, except utilities which will be removed or relocated as hereinafter specified. Particular care shall be exercised to avoid sub-surface active utility lines that are exiting electric manholes and elsewhere.

### 1.1.3 Related Work

1.1.3.1 Section 02505 -- "PCC Sidewalks and Stairs"

1.1.3.2 Section 02584 -- " Underground Duct Banks and Manholes"

1.1.3.3 Section 02901 -- "Seeding and Sodding"

1.1.3.4 Section 03300 -- "Cast-in-place Concrete"

### 1.1.4 Quality Assurance

1.1.4.1 Codes and Standards: Perform excavation work in compliance with applicable requirements of authorities having jurisdiction.

1.1.4.2 Except as modified herein, the work shall be performed in accordance with the applicable portions of IDOT Standards Specifications.

1.1.4.2.1 Excavation of unsuitable material shall conform to Section 202 of the standard specification.

1.1.4.2.2 The installation of porous granular backfill shall conform to Section 209 of the standard specification.

1.1.4.3 The work shall conform to all requirements of the City of Chicago and/or applicable local codes.

1.1.4.4 Follow all applicable regulations, codes and ordinances when removing, transporting and disposing of contaminated subgrade materials.

### 1.1.5 Project Conditions

1.1.5.1 Site Information:

1.1.5.1.1 Data in subsurface investigation reports was used for the basis of the design and are available to the Contractor for information only. Conditions are not intended as representations or warranties of accuracy or continuity

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between soil borings. The Authority and the Metra's authorized representative will not be responsible for interpretations or conclusions drawn from this data by Contractor.

- 1.1.5.1.2 Additional test borings and other exploratory operations may be performed by Contractor, at the Contractor's option; however, no change in the Contract Sum will be authorized for such additional exploration.

1.1.5.2 Existing Utilities

- 1.1.5.2.1 Located existing underground utilities in areas of excavation work. If utilities are indicated to remain in place, provide adequate means of support and protection during earthwork operations.

- 1.1.5.2.1.1 Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult the Metra's authorized representative and utility owner immediately for directions. Cooperate with Authority and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner and the Metra's authorized representative.

- 1.1.5.2.1.2 Do not interrupt existing utilities serving facilities occupied by the Owner or others, during occupied hours, except when permitted in writing by the Metra's authorized representative and then only after acceptable temporary utility services have been provided. Provide minimum of 48-hour notice to the Metra's authorized representative, and receive written notice to proceed before interrupting any utility.

- 1.1.5.2.1.3 Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shutoff of services if lines are active.

1.1.5.3 Use of Explosives

- 1.1.5.3.1 Use of explosives is not permitted.

1.1.5.4 Protection of Persons and Property

- 1.1.5.4.1 Barricade open excavations occurring as part of this work and post with warning lights and signs.

- 1.1.5.4.1.1 Operate warning lights as recommended by authorities having jurisdiction.

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- 1.1.5.4.1.2 Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

**1.2 INSPECTIONS AND TESTS**

- 1.2.1 All earthwork inspection and tests specified herein, or deemed required by the Metra's authorized representative, will be conducted by a testing laboratory employed by the Owner. These tests shall include analysis and determination of the quality of the earth strata at required excavation elevations, sub-grade compaction, backfilling and compaction operations, and such as indicated or required.
- 1.2.2 The contractor shall give notice, to the Metra's authorized representative, of each operation at least two (2) working days in advance to allow ample time for the Metra's authorized representative and the testing laboratory to witness inspections.
- 1.2.3 Maximum density and optimum moisture content of soils and aggregates shall be determined in accordance with ASTM D1557.
- 1.2.4 Testing required because of changes in materials, methods, faulty workmanship or work which fails to meet the contract requirements, shall be at the Contractor's expense.

**1.3 SPECIAL REQUIREMENTS****1.3.1 Job Conditions****1.3.1.1 Site Conditions**

- 1.3.1.1.1 The Contractor will be held to have visited the sites before bidding and shall examine to his satisfaction the soil, its condition and characteristics, traffic and means of access and any other features which may affect or influence the cost of the work.

**1.3.1.2 Bench Marks**

- 1.3.1.2.1 The Contractor shall use established benchmarks and other reference points. He shall replace same if they are destroyed or disturbed in any manner, due to his operations.

**1.3.1.3 Utilities**

- 1.3.1.3.1 The Contractor shall make all necessary arrangements and provide all services required to protect existing utility lines in the way of new work and all other items of this character. He shall assume all responsibility for coordinating his work with the utilities involved.

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- 1.3.1.4 The Contractor shall consult all public and private utility company records, The City of Chicago and Local Authorities, to fully inform himself of the location and extent of all utilities, and existing foundation walls and basements and/or tunnels of adjacent buildings.
- 1.3.1.5 The storage of equipment when not in use, shall be located in areas and in such a manner which will not interfere with normal conduct of construction on the site. Locations selected for collection of debris and/or storage of equipment or material shall be subject to approval of the owner.
- 1.3.2 The Contractor shall be responsible for and shall protect existing buildings and structures on the site and adjoining properties and public thoroughfares from damage due to his operations. The Contractor shall provide all temporary barricades, lights and other protective devices necessary to fulfill the intent of the Work, including requirements of all Federal State or Municipal laws or ordinances, and maintain same for the full period of this operation, removing same when directed or no longer required. Excavations shall be protected at all times and maintained in good order until backfill is in place.

**2 PRODUCTS****2.1 FILLING AND BACKFILLING MATERIALS**

- 2.1.1 Materials, other than approved excavated material, for filling and backfilling shall conform to the following.
  - 2.1.1.1 Crushed Stone
    - 2.1.1.1.1 Shall be coarse aggregate IDOT gradation CA-6 as follows: 100% passing 1-1/2" sieve; 90- 100% passing 1" sieve; 60-90% passing 1/2" sieve; 35-55% passing No. 4 sieve; 10-40% passing No. 16 sieve and 4-12% passing No. 200 sieve.
  - 2.1.1.2 Stabilization Stone
    - 2.1.1.2.1 Shall be coarse aggregate IDOT gradation CA-1 gradation as follows: 100% passing 3" sieve; 90-100% passing 2-1/2" sieve; 45-75% passing 2" sieve; 0-30% passing 1-1/2" sieve; and, 0-6% passing 1" sieve.
  - 2.1.1.3 Sand
    - 2.1.1.3.1 Natural sand, with the following gradation: 100% passing the 1" sieve; 65-100% passing the No. 4 sieve; 40-90% passing the No. 10 sieve; 30-80% passing the No. 16 sieve; 10-50% passing the No. 50 sieve; 0-30% passing the No. 100 sieve; and 0-10% passing the No. 200 sieve.

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**2.1.1.4 Approved Backfill Material**

- 2.1.1.4.1 Shall be either excavated material specifically approved for the backfill or approved off site borrowed earth fill containing no sod, frozen material, organic material or any material which, by decay or otherwise, might cause settlement; also no rock, stones, or broken concrete more than 3 inches in the largest dimension will be permitted.

**2.1.1.5 All Materials**

- 2.1.1.5.1 Shall be subject to approval by the testing laboratory.

**3 EXECUTION****3.1 EXCAVATION**

- 3.1.1 Excavate for caissons, foundations, footings, duct banks, manholes, light pole and signage foundations, slabs on grade, paved areas, etc., removing all fill material down to the elevations indicated on the drawings or to suitable soil bearing strata. In all cases the work shall rest on soil or approved fill which is capable of supporting the required loads. Contractor shall consult the Metra's authorized representative and obtain approval of Substrata before removing equipment.
- 3.1.2 Excavation shall provide sufficient space to permit erection of forms, placing of work, removal of forms, etc. and shall be left open until concrete, and any other work has been inspected and approved by the Metra's authorized representative.
- 3.1.3 The bottom of all excavations shall be properly leveled off. All loose materials shall be removed from excavations. All wood, timber and organic materials, that are exposed at the bottoms of all excavations shall be removed and the local depression backfilled and compacted.
- 3.1.4 Material that is to be excavated is assumed to be earth and other materials that can be removed with a power shovel. If rock is encountered within the limits of excavation, the Contractor shall immediately notify the Metra's authorized representative and shall not proceed further until instructions are given and measurements made for the purpose of establishing volume of rock excavations. Rock is defined as any stone or boulder 1/2 cubic yards or larger in size and/or ledge rock that cannot be removed by power shovel or without the use of continuous drilling or by pneumatic hammers.
- 3.1.5 Any excess or unauthorized excavations shall be backfilled with crushed stone and or approved material compacted, at no additional cost to the Owner.

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- 3.1.6 The drawings indicate the Required Subgrade Level for caissons footings, floor slabs, sidewalks and pavements. If suitable bearing is not encountered at these levels, the Contractor shall remove all unsuitable soil to the depth specified by the Metra's authorized representative and place compacted engineered fill to obtain the bearing capacity required. The cost for additional excavation and backfill shall be paid for by the cubic yard. This price shall include excavating, hauling, and disposal of unsuitable material and placement and compaction of engineered backfill.
- 3.1.7 Operations shall be done in such a manner as to avoid hazards to persons and property and interference with the use of adjacent areas or interruption of free passage to and from such areas. Care shall be taken to prevent the spread of dust and flying particles.
- 3.1.8 Excavation and removal work shall be executed in a careful and orderly manner. Accumulation of rubbish will not be permitted.
- 3.1.9 After work is started it shall be continued to completion at a rate that will allow the balance of the work to be completed within the time specified. If extra shifts are necessary beyond regular working hours the work shall proceed with a minimum of nuisance to surrounding properties.
- 3.1.10 Use of dynamite or blasting on the site is not permitted.
- 3.1.11 Metal track or cleat equipment shall not be operated over existing drives, sidewalks, curbs, and other facilities on the premises. Damage to such facilities, caused by the Contractor's equipment, shall be repaired to the satisfaction of the owner and at the Contractor's expense.
- 3.1.12 Exact extent of excavation work to be done is not fully indicated by accompanying Drawings. Determine the nature and extent of excavations that will be necessary by comparing the Drawings with the existing conditions at the site. It is expressly understood that this Contract includes all work of an excavation nature, that may be required or necessary to a full and complete execution of excavating whether particularly referred to herein or not.
- 3.1.13 Legally dispose of all excess excavated material and unacceptable backfill material. Also, remove and dispose of all wood and organic fill exposed at required excavation elevations. All debris and rubbish shall be removed, and the site left in an acceptably clean condition.
- 3.2 DRAINAGE
- 3.2.1 The Contractor shall provide and maintain all required bilge pumps, suction and discharge lines, etc., and power for running same in sufficient number and capacity to keep all excavations, free from standing water at all times, including such times as concreting

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operations are in progress. Equipment shall be maintained in good condition and operation, when so required, until excavations are backfilled.

- 3.2.2 Any pumping discharge into sewer system shall be either by way of an approved settling basin system or through adequate screening and filtering media prior to discharge into the sewer.
- 3.2.3 Dewatering, if needed, shall be performed continuously, 24 hours per day, 7 days per week, once started. The Contractor is responsible for dewatering the site to a level one (1) foot below the Required Subgrade Level for footings, floor slabs, sidewalks and pavements as part of the Contract Lump Sum Bid Price. If excavation is ordered by the Metra's authorized representative to extend below the Required Subgrade Level, the additional costs for dewatering to one (1) foot below the ordered excavation level shall be incidental to earth excavation.

**3.3 BACKFILLING**

- 3.3.1 Backfill promptly as work permits but not before foundation walls are adequately braced and have attained sufficient strength to withstand the backfilling and compacting stresses and any other work to be installed in the excavations is in place. Walls shall be uniformly backfilled on both sides.
- 3.3.2 Place approved fill and backfill material and compact in lifts to the proper elevations, as a part of this work.
- 3.3.3 No fill, backfill or sub-base shall be placed in standing water, on frozen ground or on surfaces, which have not been tested and/or approved by the Metra's authorized representative.
- 3.3.4 Suspend compaction operations, when, in the opinion of the Metra's authorized representative satisfactory results cannot be obtained because of rain or other unsatisfactory conditions.
- 3.3.5 A uniform moisture content will be required throughout the layers of fill material. Wetting or drying manipulation shall be performed as required to accomplish uniformity. Suspend compaction operations when, in the Metra's authorized representative's opinion, satisfactory results cannot be obtained because or rain or other unsatisfactory conditions.
- 3.3.6 Backfilling for all areas outside of foundation walls, except in paved areas shall be approved material. Backfill shall be compacted to 95% maximum density in accordance with ASTM D 1557 in maximum lifts of 12 inches.
- 3.3.7 Backfill, fill and base under footings, floor slabs, pavements and sidewalks shall be Crushed Stone Fill, or Stabilization Stone as shown on the Drawings or ordered by the Metra's authorized representative. This backfill, fill or base shall be placed and spread in layers or lifts

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having loose thickness not to exceed 6 inches as indicated and compacted to 98% maximum density as determined by ASTM D1557. The surface shall then be accurately graded and finished to the proper grades.

**3.4 PROOF ROLLING**

- 3.4.1 Any exterior slabs on grade and pavement areas, shall be inspected and approved by the Metra's authorized representative and then proof-rolled with a twenty-five (25) ton or heavier, steel or pneumatic tired roller making at least 4 passes over the entire area in alternate (perpendicular) directions. Any continuously yielding or unstable areas shall be locally excavated and backfilled with crushed Stone 6 inch thick layers with each layer and the entire sub-grade areas compacted to 98% of maximum density as determined by ASTM D1557.

**3.5 ROUGH GRADING**

- 3.5.1 Rough grade areas below finished grades and compact, including all areas of aggregate beds. Leave surfaces prepared for base and surface finishing of required thickness as indicated.
- 3.5.2 The limits of area to be graded shall be as necessary to produce new established grade levels, with easy slopes away from buildings and walks. Grading shall be done so as to drain surface water away from building.

**3.6 CLEAN UP**

- 3.6.1 On completion of the work and before acceptance by the Metra's authorized representative, thoroughly clean the areas affected, including areas outside the limits of the Contractor's work area where permission to work has been granted. Remove surplus construction material or debris resulting from the work and dispose of legally off the site.
- 3.6.2 Access routes to and from the site will be designated by the Metra's authorized representative and shall be kept clean of earth debris and material of any sort.
- 3.6.3 Burning of rubbish or debris on or near the premises will not be permitted.

**END OF SECTION 02200**

## SECTION 02260 – EXCAVATION SUPPORT AND PROTECTION

### 1 GENERAL

#### 1.1 SCOPE OF WORK

##### 1.1.1 General

- 1.1.1.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.1.2 Furnish and Install

- 1.1.2.1 Excavation support and protection systems Design, provide, monitor, and maintain an anchored and braced excavation support and protection system capable of resisting soil and hydrostatic pressures and supporting sidewalls of excavations.

- 1.1.2.1.1 Work includes removing excavation support and protection systems when no longer needed.

- 1.1.2.1.2 Prevent surface water from entering excavations by grading, dikes, or other means.

- 1.1.2.1.3 Install excavation support and protection systems without damaging existing buildings, pavements, and other improvements adjacent to excavation.

##### 1.1.3 Related Work

- 1.1.3.1 Section 02200 - "Excavation"

- 1.1.3.2 Section 02584 - "Underground Duct Banks and Manholes"

#### 1.2 SUBMITTALS

##### 1.2.1 Shop Drawings

- 1.2.1.1 Prepared by or under the supervision of a qualified professional engineer for excavation support and protection systems. System design and calculations must be acceptable to authorities having jurisdiction.

- 1.2.1.1.1 Include Shop Drawings signed and sealed by the qualified professional engineer responsible for their preparation.

##### 1.2.2 Qualification Data

- 1.2.2.1 For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of

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completed projects with project names and addresses, names and addresses engineers and owners, and other information specified.

- 1.2.3 Photographs or videotape, sufficiently detailed, of existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by excavation support and protection systems.

**1.3 QUALITY ASSURANCE****1.3.1 Installer Qualifications**

- 1.3.1.1 Engage an experienced installer to assume Engineering responsibility and perform work of this Section who has specialized in installing excavation support and protection systems similar to those required for this project and with a record of successful in-service performance.

**1.3.2 Professional Metra's authorized representative Qualifications**

- 1.3.2.1 A professional engineer who is legally qualified to practice in the jurisdiction where the Project is located and who is experienced in providing Engineering services for designing excavation support and protection systems that are similar to those indicated for this Project in material, design, and extent.

**1.3.2.1.1 Engineering Responsibility**

- 1.3.2.1.1.1 Engage a qualified professional engineer to prepare or supervise the preparation of data for the excavation support and protection system including drawings and comprehensive Engineering analysis that shows the system's compliance with specified requirements.

**1.3.3 Metra Temporary Shoring Guidelines**

- 1.3.3.1 See Appendix D.

**1.4 PROJECT CONDITIONS****1.4.1 Existing Utilities**

- 1.4.1.1 Do not interrupt utilities serving facilities occupied by the Owner or others unless permitted in writing by the Metra's authorized representative and then only after arranging to provide temporary utility services according to requirements indicated.

**1.4.2 Project Site Information**

- 1.4.2.1 A geotechnical report has been prepared for the various locations and is available for information only. The report is not part of the

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Contract Documents. The opinions expressed in this report are those of the geotechnical engineer and represent interpretations of the subsoil conditions, tests, and results of analyses conducted by the geotechnical engineer. Owner and its representatives will not be responsible for interpretations or conclusions drawn from this data by Contractor.

- 1.4.2.1.1 Make additional test borings and conduct other exploratory operations as necessary.
- 1.4.2.1.2 The geotechnical report is included elsewhere in the Project Manual.
- 1.4.2.1.3 The geotechnical report is referenced elsewhere in the Project Manual.
- 1.4.3 Survey adjacent structures and improvements, employing a qualified professional Metra's authorized representative or surveyor; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.
  - 1.4.3.1 During installation of excavation support and protection systems, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations for comparison with original elevations. Promptly notify Metra's authorized representative if changes in elevations occur or if cracks, sags, or other damage is evident in adjacent construction.

**2 PRODUCTS****2.1 MATERIALS**

- 2.1.1 Materials need not be new but must be in serviceable condition.
- 2.1.2 Structural Steel: ASTM A 36
- 2.1.3 Steel Sheet Piling: ASTM A 328 or ASTM A 572
- 2.1.4 Wood Lagging: Lumber, mixed hardwood, nominal rough thickness of 3 inches minimum.

**3 EXECUTION****3.1 PREPARATION**

- 3.1.1 Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.
  - 3.1.1.1 Shore, support, and protect utilities encountered.

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- 3.1.2 Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
    - 3.1.2.1 Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
  - 3.1.3 Locate excavation support and protection systems clear of permanent construction and to permit forming and finishing of concrete surfaces.
  - 3.1.4 Monitor excavation support and protection systems daily during excavation progress and for as long as excavation remains open. Promptly correct bulges, breakage, or other evidence of movement to ensure excavation support and protection systems remain stable.
  - 3.1.5 Promptly repair damages to adjacent facilities caused by installing excavation support and protection systems.
- 3.2 SOLDIER BEAMS AND LAGGING
- 3.2.1 Install steel soldier piles before staging excavation. Space soldier piles at intervals indicated. Accurately align exposed faces of flanges to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.
  - 3.2.2 Install wood lagging within flanges of soldier piles as excavation proceeds. Trim excavation as required to install lagging. Fill voids behind lagging with soil, and compact.
  - 3.2.3 Install wales horizontally at centers indicated and secure to soldier piles.
- 3.3 SHEET PILING
- 3.3.1 Install one-piece sheet piling and tightly interlock to form a continuous barrier. Accurately align exposed faces of sheet piling to vary not more than 2 inches from a horizontal line and not more than 1: 120 out of vertical alignment. Cut tops of sheet piling to uniform elevation at top of excavation.
- 3.4 TIEBACKS
- 3.4.1 Tiebacks: Drill for, install, tension, and grout tiebacks into position. Test load-carrying capacity of each tieback and replace and retest deficient tiebacks.
- 3.5 BRACING
- 3.5.1 Bracing

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- 3.5.1.1 Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move a brace, install new bracing before removing original brace.
  - 3.5.1.1.1 Do not place bracing where it will be cast into or included in permanent concrete work, unless otherwise approved by Metra's authorized representative.
  - 3.5.1.1.2 Install internal bracing, if required, to prevent spreading or distortion of braced frames.
  - 3.5.1.1.3 Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

**END OF SECTION 02260**



# TEMPORARY SHORING GUIDELINES

(10/1/2010)  
REV 0



## TEMPORARY SHORING

### I. Overview

Excavation in close proximity to railroad tracks is unavoidable. This guideline is designed to assist in the preparation of shoring documents so that review time is limited.

This document is only a guideline and the preparer is still required to follow any agency-specific requirements including: AREMA, Railroads, OSHA, IDOT, FRA, or other governing agency in the jurisdiction. Note this document is only applicable to Metra-owned tracks.

These guidelines are provided as reference and may not be taken as authority to construct without prior written approval of the Metra. The Contractor must not begin construction of any component of the shoring system affecting Metra right-of-way until written approval has been received from Metra.

### II. Submittals

To expedite shoring review the following items should be submitted with the review package.

- Design calculations stamped and signed by Illinois Licensed Structural Engineer
- Lateral pressure diagram
- Deflection calculations at top of wall and bracing locations including elastic deflection of the wall and the passive deflection of the resisting soil mass.
- Drawings or sketches of the proposed shoring consisting of:
  1. Plan view showing wall limits and distances from centerline of track (see attached example)
  2. Cross section (see attached example) showing excavation support system, top of rail elevation, distance from centerline of track to near face of excavation support, maximum excavation depth with elevations, elevation of bracing, tip elevation, etc.
  3. Connection details.
- Soil report and boring logs

### III. Design

Excavation support shall be based on AREMA Manual for Railway Engineering, Chapter 8, Section 20 and Section 24.

Lateral Pressure from train loads shall be based on Cooper E 80 train load (Figure 1) and active earth pressure due to railroad surcharge shall be calculated using the Boussinesq Equation for strip load per AREMA 8-20.3.2.2 (Figure 2). Uniform surcharge (q) shall be based on an 8.5 foot long tie, 5 foot axle spacing and 80 kip axle load resulting in  $q=1.88\text{kfsf}$ . See attached Table 1: Lateral Pressure from Train Load Example Calculation for additional variable designations

A simplified engineering analysis may be used, the railroad loading surcharge pressure may be assumed rectangular with width (P) equal to 0.8 of the maximum pressure as given by the appropriate railroad curve (Table 2: Lateral Pressure from Cooper E 80 train loads).

Temporary shoring on the Metra Electric Line may be designed for Cooper E 65 loading with approval from Metra.

All shoring systems must be analyzed for overturning, sliding and global stability.

Lateral live load deflection shall be limited to  $3/8"$  for shoring located within 18'-0" of centerline of track and  $1/2"$  for shoring located outside 18'-0". The maximum allowable vertical or horizontal displacement of rail shall be  $1/4"$ .



Material allowable stresses based on AREMA shall be as follow:

- Structural Steel: 0.55F<sub>y</sub> for compression in extreme fiber. (AREMA Table 15-1-11)
- Structural Steel: 0.35F<sub>y</sub> for Shear. (AREMA Table 15-1-11)
- Sheet Pile Sections: 2/3 of yield strength of steel. (AREMA 8.20.5.7)
- Concrete: 1/3 of Compressive Strength. (AREMA 8.20.5.7)
- Anchor Rods: ½ of yield strength of steel. (AREMA 8.20.5.7)

No AISC allowable stress increase for temporary loading condition will be allowed.

#### IV. General Requirements

All components of the temporary shoring system are to be removed when the shoring is no longer needed. Track cross section and drainage facilities must be restored.

All Temporary shoring systems within the clearance envelope (see attached AREMA Minimum Railway Clearance sketch) shall be terminated below the top of rail.

An OSHA acceptable handrail is required around all excavation.

No cantilever shoring will be allowed within 12 feet of active rails.

No MSE walls will be allowed within the limits of E80 surcharge.

Cold formed piling will not be accepted within the limits of E80 surcharge.

Track deflection monitoring shall be implemented. Elevations of top of rail shall be taken at 50 foot intervals for a distance to extend 100 feet beyond the limits of excavation. Elevations shall be recorded at the following intervals: prior to shoring construction, at completion of shoring construction, following first train through area, daily there after and once shoring has been removed or as directed by the Engineer.

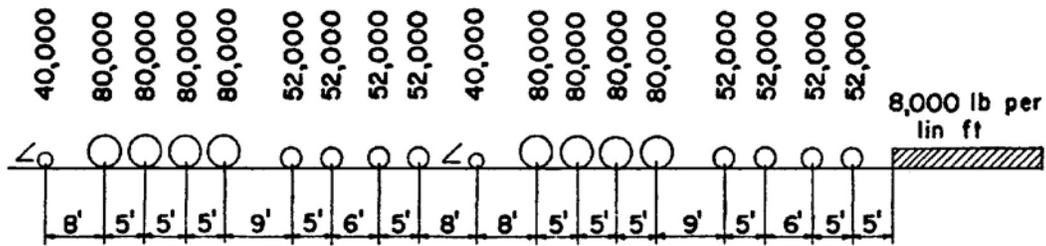


Figure 1: Cooper E 80 Load (AREMA Figure 15-1-2)

Boussinesq Equation:  $P_s = (2q / \pi) (\beta + \sin\beta \sin^2\alpha - \sin\beta \cos^2\alpha)$  (per AREMA 8-20.3.2.2.a)

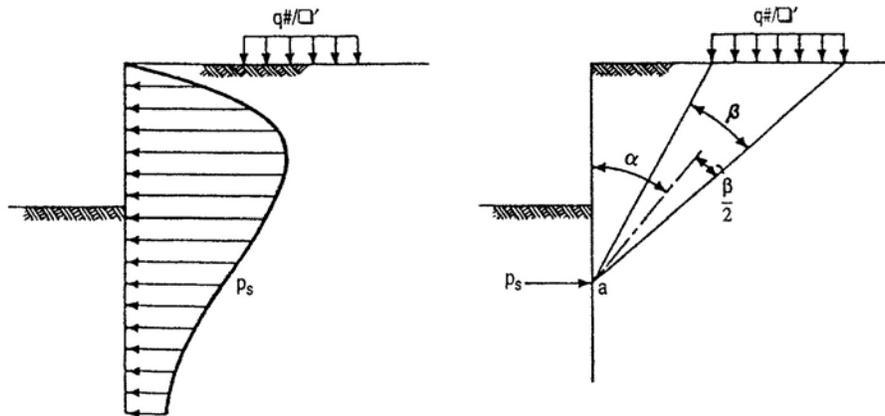
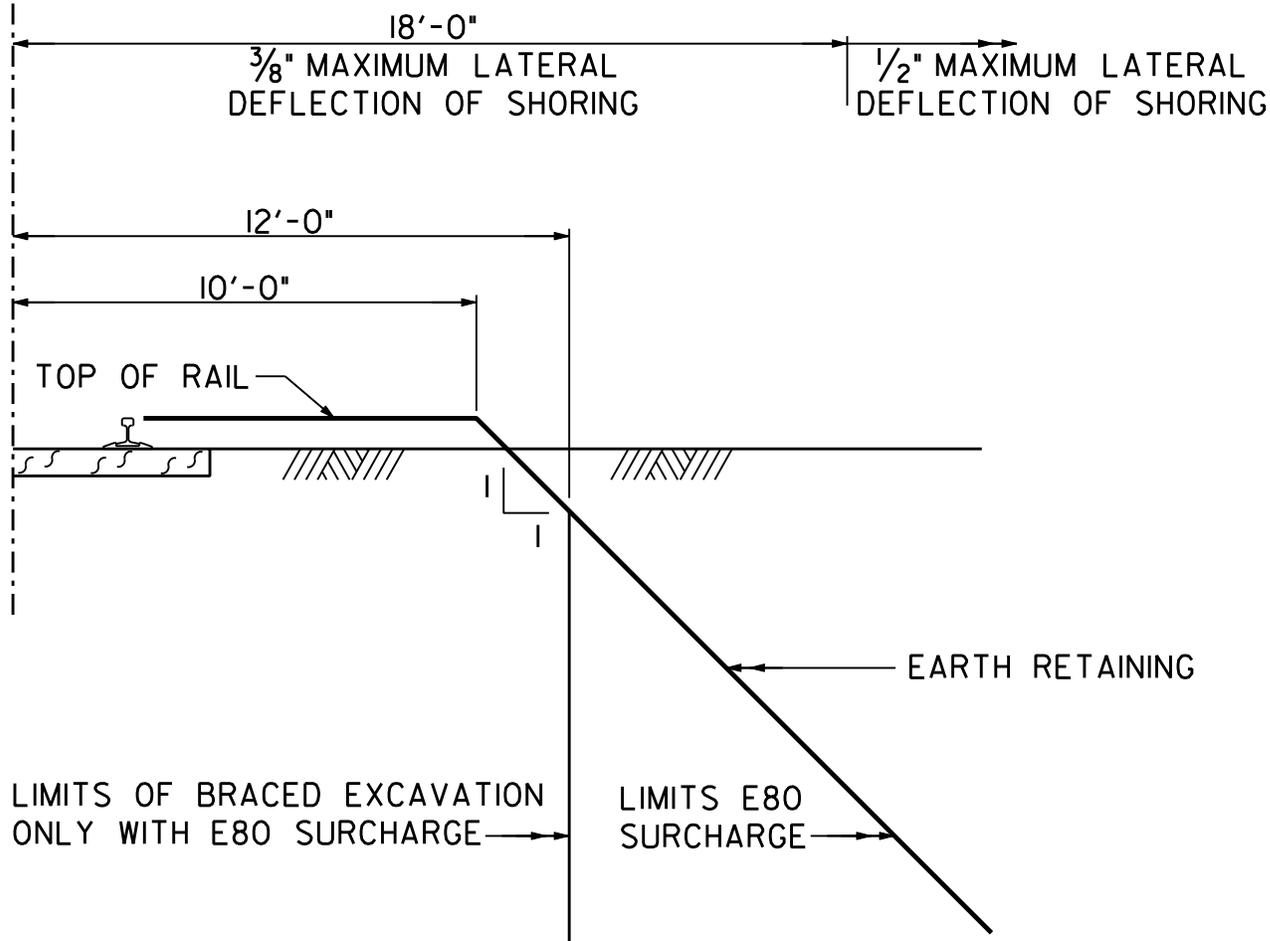


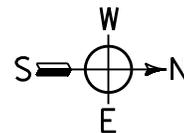
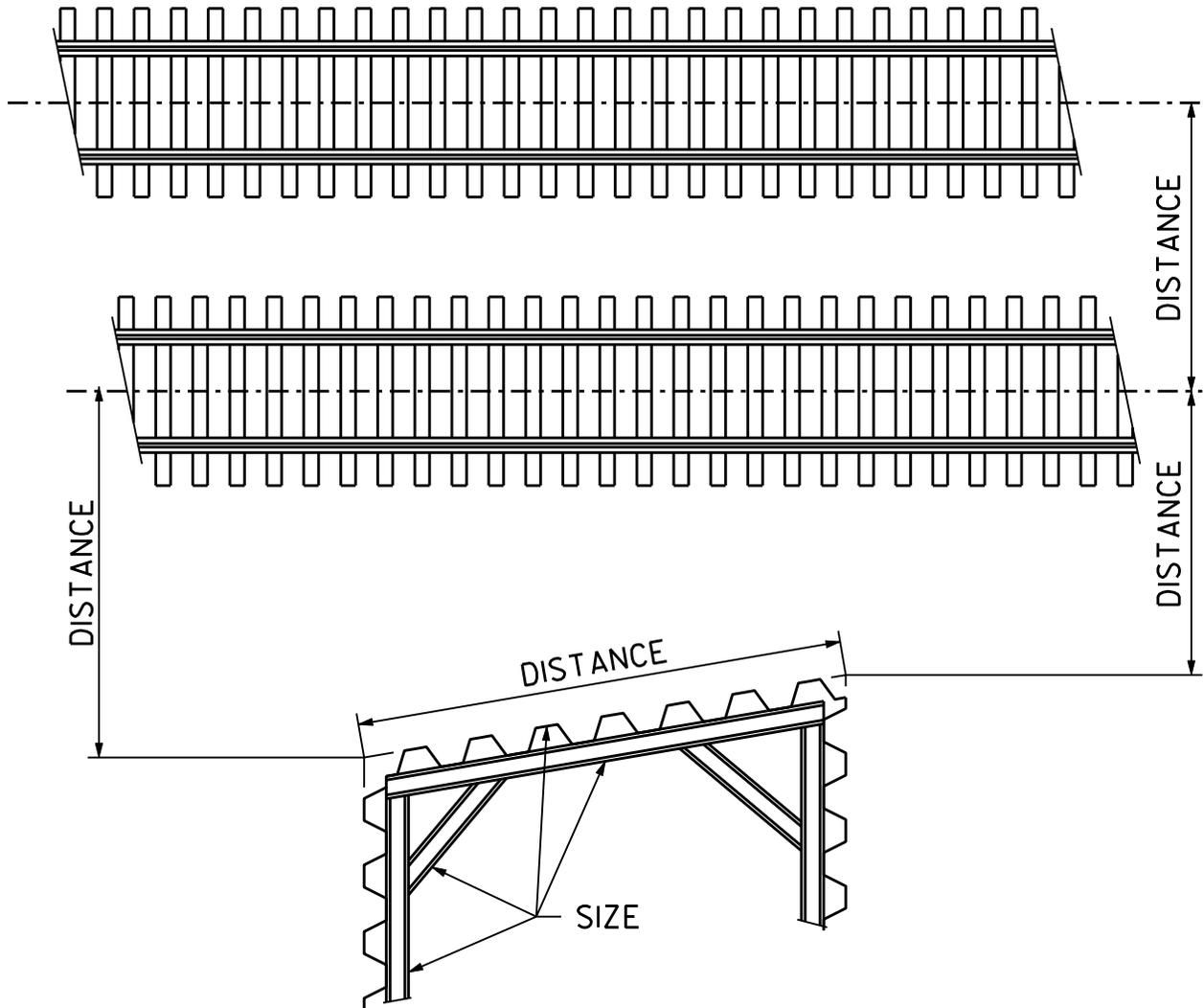
Figure 2: Pressure Distribution for Strip Load (AREMA Figure 8-20-2)

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TRACK



TITLE  
GENERAL SHORING  
REQUIREMENTS

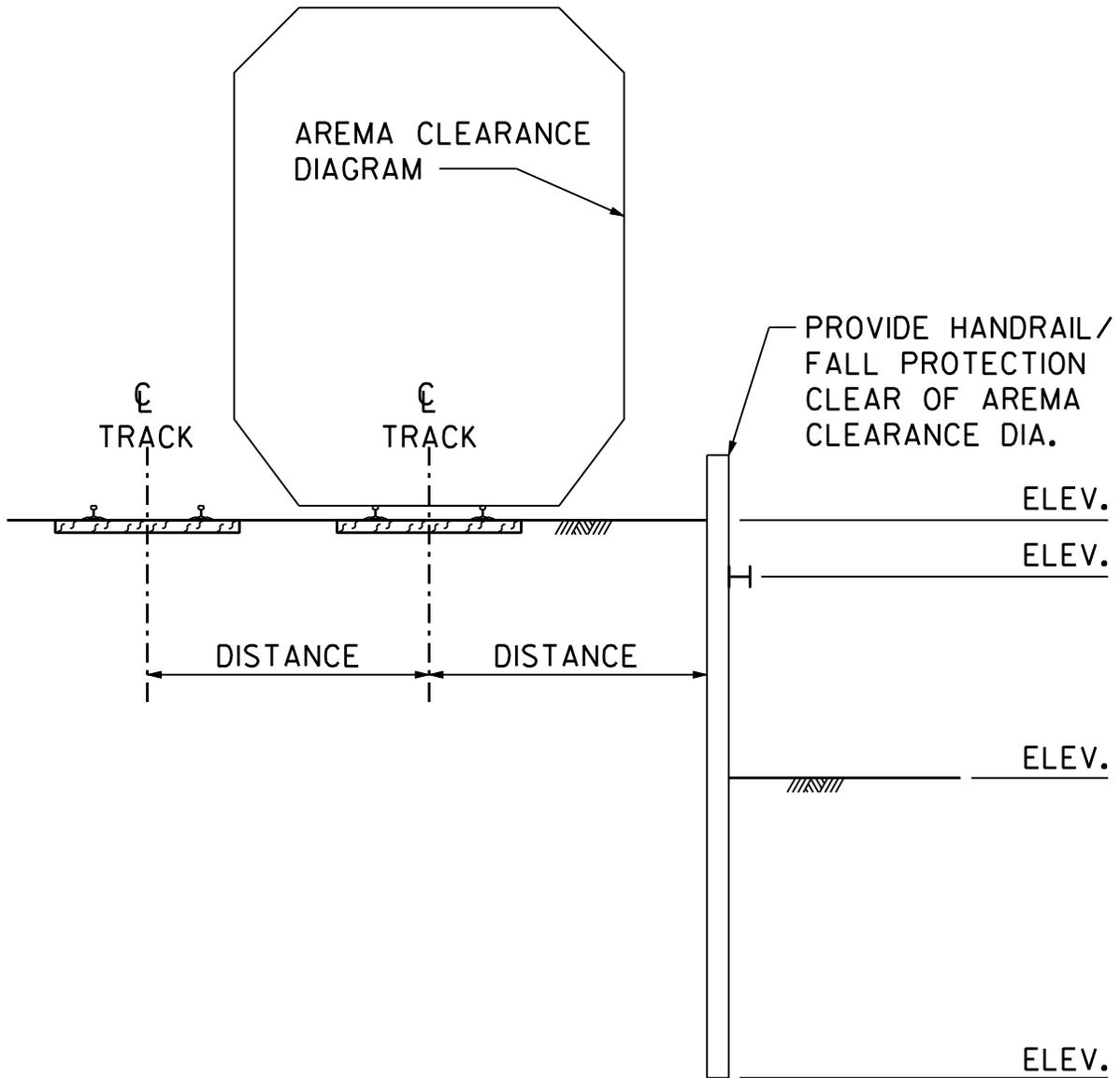
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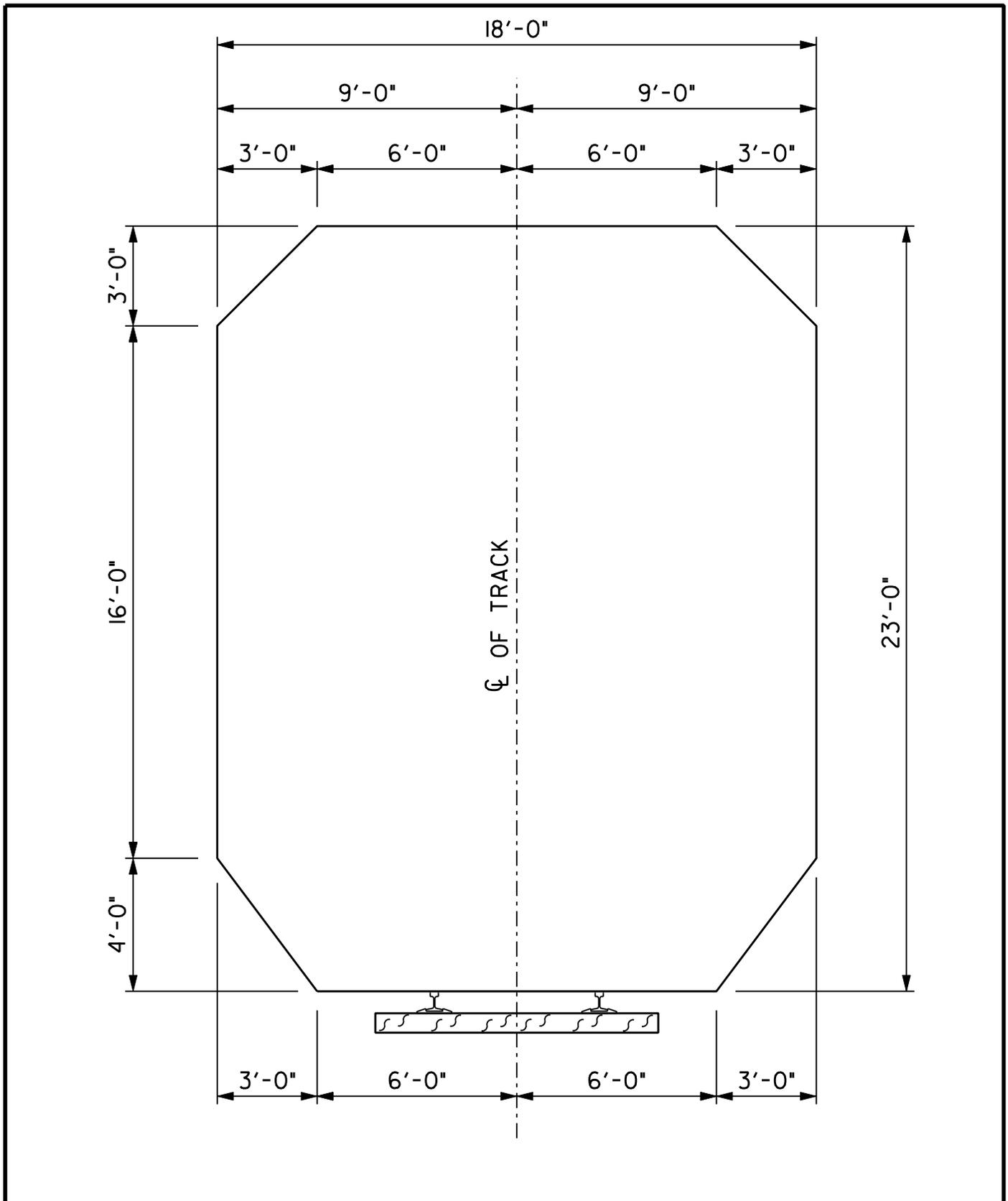
TITLE  
EXAMPLE  
PLAN VIEW

SHEET  
1 OF 1



TITLE  
EXAMPLE  
CROSS-SECTION

SHEET  
1 OF 1



TITLE  
AREMA MINIMUM  
RAILWAY CLEARANCE

SHEET  
1 OF 1

H <sub>s</sub> (ft)	Track 1			Track 2			P <sub>s</sub> total (ksf)
	β (rad)	α (rad)	P <sub>s</sub> (ksf)	β (rad)	α (rad)	P <sub>s</sub> (ksf)	
	Axle load	80 kips		Axle load	80 kips		
	TL	8.5 ft		TL	8.5 ft		
	CLT	10 ft		CLT	23 ft		
	q	1.8824 ksf		q	1.8824 ksf		
1	0.1021	1.4497	0.2410	0.0166	1.5258	0.0397	<b>0.2807</b>
2	0.1953	1.3337	0.4409	0.0330	1.4810	0.0785	<b>0.5194</b>
3	0.2734	1.2266	0.5775	0.0490	1.4366	0.1153	<b>0.6928</b>
4	0.3341	1.1301	0.6504	0.0644	1.3928	0.1495	<b>0.7999</b>
5	0.3783	1.0442	0.6723	0.0791	1.3498	0.1805	<b>0.8528</b>
6	0.4081	0.9682	0.6591	0.0930	1.3076	0.2076	<b>0.8668</b>
7	0.4265	0.9009	0.6247	0.1059	1.2664	0.2307	<b>0.8554</b>
8	0.4360	0.8412	0.5789	0.1177	1.2264	0.2497	<b>0.8287</b>
9	0.4390	0.7880	0.5287	0.1285	1.1875	0.2647	<b>0.7933</b>
10	0.4371	0.7404	0.4781	0.1382	1.1500	0.2757	<b>0.7538</b>
11	0.4317	0.6975	0.4297	0.1469	1.1137	0.2831	<b>0.7128</b>
12	0.4241	0.6589	0.3847	0.1545	1.0787	0.2872	<b>0.6720</b>
13	0.4148	0.6238	0.3437	0.1611	1.0451	0.2885	<b>0.6322</b>
14	0.4045	0.5920	0.3068	0.1668	1.0128	0.2872	<b>0.5941</b>
15	0.3937	0.5629	0.2739	0.1715	0.9818	0.2839	<b>0.5578</b>
16	0.3826	0.5363	0.2447	0.1755	0.9521	0.2788	<b>0.5235</b>
17	0.3715	0.5119	0.2189	0.1787	0.9237	0.2723	<b>0.4912</b>
18	0.3604	0.4894	0.1961	0.1812	0.8964	0.2648	<b>0.4609</b>
19	0.3496	0.4687	0.1760	0.1831	0.8703	0.2564	<b>0.4324</b>
20	0.3391	0.4495	0.1583	0.1845	0.8454	0.2474	<b>0.4057</b>
21	0.3289	0.4317	0.1426	0.1854	0.8215	0.2381	<b>0.3807</b>
22	0.3191	0.4152	0.1288	0.1858	0.7987	0.2285	<b>0.3573</b>
23	0.3097	0.3998	0.1166	0.1858	0.7769	0.2189	<b>0.3355</b>
24	0.3007	0.3855	0.1058	0.1855	0.7560	0.2093	<b>0.3151</b>
25	0.2920	0.3721	0.0961	0.1849	0.7360	0.1999	<b>0.2960</b>
26	0.2837	0.3595	0.0876	0.1841	0.7168	0.1906	<b>0.2782</b>
27	0.2758	0.3477	0.0800	0.1830	0.6985	0.1816	<b>0.2616</b>
28	0.2682	0.3367	0.0731	0.1818	0.6809	0.1729	<b>0.2460</b>
29	0.2610	0.3262	0.0671	0.1803	0.6641	0.1645	<b>0.2315</b>
30	0.2541	0.3164	0.0616	0.1788	0.6480	0.1564	<b>0.2180</b>
31	0.2475	0.3071	0.0567	0.1771	0.6325	0.1487	<b>0.2054</b>
32	0.2412	0.2984	0.0523	0.1754	0.6177	0.1414	<b>0.1936</b>
33	0.2351	0.2901	0.0483	0.1736	0.6035	0.1343	<b>0.1826</b>

Variable designation

$$P_s = (2q/\pi)(\beta + \sin\beta \sin^2\alpha - \sin\beta \cos^2\alpha) \quad \text{Active Pressure from surcharge loading AREMA 8-20.3.2.2.a}$$

$$B = \text{atan}[(\text{CLT} + \text{TL}/2)/H_s] - \text{atan}[(\text{CLT} - \text{TL}/2)/H_s] \text{ in radians}$$

$$A = \beta/2 + \text{atan}[(\text{CLT} - \text{TL}/2)/H_s] \text{ in radians}$$

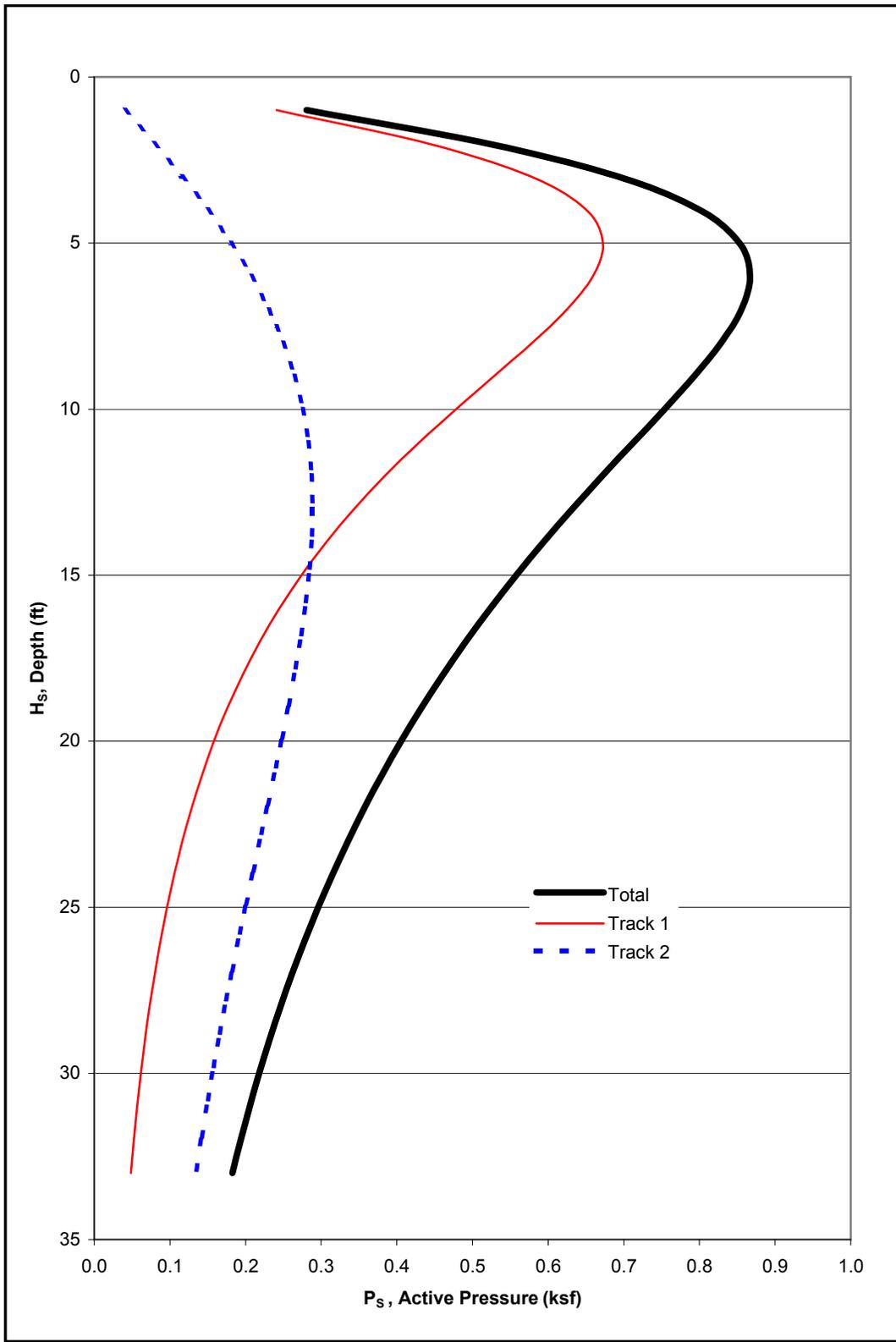
$$q = 80 \text{ kips} / (5' \times \text{TL}) \quad \text{uniform surcharge load from trains}$$

CLT = Distance from near face of retaining wall to centerline of track (feet)

TL = Tie length (8.5 feet)

H<sub>s</sub> = Depth below applied surcharge loading (feet)

*Table 1: Lateral Pressure from Train Load  
Example Calculations*



*Figure 3: Lateral Pressure from Train Load  
Example Calculations*

H <sub>s</sub>	CLT, Distance from near face of retaining wall to centerline of track (ft)																		
	8	9	10	11	12	14	16	18	20	23	26	29	32	35	39	43	47	51	55
1	0.416	0.310	0.241	0.193	0.159	0.113	0.085	0.066	0.053	0.040	0.031	0.025	0.020	0.017	0.014	0.011	0.009	0.008	0.007
2	0.700	0.550	0.441	0.361	0.301	0.218	0.165	0.130	0.104	0.078	0.061	0.049	0.040	0.034	0.027	0.022	0.019	0.016	0.014
3	0.828	0.691	0.577	0.486	0.413	0.307	0.237	0.188	0.152	0.115	0.090	0.073	0.060	0.050	0.040	0.033	0.028	0.023	0.020
4	<b>0.846</b>	<b>0.746</b>	0.650	0.565	0.492	0.378	0.297	0.239	0.196	0.150	0.118	0.095	0.078	0.066	0.053	0.044	0.037	0.031	0.027
5	0.803	0.742	<b>0.672</b>	0.603	0.538	0.429	0.345	0.282	0.233	0.180	0.143	0.116	0.096	0.081	0.066	0.054	0.045	0.039	0.033
6	0.732	0.703	0.659	<b>0.608</b>	<b>0.556</b>	0.460	0.380	0.315	0.265	0.208	0.166	0.136	0.113	0.095	0.078	0.064	0.054	0.046	0.040
7	0.653	0.647	0.625	0.592	0.554	0.474	0.402	0.340	0.290	0.231	0.187	0.154	0.129	0.109	0.089	0.074	0.062	0.053	0.046
8	0.576	0.585	0.579	0.561	0.536	<b>0.475</b>	0.413	0.357	0.309	0.250	0.205	0.170	0.143	0.122	0.100	0.083	0.070	0.060	0.052
9	0.504	0.523	0.529	0.523	0.509	0.466	<b>0.416</b>	0.366	0.322	0.265	0.219	0.184	0.156	0.133	0.110	0.092	0.078	0.067	0.058
10	0.439	0.464	0.478	0.482	0.477	0.450	0.411	<b>0.369</b>	<b>0.329</b>	0.276	0.232	0.196	0.167	0.144	0.119	0.100	0.085	0.073	0.063
11	0.382	0.411	0.430	0.440	0.442	0.428	0.401	0.367	<b>0.332</b>	0.283	0.241	0.206	0.177	0.153	0.127	0.108	0.092	0.079	0.069
12	0.333	0.363	0.385	0.399	0.406	0.404	0.386	0.360	0.331	0.287	0.248	0.214	0.185	0.161	0.135	0.115	0.098	0.085	0.074
13	0.290	0.320	0.344	0.361	0.372	0.378	0.369	0.350	0.327	<b>0.288</b>	0.252	0.220	0.192	0.168	0.142	0.121	0.104	0.090	0.079
14	0.253	0.283	0.307	0.326	0.339	0.352	0.350	0.338	0.319	0.287	0.255	0.224	0.197	0.174	0.148	0.127	0.110	0.095	0.084
15	0.222	0.250	0.274	0.294	0.309	0.327	0.331	0.324	0.310	0.284	<b>0.255</b>	0.227	0.202	0.179	0.153	0.132	0.115	0.100	0.088
16	0.195	0.221	0.245	0.265	0.281	0.302	0.311	0.309	0.300	0.279	0.254	0.228	0.205	0.183	0.158	0.137	0.119	0.104	0.092
17	0.172	0.196	0.219	0.239	0.255	0.279	0.291	0.293	0.288	0.272	0.251	<b>0.228</b>	0.206	0.186	0.161	0.141	0.123	0.108	0.096
18	0.152	0.175	0.196	0.215	0.232	0.257	0.272	0.278	0.276	0.265	0.247	0.227	<b>0.207</b>	0.188	0.164	0.144	0.127	0.112	0.099
19	0.135	0.156	0.176	0.194	0.211	0.237	0.254	0.262	0.264	0.256	0.242	0.225	0.207	0.189	0.167	0.147	0.130	0.115	0.102
20	0.120	0.139	0.158	0.176	0.192	0.218	0.236	0.247	0.251	0.247	0.237	0.222	0.206	<b>0.189</b>	0.168	0.149	0.133	0.118	0.105
21	0.107	0.125	0.143	0.159	0.175	0.201	0.220	0.232	0.238	0.238	0.230	0.218	0.204	0.189	0.169	0.151	0.135	0.121	0.108
22	0.096	0.112	0.129	0.145	0.159	0.185	0.205	0.218	0.226	0.229	0.224	0.214	0.201	0.188	<b>0.170</b>	0.153	0.137	0.123	0.110
23	0.086	0.101	0.117	0.131	0.145	0.170	0.190	0.205	0.214	0.219	0.216	0.209	0.198	0.186	0.170	0.153	0.138	0.125	0.112
24	0.077	0.092	0.106	0.120	0.133	0.157	0.177	0.192	0.202	0.209	0.209	0.204	0.195	0.184	0.169	0.154	0.139	0.126	0.114
25	0.070	0.083	0.096	0.109	0.122	0.145	0.165	0.180	0.191	0.200	0.202	0.198	0.191	0.182	0.168	<b>0.154</b>	0.140	0.128	0.116
26	0.063	0.075	0.088	0.100	0.112	0.134	0.153	0.169	0.180	0.191	0.194	0.192	0.187	0.179	0.167	0.154	0.141	0.128	0.117
27	0.057	0.069	0.080	0.091	0.103	0.124	0.143	0.158	0.170	0.182	0.187	0.186	0.182	0.176	0.165	0.153	<b>0.141</b>	0.129	0.118
28	0.052	0.063	0.073	0.084	0.094	0.115	0.133	0.148	0.160	0.173	0.179	0.180	0.178	0.173	0.163	0.152	0.141	0.130	0.119
29	0.048	0.057	0.067	0.077	0.087	0.106	0.124	0.139	0.151	0.164	0.172	0.174	0.173	0.169	0.161	0.151	0.140	<b>0.130</b>	0.120
30	0.044	0.052	0.062	0.071	0.080	0.099	0.115	0.130	0.143	0.156	0.165	0.168	0.168	0.165	0.158	0.149	0.140	0.130	0.120
31	0.040	0.048	0.057	0.065	0.074	0.092	0.108	0.122	0.135	0.149	0.158	0.162	0.163	0.161	0.156	0.148	0.139	0.129	0.120
32	0.037	0.044	0.052	0.060	0.069	0.085	0.101	0.115	0.127	0.141	0.151	0.156	0.158	0.157	0.153	0.146	0.138	0.129	<b>0.120</b>
33	0.034	0.041	0.048	0.056	0.064	0.079	0.094	0.108	0.120	0.134	0.145	0.151	0.153	0.153	0.150	0.144	0.136	0.128	0.120

Table 2: Lateral Pressure from Cooper E 80 Train Loads (ksf)

note boxed value represents the maximum pressure for each value of CLT

## SECTION 02443 - CHAIN LINK FENCE AND GATES

### 1 GENERAL

#### 1.1. SCOPE OF WORK:

##### 1.1.1 General

1.1.1.1 Work under this Section is subject to the requirements of the Contract Documents, including the Supplementary Conditions.

##### 1.1.2 Furnish and Install

1.1.2.1 Chain link fence and gates of size and type specified on the Drawings and specified herein. The work under this section shall include all labor, materials, tools, equipment and incidentals required for the construction of the chain link fence and gates, as specified herein, shown on the Plans or as directed by the Engineer.

##### 1.1.2.2 Gate Hardware

##### 1.1.3 Related Work

1.1.3.1 Except as modified herein, (including mesh fabric) the Work shall conform to the applicable portions of the IDOT Standard Specifications, Sections 664, Chain Link Fence; 1006, Metals; and 1020, Portland Cement Concrete.

1.1.3.2 Applicable portions of IDOT Highway Standard No. 2168, latest edition, and the Drawings.

1.1.3.3 Section 03300 – Cast-In-Place Concrete

#### 1.2 SUBMITTALS

1.2.1 The Contractor shall submit manufacturer's brochures or certificates for all materials indicating compliance with these Specifications.

1.2.2 Furnish engineering calculations as prepared by an Illinois licensed Structural Engineer, showing that maximum stresses and deflections do not exceed performance requirements under full design loading. Calculations shall be prepared and sealed by an Illinois licensed Structural Engineer.

1.2.3 Shop drawings indicating plans, elevations and details for complete installation of work.

1.2.4 Submit product data for gate hardware indicating all materials, sizes, installation instructions, etc.

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**1.3 QUALITY ASSURANCE**

- 1.3.1 Contractor is solely responsible for quality control of the materials and installation.
- 1.3.2 Regulatory Requirements: Comply with applicable requirements of the laws, codes, ordinances and regulations of Federal, State and Municipal authorities having jurisdiction. Obtain necessary approvals from all such authorities for placement and installation of all fencing.
- 1.3.3 Chain link fencing materials and construction shall conform to the applicable portions of Section 664 of the I.D.O.T. Standard Specifications.

**1.4 DELIVERY, STORAGE, AND HANDLING**

- 1.4.1 Deliver and store materials in manufacturer's original packaging labeled to show name, brand, type, and grade. Store materials in protected dry location off ground in accordance with manufacturer's instructions. Do not open packaging nor remove labels until time for installation.

**1.5 PROJECT CONDITIONS**

- 1.5.1 Locate existing underground utilities and other site improvements before starting installation of piers for fencing. Survey site for any possible obstructions in fence line and necessary clearances. Determine subsurface and surface conditions for installation of piers. Verify grades and determine elevation required for level installation of horizontal members.
- 1.5.2 Field Measurements: Verify lay-out information for chain link fences and gates shown on drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

**2 PRODUCTS****2.1 MATERIALS**

- 2.1.1 General: Material requirements specified in this section establish minimum requirements for all work defined in this section:
  - 2.1.1.1 Materials shall meet the requirements of Articles 1006.26, 1006.27 and 1006.28 of the Standard Specifications, except as modified herein.
- 2.1.2 Chain Link Fabric shall be woven in 5/8" mesh with 9 gauge wire, galvanized:
  - 2.1.2.1 Zink coating in accordance with ASTM A 392, Type II, Class 2, 1.8oz/sq.ft.

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- 2.1.2.2 Hot-dip galvanized, complying with zinc coating requirements of Article 1006.27d of the IDOT Standard Specifications.
- 2.1.3 All posts shall conform to IDOT Standard Specifications, Article 1006.27(b). In addition:
  - 2.1.3.1 Posts, fence framework, tension wire, fabric ties and fittings shall be zinc coated conforming to set of standards identified in IDOT Standard Specifications, Article 1006.27.
  - 2.1.3.2 Metal posts and rails shall conform to ASTM F 669, Group IA, Schedule 40.
  - 2.1.3.3 Member sizes shall be as required per approved engineering calculations, but not less than as shown on drawings.
- 2.1.4 Fittings and Accessories: In accordance with ASTM F 626. Provide components necessary for a complete installation. Hot dipped galvanized finish unless otherwise specified.
  - 2.1.4.1 Caps: Caps for posts and rails manufactured from steel or cast iron with hot dipped galvanized finish. Weathertight design for use on top of posts.
  - 2.1.4.2 Tension and Stretcher Bars: One bar for each gate and end post and 2 bars for each corner and pull post. Hot dipped galvanized finish. Minimum 1/4" x 3/4" flat steel.
  - 2.1.4.3 Stretcher Bar Bands: Galvanized flat steel bar not less than 1/8" x 1" with 3/8" galvanized carriage bolt.
  - 2.1.4.4 Brace: Horizontal member approximately 1/3 the height distance from top, secured to posts, at both sides of terminal (pull) posts, corner posts, and at fence side of gate posts.
  - 2.1.4.5 Tie Wire: 12 gage galvanized steel with ASTM F 626, Class 3 zinc coating.
  - 2.1.4.6 Tension wire shall be in accordance with ASTM A 824, Type II, Class 3. Diameter of coated wire shall be 7 gauge minimum. Conform to IDOT Specifications Article 1006.27(c)
  - 2.1.4.7 Truss Rods: One diagonally at ends, two diagonally at gates. Galvanized steel rod and turnbuckle assembly.
- 2.1.5 Gates: Use steel pipe frame in accordance with ASTM F 1043 and ASTM F 1083, Schedule 40, with not less than 1.8 oz./ft<sup>2</sup> zinc coating of surface area coated. Assemble gates by welding framing members. Use 5/16" dia. truss rod cross bracing to prevent sagging for leaves 5 feet wide or wider

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- 2.1.5.1 Fabric Height: Two inches less than adjacent fence height. Chain Link Fabric shall be of material and finish matching the fence.
  - 2.1.5.2 Hardware: Provide operating hardware including rollers, tracks, hinges, gate latch to accommodate padlock, plunger rod with latch with provisions for locking and all other appurtenances. Galvanized finish in accordance with ASTM A 153.
  - 2.1.5.3 Comply with ASTM F 900. Welded frame corner construction.
  - 2.1.5.4 Gates shall conform to IDOT Standard Specifications, Article 1006.27 for materials.
- 2.1.6 Concrete shall be class SI as identified in IDOT Standard Specifications, Section 1020,  $f'c= 3,500$  psi.

**3 EXECUTION****3.1 INSTALLATION GENERAL**

- 3.1.1 The Contractor shall install the fence and gates in accordance with applicable articles of Section 664 of the IDOT Standard Specifications.

**3.2 EXAMINATION**

- 3.2.1 Verification of Conditions: Examine the areas to receive the Work and the conditions under which the Work would be performed. Contractor shall remedy conditions detrimental to the proper and timely completion of the Work. Do not proceed until unsatisfactory conditions have been corrected.
- 3.2.2 Extent of work including height of fencing, size and location of gates, as shown on the drawings. Layout, dimensions and elevations at site for fencing to be verified in the field. Verify locations of obstructions and any other site conditions affecting installation.

**3.3 INSTALLATION OF FENCING**

- 3.3.1 Posts shall be installed as required per IDOT Standard Specifications, Article 664.04.
  - 3.3.1.1 General: Install in accordance with ASTM F 567. Space posts uniformly and not to exceed 8'-0" o.c. Posts to be set plumb, aligned, and at correct height and spacing. Hold in position until set. Install components with secure attachment, true to line, plumb and level.
- 3.3.2 Terminal Posts: Locate terminal end, corner, and gate posts per ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment.

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- 3.3.3 Space line posts uniformly.
- 3.3.4 Post Bracing and Intermediate Rails: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Install braces at end and gate posts and at both sides of corner and pull posts.
  - 3.3.4.1 Locate horizontal braces at midheight of fabric 6 feet or higher, on fences with top rail and at 2/3 fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.
- 3.3.5 Tension Wire: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch- diameter hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches O.C. Install tension wire in locations indicated before stretching fabric.
  - 3.3.5.1 Top Tension Wire: Install tension wire through post cap loops.
  - 3.3.5.2 Bottom Tension Wire: Install tension wire within 6 inches of bottom of fabric and tie to each post with not less than same diameter and type of wire.
- 3.3.6 Top Rail: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or posts caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.
- 3.3.7 Bottom rails: Install spanning between posts.
- 3.3.8 Bracing: Provide horizontal pipe brace at mid-height at each side of terminal posts and install diagonal truss bracing at these locations. Adjust truss rods to ensure posts remain plumb.
- 3.3.9 Chain Link Fabric: Apply fabric to inside or outside (as shown or directed) of enclosing framework. Leave 3 inch between finish grade or surface and bottom selvage, unless otherwise indicated. This distance may vary with uneven ground. Pull fabric taut and tie to posts, rails and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.
- 3.3.10 Tension or Stretcher Bars: Thread fabric through entire length of tension or stretcher bars and secure stretcher bars to end, corner, pull, and gate posts with galvanized tension bands spaced not more than 15 inches O.C. vertically.
- 3.3.11 Tie Wires: Use wires of proper length to firmly secure fabric to line posts and rails. Attach wire at 1 end to chain link fabric, wrap wire around post

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a minimum of 180 degrees, and attach other end to chain link fabric per ASTM F 626. Bend ends of wire to minimize hazard to individuals and clothing.

3.3.11.1 Maximum Spacing: Tie fabric to line posts at 12 inches O.C. and to braces at 24 inches O.C. horizontally.

3.3.12 Fasteners: Install nuts for tension bands and carriage bolts on the side of the fence opposite the fabric side.

**3.4 GATE INSTALLATION**

3.4.1 Install gates according to details shown on drawings and hardware manufacturer recommendations.

3.4.2 Install gates according to manufacturer's written instructions, level, plumb and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Drill hole(s) in pavement for plunger rod and/or foot bolt as required. Adjust hardware for smooth operation and lubricate where necessary.

**3.5 ADJUSTING**

3.5.1 Upon completion of the Work, repair surfaces that have been permanently stained, marred, or otherwise damaged. Replace Work which is damaged or cannot be adequately cleaned as directed.

3.5.2 Gate: Adjust gate to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

**3.6 CLEANING**

3.6.1 Upon completion of the Work, remove unused materials, debris, containers and equipment from the project site. In addition to the initial cleaning procedure required, and not more than two days before occupancy by the Authority, clean the Work as recommended by the manufacturer.

**END OF SECTION**

## SECTION 02466 – CONCRETE CAISSONS

### 1 GENERAL

#### 1.1 SCOPE OF WORK

##### 1.1.1 General

1.1.1.1 Work under this Section is subject to the requirements of the Contract Documents, including the Supplementary Conditions.

##### 1.1.2 Furnish and Install

1.1.2.1 All cast-in-place concrete caissons and work indicated on the drawings and specified, including but not limited to the following:

1.1.2.1.1 All cast-in-place concrete caissons and casing.

#### 1.2 SUBMITTALS

##### 1.2.1 Product Data:

1.2.1.1 For each type of product specified. Include reinforcement and admixtures.

##### 1.2.2 Shop Drawings:

1.2.2.1 For concrete reinforcement detailing fabricating, bending, and placing.

##### 1.2.3 Design Mixes:

1.2.3.1 For each class of concrete. Include revised mix proportions when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

##### 1.2.3.1.1 Laboratory Test Results

1.2.3.1.1.1 For evaluation of concrete materials and mix design test.

##### 1.2.4 Welding Certificates:

1.2.4.1 Copies of certificates indicating compliance of welding procedures and personnel with requirements in "Quality Assurance" Article.

##### 1.2.5 Qualification Data:

1.2.5.1 For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and

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addresses of Engineers and owners, and other information specified.

- 1.2.6 Record drawings at Project closeout according to Division 1 Section "Contract Closeout."

**1.3 QUALITY ASSURANCE****1.3.1 Installer Qualifications:**

- 1.3.1.1 Engage an experienced installer who has specialized in installing caissons similar to those required for this Project.

**1.3.2 Caisson Standard:**

- 1.3.2.1 Comply with provisions of ACI 336.1, "Specification for the Construction of Drilled Piers," unless modified in this Section.

- 1.3.2.1.1 The slurry displacement method of installation will not be permitted.

**1.3.3 Survey Work:**

- 1.3.3.1 Engage a registered surveyor or licensed professional engineer to perform surveys, layouts, and measurements for caissons. Lay out each caisson to lines and levels required before excavation and record actual measurements of each caisson's location, shaft diameter, bottom and top elevations, deviations from specified tolerances, and other specified data.

- 1.3.3.1.1 Record and maintain information pertinent to each caisson and cooperate with Owner's testing and inspecting agency to provide data for required reports.

**1.3.4 Testing Agency Qualifications:**

- 1.3.4.1 Qualify and engage an independent testing agency with the experience and capability to conduct the following testing without delaying the Work:

- 1.3.4.1.1 Qualify testing agency, according to ASTM E 329 and ASTM C 1077, to perform materials evaluation tests and to design concrete mixes.

**1.3.5 Welding Standards:**

- 1.3.5.1 Qualify welding procedures and welding personnel to perform the welding processes for this Project according to the following AWS standards:

- 1.3.5.1.1 AWS D1.1, "Structural Welding Code—Steel."

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1.3.5.1.2 AWS D1.4, "Structural Welding Code—Reinforcing Steel."

1.3.6 Trial Caisson:

1.3.6.1 Construct trial caisson of same diameter and depth as permanent caissons. Locate trial caisson at least 5 diameters clear of permanent caissons. Trial caisson shall demonstrate Installer's construction methods, equipment, standards of workmanship, and tolerances.

1.3.6.1.1 When Metra's authorized representative determines that trial caisson does not meet requirements, excavate for and cast another until trial caisson is accepted.

1.3.7 Pre-installation Conference:

1.3.7.1 Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."

1.4 PROJECT CONDITIONS

1.4.1 Existing Utilities:

1.4.1.1 Locate existing underground utilities before excavating caissons. If utilities are to remain in place, provide protection from damage during -caisson operations.

1.4.1.1.1 Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult Metra's authorized representative immediately for directions as to procedure. Cooperate with Owner and utility companies in keeping services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.

1.4.2 Site Information:

1.4.2.1 A geotechnical report has been prepared for this Project and is available for information only. The report is not part of the Contract Documents. Opinions expressed in this report are those of the geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by the geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from this data by Contractor.

1.4.2.1.1 Make additional test borings and conduct other exploratory operations as necessary.

1.4.2.1.2 The geotechnical report is included elsewhere in the Project Manual.

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- 1.4.2.1.3 The geotechnical report is referenced elsewhere in the Project Manual.

**2 PRODUCTS****2.1 REINFORCING MATERIALS****2.1.1 Reinforcing Bars:**

- 2.1.1.1 ASTM A 615, Grade 60 (ASTM A 615M, Grade 400), deformed, epoxy coated.

**2.2 CONCRETE MATERIALS**

- 2.2.1 Comply with the requirements of Specification Section 03300 Cast-In-Concrete.

- 2.2.2 Sand-Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Minimum compressive strength of grout shall be 2000 psi.

**2.3 STEEL CASINGS****2.3.1 Steel Pipe Casings:**

- 2.3.1.1 ASTM A 283 (ASTM A 283M), Grade C; or ASTM A 36 (ASTM A 36M) carbon-steel plate, with vertical joints full-penetration welded according to AWS D1.1.

**2.4 CONCRETE MIX**

- 2.4.1 Comply with the requirements of Specification Section 03300 Cast-in-Place Concrete.

- 2.4.2 The concrete mix shall be designed with a slump of 6" to 8", to be sufficiently fluid to fill the entire excavation as the temporary steel liner is pulled. A water reducer and/or plasticizer should be added to the concrete.

**3 EXECUTION****3.1 PREPARATION**

- 3.1.1 Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, vibration, and other hazards created by -caisson operations.

**3.2 EXCAVATION**

- 3.2.1 Excavation is unclassified and includes excavation to bearing elevations regardless of character of materials or obstructions encountered.

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- 3.2.1.1 Obstructions:
  - 3.2.1.1.1 Unclassified excavation includes removal of unanticipated boulders, concrete, masonry, or other subsurface obstructions.
- 3.2.2 Dewatering:
  - 3.2.2.1 Prevent surface and ground water from entering excavated shafts. Dewater excavated shafts before concreting. Conduct water to site drainage facilities.
- 3.2.3 Excavate shafts for caissons to indicated elevations.
  - 3.2.3.1 Excavate bottom of caissons to level plane.
  - 3.2.3.2 Remove loose material and water from bottom of excavation.
- 3.2.4 Notify and allow testing and inspecting agency to test and inspect bottom of excavation. If unsuitable bearing stratum is encountered, make adjustments to caissons as determined by the Geotechnical Engineer.
  - 3.2.4.1 Do not excavate shafts deeper than elevations indicated, unless approved by Geotechnical Engineer.
  - 3.2.4.2 Additional excavation will be paid according to Contract provisions for changes in the Work.
- 3.2.5 Make auger probe to a depth below bearing elevation equal to bearing area of caisson or 96 inches, whichever is less. Verify continuity and thickness of stratum. Determine whether voids, clay seams, or solution channels exist.
  - 3.2.5.1 Test the first 2 caissons and 1 of every 5 caissons thereafter.
- 3.2.6 Excavate shafts for closely spaced caissons and those occurring in fragile or sand strata, only after adjacent caissons are filled with concrete and allowed to set.
- 3.2.7 Slurry:
  - 3.2.7.1 Stabilize excavation with slurry maintained a minimum of 60 inches above ground-water level and above unstable soil strata to prevent caving or sloughing of shaft.
    - 3.2.7.1.1 Excavate and complete concreting of caisson on same day or redrill shaft and clean, recirculate, desand, or replace slurry.
    - 3.2.7.1.2 Clean bottom of each shaft before concreting.

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**3.2.8 Temporary Casings:**

3.2.8.1 Install watertight steel casings of sufficient length and thickness to prevent water seepage into shaft; to withstand compressive, displacement, and withdrawal stresses; and to maintain stability of shaft walls.

3.2.8.1.1 Temporary casings may be left in place or may be withdrawn during concrete placement at Contractor's option.

**3.2.9 Bells:**

3.2.9.1 Excavate bells for caissons to shape, base thickness, and slope angle indicated. Excavate bottom of bells to level plane and remove loose material before concrete is placed.

3.2.9.1.1 Shore bells in unstable soil conditions to preclude cave-in during excavation, inspection, and concreting.

**3.2.10 Tolerances:**

3.2.10.1 Construct caissons to remain within the following tolerances:

3.2.10.1.1 Maximum Variation from Location:

3.2.10.1.1.1 Not more than the lesser of 4 percent of caisson shaft diameter or 2 inches from design center location.

3.2.10.1.2 Out-of-Plumb:

3.2.10.1.2.1 Plumb to within 2 inches for each 20 feet of depth.

3.2.10.1.3 Concrete Cutoff Elevation:

3.2.10.1.3.1 Plus 1 inch, minus 3 inches.

3.2.10.1.4 Bottom Area of Caisson:

3.2.10.1.4.1 Not less than 96 percent of caisson area required.

3.2.10.1.5 Shaft Diameter:

3.2.10.1.5.1 Not less than 98 percent or more than 110 percent of shaft diameter indicated.

3.2.11 If location or out-of-plumb tolerances are exceeded, provide corrective construction. Submit design and construction proposals to Metra's authorized representative for review before proceeding.

3.2.12 Inspection:

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3.2.12.1 Each caisson must be inspected and tested before placing concrete.

3.2.12.1.1 Provide and maintain facilities with equipment required for testing and inspecting excavations. Cooperate with testing and inspecting personnel to expedite the Work.

3.2.12.1.2 Notify Metra's authorized representative and testing agency at least 6 hours before excavations are ready for tests and inspection.

**3.3 PERMANENT STEEL CASINGS**

3.3.1 Design and install steel pipe casings with inside clear diameter not less than diameter of caisson.

3.3.1.1 Install casings as excavation proceeds, to maintain sidewall stability.

3.3.1.2 If rock stratum is anticipated, fabricate bottom edge of lowest casing section with a cutting shoe capable of penetrating rock and achieving a water seal.

3.3.1.3 Connect casing sections by continuous penetration welds to form a watertight, continuous casing.

3.3.1.4 Remove and replace, or repair, casings that have been damaged during installation and that could impair strength or efficiency of caisson.

3.3.1.5 Fill annular void between casing and shaft wall with sand-cement grout.

**3.4 REINFORCEMENT**

3.4.1 Comply with recommendations of CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

3.4.2 Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy bond with concrete.

3.4.3 Fabricate and install reinforcing cages symmetrically about axis of shafts in a single unit.

3.4.4 Accurately position, support, and secure reinforcement against displacement during concreting. Maintain minimum cover to reinforcement.

3.4.5 Use templates to set anchor bolts, leveling plates, and other accessories furnished in work of other Sections. Provide blocking and

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holding devices to maintain required position during final concrete placement.

- 3.4.6 Protect exposed ends of extended reinforcement, dowels, or anchor bolts from mechanical damage and exposure to weather.

**3.5 CONCRETE PLACEMENT**

- 3.5.1 Place concrete in a continuous operation and without segregation immediately after inspection and approval of the shaft by an independent testing and inspecting agency.
- 3.5.2 Place concrete by means of bottom discharge bucket, flexible drop chute, elephant-trunk hopper, or tremie. Use chutes or tremies for placing concrete where a drop of more than 25 feet is required, or pump concrete into place.
- 3.5.3 Place concrete in a dry shaft, unless placement underwater is approved by the Metra's authorized representative.
- 3.5.3.1 Place concrete underwater by tremie method or pumping. Control placement operations to ensure tremie is embedded no less than 36 inches into concrete, and the flow of tremied concrete is continuous from bottom to top of caisson.
- 3.5.3.2 Other methods of depositing concrete may be used, if approved by Engineer.
- 3.5.4 Coordinate withdrawal of temporary casings with concrete placement operations to maintain a head of concrete no less than 60 inches above casing bottom.
- 3.5.5 Screed concrete at cutoff elevation level, install the shear key and apply a scoured, rough finish. Where cutoff elevation is above the ground elevation, form top section above grade and extend shaft to required elevation.
- 3.5.6 Construct a cold joint if concrete placement is delayed more than one hour. Level top surface of concrete and insert joint dowel bars. Before placing remainder of concrete, clean surface laitance, roughen, and slush with a commercial bonding agent or with a sand-cement grout mixed at the ratio of 1:1.
- 3.5.7 Protect concrete work, according to ACI 301, from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures.
- 3.5.7.1 Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

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- 3.5.7.2 Do not use calcium chloride, salt, or other mineral-containing antifreeze agents or chemical accelerators.
- 3.5.8 When hot-weather conditions exist that would seriously impair quality and strength of concrete, place concrete according to ACI 301 to maintain delivered temperature of concrete without exceeding 90 deg F (32 deg C).
  - 3.5.8.1 Place concrete immediately on delivery. Wet cure exposed concrete surfaces and formed shaft extensions by fog sprays, wet burlap, or other effective means for a minimum of 7 days.
- 3.6 FIELD QUALITY CONTROL
  - 3.6.1 Testing Agency:
    - 3.6.1.1 **Owner will engage** a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during excavation and concrete placement for caissons.
  - 3.6.2 A caisson report shall be prepared for each caisson and include all applicable items below:
    - 3.6.2.1 Actual top and bottom elevations.
    - 3.6.2.2 Top of rock elevation.
    - 3.6.2.3 Description of soil materials.
    - 3.6.2.4 Description, location, and dimensions of obstructions.
    - 3.6.2.5 Final top centerline location.
    - 3.6.2.6 Variation of shaft from plumb.
    - 3.6.2.7 Shaft excavating method.
    - 3.6.2.8 Design and tested bearing capacity of bottom.
    - 3.6.2.9 Depth of rock socket.
    - 3.6.2.10 Levelness of bottom and adequacy of cleanout.
    - 3.6.2.11 Ground-water conditions and water-infiltration rate, depth, and pumping.
    - 3.6.2.12 Description, diameter, and top and bottom elevations of temporary or permanent casings.
    - 3.6.2.13 Description of soil or water movement, sidewall stability, loss of ground, and means of control.

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- 3.6.2.14 Bell dimensions and variations from original design.
- 3.6.2.15 Date and time of starting and completing excavation.
  
- 3.6.2.16 Inspection report.
- 3.6.2.17 Position of reinforcing steel.
- 3.6.2.18 Concrete placing method, including elevation of consolidation and delays.
- 3.6.2.19 Elevation of concrete during removal of casings.
- 3.6.2.20 Location of construction joints.
- 3.6.2.21 Remarks, unusual conditions encountered, and deviations from requirements.
- 3.6.2.22 Concrete testing results.

**3.6.3 Soil Testing:**

- 3.6.3.1 Bottom elevations, bearing capacities, and lengths of caissons indicated have been estimated from available soil data. Actual elevations and -caisson lengths, and bearing capacities shall be determined by a qualified independent testing and inspecting agency. Final evaluations and approval of data will be determined by the Engineer.

**3.6.3.1.1 Hardpan-Bearing Caissons:**

- 3.6.3.1.1.1 Testing agency will take undisturbed rock core samples from -caisson bottoms; test each sample to determine its bearing capacity and report results and evaluations to the Metra's authorized representative.

**3.6.3.1.2 Soil-Bearing Caissons:**

- 3.6.3.1.2.1 Testing agency will take undisturbed soil samples from caisson bottoms; test each sample to determine its bearing capacity and the required bearing area and report results and evaluations to the Metra's authorized representative.

**3.6.4 Concrete Testing:**

- 3.6.4.1 Sampling and testing of concrete for quality control shall comply with the requirements of Specification Section 03300 Cast-In-Concrete.

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**3.6.4.2 Nondestructive Testing:**

3.6.4.2.1 Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.

**3.6.4.3 Additional Tests:**

3.6.4.3.1 Testing and inspecting agency shall make additional tests of concrete when test results indicate concrete strengths or other requirements have not been met.

3.6.4.3.1.1 Continuous coring of caissons may be required, at Contractor's expense, where observations of placement operations indicate deficient concrete quality, presence of voids, segregation, or other possible defects.

**3.7 DISPOSAL OF MATERIALS**

3.7.1 Remove surplus excavated material and slurry and legally dispose of it off Owner's property.

**END OF SECTION 02466**

## SECTION 02505 – PORTLAND CEMENT CONCRETE SIDEWALK AND STAIRS

### 1 GENERAL

#### 1.1 SCOPE OF WORK

##### 1.1.1 General

1.1.1.1 Work under this Section is subject to the requirements of the Contract Documents, including the Supplementary Conditions.

##### 1.1.2 Furnish and Install

1.1.2.1 All work indicated on the drawings and specified herein, including but not limited to the following:

1.1.2.1.1 Constructing Portland cement concrete sidewalks, curbs and stairs at the location shown in the plans, or as directed by the Metra's authorized representative. This work shall include all excavation and backfill; preparation of subgrade; furnishing, placing, and compacting subbase granular material, Type B; furnishing, installing, and removal of formwork; furnishing and installing of reinforcement and handrails; furnishing and placing concrete, class SI, and protective coat; furnishing and installing joint sealants; constructing expansion and contraction joints; regrading; and all labor, tools, and equipment necessary to complete the work as specified, including clean-up and restoration of the location.

##### 1.1.3 Related Work

1.1.3.1 Work under this item shall be performed in accordance with Sections 201, 202, 204, 205, 301, 311, 406, 407, 420, 424, 508, 1003, 1004, 1006, 1020, 1021, 1022, 1023, 1050, 1051, 1058, and 1103 of the Standard Specifications, except as herein modified.

1.1.3.2 Section 03300; "Cast-in-Place Concrete"

1.1.3.3 Applicable portions of IDOT Highway Standard No. 424001.

1.1.3.4 PCC Sidewalk and stair details, as shown on the Drawings.

#### 1.2 GENERAL REQUIREMENTS

1.2.1 Conduct site-clearing operations to ensure minimum interference with railway, roads, streets, walks and/or adjacent facilities. Do not close travel ways without written permission from authorities having jurisdiction.

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- 1.2.2 Provide protection to prevent damage to existing structures, track, roadway, sidewalk and/or other improvements on or adjacent to the job site. Restore any damaged improvement to its original condition as acceptable to parties having jurisdiction, with no additional compensation due to the Contractor.

**1.3 SUBMITTALS****1.3.1 Cast-in-Place Concrete****1.3.1.1 The Contractor shall submit the following:**

- 1.3.1.1.1 The proposed concrete mix design(s) for review and approval by the Metra's authorized representative. All mix designs shall be IDOT mix designs approved for the ready-mix supplier.
- 1.3.1.1.2 Manufacturer's Data: Furnish copies of the manufacturer's specifications for the admixtures, bonding agent, patching and surfacing compound, non-slip material, form oil, joint fillers and vapor barrier, including methods of application and installation.

- 1.3.2 The Contractor shall submit to the Metra's authorized representative a certificate from the supplier indicating the grade of steel being furnished to the job.

**1.3.3 Preformed Expansion Joint Filler****1.3.3.1 The Contractor shall submit the following:****1.3.3.1.1 Manufacturer's Literature:**

- 1.3.3.1.1.1 Material descriptions and installation instructions for each type of compound and filler to be used.

**1.3.3.1.2 Guarantees:**

- 1.3.3.1.2.1 Guarantee period shall be five years and shall include protection against.

- 1.3.3.1.2.1.1 Loss of adhesion or cohesion.
- 1.3.3.1.2.1.2 Loss of elasticity.
- 1.3.3.1.2.1.3 Staining or bleeding.
- 1.3.3.1.2.1.4 Running or sagging.
- 1.3.3.1.2.1.5 Shrinkage or opening of joints.
- 1.3.3.1.2.1.6 Loss of color stability.

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**1.4 QUALITY CONTROL****1.4.1 Concrete Formwork**

1.4.1.1 The Work shall be performed in accordance with the applicable portions of Section 424 of the Standard Specifications and the following requirements.

**1.4.1.1.1 Qualifications of Workmen**

1.4.1.1.1.1 Provide at least one person who shall be present at all times during execution of this portion of the Work and who shall be thoroughly familiar with the type of materials installed, the referenced standards and the requirements of this Work, who shall direct all Work performed under this section.

**1.4.1.1.2 Codes and Standards**

1.4.1.1.2.1 Unless otherwise shown or specified, design, construct, erect, maintain and remove forms and related structures for cast-in-place concrete work in compliance with American Concrete Institute Standards ACI 347, "Recommended Practice for Concrete Formwork".

**1.4.1.1.3 Allowable Tolerances**

1.4.1.1.3.1 Except as specified in this section herein, construct formwork to provide completed cast-in-place concrete surfaces complying with the tolerances specified in ACI 347. Before concrete placement, check the lines and levels of erected formwork. Make corrections and adjustments to ensure proper size and location of concrete members and stability of forming systems. During concrete placement, check formwork and related supports to ensure that forms are not displaced and that completed work will be within specified tolerances.

1.4.1.1.4 The Contractor shall submit to the Metra's authorized representative his proposed installation. The Contractor shall make modifications, if required, to his procedure to the satisfaction of the Engineer, but it is understood that the Metra's authorized representative approval shall not relieve the Contractor from his sole responsibility for obtaining satisfactory results.

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**1.4.2 Cast-in-Place Concrete**

1.4.2.1 All work included in this section shall be performed in accordance with applicable portions of Sections 420, 508, 1020, 1021, 1022, 1023, 1051, and 1058 of the Standard Specifications.

**1.4.2.2 Correction of Defective Work**

1.4.2.2.1 All concrete work which does not conform to the requirements of the Contract Documents, including strength, tolerances, and finishing, shall be corrected as directed by the Metra's authorized representative at the Contractor's expense. The Contractor shall be responsible for the cost of corrections to any other work affected by or resulting from corrections to the concrete work.

**2 PRODUCTS****2.1 BORROW**

2.1.1 Borrow material shall be provided by the Contractor, as required, from a borrow site approved by The Metra's authorized representative. It shall meet the requirements of Section 204 of the Standard Specifications.

**2.2 SUB-BASE GRANULAR MATERIAL, TYPE B**

2.2.1 The material shall have a CA-6 gradation conforming to Article 1004.04 of the Standard Specifications, except wet bottom boiler slag as defined in Article 1004.01 will not be permitted.

**2.3 FORMWORK**

2.3.1 Formwork shall meet the requirements of Article 1103.05 of the Standard Specifications.

**2.3.2 Form Materials**

2.3.2.1 Form concrete surfaces with plywood, lumber, metal, or other acceptable material. Provide lumber that is dressed on at least two edges and one side for tight fit. Forms shall provide a 3/4" chamfer on all concrete edges.

**2.3.3 Form Coating**

2.3.3.1 Provide commercial formulation, form-coating compounds that will not bond with, stain, nor adversely affect concrete surfaces, and will not impair subsequent treatment of concrete surfaces requiring bond or adhesion, nor impede the wetting of surfaces to be cured with water or curing compound.

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## 2.4 CONCRETE MATERIALS

2.4.1 Concrete materials shall meet the requirements of Sections 1020, 1021, 1022, and 1023 of the Standard Specifications. The concrete shall be Class SI and meet the following requirements:

## 2.4.1.1 Portland Cement

2.4.1.1.1 ASTM C150, domestic brand, Type I, normal Portland Cement; Type III for high-early strength Portland cement as per the requirements of Section 1001 of the Standard Specifications. The same brand of Portland cement shall be used for exposed concrete throughout the job unless a change is approved by the Metra's authorized representative. Air entraining cement is not acceptable.

2.4.1.2 High-early strength concrete may be used subject to Metra's authorized representative approval. All provisions of the specifications shall apply except that the 7-day compressive strength shall equal the 28-day compressive strength required for normal concrete.

## 2.4.1.3 Admixtures

2.4.1.3.1 Admixtures shall meet the requirements of Article 1020.05 and Section 1021 of the Standard Specifications.

## 2.4.1.4 Water-Reducing Admixture

2.4.1.4.1 As per the requirements of Article 1021.03 of the Standard Specifications.

## 2.4.1.5 Air-Entraining Admixture

2.4.1.5.1 Use air-entraining admixtures in all concrete, as per the requirements of Article 1021.02 of the Standard Specifications. Add air-entraining admixture at the manufacturer's prescribed rate to result in concrete at the point of placement having an air content of not less than 5% no more than 7% of the volume of the concrete.

## 2.4.1.6 Fly Ash

2.4.1.6.1 Shall not exceed 25% of the cementitious materials by weight.

## 2.4.1.7 Calcium Chloride

2.4.1.7.1 Shall not be used.

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**2.4.1.8 Concrete Curing Materials**

2.4.1.8.1 Burlap curing blankets, waterproof paper blankets, white polyethylene sheeting, and burlap-polyethylene blanket shall meet the requirements of Section 1022 of the Standard Specifications.

**2.4.1.9 Curing and Finishing Materials**

2.4.1.9.1 Liquid Membrane-Forming Compounds for Curing Concrete: Fed. Spec. TT-C-800A, Type I Styrene Acrylate or Type II Chlorinated Rubber; non-pigmented; "Kure-N-Seal" (Sonneborn Div. of Contech Inc.), "Dekote T130" (W.R. Grace & Co.) or "CR-26" (W.R. Meadows, Inc.).

2.4.1.9.2 Curing compounds shall be guaranteed not to affect the bond, adhesion or effectiveness of damp-proofing, or surface treatments.

**2.4.1.10 Ready Mix Concrete**

2.4.1.10.1 All ready-mixed concrete shall comply with Article 1020.11 of the Standard Specifications.

2.4.1.10.2 The ready-mixed concrete producer shall submit duplicate delivery tickets, one for the Contractor and one for the Metra's authorized representative, with each load of concrete delivered to the site.

2.4.1.10.3 Delivery tickets shall provide the following information:

2.4.1.10.3.1 Date

2.4.1.10.3.2 Name of ready-mix concrete plant

2.4.1.10.3.3 Contractor

2.4.1.10.3.4 Job Location

2.4.1.10.3.5 Truck number

2.4.1.10.3.6 Time dispatched, and time unloaded

2.4.1.10.3.7 Mix number

2.4.1.10.3.8 Amount of concrete in load in cubic yards

2.4.1.10.3.9 Admixtures in concrete, if any

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## 2.5 REINFORCEMENT

- 2.5.1 Reinforcement bars shall be epoxy coated, deformed bars, Grade 60 conforming to Article 1006.10 (b) of the Standard Specifications.
- 2.5.2 Dowel bars shall be epoxy coated, smooth bars, Grade 70 through 80, conforming to Article 1006.11 (b) of the Standard Specifications.
- 2.5.3 Welded wire fabric shall be epoxy coated, 6" x 6" (W2.9 x W2.9) conforming to Article 1006.10 of the Standard Specifications.
- 2.5.4 Tie wire shall be black annealed wire, 16 gauge or heavier if necessary for providing cage rigidity. Where the tie wire is in contact with epoxy-coated bars, the tie wire shall be epoxy coated.

## 2.6 CONCRETE JOINT SEALER

## 2.6.1 Polyurethane Sealant Type H:

- 2.6.1.1 ASTM C920, Grade P, Class 25, Use NT, M, A, O; multi-component, chemical curing, non-staining, non-bleeding, capable of continuous water immersion, non-sagging, self-leveling, gun grade type. Use primer recommended by the sealant manufacturer. Primer and sealant shall not cause visible stain on top surface of the substrate to which they are applied. All sealants shall match in color. The following products are acceptable:

- 2.6.1.1.1 Horizontal surfaces: Sonneborn "Sonolastic SL1" or equal.

- 2.6.1.1.2 Vertical surfaces: Sonneborn "Sonolastic NP1" or equal.

## 2.6.2 Primers, Solvents, Cleaners:

- 2.6.2.1 Non-staining materials recommended by sealant manufacturer for conditions of application; primer as necessary as required for the particular joint materials and sealant to be used and solvents which will clean substrate and remove sealant without deleterious effect.

## 2.6.3 Backer Rods and Strips ASTM D1056 Round:

- 2.6.3.1 Closed-cell, expanded polyethylene foam, "Ethafoam" (The Dow Chemical Co.), "Expand-O-Foam" (Williams Products), or approved equal. Furnish continuous lengths over-sized, larger than 30% to 50% joint width, and depth as indicated on Plans or as directed.

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**2.6.4 Bond Breaker:**

- 2.6.4.1 Polyethylene tape film or other approved material compatible with sealant. Bond breaker is required where sealant would otherwise bond to back surface of joint recess.

**2.7 PROTECTIVE COAT**

- 2.7.1 The material shall meet the requirements of Section 1023 of the Standard Specifications.

**3 EXECUTION****3.1 EARTHWORK**

- 3.1.1 Work under this item shall be performed in accordance with Sections 201, 202, 204, and 205 of the Standard Specifications, except as herein modified.
  - 3.1.1.1 Before any material is placed for construction of embankments, topsoil within the limits of clearing and grubbing shall be excavated and stockpiled on site for subsequent placement on finished embankment, as needed. Excess quantities of topsoil are to be hauled off-site. Placement of embankment may proceed upon acceptance of a proof-rolling test. The Metra's authorized representative shall approve the equipment used for the proof rolling.
  - 3.1.1.2 Embankment shall be compacted in accordance with the requirements of Article 205.06 of the Standard Specifications.
  - 3.1.1.3 All material shall be disposed of in accordance with Article 202.03 of the Standard Specifications at the Contractor's expense. Metra shall be informed of the disposal site and shall be given a copy of necessary permit(s). If the disposal site is on private property, Metra shall be given a copy of written permission from the property owner allowing the disposal.
  - 3.1.1.4 The Contractor shall support, maintain, and protect all utility lines to remain in service.
  - 3.1.1.5 When necessary, due to weather conditions, the Contractor shall remove snow and ice from the work area to the satisfaction of the Metra's authorized representative.
  - 3.1.1.6 Prior to placement of granular sub-base material, the Contractor will coordinate for Metra's authorized representative to inspect earthwork performed.
  - 3.1.1.7 Prior to excavating greater than the estimated amounts (within 10%), the Contractor shall notify Metra's authorized representative in writing. Failure to do so will result in additional excavation

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being paid for by the Contractor, with no additional compensation due.

3.1.1.8 The Contractor shall control dust on the site by spraying water or by other means satisfactory to the Metra's authorized representative.

3.1.1.9 The Contractor shall contact J.U.L.I.E. or DIGGER, and have utilities located before any earthwork may begin.

**3.2 SUB-BASE GRANULAR MATERIAL, TYPE B**

3.2.1 Work under this item shall be performed in accordance with Section 311 of the Standard Specifications, except as herein modified.

3.2.1.1 Construct a granular subbase of specified thickness according to Article 311.05(b) and the Metra's authorized representative approval. Gradation of granular material shall be CA-6.

3.2.1.2 The granular material shall be compacted to not less than 98 percent of the standard laboratory density.

3.2.1.3 The subbase granular material shall not be placed on a wet subgrade, a subgrade rutted by the Contractor's equipment, or a non-compacted and "Proof-rolled" subgrade.

3.2.1.4 The subgrade shall be prepared in accordance with Section 301 of the Standard Specifications. Preparation of the subgrade shall not be paid for separately but considered incidental to the Work.

3.2.1.5 It is understood that a certain amount of sub-base granular material may be displaced into the existing soil when the material is placed and compacted, however, any such material will not be measured for payment and the cost thereof considered incidental to the item.

3.2.1.6 The contractor will be required to drain off all rainfall as rapidly as possible and maintain the subgrade in a dry, smooth and compacted condition until the granular material is placed.

3.2.1.7 The Engineer may restrict hauling over the completed or partially completed work after inclement weather or at any time when the earth subgrade is soft and there is a tendency for the earth to work into the granular material.

**3.3 CONCRETE FORMWORK**

3.3.1 Work under this item shall be performed in accordance with Sections 420 and 424 of the Standard Specifications, except as herein modified.

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**3.3.2 Design of Work**

- 3.3.2.1 The design and engineering of the formwork, as well as its construction, shall be the responsibility of the Contractor and shall conform to "Recommended Practice for Concrete Formwork", ACI 347.
- 3.3.2.2 Forms shall conform to shape, lines and dimensions shown on the Drawings. They shall be designed to safely resist the pressure and weight of the concrete, and shall be properly tied and braced or shored so as to maintain position and shape.
- 3.3.2.3 Design formwork to be readily removable without impact, shock or damage to cast-in-place concrete surfaces and adjacent materials.
- 3.3.2.4 Temporary Openings: Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement and for placement of concrete. Brace temporary closures and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings on forms in as inconspicuous locations as possible, consistent with project requirements.

**3.3.3 Construction Formwork****3.3.3.1 General:**

- 3.3.3.1.1 Construct all required forms to be substantial, sufficiently tight to prevent leakage of mortar, and able to withstand internal pressure when filled with wet concrete.

**3.3.3.2 Layout:**

- 3.3.3.2.1 Form all required cast-in-place concrete to the shapes, sizes, lines and dimensions indicated on the Drawings.
- 3.3.3.2.2 Exercise particular care in the layout of forms to avoid necessity for cutting of concrete after forms have been removed.
- 3.3.3.2.3 Make proper provision for all openings, offsets, recesses, anchorage, blocking and other features of the Work as shown or required.
- 3.3.3.2.4 Carefully examine the Drawings and Specifications and consult with other trades as required, relative to provision for openings, anchor bolts and other items in the forms.

**3.3.3.3 Tolerances**

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- 3.3.3.3.1 Construct all forms straight, true, plumb and square within a tolerance horizontally of 1/8 inch and a tolerance vertically of 1/8 inch.
- 3.3.3.4 Wetting:
  - 3.3.3.4.1 Keep forms sufficiently wetted to prevent joints opening up before concrete is placed.
- 3.3.4 Work Prior to Concrete Placement
  - 3.3.4.1 Form Coatings:
    - 3.3.4.1.1 Coat form contact surfaces with form-coating compound before reinforcement is placed. Do not allow excess form-coating material to accumulate in the forms or to come into contact with surfaces which will be bonded to fresh concrete. Apply in compliance with manufacturer's instructions. Coat steel forms with a non-staining, rust-preventative form oil or otherwise protect against rusting. Rust stained steel formwork is not acceptable.
    - 3.3.4.2 Cleaning and Tightening:
      - 3.3.4.2.1 Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete is to be placed. Retighten forms immediately after placement as required to eliminate mortar leaks.
    - 3.3.4.3 Edge Forms and Screed Strips:
      - 3.3.4.3.1 Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in the finished slab surface. Provide and secure units to support types of screeds required.
    - 3.3.4.4 Once forms are set and at least 24 hours prior to the placement of concrete, the Contractor shall notify the Engineer that the formwork is ready for final inspection.
  - 3.3.5 Removal of Formwork:
    - 3.3.5.1 Side forms not supporting vertical loads may be removed after cumulative curing at not less than 50° F for 24 hours after placing concrete, providing the concrete is sufficiently hard not to be damaged by form removal operations and providing that curing and protection operations are maintained.
  - 3.3.6 Reuse Forms:

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- 3.3.6.1 Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable. Apply new form-coating compound material to concrete contact surfaces as specified for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close all joints. Align and secure joints to avoid offsets. Do not use "patched" forms for exposed concrete surfaces.

**3.4 CONCRETE PLACEMENT**

- 3.4.1 Work under this item shall be performed in accordance with Sections 420 and 424 of the Standard Specifications, except as herein modified.
  - 3.4.1.1 No sidewalk shall be placed on a frozen subbase or base.
  - 3.4.1.2 The Contractor shall construct curb ramps at the intersection of streets and wherever it is shown on the plans and as directed by the Engineer. This work shall be in accordance with the applicable portion of Sections 508 and 424 of the Standard Specifications and Standard Drawing 424001.
  - 3.4.1.3 The curb ramps and side flares shall be constructed to a uniform 5-inch thickness, except that where shown in the plans, the uniform ramp thickness shall be 8 inches.
  - 3.4.1.4 Pre-placement Inspection:
    - 3.4.1.4.1 Before placing concrete, inspect and complete the formwork installation, reinforcing steel, and items to be embedded or cast-in. Notify other trades to permit the installation of their Work; cooperate with other trades in setting such work as required. Thoroughly wet wood forms immediately before placing concrete, as required where form coatings are not used. Coordinate the installation of joint materials with placement of forms and reinforcing steel.
  - 3.4.1.5 General Requirements:
    - 3.4.1.5.1 Comply with Section 420 of the Standard Specifications.
  - 3.4.1.6 Temperature Control for Placement:
    - 3.4.1.6.1 Comply with Article 1020.14 of the Standard Specifications.
  - 3.4.1.7 Concrete Curing and Protection:
    - 3.4.1.7.1 Concrete curing shall meet the requirements of Article 1020.13 of the Standard Specifications.
  - 3.4.1.8 Concrete Joints:

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- 3.4.1.8.1 Expansion joints, construction joints, and control joints shall be as shown on the Drawings, and as specified. Additional construction joints shall be subject to approval by the Metra's authorized representative.
- 3.4.1.9 Tooled or sawed construction joints shall be spaced at intervals equaling the width of the concrete walk, but not less than 5 feet, or as shown on the Plans.
- 3.4.1.10 Full depth expansion joints (3/4 inch wide) shall be spaced 20 feet maximum on centers.
- 3.4.1.11 Concrete Finishing:
  - 3.4.1.11.1 Horizontal concrete surfaces shall be finished as per Article 424.06 of the Standard Specifications.
  - 3.4.1.11.2 Vertical concrete surfaces shall be finished smooth and even, and given a light brush finish while the concrete is still workable. The edges shall be rounded with approved finishing tools having the radii shown on the plans.

**3.5 CONCRETE JOINT SEALER**

- 3.5.1 Work under this item shall be performed in accordance with Section 420 of the Standard Specifications, except as herein modified.
  - 3.5.1.1 Before commencing installation, the Metra's authorized representative shall examine the substrate to determine that they are free of conditions, which might be detrimental to timely completion of the Work.
  - 3.5.1.2 Verify that joint backing and release tapes are compatible with sealant.
  - 3.5.1.3 Clean substrate and remove protective coatings, which might fail in adhesion or interfere with bond of compound so that surfaces are free of deleterious substances, which might impair the Work. Elastomeric sealants shall not be applied to joint surfaces previously treated with paint, lacquer, sealer, curing compound, water repellent or other coatings unless such coatings have been entirely removed.
  - 3.5.1.4 Prime substrate in accordance with the instructions of the sealant manufacturer.
  - 3.5.1.5 Install bond breakers in locations and of type recommended by the sealant manufacturer to surface where such bond might impair the performance of the sealant.
  - 3.5.1.6 Before applying materials, joints shall be clean. Remove dust and other loose debris with a stiff brush or compressed air. Wire brush

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to remove rust or corrosion from metals. If concrete joints were "wet" sawed, remove laitance from sides of joint by approved means. Eliminate traces of oil, grease, or lacquers with a solvent wash, using toluene, xylene, or methylethyl ketone (MEK) applied with a clean brush and wiped dry with frequently changed clean rags.

- 3.5.1.7 Mix and install all materials in accordance with the manufacturer's printed instructions.

**3.6 PROTECTIVE COAT**

- 3.6.1 Work under this item shall be performed in accordance with Section 420 of the Standard Specifications, except as herein modified.

- 3.6.1.1 Protective coat shall be applied on all concrete sidewalks in accordance with Article 420.18 of the Standard Specifications.

- 3.6.1.2 Inspection:

- 3.6.1.2.1 Before commencing work, the surface shall be examined to determine that it is clean, dry and free of grease, oil or other surface contaminants which might be detrimental to proper and timely completion of work.

- 3.6.1.3 Clean adjoining surfaces of smears, compound, or other soiling due to these operations, as work progresses. Restore, refinish or replace any adjacent surfaces or materials, which are marred or damaged to the satisfaction of the Engineer.

**END OF SECTION 02505**

## SECTION 02525 – CONCRETE CURB AND GUTTER

### 1 GENERAL

#### 1.1 DESCRIPTION

1.1.1 This work shall consist of furnishing materials, labor, equipment, and services necessary to construct concrete gutter, curb, and monolithic curb and gutter as shown on the Plans and as specified herein.

1.1.2 All work shall be in accordance with Section 606 of the Standard Specifications except as herein modified.

#### 1.2 RELATED WORK SPECIFIED ELSEWHERE

1.2.1 Section 02200 – Excavation

1.2.2 Section 02547 – Hot-Mix Asphalt Pavement

1.2.3 Section 03300 – Cast-in-Place Concrete

#### 1.3 SUBMITTALS

1.3.1 The Contractor shall submit manufacturer's brochures or certificates for expansion joint filler material and joint sealer indicating compliance with these specifications.

1.3.2 The Contractor shall furnish copies of the manufacturer's specifications including methods of application and installation for the admixtures and bonding agents.

#### 1.4 QUALITY ASSURANCE

1.4.1 Comply with requirements of specification section 03300 – Cast-in-Place Concrete.

### 2 PRODUCTS

#### 2.1 MATERIALS

2.1.1 All materials shall be in conformance with Article 606.02 of the Standard Specifications.

2.1.1.1 Concrete shall comply with requirements of specification section 03300 – Cast-in-Place Concrete.

2.1.1.2 Reinforcing steel shall conform to ASTM A615, Grade 60, epoxy coated.

- 2.1.1.3 Welded wire fabric shall conform to ASTM A185, epoxy coated.
- 2.1.1.4 Preformed expansion joint filler shall conform to Article 1051 of the Standard Specifications.

### 3 EXECUTION

#### 3.1 CONSTRUCTION REQUIREMENTS

- 3.1.1 No curb or gutter shall be placed until the base course has been placed and compacted according to Section 02547-Hot-Mix Asphalt Pavement and approved by the Metra's authorized representative.
- 3.1.2 Construction, contraction, and expansion joints shall be installed in the curb, gutter, or curb and gutter in prolongation with joints in adjacent P.C.C. pavement or base course except that dowel bars will not be required in such contraction joints.
- 3.1.3 All construction joints shall be provided with No. 4 deformed steel tie bars 30 inches long conforming to AASHTO M-31 or M-53. Tie bars shall be placed on 9 inches centers (minimum 2 per joint).
- 3.1.4 Longitudinal joints between P.C.C. pavement or base course shall be provided with No. 4 deformed steel bars 30 inches long on 30 inch centers, embedded 15 inches into the pavement or base course at mid-depth. Pavement edge shall be flush against the face of the gutter; no joint filler shall be used.
- 3.1.5 Where the new curb and gutter is adjacent to existing concrete pavement the No. 4 deformed steel tie bars shall be drilled 15 inches into the existing pavement and grouted into place with non-shrink grout.
- 3.1.6 Expansion joints in curbs shall contain two dowel bars and one inch preformed joint filler.
- 3.1.7 Joints shall be no more than 40 feet apart. If an intermediate joint is needed to meet this requirement it shall be a contraction joint.
- 3.1.8 Do not install curb, gutter, or curb and gutter adjacent to concrete pavement prior to placement of concrete pavement.
- 3.1.9 No curb and gutter shall be placed on a frozen surface.

**END OF SECTION 02525**

## SECTION 02547 – HOT-MIX ASPHALT PAVING

### 1 GENERAL

#### 1.1 SCOPE OF WORK

##### 1.1.1 General

1.1.1.1 Work under this Section is subject to the requirements of the Contract Documents, including the Supplementary Conditions.

##### 1.1.2 Furnish and Install

1.1.2.1 All Hot-Mix Asphalt (HMA) paving and miscellaneous patching as indicated on the drawings and specified, including but not limited to the following:

1.1.2.1.1 Furnishing, placing and compacting aggregate base course.

1.1.2.1.2 Furnishing, placing and compacting HMA binder course and surface course over base course to match and patch existing.

1.1.2.1.3 Installation of seal coat over new surfaces, replacing any pavement markings, and new pavement markings.

1.1.2.1.4 Patching existing HMA pavements removed for the construction of new work or removed for resetting existing catch basin covers and drain inlets along curbs, or as required to provide proper transition between existing street paving and new construction work. The preparation of the sub-grade and the aggregate base or concrete base shall be included as work required under this section.

1.1.2.1.5 Pavement stripping.

##### 1.1.3 Related Work

1.1.3.1 Specified in the following Sections:

1.1.3.1.1 Section 02200; "Excavation"

1.1.3.1.2 Section 03300; "Cast-in-Place Concrete"

#### 1.2 SUBMITTALS

1.2.1 Tests; comply with the requirements of the Supplementary Conditions and include:

1.2.1.1 All HMA paving inspections and tests specified herein, or deemed required by the Metra's authorized representative, will be performed by a testing laboratory, employed by the Owner. The

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Contractor shall cooperate with said testing laboratory in every respect by providing samples for testing and necessary facilities at the job site for field tests and sample procurement. Patch all cuts made for test samples.

1.2.1.2 Tests shall include analysis and determination of the quality of various HMA compositions, base material, and compaction of HMA paving, verifying design as indicated or required.

1.2.2 Guarantees; comply with the requirements of the Supplementary Conditions.

1.2.2.1 The Contractor hereby guarantees the work, according to the Supplementary Conditions. Areas showing cracks, blisters, buckles or depressions greater than the tolerances specified, within one (1) year of completion and final acceptance of the work, shall be repaired or replaced to the satisfaction of and at no cost to the Owner.

### 1.3 SPECIAL REQUIREMENTS

1.3.1 Reference Standards; the work is subject to requirements of applicable sections of the following:

1.3.1.1 IDOT "Standard Specifications for Road and Bridge Construction" prepared by the State of Illinois, Department of Transportation, Division of Highways. The "Standard Specification for Road and Bridge Construction" is referred to in the following Articles as the "Standard Specifications" and except as may be otherwise stated, the work to be done under this Section shall conform to the requirements of said "Standard Specifications". Contractor's field office and laboratory is not a requirement.

1.3.1.2 Where the "Standard Specifications" refer to the "Engineer" it shall be understood to mean METRA's authorized representative.

1.3.1.3 **Note:** Articles referring to "Method of Measurement" and "basis of payment" are not applicable.

1.3.2 Protection; Protect materials against damage from mechanical abuse, salts, acids, and other foreign matter by an approved means during transportation, storage and erection and until completion of construction work. All unsatisfactory materials shall be removed from the premises, and all damaged materials replaced with new materials.

## 2 PRODUCTS

### 2.1 MATERIALS

2.1.1 Materials shall be of the best quality throughout, using approved aggregates and bituminous materials. It is the intent of the

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specifications to indicate the standard of construction desired and the Contractor shall, before starting this work, submit to the Metra's authorized representative for approval, mix proportions he intends to use and the means and methods of construction he intends to employ.

- 2.1.2 Aggregate Base Course: Standard Specifications, SSRBC Section 351, Type B. Provide only gradation CA-6 aggregate.
- 2.1.3 HMA Concrete Binder and Surface Courses shall be class 1 as specified in Section 406 of the "Standard Specifications".
  - 2.1.3.1 Binder mixture " IL-9.5, N50" shall be used for the binder course and be not less than one and a half inches (1-1/2") thick.
  - 2.1.3.2 Surface mixture " Mix D, N50" shall be used for the surface course and shall not be less than one and a half inches (1-1/2") thick.
- 2.1.4 HMA Prime and Tack Coats: Standard Specifications, SSRBC Section 406.
- 2.1.5 Pavement striping materials shall meet the requirements of Standard Specifications, SSRBC Section 780.

**3 EXECUTION****3.1 INSPECTION**

- 3.1.1 It is understood that the commencing of HMA paving work shall be an indication of the acceptance of sub-grade and the Contractor will be held responsible for the satisfactory execution and results of the finished work.

**3.2 INSTALLATION**

- 3.2.1 The pavements shall be finished to indicated grades, slopes and elevations and shall meet existing or established grades as applicable. All work required to adapt to existing conditions to obtain proper transition between the new work and the existing shall be performed. No depressions or waves will be permitted over 1/4 inch in 10 feet, non-cumulative. HMA concrete shall not be placed in cold or inclement weather; or within three hours before sunset, unless artificial light is provided for proper handling and finishing, as approved by the Metra's authorized representative.
- 3.2.2 Sub-grade:
  - 3.2.2.1 Before proceeding with the installation of any pavement prepare the Required Subgrade Level to a finished condition as specified in Section 02200.
- 3.2.3 Aggregate Base Course:

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3.2.3.1 After the Required Subgrade Level has been approved by the Testing Laboratory, the aggregate base course indicated on the drawings or specified shall be installed. The aggregate base course shall be placed and compacted as specified in Section 02200 and no HMA concrete placed until the base has been approved by the Testing Laboratory.

3.2.4 Primer:

3.2.4.1 Apply a uniform application of medium curing type asphalt primer, grade as approved by the Metra's authorized representative, by means of pressure distribution at the rate of 0.25 to 0.50 gallons per square yard to all base surfaces before laying binder course.

3.2.5 Binder and Surface Courses:

3.2.5.1 Machine lay a 1-1/2 inch thick HMA concrete binder course followed by a 1-1/2 inch thick surface course, using the approved plant mixed, mechanically spread and rolled material. HMA concrete binder and surface courses shall be Class 1, as specified in Section 406 of the "Standard Specifications". Rolling shall be done on each of the separate courses by utilizing a test strip to determine the maximum obtainable density and shall be continued until at least 98% of the maximum density is obtained. If there is any doubt as to the adequacy of the HMA courses, cores will be taken and density checked as specified in Section 406 of the Standard Specifications to determine if the placed mix conform to the approved mix.

3.2.6 Protection:

3.2.6.1 Adequate barriers shall be provided to prevent the movement of traffic over the HMA pavement until it has set for at least 24 hours. Also, the Contractor shall be responsible for any damage to adjacent concrete caused by the paving operations.

3.2.7 Inspection:

3.2.7.1 All thickness specified above are measured after compaction and are subject to inspection and approval. The Contractor shall patch any cuts made for inspection and density tests, as part of the work. Tolerances in surface shall be as specified.

3.3 SEAL COATS

3.3.1 After the surface course has hardened and cured, sweep and flush down with water, and while surface is damp but free from standing water apply two coats of coal tar emulsion sealer, "Jennite J-16" (Maintenance, Inc.) or "Super Pavement Sealer" (Koppers Co., Inc.) at the rate for the two coats of not less than two gallons per 100 sq. feet.

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Each gallon of first coat shall contain from 2 to 3 pounds of fine washed sand and not more than 1/15 gallon of water to be completely mixed with each gallon of sealer. Second coat shall be applied unadulterated as it comes from the container. Coat to dry for not less than 24 hours before permitting traffic. Apply sealer in accordance with the sealer manufacturer's application instructions.

**3.4 PAVEMENT PATCHING**

3.4.1 Pavement patching shall be done in accordance with applicable portions of Section 442 of the Standard Specifications for "Pavement Patching".

3.4.2 The HMA concrete binder and surface courses shall be equal to Class 1, in accordance with applicable portions of Section 406 of the Standard Specification for "HMA Concrete Binder and Surface Courses", but in no case less than the following:

3.4.2.1 Binder mixture "IL-19.0" shall be used for the binder course and be not less than one and a half inches (1-1/2") thick.

3.4.2.2 Surface mixture "Superpave, Mix C, N50" shall be used for the surface course and shall not be less than one and a half inches (1-1/2") thick.

3.4.2.3 The following articles are not applicable: Article 406.11, 406.12, 406.13 and 406.14.

**3.5 CONCRETE CURBS**

3.5.1 Where existing concrete curbs are to be cut for new driveways, patching of HMA paving required shall be coordinated with work to be performed under Section 02525 - "Concrete Curb and Gutter". Provide all HMA paving necessary to restore existing paved area along curbs and at driveways between new work and edge where existing pavement has been cut.

**3.6 CLEANING**

3.6.1 All rubbish and debris resulting from the work of this section shall be collected removed from the site and disposed of legally.

**END OF SECTION 02547**

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**SECTION 02584 – UNDERGROUND DUCT BANKS AND MANHOLES****1 GENERAL****1.1 SCOPE OF WORK****1.1.1 General**

1.1.1.1 This Section covers the construction and placement of buried duct banks and manholes as site infrastructure. It does not cover the pulling of wire or cables into the finished ductbank or manhole.

**1.1.2 Furnish and Install**

1.1.2.1 The following items and accessory materials are addressed:

1.1.2.1.1 Ducts in concrete-encased duct banks.

1.1.2.1.2 Manholes and manhole accessories.

**1.1.3 Related Work**

1.1.3.1 Specified in the following Sections:

1.1.3.1.1 Section 01330; "Submittal Procedures"

1.1.3.1.2 Section 02080; "Bedding and Trench Backfill"

1.1.3.1.3 Section 02200; "Earthwork"

1.1.3.1.4 Section 02260; "Excavation Support and Protection"

1.1.3.1.5 Section 03300; "Cast-In-Place Concrete"

1.1.3.1.6 Section 16010; "Basic Electrical Materials and Methods"

**1.2 REFERENCES**

1.2.1 The current editions of the referenced standards are a part of this section.

**1.2.2 Manholes**

1.2.2.1 AASHTO - Standard Specification for Highway Bridges.

1.2.2.2 AREMA – Manual for Railway Engineering.

1.2.2.3 ASTM A153 – Standard Specification for Zinc Coating of Iron and Steel Hardware.

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- 1.2.2.4 ASTM A48 – Standard Specification for Gray Iron Castings
- 1.2.2.5 ASTM C478 – Standard Specification for Precast Reinforced Concrete Manhole Sections

**1.3 SUBMITTALS**

- 1.3.1 The Contractor shall submit catalog data as required per Standard Specification, Section 01330, Submittal Procedures.

**2 PRODUCTS****2.1 GENERAL**

- 2.1.1 All materials shall be new and applicable as listed, labeled, or approved by the Underwriters' Laboratories, Inc. Defective equipment or equipment damaged in the course of installation or test shall be replaced or repaired in an approved manner.

**2.2 CONDUITS**

- 2.2.1 Conduit shall be of the type specified in the drawings. Comply with specification section 16010, Basic electrical materials and methods.
- 2.2.2 Conduits shall be joined in such a way as to prevent water and solid matter from entering the joints. Joints shall form a continuous smooth interior surface between joining conduit sections so that cable will not be damaged when pulled past the joint.
- 2.2.3 The concrete for the duct bank envelope shall conform in quality to all requirements for placing and curing as described in Section 03300. Concrete shall not be placed until inspection approval of the completed ducts is obtained from the Metra's authorized representative.
- 2.2.4 Backfilling of the excavation shall not occur until the concrete has set for 24 hours. Conduit shall not be covered with backfill until the installation approval is obtained from the Metra's authorized representative.
- 2.2.5 For vertical stub-ups, horizontal bends, and any offsets greater than 22° in primary electrical and communication underground conduit runs, use pre-manufactured factory bends. For electrical conduits, the minimum radius shall be 24 inches for 3 inches and smaller conduit and 36 inches radius for conduit larger than 3 inches, unless noted otherwise on the drawings. Standard radius conduit can be used for secondary electrical conduit if so specified on drawings

**2.3 CORROSION PROTECTION**

- 2.3.1 Non-PVC-coated underground metallic conduit and fittings that are in direct contact with the earth or concrete shall be protected from corrosion. One of the following methods shall be used:

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2.3.1.1 One application, half-lapped, of Minnesota Mining and Manufacturing Company "Scotchwrap" No. 51, Plymouth Rubber Co. "Plywrap 20" or Westape, Inc. 20 mil Pipe Wrap, or equivalent, shall be applied. A "Scotch Coat" No. 101 pipe coating resin treatment, or equivalent, will also be accepted.

2.3.1.1.1 All elbows or bends shall have the wrap applied after the conduit is bent.

2.3.1.1.2 Fittings shall have two separate applications of the above, half lapped and extending one tape width onto the adjoining ducts.

2.3.1.2 Factory coated PVC on rigid conduit.

**2.4 MANHOLES**

2.4.1.1 Manufacturer shall have documented experience in the manufacture of manholes for a minimum of five years.

2.4.1.2 Subbase material shall be 3 to 4 inches of sand over native subgrade compacted to 95% standard Proctor density.

2.4.1.3 Precast concrete: Air-entrained, 5,000-psi compressive strength at 28 days.

2.4.1.4 Roof design live load: AASHTO H20 highway loading with 30% increase for impact.

2.4.1.5 Wall design live load: AREMA Cooper E80 train loading.

2.4.1.6 Inside Dimensions: As indicated on drawings.

2.4.1.7 Manhole Shape: As indicated on drawings.

2.4.1.8 Provide grooved opening in top section for frame and cover.

2.4.1.9 Provide end bell type terminators for each ductbank entry.

2.4.1.10 Provide cable support hardware and all supports for all cable, cable splices and cable terminations as required for support of cables inside manhole.

2.4.1.11 Provide 24 inches inside diameter by 36 inches deep (minimum dimensions) precast sump.

2.4.1.12 Ram-Nek, Kent Seal or approved equal sealants shall be used to seal the joints in the manhole.

**2.5 MANHOLE ACCESSORIES**

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- 2.5.1.1 Manhole Frames and Covers: ASTM A48; Class 30B gray cast iron, machine finished with flat bearing surfaces. Covers shall be round and have "Electric" or "Signal" as designated on plans and "METRA" in permanent lettering. Provide 36-inch diameter clear opening for power manholes and 30-inch diameter for communication manholes. The frame shall be AASHTO H20 rated and shall be doweled into the manhole to prevent any movement away from the opening.
- 2.5.1.2 Sump Covers: ASTM A48; Class 30B gray cast iron.
- 2.5.1.3 Pulling Irons: 7/8-inch diameter steel bar forming a triangle of 9 inches per side when set. Galvanize to ANSI/ASTM A153 for irregular shaped articles. Locate opposite of each duct entry.
- 2.5.1.4 Cable Rack Inserts: See Section 16010
- 2.5.1.5 Cable Rack Channel: See Section 16010
- 2.5.1.6 Cable Racks: See Section 16010
- 2.5.1.7 Manhole Ladder: Supply one fiberglass ladder for each manhole entrance. Ladders shall be fire retardant yellow fiberglass reinforced plastic (FRP), extruded structural shapes. Ladders shall have 2 inch x 2 inch square tube ¼ thick side rails 18 inches apart, and 1 3/8 inch round rungs with grit top non-skid surface set into and joined to side rails and spaced approximately 12 inches apart. The length of the ladder shall extend from the bottom of the manhole to within 3 inch of the cover, and shall be anchored top and bottom. Anchors and hardware shall be stainless steel, and shall be designed so that ladders can be readily removed.
- 2.5.1.8 Grade Rings: Pre-cast concrete (5000 psi. compressive strength at 28 days) with inside diameter equivalent to manhole opening specified in Part 2.5A. The ring shall have circumferential rebar #3 minimum with a trowel finish to provide a true plane within 1/8 inch, as determined with a 5-ft straight edge.

**3 EXECUTION****3.1 EXCAVATION**

- 3.1.1 Comply with the following OSHA Part 1926 – Safety and Health Regulations for Construction, Subpart P – Excavation.
  - 3.1.1.1 1926.650 - Requirements for Open Excavations
  - 3.1.1.2 1926.651 - Requirements for Specific Excavations
  - 3.1.1.3 1926.652 - Requirements for Protective Systems
  - 3.1.1.4 1926.653 - Definitions

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- 3.1.2 Before beginning trenching operations, stake out the proposed ductbank routing including trench width and obtain approval from the Owner's representative. After trenching has begun and before any ducts or conduits are placed, notify the Engineer so that the trenching and installation may be inspected. Also notify the Metra's authorized representative prior to any placement of concrete for duct banks, so that he may observe the placement
- 3.1.3 Excavate to permit installation of the duct bank along the grades shown on the Drawings. Deviations to ductbank depth must have prior approval from the Metra's authorized representative.
- 3.1.4 Excavate a trench of sufficient width to allow thorough compacting of the backfill under and around the duct bank. A level sand bed a minimum of 6 inches deep shall be placed in the trench before conduit is installed
- 3.1.5 Where excavation is in rock, remove all rock to a depth below the grade shown on the Drawings. Rock is defined as material that cannot be ripped or excavated by a backhoe with a one cubic yard bucket with rock teeth. Water shall be continuously pumped out from the trench.
- 3.1.6 The Metra's authorized representative approval is required for the extent of the trench excavation prior to the duct bank installation. Contractor shall schedule excavation in accordance with the Metra's authorized representative requirements prior to beginning construction.
- 3.1.7 Provide all necessary bracing and bridging to maintain traffic flow during construction through all areas interrupted by trenching. Provide construction signage, traffic barriers, and warning notices throughout the construction period.
- 3.1.8 Provide all necessary repairs to erosion control measures and reseeding of grass in areas disturbed by trenching.
- 3.1.9 Sheet and brace the excavation as required to prevent caving. The trench width may be increased accordingly. Maintain sheeting until the ductbank has been inspected and backfilled. Leave sheeting and shoring in place where directed by the Metra's authorized representative. Comply with requirements of specification section 02260 – Excavation Support and Protection.

**3.2 CONDUITS**

- 3.2.1 Where underground crossings are known, field verify horizontal and vertical locations prior to excavation and placement of conduit. Notify the Engineer of any deviations to the drawings. Any profile changes and existing utility line crossings are to be as built on drawings showing: type of line, size, and depth below the surface.

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- 3.2.2 Install at 36" minimum depth of burial to top of electrical ductbank (top of concrete to finished grade), unless otherwise noted in drawing. If site conditions do not permit this depth of burial, contact the Metra's authorized representative for instructions.
- 3.2.3 Spacers shall be used where more than one duct is installed and shall be the standard product of the duct manufacturer for the type and size duct. They shall be located at not more than five-foot intervals, secured to the ducts with #16 gage iron wire. The spacers shall be securely anchored every ten (10) feet to the bottom of the trench to prevent ducts from floating during concrete pouring. Unless otherwise noted on drawings, provide a minimum of 2 inches clear spacing between conduits, horizontally and vertically and minimum of 3 inches clear concrete cover.
- 3.2.4 Preparation and placing of concrete shall be in accordance with provisions of Section 03300, "Cast-In-Place Concrete." Concrete mix design shall be a minimum of 3000 psi with maximum 3/4" aggregate and maximum 6" slump. Care shall be taken in the placement to prevent voids around the ducts. The top of the concrete encasement shall be a smooth finish accomplished by mechanical vibrator or spading the surface.
- 3.2.5 Terminate conduits in an end bell at manhole and building foundation penetrations. Stub-ups of rigid or IMC duct in equipment pads shall have insulated grounding bushings.
- 3.2.6 Conduit and duct runs shall be short, straight runs between points of the system.
- 3.2.7 Duct runs shall be graded to drain toward manholes. The slope shall not be less than 2 inches for every 100 ft. of length, unless otherwise shown on contract drawings.
- 3.2.8 Conduits and duct runs shall be installed on compacted soil when entering a manhole, building foundation, crossing a road, railroad track, or bridge abutment to prevent shear stress on the conduit.
- 3.2.9 All paving and concrete cuts shall be made with a concrete saw. All surfaces and structures to be replaced shall match existing condition.
- 3.2.10 Conduit penetrations into buildings, or through aboveground foundations, shall be sealed with duct seal or conduit sealer to prevent gas or water entry.
- 3.2.11 Trenching and backfilling shall be in accordance with Sections 02080, "Bedding and trench backfill" and 02200, "Excavation".
- 3.2.12 Empty ducts running between manholes shall have a 1/4" diameter polypropylene pull rope provided in each duct, with 3 feet of slack at

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each end, and with the ends secured to a suitable structure (not a conductor) inside each manhole.

- 3.2.13 Empty ducts not running between two manholes (i.e. between switchgear and a manhole, or switchgear and a transformer, etc.) shall be labeled at both ends with a Panduit Marker Plate (Model # MP350-C). The label shall be marked with a Sharpie Permanent Ink Pen and secured to the pull rope on the inside of the duct so as to indicate destination of the duct.
- 3.2.14 When multiple channel inner ducts (FO-DUCT) are pulled through conduit, secure every 10-ft section so as to prevent rolling of channels within conduit. Leave one-foot ends protruding from face of manhole.
- 3.2.15 Conduit or duct banks shall maintain 1-foot vertical and 1 foot horizontal separation from other utility lines where possible.
- 3.2.16 Identify the ductbank location with metallic safety tape or vinyl tape with magnetic tracer marked "CAUTION! BURIED HIGH VOLTAGE ELECTRICAL LINE". Tape shall be located 12 inches above the ductbank. Identify each individual conduit as per the schedule in the Drawings. Conduits shall be identified in accordance with Section 16195, Electrical Identification.
- 3.2.17 Swab the duct at completion of construction. A mandrel approximately 1/4" smaller than the conduit shall be pulled through each conduit. A circular plastic wire brush with the same diameter as the conduit shall be pulled through the conduit. After cleaning, install caps as herein specified, to protect against the entry of dirt or moisture.

**3.3 MANHOLES**

- 3.3.1 Excavate, install base material, and compact base material. Compact subgrade to 95% standard Proctor density or as required by manufacturer.
- 3.3.2 Install, seal, and waterproof precast sections in accordance with manufacturer's instructions.
- 3.3.3 Use precast grade ring sections to bring manhole entrance to proper elevation.
- 3.3.4 Install manholes plumb.
- 3.3.5 Set the top of each manhole to finished elevation.
- 3.3.6 Install a one-foot wide concrete (3,000 psi, 3/4-inch aggregate) collar around the manhole, unless noted otherwise on drawings.
- 3.3.7 As a minimum the height of the concrete collar should go from the top of the manhole cover to twelve inches below grade.

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- 3.3.8 The top of the concrete collar shall slope down away from the cover so that no water will accumulate around the cover.

**3.4 TRENCH BACFILLING**

- 3.4.1 Backfill using fine material up to 24 inches above the top of the ductbank placed in 6-inch lifts and thoroughly tamped.
- 3.4.2 Consolidate the ductbank fill material under roads or similar traffic areas in such a manner as to provide an unyielding foundation for the paving. Remove all excess materials.
- 3.4.3 Compact backfill by tamping or other method as approved by the Metra's authorized representative. Maintain compaction at a minimum of 95 percent standard Proctor density.
- 3.4.4 Contractor shall assume full responsibility for any deficiency in quantity of material or filling of depressions caused by settlement of backfill material. Damage to other trade's work caused by settling shall be corrected at the Contractor's expense. Contractor shall assume full responsibility for damages to any underground utility lines or other structure.
- 3.4.5 Dispose of all excess material from the construction site as directed by the Owner. Contractor should remove excess spoils and other material from the site.

**3.5 RECORD ArcGIS GEODATABASE AND MAPS**

- 3.5.1 Create ductbank and manhole geodatabase and map utilizing ESRI ArcGIS software platform. The database shall include the following as a minimum:
  - 3.5.1.1 Substation name, mile post, and GPS coordinate.
  - 3.5.1.2 Manhole number, type, size and GPS coordinate. Include as built elevation of each wall showing conduit number and size, cable size and tag.
  - 3.5.1.3 Ductbank centerlines shall be located at ends and change of directions. Record accurately all ductbank bends (radius and center point). Record depth below finished grade at each end and at each change of direction.
  - 3.5.1.4 Record the installed length of each conduit in the ductbank to the nearest foot.
  - 3.5.1.5 Include as built ductbank crosssection at ends and at each change of size or shape. Show conduit number and size, cable size and tag.

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**END OF SECTION**

## SECTION 02700 – SITE UNDERGROUND UTILITIES

### 1 GENERAL

#### 1.1 SCOPE OF WORK

- 1.1.1 The General provisions of the Contract, including Supplementary Conditions apply to the work specified in this section.

#### 1.2 DESCRIPTION OF WORK

- 1.2.1 Contractor shall provide all labor, equipment, tools, services and materials necessary for, or incidental to, the new construction, installation, alterations or removal of underground electrical power lines, telephone lines, cable television, communication lines, sanitary and storm sewers, and drainage ditches in accordance with; but not limited to the following:

1.2.1.1 Provide all materials and construction.

1.2.1.2 All trenching, excavation, backfilling and plugging and/or removal of existing utility piping or structures as required for the new construction, installation and/or alterations to the existing utility systems which may be disrupted by the new construction, as stated herein or shown on the Drawings.

1.2.1.3 Testing all utility piping systems and/or sterilization of associated part of such systems as applicable as stated herein.

1.2.1.4 In general, all proposed utility systems as covered in this section will be installed in the confines of the site unless otherwise noted on the Drawings.

#### 1.2.2 Related Work Specified Elsewhere:

1.2.2.1 Structural, electrical and communication work, sewer and water lines.

#### 1.3 REFERENCES

1.3.1 ASTM C12: Practice for installing Vitrified Clay Pipe Lines.

1.3.2 ASTM C425: Compression joints for Vitrified Clay Pipe and Fittings.

1.3.3 ANSI/ASTM D698: Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 Lbs. Rammer and 12 Inch Drop.

1.3.4 ASTM C700: Vitrified Clay Pipe, Extra Strength, Standard Strength and Perforated.

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- 1.3.5 ANSI / AWWA C104/A21.4: Cement-Mortar Lining for Ductile Iron and Gray Iron Pipe and Fittings for Water.
  - 1.3.6 ANSI / AWWA C151/A21.51: Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined molds, for Water or Other Liquids.
  - 1.3.7 ANSI / AWWA C110/A2110: Ductile Iron and Gray Iron Fittings, 3 inch through 48 inch for Water and Other Liquids.
  - 1.3.8 ANSI / AWWA C111/A21.11: Rubber Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings.
  - 1.3.9 IDOT Standard Specifications: IDOT Standard Specifications for Road and Bridge Construction.
  - 1.3.10 Illinois Standards: Standard Specifications for Water and Sewer Main Construction.
- 1.4 SUBMITTALS
- 1.4.1 Shop drawings or manufacturers cuts shall be submitted to the Metra's authorized representative for review of all frames, grates, handholes, pipe materials and joint pipe accessories.
  - 1.4.2 Product Data:
    - 1.4.2.1 Provide data indicating pipe, pipe accessories, and structures meet the specifications.
  - 1.4.3 Manufacturer's Certificates:
    - 1.4.3.1 Provide certification that products meet or exceed specified requirements.
  - 1.4.4 Manufacturer's Installation Instructions:
    - 1.4.4.1 Indicate special procedures required to install products specified.
  - 1.4.5 Permit Application:
    - 1.4.5.1 Submit three (3) copies of the permit application prior to submitting to the Authority.
- 1.5 REQUIREMENTS OF REGULATORY AGENCIES
- 1.5.1 Construction as shown on the Drawings or stated herein shall be performed in accordance with current and applicable requirements as established by Metra, the Local Authorities, and the Illinois Environmental Protection Agency. Where conflicts arise between the construction documents and Local Building Codes the Local Codes hold precedence. If such ordinances shall require a change in the work as

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stated herein or shown in the Drawings, the Contractor shall stop work and notify for further direction.

- 1.5.2 The appropriate Governing Agency and Metra's authorized representative shall be notified a minimum of 48 hours before contractor starts connection to off site water and sanitary utility.

**2 PRODUCTS****2.1 STORM SEWERS****2.1.1 Precast Concrete Drainage Ditch:**

2.1.1.1 All Drainage Ditches shall meet the requirements of Section 602 of IDOT Standard Specifications and shall comply with Articles 602.07 and 1042.10 of the same.

2.1.1.2 Article 602.16 of the IDOT Standard Specifications is not applicable to this project.

**2.1.2 Ductile Iron Sewer Pipe and Fittings:****2.1.2.1 General:**

2.1.2.1.1 All ductile iron sewer pipe and fittings shall be of the sizes, lengths and quantities shown and the quality specified. All ductile iron sewer pipe underground shall be push-on type thickness Class 55 tar-coated on the outside and cement lined on the inside and shall conform to the following specifications for types and sizes as shown on the drawings.

2.1.2.2 All Ductile Iron Pipe (underground) shall meet the requirements of ASTM A 746 for Ductile Iron Gravity Sewer Pipe with cement lining conforming to A 21.4 (AWWA C114) ANSI.

2.1.2.3 Push On Joint Fittings shall meet the requirements of A 21.11 (AWWA C111) ANSI with cement lining.

**2.1.2.4 Gaskets:**

2.1.2.4.1 For push-on joints, they shall be standard neoprene type and for flange joints they shall be 1/16" thick, full face, compressed asbestos composition, graphite-coated both sides.

2.1.3 Extra Strength Vitrified Clay Sewer Pipe: ASTM C700 with joints conforming to ASTM C425.

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**2.2 BEDDING AND BACKFILL MATERIAL FOR UTILITY TRENCHES**

- 2.2.1 Comply with requirements of Specification Section 02080-“Bedding and trench backfill”.

**3 EXECUTION****3.1 EXAMINATION****3.1.1 Verification:**

- 3.1.1.1 Verify that trench cut is ready to receive work, and excavations dimensions, and elevations are as indicated on Drawings.

**3.2 EXCAVATION, BEDDING AND BACKFILL****3.2.1 Excavation:**

- 3.2.1.1 Hand trim excavation for accurate placement of pipe to elevations indicated. Remove large stones or other hard matter, which could damage pipe or impede consistent backfilling or compaction.

**3.2.2 Bedding:**

- 3.2.2.1 Place bedding material at trench bottom, level material in continuous layers, not exceeding 6 inch loose lifts and compact to 95 percent of maximum density.

**3.2.3 Backfilling:**

- 3.2.3.1 Do not displace or damage pipe when compacting. Maintain dry pipe foundations during progress of laying pipe.

**3.2.4 Moisture Content:**

- 3.2.4.1 Maintain optimum moisture content of bedding material to attain required compaction density.

**3.3 INSTALLATION OF STORM SEWERS, TRENCH AND PIPE DRAINS****3.3.1 General:**

- 3.3.1.1 Install pipe, fittings, and accessories in accordance with Section 550 of the IDOT Standard Specifications and manufacturer's instructions. Seal joint watertight. Lay pipe to slope gradients. Plug partially completed sections to prevent entrance of water and debris.

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- 3.3.2 Bedding:
    - 3.3.2.1 Install bedding at sides and over top of pipe to minimum compacted thickness of 4 inches. Thoroughly rod and tamp bedding under haunches of pipe.
  - 3.3.3 Repair Broken Pipe:
    - 3.3.3.1 Where broken sewer is discovered, the Contractor shall replace the broken pipe and the work shall be paid for at the Contract Unit Price per lineal foot for storm sewer of the corresponding type and diameter, or if applicable unit price is not available on a time and material basis as described in the IDOT Standard Specifications.
  - 3.3.4 Install trench drains in accordance with Section 601 of the IDOT Standard Specifications.
- 3.4 INSTALLATION OF NEW UTILITY SYSTEMS
- 3.4.1 Excavating and Backfilling
    - 3.4.1.1 Contractor shall do all excavating of any and all materials encountered in the course of all underground utility systems. After the work is in place, backfill with suitable earth or selected granular backfill materials (as detailed on the drawings), free from rocks, organic material, etc. All piping under basements, driveways, parking areas, sidewalks, and all basins and manholes, shall be entirely backfilled with lake or bank run sand only. Foundry sand will NOT be allowed.
      - 3.4.1.1.1 Provide all necessary shoring required for the protection of excavations, existing utilities and workmen and do all necessary pumping required to keep excavation relatively free from water from any source at all times.
      - 3.4.1.1.2 Provide sufficient barricades, etc., adjacent to excavations to safeguard against injury to workmen and the public. Provide and maintain sufficient warning lanterns at walks, roadways and parking areas to provide safety at night.
      - 3.4.1.1.3 Where rock is encountered it shall be removed by the trade installing the work for which the excavation is done, by appropriate methods.
      - 3.4.1.1.4 Where roots of live trees are encountered in excavations, they shall be carefully protected during construction.
      - 3.4.1.1.5 After installation and test of piping and equipment have been completed, backfill all excavations carefully. Place backfill in 6" layers and compact to at least 85% of the maximum dry density. Compaction under paved areas shall

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not be less than 95% of maximum dry density. Maximum dry density shall be determined by Compaction Test ASTM D-1557, "Moisture-Density Relations of Soils (Using 10 pound rammer and 18 in. drop)".

- 3.4.1.1.6 Exercise special care in backfilling trenches in which sewers are laid to guard against disturbing the joints. Such backfilling shall be placed evenly in 18" layers and carefully compacted. Compaction shall not start until Contractor has placed a minimum of 24" of backfill over top of pipe.
- 3.4.1.1.7 Remove and dispose of any material not used for backfill.
- 3.4.1.2 Removal of subsurface obstructions which are uncovered during the excavation for installation of the utility systems shall be removed by the Contractor at his expense. This shall include removal of existing concrete or brick of existing building foundations, footings, abandoned utility piping, wires, structures, rock boulders, etc., which may not be visible from surface investigations before construction, but will interfere with new installations. If such obstructions are encountered they shall be removed two (2) feet from around the area of new manholes, catch basins, and sewer piping and backfilled with suitable material as specified.
- 3.4.1.3 Construction of Underground Utility Structures:
  - 3.4.1.3.1 All structures and underground utilities shall be constructed so that no water pipe is in contact with or enclosed by any part of a sewer manhole or other similar structure.
  - 3.4.1.3.2 Cast Iron Frames shall be accurately set in full 1" mortar beds to finish elevation, unless noted otherwise on the Drawings.
  - 3.4.1.3.3 Dewatering shall be continued until sufficient to maintain the water level at or below the surface of trench bottom or base of the bedding course, and shall be accomplished prior to pipe laying and joining. The dewatering operation, however accomplished, shall be carried out so that it does not destroy or weaken the strength of the soil under or alongside the trench.
  - 3.4.1.3.4 The pipe bedding shall be placed so that the entire length of the pipe will have full bearing. No blocking of any kind shall be used to adjust the pipe to grade.
  - 3.4.1.3.5 Plugs and Connections: When specified on Drawings stubs or other open ends which are not to be immediately connected shall be made of an approved material and shall be secured in place with a joint comparable to the main line

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joint. Stoppers may be of an integrally cast breakout design as supplied by the manufacturer. Contractor shall mark sewer stubs if required as indicated on the drawings.

**3.5 TESTING OF NEW UTILITY SYSTEMS****3.5.1 Testing Technique for Sanitary Sewers:**

3.5.1.1 Testing for Acceptance of Sanitary Sewers: Testing sanitary sewers for acceptability shall be conducted by the infiltration by water testing technique or other method if so directed by the local sanitary district.

3.5.1.2 All Testing Methods: All wyes, tees and stubs shall be plugged with flexible jointed caps, or acceptable alternate, securely fastened to withstand the internal test pressure. Such plugs or caps shall be readily removable.

3.5.1.3 Infiltration Method Procedures: The section of sewer to be tested shall have been trench backfilled and the tests conducted by inducing infiltration conditions by jetting the sewer trench for a sufficient length of time to insure that the water level in the trench is a minimum of 18 inches over the crown of the sewer pipe. The test must be performed before sewage flow is allowed in the sewers.

**3.5.1.4 Allowable Leakage for Sanitary Sewers:**

3.5.1.4.1 Infiltration flow shall be measured by a 90 degree V notch weir with free fall discharge or other means acceptable to the Engineer. Infiltration leakage shall not exceed 100 gallons per inch of pipe diameter per mile per day of sewer pipe, including manholes in the test section.

**3.5.2 Testing**

3.5.2.1 Testing of the newly laid piping or any valved section of piping shall be accomplished after the lines are laid, the joints and accessories installed, and the trench partially backfilled, leaving the joint exposed for examination. The piping shall be subjected for a minimum of two hours to a pressure of one and one-half times the working pressure, but in no case less than 100 psi. Examine all exposed pipe, joints, fittings and accessories during the test period. Replace or repair defective portions of the system, and repeat tests until results are satisfactory. Allowable leakage shall be as specified in AWWA C-600, Table 3.

### 3.6 EXISTING UTILITY SYSTEMS TO BE ABANDONED (WHERE APPLICABLE)

#### 3.6.1 Abandonment of Structures or Utility Lines:

3.6.1.1 Sewer structures and lines to be plugged shall be plugged where indicated on the Drawings at each end of the line at each structure. Structures of sewers being plugged shall be removed to a point three feet below the proposed grade of the improvement, and the inlets and outlet pipes shall be securely sealed with concrete or brick masonry, and the structure filled with gravel and compacted to 95% of its dry density. Sewer pipelines shall be plugged with pre-manufactured device as recommended by pipe manufacturer or Association for the type of pipe being plugged.

3.6.1.2 All debris generated by the plugging and/or removal operations as specified herein shall become the property of the Contractor and shall be promptly removed from the site as it accumulates.

3.6.1.3 Existing drainage structures and sewer lines, which are designated to be abandoned, shall be removed or plugged as indicated on the Drawings.

#### 3.6.2 Removal of Structures or Utility Lines:

3.6.2.1 Drainage structures to be removed (as designated on the Drawings) shall be removed in their entirety. The voids shall be filled to surrounding grade with gravel compacted to a minimum density of 95 percent as determined by ASTM D 1557, "Moisture-Density Relations of Soils (Using 10 Pound Rammer and 18 inch Drop)".

### 3.7 CLEANUP

#### 3.7.1 General Requirements

3.7.1.1 At the completion of the proposed utility installations and prior to the Owner's final acceptance, sediment and debris shall be removed from new sanitary and storm sewers and their structures.

**END OF SECTION 02700**

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**SECTION 02901 – TOPSOIL, SEEDING AND EROSION CONTROL BLANKET****1 GENERAL****1.1 SCOPE OF WORK****1.1.1 General**

1.1.1.1 Work under this Section is subject to the requirements of the Contract Documents, including the Supplementary Conditions.

**1.1.2 Furnish and Install**

1.1.2.1 The work under this section shall include all labor, materials, tools and equipment to prepare seed and sod bed, furnish, deliver and install seeding and sodding including all nutrients and fertilizers.

**1.1.3 Related Work**

1.1.3.1 Section 02110 – Site Clearing-Removal

1.1.3.2 Section 02190 – Erosion Control

1.1.3.3 Section 02200 – Excavation

**2 PRODUCTS****2.1 GENERAL REQUIREMENTS**

2.1.1 Seeds shall meet the requirements of IDOT Standard Section 1081.03 and 1081.04. The seed mixture shall meet the requirements of Article 250.07 of the Standard Specifications for Class 1B, 3 or 4A as applicable. Furnishing and placement of sod shall meet the requirements of section 252.

2.1.2 The nutrients provided shall meet the requirements of Article 1081.08 of the Standard Specifications for nitrogen fertilizer nutrient, phosphorous fertilizer nutrient and potassium fertilizer nutrient.

**3 EXECUTION****3.1 GENERAL REQUIREMENTS**

3.1.1 Seedbed preparation and seeding and sodding method and installation shall comply with the requirements of section 250 and 252.

3.1.2 Mulching seeded areas shall comply with Article 251.03.b.3 of the Standard Specifications.

**END OF SECTION 02901**

## SECTION 03300 – CAST-IN-PLACE CONCRETE

### 1 GENERAL

#### 1.1 SCOPE OF WORK

##### 1.1.1 General

1.1.1.1 Work under this Section is subject to the requirements of the Contract Documents, including the Supplementary Conditions.

##### 1.1.2 Furnish and Install

1.1.2.1 Cast-in-Place Concrete required to complete the work indicated on all the project construction drawings except for related sections.

##### 1.1.3 Related Work

1.1.3.1 Section 02466 - Concrete Caissons

1.1.3.2 Section 02505 - Portland Cement Concrete Sidewalk and Stairs

#### 1.2 DEFINITIONS

##### 1.2.1 Cementitious Materials:

1.2.1.1 Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans.

#### 1.3 SUBMITTALS

##### 1.3.1 Product Data:

1.3.1.1 Submit preprinted data for each type of manufactured material and product demonstrating compliance requested by the Metra's authorized representative.

##### 1.3.2 Design Mixes:

1.3.2.1 Submit design mix for each concrete mix. Include field test data used to establish the required average strength in accordance with ACI 301. Review of design mixes and field test data will be for general information only. Production of concrete to comply with specified requirements is the responsibility of the contractor. Submit written reports to the Metra's authorized representative of each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until each mix has been reviewed by the Metra's authorized representative.

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1.3.2.1.1 Indicate amounts of mix water to be withheld for later addition at Project site.

1.3.3 Shop Drawings:

1.3.3.1 Steel Reinforcement Shop Drawings: Submit details of fabrication, bending, and placement, prepared according to ACI 315, "Details and Detailing of Concrete Reinforcement." Include material, grade, bar schedules, stirrup spacing, bent bar diagrams, arrangement, and supports of concrete reinforcement. Include special reinforcement required for openings through concrete structures.

#### 1.4 QUALITY ASSURANCE

1.4.1 Installer Qualifications:

1.4.1.1 An experienced installer who has completed concrete Work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

1.4.2 Manufacturer Qualifications:

1.4.2.1 A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.

1.4.3 Testing Agency Qualifications:

1.4.3.1 An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.

1.4.4 Source Limitations:

1.4.4.1 Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.

1.4.5 Publications:

1.4.5.1 Comply with the latest edition of the following, except as modified by the Contract Documents. Maintain a copy of the latest edition of ACI 301, 117, 318, and 347 at the project site at all times. Where provisions of the above codes and standards are in conflict with the building code in force for the Project, the building code shall govern.

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- 1.4.5.1.1 ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
  - 1.4.5.1.2 ACI 301, "Standard Specification for Structural Concrete."
  - 1.4.5.1.3 ACI 302, "Guide for Concrete Floor and Slab Construction."
  - 1.4.5.1.4 ACI 305, "Hot Weather Concreting"
  - 1.4.5.1.5 ACI 306, "Cold Weather Concreting"
  - 1.4.5.1.6 ACI 308, "Standard Practice for Curing Concrete"
  - 1.4.5.1.7 ACI 318 "Building Code Requirements for Structural Concrete"
  - 1.4.5.1.8 ACI 347 "Recommended Practice for Concrete Formwork"
  - 1.4.5.1.9 ASTM C494 Standard Specification for Chemical Admixtures for Concrete.
  - 1.4.5.1.10 AWS D12.1 "Recommended Practices for Welding Reinforcing Steel, Metal Inserts and Connections in Reinforced Concrete Construction."
  - 1.4.5.1.11 CRSI "Manual of Standard Practice."
- 1.4.6 Concrete Testing Service:
- 1.4.6.1 The Owner will employ a testing laboratory to perform initial field quality control testing.
    - 1.4.6.1.1 Materials and installed Work may require testing and retesting, at anytime during the progress of the Work. Allow free access to material stockpiles and facilities at all times. Tests, not specifically indicated to be done at the Owner's expense, including the retesting of rejected materials and installed Work, shall be done at the Contractor's expense.
- 1.4.7 Pre-Concrete Conference
- 1.4.7.1 Conduct a meeting to review the detailed requirements for preparing the concrete design mixes and to review the drawings, specifications, and the project.
  - 1.4.7.2 Require responsible representatives of every party who is concerned with the concrete work to attend the conference, including but not limited to the following:
    - 1.4.7.2.1 Contractor's superintendent

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1.4.7.2.2 Laboratory responsible for the concrete design mix

1.4.7.2.3 Laboratory responsible for the field quality control

1.4.7.2.4 Concrete subcontractor

1.4.7.2.5 The Metra's authorized representative

1.4.7.3 Type and print minutes from the meeting and distributed to all parties within 5 days of the meeting.

**1.5 DELIVERY, STORAGE, AND HANDLING**

1.5.1 Deliver, store, and handle steel reinforcement to prevent bending and damage.

1.5.1.1 Avoid damaging coatings on steel reinforcement.

**1.6 PROJECT CONDITIONS**

1.6.1 Before commencing work, examine all adjoining work on which this work is in any way dependent for proper installation and workmanship and report to the Contractor any condition which prevents performing first class work.

1.6.2 Protection of Footings against Freezing: Cover completed work at footing level with sufficient temporary or permanent cover as required to protect footings and adjacent subgrade against possibility of freezing; maintain cover for time period as necessary.

1.6.3 Protect adjacent finish materials against spatter during concrete placement.

1.6.4 Provide all barricades and safeguards at all pits, holes, shaft and stairway openings, and the like. Provide all safeguards as required by authorities having jurisdiction. Take full responsibility for safety precautions and methods.

**2 PRODUCTS****2.1 FORM-FACING MATERIALS**

2.1.1 Formed Concrete:

2.1.1.1 Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

2.1.1.1.1 Rust-free metal.

2.1.1.1.2 Wood Forms:

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- 2.1.1.1.2.1 Finish No. 1 (for concealed below-grade concrete) exterior plywood B-B concrete form Class II, PS-1-74.
- 2.1.1.1.2.2 Finish No. 2 (for smooth exposed concrete) exterior type, resin coated plywood, high density concrete form overlay, Class I, PS-1-74.

**2.1.2 Forms for Cylindrical Columns, Pedestals, and Supports:**

- 2.1.2.1 Metal, glass-fiber-reinforced plastic, paper, or fiber tubes. Construct paper or fiber tubes of laminated plies using water-resistant adhesive with wax-impregnated exterior for weather and moisture protection. Provide units with sufficient wall thickness to resist plastic concrete loads imposed by concrete without deformation.

**2.1.3 Chamfer Strips:**

- 2.1.3.1 Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.

**2.1.4 Form-Release Agent:**

- 2.1.4.1 Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

- 2.1.4.1.1 Formulate form-release agent with rust inhibitor for steel form-facing materials.

**2.1.5 Form Ties:**

- 2.1.5.1 Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
  - 2.1.5.1.1 Furnish units that will leave no corrodible metal closer than 1 inch (25 mm) to the plane of the exposed concrete surface.
  - 2.1.5.1.2 Furnish ties that, when removed, will leave holes not larger than 1 inch (25 mm) in diameter in concrete surface.
  - 2.1.5.1.3 Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

**2.2 STEEL REINFORCEMENT****2.2.1 Reinforcing Bars:**

- 2.2.1.1 ASTM A 615, Grade 60, deformed, epoxy coated.

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- 2.2.2 Plain-Steel Welded Wire Fabric:
  - 2.2.2.1 ASTM A 185, fabricated from as-drawn steel wire into flat sheets and epoxy coated.
- 2.3 REINFORCEMENT ACCESSORIES
  - 2.3.1 Bar Supports:
    - 2.3.1.1 Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows.
      - 2.3.1.1.1 For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected or CRSI Class 2 stainless-steel bar supports.
      - 2.3.1.1.2 Do not use wood, masonry, concrete or other similar supports.
  - 2.3.2 Joint Dowel Bars:
    - 2.3.2.1 Plain-steel bars, ASTM A 615, Grade 60. Cut bars true to length with ends square and free of burrs.
  - 2.3.3 Mechanical Reinforcement Couplers:
    - 2.3.3.1 ASTM A-519, Minimum tensile strength 100,000 psi.
- 2.4 CONCRETE MATERIALS
  - 2.4.1 Portland Cement:
    - 2.4.1.1 ASTM C 150, Type I. Type III cement may be used in lieu of Type I at Contractor's option, when acceptable to the Metra's authorized representative.
      - 2.4.1.1.1 Use only one brand of cement throughout project, except as otherwise indicated.
  - 2.4.2 Fly Ash:
    - 2.4.2.1 ASTM C618, Class C or F
  - 2.4.3 Normal-Weight Aggregate:
    - 2.4.3.1 ASTM C 33, uniformly graded, and as follows:

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2.4.3.1.1 Class:

2.4.3.1.1.1 Severe weathering region, but not less than 3S.

2.4.3.1.2 Nominal Maximum Aggregate Size:

2.4.3.1.2.1 3/4 inch (19 mm) unless otherwise indicated.

2.4.4 Water:

2.4.4.1 Potable and complying with ASTM C 94.

## 2.5 ADMIXTURES

2.5.1 General:

2.5.1.1 Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material and to be compatible with other admixtures and cementitious materials. Do not use admixtures containing calcium chloride thycyanates or admixtures containing more than 0.1 percent chloride ions.

2.5.2 Air-Entraining Admixture: ASTM C 260

2.5.3 Water-Reducing Admixture: ASTM C 494, Type A.

2.5.4 High-Range, Water-Reducing Admixture (Super Plasticizer):  
ASTM C 494, Type F.

## 2.6 CURING MATERIALS

2.6.1 Absorptive Cover:

2.6.1.1 AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) dry.

2.6.2 Moisture-Retaining Cover:

2.6.2.1 ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

2.6.3 Water: Drinkable.

2.6.4 Clear, Waterborne, Membrane-Forming Curing Compound:  
ASTM C 309, Type 1, Class B.

## 2.7 RELATED MATERIALS

2.7.1 Joint-Filler Strips:

2.7.1.1 ASTM D 1752, cork or self-expanding cork.

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**2.7.2 Bonding Agent:**

- 2.7.2.1 ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

**2.8 REPAIR MATERIALS****2.8.1 Repair Underlayment:**

- 2.8.1.1 Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.

**2.8.1.1.1 Cement Binder:**

- 2.8.1.1.1.1 ASTM C 150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.

**2.8.1.1.2 Primer:**

- 2.8.1.1.2.1 Product of underlayment manufacturer recommended for substrate, conditions, and application.

**2.8.1.1.3 Aggregate:**

- 2.8.1.1.3.1 Well-graded, washed gravel, 1/8 to 1/4 inch (3 to 6 mm) or coarse sand as recommended by underlayment manufacturer.

**2.8.1.1.4 Compressive Strength:**

- 2.8.1.1.4.1 Not less than 4000 psi at 28 days when tested according to ASTM C 109.

**2.8.2 Repair Topping:**

- 2.8.2.1 Traffic-bearing, cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch (6 mm).

**2.8.2.1.1 Cement Binder:**

- 2.8.2.1.1.1 ASTM C 150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.

**2.8.2.1.2 Primer:**

- 2.8.2.1.2.1 Product of topping manufacturer recommended for substrate, conditions, and application.

**2.8.2.1.3 Aggregate:**

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2.8.2.1.3.1 Well-graded, washed gravel, 1/8 to 1/4 inch (3 to 6 mm) or coarse sand as recommended by topping manufacturer.

2.8.2.1.4 Compressive Strength:

2.8.2.1.4.1 Not less than 5700 psi at 28 days when tested according to ASTM C 109.

**2.9 CONCRETE MIXES**

2.9.1 Prepare design mixes for each type and strength of concrete determined by either laboratory trial mix or field test data bases, as follows:

2.9.1.1 Proportion normal-weight concrete according to ACI 211.1 and ACI 301.

2.9.2 Use a qualified independent testing agency for preparing and reporting proposed mix designs for the laboratory trial mix basis.

2.9.3 Provide a minimum 28 day compressive strength of 4000 psi and a maximum water-cementitious material ratio of 0.44, air-entrained.

2.9.4 Cementitious Materials:

2.9.4.1 For concrete exposed to deicers, limit percentage, by weight, of cementitious materials other than Portland cement according to ACI 301 requirements.

2.9.4.2 For all other concrete, limit percentage, by weight, of cementitious materials other than Portland cement in concrete as follows:

2.9.4.2.1 Fly Ash: 25 percent by weight.

2.9.5 Air Content:

2.9.5.1 Use air-entraining admixture in exterior exposed concrete. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content as follows within a tolerance of plus or minus one percent, unless otherwise indicated:

2.9.5.1.1 Air Content: 5-8 percent for 3/4-inch nominal maximum aggregate size.

2.9.6 Do not air entrain interior normal-weight concrete. Do not allow entrapped air content to exceed 3 percent.

2.9.7 Admixtures: Use admixtures according to manufacturer's written instructions.

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- 2.9.7.1 Use water-reducing admixture or high-range water-reducing admixture (superplasticizer) in concrete, as required, for placement and workability.
- 2.9.7.2 Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
- 2.9.7.3 Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
- 2.9.7.4 Use corrosion-inhibiting admixture in concrete mixes where indicated.
- 2.9.8 Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If trial batch method is used, use an independent testing facility acceptable to the Metra's authorized representative for preparing and reporting proposed mix designs.

**2.10 FABRICATING REINFORCEMENT**

- 2.10.1 Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice." In the case of fabrication errors, do not rebend or straighten reinforcement.
- 2.10.2 Unacceptable Materials:
  - 2.10.2.1 Reinforcement with any of the following defects will not be permitted in the Work:
    - 2.10.2.1.1 Bar lengths, depths or bends exceeding specified fabrication tolerances.
    - 2.10.2.1.2 Bends or kinks not indicated on the Drawings or final Shop Drawings.
    - 2.10.2.1.3 Bars with reduced cross section due to excessive corrosion or other cause.
    - 2.10.2.1.4 Bars with damaged corrosion resistive coating (if specified).

**2.11 CONCRETE MIXING**

- 2.11.1 Ready-Mixed Concrete:
  - 2.11.1.1 Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116, and furnish batch ticket information.

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- 2.11.1.1.1 When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 90 minutes to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

**3 EXECUTION****3.1 FORMWORK**

- 3.1.1 Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads within acceptable deflection limits.
- 3.1.2 Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages, and inserts, and other features required.
- 3.1.3 Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
  - 3.1.3.1 Class A, 1/8 inch (3 mm), for surfaces predominantly exposed to public view.
  - 3.1.3.2 Class B, 1/4 inch (6 mm), for course-textured concrete formed surfaces intended to receive plaster, stucco, or wainscoting.
  - 3.1.3.3 Class C, 1/2 inch (13 mm). for all other surfaces.
- 3.1.4 Construct forms tight enough to prevent loss of concrete mortar.
- 3.1.5 Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.
  - 3.1.5.1 Do not use rust-stained steel form-facing material.
- 3.1.6 Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- 3.1.7 Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels

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tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

- 3.1.8 Chamfer exterior corners and edges of permanently exposed concrete with 3/4" x 3/4" strips (unless otherwise indicated) accurately formed and surfaced to produce uniform straight lines and tight edges. Unexposed corners may be formed square or chamfered.
- 3.1.9 Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items, including those under separate prime contracts (if any).
- 3.1.10 Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- 3.1.11 Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- 3.1.12 Coat contact surfaces of forms with non-staining, rust preventative form-release agent, according to manufacturer's written instructions, before placing reinforcement. Rust stained steel formwork is not acceptable.
- 3.1.13 Support form facing materials by structural members spaced sufficiently close to prevent deflection. Fit forms placed in successive units for continuous surfaces of accurate alignment, from irregularities and within allowable tolerances.
- 3.1.14 Elevate formwork as required for anticipated deflections due to weight and pressures of fresh concrete, shortening of formwork system, and construction loads.
- 3.1.15 Carefully inspect falsework and formwork during and after concrete placement to determine abnormal deflection or signs of failure; make necessary adjustments to produce work of required dimensions.
- 3.1.16 Form intersecting planes to provide true, clean-cut corners, with edge grain of plywood not exposed as form for concrete.
- 3.1.17 Forms for exposed Concrete:
  - 3.1.17.1 Drill forms to suit ties used and to prevent leakage of concrete mortar around tie holes.
  - 3.1.17.2 Do not use metal cover plates for patching holes or defects in forms.
  - 3.1.17.3 Provide sharp, clean corners at intersecting planes, without visible edges or offsets. Back joints with extra studs or girts to maintain true, square intersection.

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- 3.1.17.4 Use extra studs, walers and bracing to prevent bowing of forms between studs and to avoid bowed appearance of concrete. Do not use narrow strips of form material that will produce bow.
- 3.1.17.5 Assemble forms so they may be readily removed without damage to exposed concrete surfaces.

**3.2 EMBEDDED ITEMS**

- 3.2.1 Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 3.2.1.1 Install anchor rods, accurately located, to elevations required.
  - 3.2.1.2 Install reglets to receive top edge of foundation sheet waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
  - 3.2.1.3 Install dovetail anchor slots in concrete structures as indicated.

**3.3 REMOVING AND REUSING FORMS**

- 3.3.1 General:
  - 3.3.1.1 Formwork, for sides of beams, walls, columns, and similar parts of the Work, that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete provided concrete is hard enough to not be damaged by form-removal operations and provided curing and protection operations are maintained.
- 3.3.2 Leave formwork, for beam soffits, joists, slabs, and other structural elements, that supports weight of concrete in place until concrete has achieved 28-day design compressive strength.
  - 3.3.2.1 Determine compressive strength of in-place concrete by testing representative field- or laboratory-cured test specimens according to ACI 301.
  - 3.3.2.2 Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- 3.3.3 Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- 3.3.4 When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not

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use patched forms for exposed concrete surfaces unless approved by Metra's authorized representative.

**3.4 STEEL REINFORCEMENT****3.4.1 General:**

3.4.1.1 Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

3.4.1.1.1 Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

3.4.2 Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials.

3.4.3 Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

3.4.3.1 At a spacing not to exceed 4'-0" on center in either direction. For slabs on grade, use supports not to exceed 4'-0" o.c. with sand plates or horizontal runners where base material will not support chair legs.

3.4.3.2 Shop- or field-weld reinforcement according to AWS D1.4, where indicated.

3.4.4 Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

3.4.5 Install welded wire fabric in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least two mesh spacings. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.4.6 Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963.

**3.5 JOINTS****3.5.1 General:**

3.5.1.1 Construct joints true to line with faces perpendicular to surface plane of concrete.

**3.5.2 Construction Joints:**

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- 3.5.2.1 Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Metra's authorized representative.
  - 3.5.2.1.1 Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated.
  - 3.5.2.1.2 Form from preformed galvanized steel, plastic keyway-section forms, or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
  - 3.5.2.1.3 Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
  - 3.5.2.1.4 Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
  - 3.5.2.1.5 Space vertical joints in walls at not more than 60 feet in any horizontal direction. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
  - 3.5.2.1.6 Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- 3.5.3 Contraction Joints in Slabs-on-Grade:
  - 3.5.3.1 Form weakened-plane contraction joints, sectioning concrete into 15-foot maximum perpendicular strips, and areas not exceeding 225 square feet. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness, as follows:
    - 3.5.3.1.1 Sawed Joints:
      - 3.5.3.1.1.1 Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3-mm-) wide joints into concrete within 24-hours after initial floating, when cutting action will not tear, abrade, or otherwise damage surface, and before concrete develops random contraction cracks.
- 3.5.4 Isolation Joints in Slabs-on-Grade:

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3.5.4.1 Install joint-filler strips at all slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

3.5.4.1.1 Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.

3.5.4.1.2 Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants are indicated.

3.5.4.1.3 Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

3.5.5 Dowel Joints:

3.5.5.1 Install dowel sleeves and dowels or dowel bar and support assemblies at joints where indicated.

3.5.5.1.1 Use dowel sleeves or lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.6 CONCRETE PLACEMENT

3.6.1 Pre-Placement Inspection:

3.6.1.1 Before concrete placement, check the lines and levels of erected formwork. Make corrections and adjustments to ensure proper size and location of concrete members and stability of forming systems. During concrete placement, check formwork and related supports to ensure that forms are not displaced and that completed Work will be within specified tolerances.

3.6.1.2 Before placing concrete, inspect and complete the formwork installation, reinforcing steel, and items to be embedded or cast-in. Notify other crafts involved in ample time to permit the installation of their Work; cooperate with other trades in setting such Work, as required.

3.6.1.3 Thoroughly wet wood forms immediately before placing concrete, as required where form coatings are not used.

3.6.1.4 Soil at bottom of foundation systems are subject to testing for soil bearing value by the testing laboratory, as directed by the Metra's authorized representative. Place concrete immediately after approval of foundation excavations.

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- 3.6.1.5 Coordinate the installation of joint materials and moisture barriers with placement of forms and reinforcing steel.
- 3.6.1.6 Remove soil, debris, standing water, ice, snow, loose mill scale or coating and other foreign matter from formwork and metal deck.
- 3.6.2 Do not add water to concrete during delivery, at Project site, or during placement, unless indicated on trip ticket.
- 3.6.3 Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation.
- 3.6.4 Deposit concrete in forms in horizontal layers no deeper than 24 inches and in a manner to avoid inclined construction joints. Place each layer while preceding layer is still plastic, to avoid cold joints.
  - 3.6.4.1 Consolidate placed concrete with mechanical vibrating equipment. Use equipment and procedures for consolidating concrete recommended by ACI 309R.
  - 3.6.4.2 Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the vibrator. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix constituents to segregate.
- 3.6.5 Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete. Place concrete in accordance with the practices and recommendations of ACI 304, and as herein specified.
  - 3.6.5.1 Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
  - 3.6.5.2 Maintain reinforcement in position on chairs during concrete placement.
  - 3.6.5.3 Screed slab surfaces with a straightedge and strike off to correct elevations.
  - 3.6.5.4 Slope surfaces uniformly to drains where required.

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3.6.5.5 Begin initial floating using bull floats or derbies to form a uniform and open-textured surface plane, free of humps or hollows, before excess moisture or bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

3.6.6 Cold-Weather Placement:

3.6.6.1 Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

3.6.6.1.1 When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.

3.6.6.1.2 Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

3.6.6.1.3 Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.

3.6.7 Hot-Weather Placement:

3.6.7.1 Place concrete according to recommendations in ACI 305R and as follows, when hot-weather conditions exist:

3.6.7.1.1 Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

3.6.7.1.2 Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.

3.6.7.1.3 Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.7 FINISHING FORMED SURFACES

3.7.1 Rough-Formed Finish:

3.7.1.1 As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched. Remove fins

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and other projections exceeding ACI 347R limits for class of surface specified.

**3.7.2 Smooth-Formed Finish:**

3.7.2.1 As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections.

3.7.2.1.1 Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, or painting.

3.7.2.1.2 Do not apply rubbed finish to smooth-formed finish.

**3.7.3 Related Unformed Surfaces:**

3.7.3.1 At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

**3.8 FINISHING FLOORS AND SLABS****3.8.1 General:**

3.8.1.1 Comply with recommendations in ACI 302.1R for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

**3.8.1.1.1 Trowel Finish:**

3.8.1.1.1.1 Apply first trowel finish and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighen until surface is free of trowel marks and uniform in texture and appearance.

**3.9 MISCELLANEOUS CONCRETE ITEMS****3.9.1 Filling In:**

3.9.1.1 Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete Work.

**3.9.2 Curbs:**

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- 3.9.2.1 Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

**3.10 CONCRETE PROTECTION AND CURING****3.10.1 General:**

- 3.10.1.1 Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 301, ACI 306.1 for cold-weather protection, and with recommendations in ACI 305R for hot-weather protection during curing.

**3.10.2 Evaporation Retarder:**

- 3.10.2.1 Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

**3.10.3 Formed Surfaces:**

- 3.10.3.1 Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing by one or a combination of the following methods:

**3.10.4 Unformed Surfaces:**

- 3.10.4.1 Begin curing immediately after finishing concrete. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive resilient sheet floor coverings. Cure concrete surfaces to receive other floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer recommends for use with floor coverings.

**3.10.4.1.1 Moisture Curing:**

- 3.10.4.1.1.1 Keep surfaces continuously moist for not less than seven days with the following materials:

- 3.10.4.1.1.1.1 Water

- 3.10.4.1.1.1.2 Continuous water-fog spray.

- 3.10.4.1.1.1.3 Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and

edges with 12-inch lap over adjacent absorptive covers.

3.10.4.1.2 Moisture-Retaining-Cover Curing:

3.10.4.1.2.1 Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

3.10.4.1.3 Curing Compound:

3.10.4.1.3.1 Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.11 CONCRETE SURFACE REPAIRS

3.11.1 Defective Concrete:

3.11.1.1 Repair and patch defective areas when approved by Metra's authorized representative. Remove and replace concrete that cannot be repaired and patched to the Metra's authorized representative approval. Comply with ACI 301.

3.11.2 Patching Mortar:

3.11.2.1 Mix dry-pack patching mortar, consisting of one part Portland cement to two and one-half parts fine aggregate passing a No. 16 (1.2-mm) sieve, using only enough water for handling and placing.

3.11.3 Repairing Formed Surfaces:

3.11.3.1 Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

3.11.3.1.1 Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with

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patching mortar or cone plugs secured in place with bonding agent.

3.11.3.1.2 Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.

3.11.3.1.3 Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Metra's authorized representative.

3.11.4 Repairing Unformed Surfaces:

3.11.4.1 Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

3.11.4.1.1 Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

3.11.5 Perform structural repairs of concrete, subject to Metra's authorized representative approval, using epoxy adhesive and patching mortar.

3.11.6 Repair materials and installation not specified above may be used, subject to Metra's authorized representative approval.

3.12 FIELD QUALITY CONTROL

3.12.1 Testing Agency:

3.12.1.1 Owner will engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement. Sampling and testing for quality control may include those specified in this Article.

3.12.2 Testing Services:

3.12.2.1 Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

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## 3.12.2.1.1 Testing Frequency:

3.12.2.1.1.1 Obtain one composite sample of 5 cylinders for each day's pour of each concrete mix exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.

3.12.2.1.1.1.1 When frequency of testing will provide fewer than five compressive-strength tests for each concrete mix, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

## 3.12.2.1.2 Slump:

3.12.2.1.2.1 ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change. Maximum slump shall be 2"-4".

## 3.12.2.1.3 Air Content:

3.12.2.1.3.1 ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.

## 3.12.2.1.4 Concrete Temperature:

3.12.2.1.4.1 ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.

## 3.12.2.1.5 Unit Weight:

3.12.2.1.5.1 ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.

## 3.12.2.1.6 Compression Test Specimens:

3.12.2.1.6.1 ASTM C 31/C 31M; cast and laboratory cure one set of five standard cylinder specimens for each composite sample.

## 3.12.2.1.7 Compressive-Strength Tests: ASTM C 39

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- 3.12.2.1.7.1 Test one specimen at 7 days and 14 days, two at 28 days and one at 56 days if 28-day compressive strength has not yet been obtained.
- 3.12.2.1.7.2 A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at age indicated.
- 3.12.3 Strength of each concrete mix will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- 3.12.4 Test results shall be reported in writing to Metra's authorized representative, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-, 14- and 28-day tests.
- 3.12.5 Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Metra's authorized representative but will not be used as sole basis for approval or rejection of concrete.
- 3.12.6 Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Metra's authorized representative. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Metra's authorized representative.
- 3.12.7 Defective Work: Concrete work which does not conform to the specified requirements, including strength, tolerances, and finishes, shall be corrected at the Contractor's expense without extension of time. The contractor shall also be responsible for the cost of corrections to any other work affected by or resulting from corrections to the concrete work.

**END OF SECTION 03300**

## SECTION 05030 – HOT DIP GALVANIZING

### 1 GENERAL

#### 1.1 SCOPE OF WORK

##### 1.1.1 General

- 1.1.1.1 Drawings and general provisions of Contract, including General and Special Conditions and Division 1 Specification sections, apply to this section.

##### 1.1.2 Furnish and Install

- 1.1.2.1 All hot dip galvanizing of iron and steel materials after manufacture or fabrication including, but not limited to, all new structural steel, metal fabrications, and all miscellaneous metal items unless noted otherwise.

##### 1.1.3 Related Work

- 1.1.3.1 Section 05120 - "Structural Steel"
- 1.1.3.2 Section 05900- "Miscellaneous Steel"

##### 1.1.4 References

- 1.1.4.1 ASTM A 123: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- 1.1.4.2 ASTM A 143: Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
- 1.1.4.3 ASTM A 153: Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- 1.1.4.4 ASTM A 384: Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Articles.
- 1.1.4.5 ASTM A 385: Providing High-Quality Zinc Coatings (Hot-Dip)
- 1.1.4.6 ASTM A 780: Repair of Damaged Hot-Dip Galvanized Coatings.

##### 1.1.5 Federal Specifications

- 1.1.5.1 DOD-P-21035: Paint, High Zinc Dust Content, and Galvanizing Repair.
- 1.1.5.2 MIL-P-26915: Primer Coating, Zinc Dust Pigmented.

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**1.1.6 Publications****1.1.6.1 Publications by American Galvanizers Association (AGA)****1.1.6.2 The Society for Protective Coatings (SSPC):****1.1.6.2.1 Surface Preparation Specifications:****1.1.6.2.1.1 No. 1 Solvent Cleaning****1.1.6.2.1.2 No. 2 Hand Tool Cleaning****1.1.6.2.1.3 No. 3 Power Tool Cleaning****1.1.6.2.1.4 No. 7 Brush-Off Blast Cleaning****1.1.7 Quality Assurance****1.1.7.1 Coating Applicator: Company specializing in hot dip galvanizing after fabrication and following the procedures of the Quality Assurance Manual of the American Galvanizers Association.****1.2 SUBMITTALS****1.2.1 Submit a Certificate of Compliance issued by the coating applicator indicating that the hot dip galvanized coating meets or exceeds the specified requirements of ASTM A 123, A 767, or A 153.****1.3 DELIVERY, STORAGE AND HANDLING****1.3.1 Store, protect, load, and handle galvanized articles to avoid damage to surfaces.****2 PRODUCTS****2.1 STEEL MATERIALS****2.1.1 Galvanizer shall verify that materials to be galvanized are geometrically, chemically, and otherwise suitable for galvanizing. Avoid use of steel with an ultimate tensile strength greater than 150 ksi.****2.2 FABRICATION REQUIREMENTS****2.2.1 Fabricate structural steel in accordance with Class I, II, III guidelines as described in AGA's "Recommended Details for Galvanized Structures".****2.2.2 Fabrication practices for products to be in accordance with the applicable portions of ASTM A 143, A 384, and A 385, except as herein specified. Avoid fabrication techniques which could cause distortion or embrittlement of the steel.**

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- 2.2.3 The fabricator shall consult with the galvanizer regarding potential problems or potential handling problems during the galvanizing process.
- 2.2.4 Remove all welding slag, splatter, anti-splatter compounds, and burrs prior to delivery to the galvanizer.
- 2.2.5 Provide holes and/or lifting lugs to facilitate handling during the galvanizing.
- 2.2.6 Avoid unsuitable marking paints. Consult with the galvanizer about removal of grease, oil paint and other deleterious material prior to fabrication. Provide approved means of identification.
- 2.2.7 Remove by blast cleaning or other methods, surface contaminants and coatings which would not be removable by the normal chemical cleaning process in the galvanizing operation.
- 2.2.8 Whenever possible, minimize field welding of material.
- 2.2.9 Provide for the flow of cleaning solutions, fluxes, air, and zinc.
- 2.2.10 Identify the location and limits of contact surfaces. Contact surfaces to be roughened by means of hand wire brushing per ASTM A123. Power wire brushing is not permitted.

**3 EXECUTION****3.1 PREPARATION**

- 3.1.1 Pre-clean steelwork in accordance with accepted methods to produce an acceptable surface for hot dip galvanizing.
- 3.1.2 Remove all residue from welding prior to galvanizing.
- 3.1.3 Tube assemblies and other sealed cavities should have adequate venting and drainage holes; consult with galvanizer in regards to size and location of holes.

**3.2 APPLICATION OF COATING**

- 3.2.1 Galvanize steel members, fabrications, and assemblies after fabrication by the hot dip process in accordance with ASTM A 123 or A 153.
- 3.2.2 Dip all structural steel members and metal fabrications assuring a sufficient coating of all surfaces, including corners, joints, holes, and other surfaces.
- 3.2.3 Long steel members and large fabrications too large for a single dip in the galvanizing vat, shall be dipped in two applications to assure all surfaces are thoroughly and fully coated.

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- 3.2.4 Galvanize bolts, nuts and washers and iron and steel hardware components in accordance with ASTM A 153. Oversize components, threads or otherwise allow for additional thickness of galvanizing.
  - 3.2.5 Safeguard products against steel embrittlement in conformance with ASTM A 143.
  - 3.2.6 Handle all articles to be galvanized in such a manner as to avoid any mechanical damage or any distortion.
- 3.3 COATING REQUIREMENTS
- 3.3.1 Coating Weight: conform to paragraph 5.1 of ASTM A 123, Table 1 of A 767, or Table 1 of ASTM A 153, as applicable.
  - 3.3.2 Surface Finish: Continuous, adherent, as smooth and evenly distributed as possible and free from any defect detrimental to the stated end use of the coated article.
  - 3.3.3 Adhesion: Withstand normal handling consistent with the nature and thickness of the coating and normal use of the article.
- 3.4 INSPECTION
- 3.4.1 Galvanizer shall inspect the entire galvanized surface to ensure compliance with ASTM requirements.
- 3.5 TESTS
- 3.5.1 Inspection and testing of hot dip galvanized coatings shall be done under the guidelines provided in the AGA publication "Inspection of Products Hot Dip Galvanized After Fabrication"
  - 3.5.2 Include visual examination and tests in accordance with ASTM A 123, A 767 or A 153 as applicable to determine the thickness of the zinc coating on the metal surface.
  - 3.5.3 Furnish a certificate indicating compliance with ASTM Standards and Specifications herein listed. The certificate must be signed by the galvanizer and contain a detailed description of the material processed as well as information as to the ASTM standard used for the coating.
- 3.6 REPAIR OF DAMAGED COATING
- 3.6.1 The maximum area to be repaired is defined in accordance with ASTM A 123 Section 4.6 current edition. Minimize the area to be repaired in the field.
  - 3.6.2 Repair areas damaged by welding, flame cutting or during handling, transport or erection, by one of the approved methods in accordance with ASTM A 780 whenever damage exceeds 3/16" in width. Minimum

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thickness requirements for the repair are those described in ASTM A 123 Section 4.6 current edition.

**END OF SECTION 05030**

## SECTION 05120 – STRUCTURAL STEEL

### 1 GENERAL

#### 1.1 SCOPE OF WORK

##### 1.1.1 General

- 1.1.1.1 Work under this Section is subject to the requirements of the Contract Documents, including the Supplementary Conditions.

##### 1.1.2 Furnish and Install

- 1.1.2.1 all structural steel work indicated on the drawings and specified, including but not limited to the following

- 1.1.2.1.1 Columns

- 1.1.2.1.2 Beams and Girders

- 1.1.2.1.3 Plates, shims, clips, fasteners, etc., necessary to install structural steel.

- 1.1.2.1.4 Field touch-up painting of welds and abrasions.

##### 1.1.3 Furnish

- 1.1.3.1 All structural steel items indicated on the drawings and specified, to be installed under other sections, including but not limited of the following:

- 1.1.3.1.1 Anchor Bolts

- 1.1.3.1.2 Setting plates and base plates

##### 1.1.4 Related Work

- 1.1.4.1 Section 03300 - Cast-in-place Concrete

- 1.1.4.2 Section 05990 - Miscellaneous Metals

#### 1.2 SUBMITTALS

##### 1.2.1 Shop Drawings

- 1.2.1.1 Shall comply with the requirements of the Supplementary Conditions, and include:

- 1.2.1.1.1 Shop drawings shall show all materials, method of joining, sizes of members, and thickness of metal, and shall contain

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full and complete information regarding joints and fastenings. Drawings shall show relative layout of walls, beams, girders, and other supports, as well as openings, all correctly dimensioned.

- 1.2.1.1.2 Use AWS symbols to indicated welding and show length, size, and spacing (if not continuous). Auxiliary view shall be shown to clarify all welding. Notes such as 1/4" weld", "tack weld" will not be acceptable.
- 1.2.1.1.3 Compare and cross check structural steel shop drawings with shop drawings of reinforced cast-in-place concrete and other work related to structural steel.
- 1.2.1.1.4 Erection diagrams clearly indicate the method and sequence of erection, item mark numbers, equipment loads and calculations indicating the adequacy of the permanent construction to sustain equipment and construction loads and required tolerance for setting embedded items.

**1.2.2 Samples**

- 1.2.2.1 Shall comply with the requirements of the Supplementary Conditions.

**1.2.3 Tests**

- 1.2.3.1 Shall comply with the requirements of the Supplementary Conditions.

**1.2.4 Guarantees**

- 1.2.4.1 Shall comply with the requirements of the Supplementary Conditions.

**1.2.5 Certificates**

- 1.2.5.1 Furnish the Metra's authorized representative with two (2) Certified copies of mill reports covering the chemical and physical properties of all steel used in the work.
- 1.2.5.2 Certification of Welders; hereinafter specified.

**1.3 SPECIAL REQUIREMENTS****1.3.1 Reference Standards**

- 1.3.1.1 The work is subject to requirements of applicable sections of the following:
  - 1.3.1.1.1 "Manual of Steel Construction", American Institute of Steel Construction.
  - 1.3.1.1.2 "Specification for Structural Steel Buildings", American Institute of Steel Construction.

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- 1.3.1.1.3 "Code of Standard Practice for Steel Buildings and Bridges", American Institute of Steel Construction.
- 1.3.1.1.4 "Specification for Structural Joints using ASTM A 325 or A 490 Bolts", American Institute of Steel Construction.
- 1.3.1.1.5 AREMA - "American Railway Engineering and Maintenance-of-Way Association".
- 1.3.1.1.6 ANSI B18.2.2 " Square and Hex Nuts", American National Standards Institute.
- 1.3.1.1.7 AWS D1.1 "Structural Welding Code", American Welding Society.
- 1.3.1.1.8 AWS SR-1 "Special Ruling for Gas-Metal Arc Welding with Carbon Dioxide Shielding", American Welding Society.
- 1.3.1.1.9 "Specifications for Assembly of Structural Joints Using High Strength Steel Bolts", Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation.
- 1.3.1.1.10 SSPC-SP2 " Surface Preparation Specification No. 2, Hand Tool Cleaning", Steel Structures Painting Council.
- 1.3.1.1.11 SSPC-SP3 "Surface Preparation Specification No. 3, Power Tool Cleaning", Steel Structure Painting Council.
- 1.3.1.1.12 SSPC -SP 6 "Surface Preparation Specification No. 6, Commercial Blast Cleaning", Steel Structures Painting Council.
- 1.3.1.1.13 References to ASTM specifications are to the designated specifications of the American Society for Testing and Materials.

## 1.3.2 Field Measurements

- 1.3.2.1 Before proceeding with erection and in time to permit correction of defective setting, verify the location and elevation of all anchor bolts and setting plates. Immediately report discrepancies to the Metra's authorized representative in writing. Otherwise the Contractor shall pay the entire cost of removing and resetting anchor bolts found to be incorrectly placed, and the cost of necessary changes in steel work required by reason of incorrectly placed bolts.

## 1.3.3 Delivery, Storage and Handling

- 1.3.3.1 Exercise care in storing, handling and erecting structural steel and provide necessary blocking or other supports required and in supporting it properly at all to insure that no piece will be bent, twisted, or otherwise damaged. Damaged material shall be corrected to the approval of the Metra's authorized representative before being erected, or replace when so directed by the Owner.

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**1.3.4 General Welding Requirements**

- 1.3.4.1 Welders shall be certified, by an approved testing laboratory, to make groove and fillet welds in all positions. Certifications shall be submitted prior to welding operations.
- 1.3.4.2 Standard welded connections for simple framing shall be as shown in Tables III and IV of the "Manual of Steel Construction".
- 1.3.4.3 Where welding occurs, it shall be by the electric arc process in accordance with referenced standards.
- 1.3.4.4 Welded connection of equal value may be substituted for riveted or bolted connection as shown on the Drawings, subject to approval of the Metra's authorized representative.
- 1.3.4.5 Shop and field welding procedures and standards of acceptance shall be in accordance with AWS D1.1 "Structural Welding Code", American Welding Society.
- 1.3.4.6 An independent testing laboratory will be retained by the «owner» and will attest to welder qualification tests.
- 1.3.4.7 The testing laboratory retained by the owner shall be notified of all welding operations and staging shall be left in place until tests and inspections have been completed.

**1.3.5 Protection**

- 1.3.5.1 Protect materials against damage from mechanical abuse, salts, acids, staining and other foreign matter by an approved means during transportation, storage and erection and until completion of construction work. All unsatisfactory materials shall be removed from the premises, and all damaged materials replaced with new materials.

**2 PRODUCTS****2.1 MATERIALS****2.1.1 Structural Steel**

- 2.1.1.1 Conform to the following ASTM designations. Certify that all members are fabricated from the type of steel specified.
  - 2.1.1.1.1 Structural wide flange shapes shall be ASTM A992 (Fy = 50 ksi).
  - 2.1.1.1.2 Structural tubes shall be ASTM A500, Grade B (Fy = 46 ksi).
  - 2.1.1.1.3 Structural pipes shall be ASTM A53, Grade B, type s (Fy = 35 ksi).
  - 2.1.1.1.4 All other structural steel shall be ASTM A36 (Fy = 36 ksi).

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2.1.1.1.5 All steel shall be hot dipped galvanized after fabrication.

2.1.2 Fasteners

2.1.2.1 High strength bolts, nuts, and washers: ASTM A325. Bolts, nuts, and washers shall conform to ANSI B18.2.2, regarding dimensions.

2.1.3 Welding Electrodes

2.1.3.1 In accordance with AWS standards.

2.1.4 Anchor Bolts

2.1.4.1 ASTM F1554, Grade 36, hot-dip galvanized

2.2 DESIGN

2.2.1 Complete the design of connections for sections of the structure and connections not fully detailed on the Drawings, conforming to applicable codes and standards.

2.2.2 Details indicated on the Drawings may be modified in order to simplify or expedite erection. Such modifications shall be submitted prior to shop detailing. Do not make changes, substitution, or modifications subsequent to approval of shop drawings without resubmission and approval of the Metra's authorized representative.

2.3 SHOP WELDERS QUALIFICATION

2.3.1 Welders for shop fabrication, including tack welders, shall be certified. Those currently certified, and who are performing under the classification necessary for their work for this Contract, need not be rectified. Aforementioned certification by the Contractor will be acceptable if submitted prior to welding for the project.

2.3.2 In the event that the Metra's authorized representative or the testing laboratory requests in writing, recertification of a welder doing work for this Contract, the welder will be required to do so for this work. The tests and certification will be paid for by the Owner if the welder passes the certification tests. Otherwise the costs incurred shall be paid for by the Contractor.

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**2.4 MARKING**

- 2.4.1 Mark each member with an identifying mark. Marks shall not be duplicated for different types of steel and shall be legible throughout fabrication and visible during field erection.
- 2.4.2 Identifying marks shall correspond to marks shown on approved erection diagrams.

**2.5 FABRICATION**

- 2.5.1 Materials shall be new, clean and free from excessive mill scale, flake, rust or pitting.
- 2.5.2 Fabricate only from approved shop drawings. Substitutions of sections or modifications of details shall be made only when approved by the Metra's authorized representative, and at no additional cost to the Contract. Cut or dress abutting joints true and straight to allow a close fit. All members shall be free from twist, kinks, buckles, or open joints and shall be made accurately so that when assembled, parts shall come together without distortion and shimming.
- 2.5.3 Parts assembled with bolts shall be in close contact, except where separators are required. Separators shall be close fitting.
- 2.5.4 Bearings stiffeners for girders shall have their bearing ends closely fitted to the flanges.
- 2.5.5 Members to be milled shall be completely assembled and riveted or welded before milling.
- 2.5.6 Beams and girders shall be cambered as indicated in accordance with AISC Specifications.
- 2.5.7 Allowance for draw shall be made in all tension bracing.
- 2.5.8 Column bases shall be rolled or cast. Bearing ends of columns and tops of column base plates over 3" thick shall have machined bearing surfaces, 3" and under shall be straightened by pressing to provide satisfactory contact bearing between plate and column above. Shimming in accordance with agreed upon procedures will be permitted at column splices.
- 2.5.9 Machined bearing surfaces shall be coated with Type 3 metal primer immediately after machining.
- 2.5.10 Butt welds on exterior exposed surfaces and where indicated on the Drawings shall be ground flush.

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- 2.5.11 Drill required holes in base or bearing plates. Drill grout holes in column bearing plates where shown. Drill holes in members for the work of other trades where shown on the Drawings.
- 2.5.12 Shop connections shall be as shown on the Drawings, either welded or high strength bolts (ASTM A 325 or A 490).
  - 2.5.12.1 Where connections are not fully detailed on the Drawings. provide connections per Tables I and II, 3/4" diameter connections, of the "Manual for Steel Construction.
  - 2.5.12.2 Where more than one connection is indicated for the same member, connection shall be approved by the Metra's authorized representative.
  - 2.5.12.3 Welded connections shall be per AWS D1.1 or as shown.
  - 2.5.12.4 One-sided or other types of eccentric connections will not be permitted unless shown on the Drawings and approved.
- 2.5.13 Furnish anchor bolts, setting plates, and templates in ample time to prevent delay in the work of other trades.
- 2.5.14 Furnish and install all additional clips, angles, braces, framing and supports required for anchoring work to the structural frame of building. Provide proper expansion joints in continuous metal work where required, as approved by the Metra's authorized representative. Exposed work shall be finished smooth, and even with close joints and connections. Exterior joints and connections shall be formed to exclude water.

**2.6 SHOP FINISHES**

- 2.6.1 All steel to be hot dip galvanized.
  - 2.6.1.1 Galvanization shall meet the requirements specified in ASTM A123. See Section 05030 "Hot Dipped Galvanization."

**3 EXECUTION****3.1 INSPECTION**

- 3.1.1 Before commencing steel erection, examine substrate surfaces to determine that they are free of conditions, which might be detrimental to proper and timely completion of the work. Start of work shall indicate acceptance of the substrate.

**3.2 FIELD WELDERS QUALIFICATIONS**

- 3.2.1 Field welders shall be qualified according to applicable specification for Manual shielded-arc welders and according to AWS SR-1 for gas metal-arc welders. Those currently certified for the classifications necessary

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for their work will not be required to be re-certified. The Aforementioned certification will be acceptable if submitted to the Metra's authorized representative prior to the start of any field welding.

- 3.2.2 In the event the Metra's authorized representative or the Testing Laboratory retained by the Owner requests in writing for the requalification of welder at any time during the erection welding activities of the project, said welder shall be requalified. If the welder passes, the Owner will pay the costs or retesting. If the welder fails to pass, the Contractor shall pay the costs. Gas metal-arc welders (including internship) need only be qualified for those weld positions for which they will be actually engaged. Manual shielded arc welders shall be qualified for at least unlimited horizontal groove and vertical fillet welds.

**3.3 ERECTION EQUIPMENT**

- 3.3.1 Furnish erection equipment, derricks, hoists, planking, and other equipment required for the proper and safe execution of all erection work.
- 3.3.2 Provide temporary bracing, guys or other devices required to provide safety and stability for the erection of structural steel. Leave bracing in place until steel work is in final position and approved. Maintain adequate lateral support throughout construction.
- 3.3.3 Torque wrenches for tightening high strength bolts may be either manual or power type. Method of calibrating shall be approved by the Metra's authorized representative. Calibration of wrenches shall be checked daily by an approved method. Check at other times when setups change or other conditions vary. Required bolt tension and torque values shall be approved by the Metra's authorized representative.

**3.4 ERECTION**

- 3.4.1 Assume responsibility for the correct fitting of all structural members and for the elevation and alignment of the finished structure and any adjustments necessary in the steel frame because of discrepancies in elevations and alignment.
- 3.4.2 Work shall be assembled and erected in place as rapidly as the progress of other work will permit.
- 3.4.3 Columns shall be erected, securely braced and guyed, and held plumb and in line until after bolting has been completed. Setting plates shall be set on grout at least 72 hours prior to the erection of base plates and columns.
- 3.4.4 No welding or bolts shall be done until as much of the structure as will be stiffened by the welding or bolting has been properly aligned.
- 3.4.5 Drift pins shall not be used to enlarge unfair holes in main material. Holes that must be enlarged to admit bolts shall be reamed. Burning and drifting to align unfair holes shall not be used.

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- 3.4.6 Field connections shall be high strength bolts as shown. Minimum bolted connections shall be framed beam connections conforming to design procedure set forth in the "Manual of Steel Construction."
- 3.4.7 Where shims are required to plumb columns, use thin steel shims equal in strength to column strength. Drive shims tight, filling the gap. Erection bolts at splices shall be removed where welds may crack if restrained on cooling. Maximum total thickness of shims shall be 3/8". If gaps are greater use full penetration welds.
- 3.4.8 No cutting of structural steel in the field will be allowed without the Approval of the Metra's authorized representative.

**3.5 FIELD TOUCH UP**

- 3.5.1 Damaged and abraded spots, shall be touched-up with zinc reach primer to match adjacent color.

**3.6 TESTS AND INSPECTIONS**

- 3.6.1 The Metra's authorized representative reserves the right to have materials and workmanship subject to inspections and tests in either mill or shop witnessed by an independent testing laboratory retained by the Owner. Contractor shall notify the Metra's authorized representative of mill and shop schedules so that arrangements can be made for the Metra's authorized representative or Testing Laboratory to be present when inspection or tests are to be made.
- 3.6.2 Periodic inspection and tests, which may be required by the Metra's authorized representative, is in addition to the Contractors constant inspection and shall not relieve the Contractor of the responsibility to furnish satisfactory materials and workmanship.
- 3.6.3 Check all shop welds by visual means, by magnetic particle methods conforming to ASTM E 709, or by ultrasonic methods conforming to ASTM E 164.
- 3.6.4 The Owner shall engage the services of an independent testing laboratory to perform the following field tests and submit 3 copies of all reports to the Metra's authorized representative. Corrective measures, including additional and more complete testing, which may result from these tests, shall be the Contractor's responsibility at not additional cost to the Owner.
  - 3.6.4.1 High strength bolted connections shall be checked in accordance with the procedures indicated in "Specifications for Structural Joints Using ASTM A 325 Bolts"; Section 8 (c) shall be used unless otherwise approved in writing by the Metra's authorized representative.
  - 3.6.4.2 All welds shall be visually inspected.
  - 3.6.4.3 All full penetration welds shall be ultrasonically tested in accordance with the requirements of ASTM E 164.

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- 3.6.5 Cooperate with the laboratory and leave all staging in place until inspections and tests have been completed.
  - 3.6.6 Provide certified survey of the structural steel components, including but not limited to the following:
    - 3.6.6.1 Alignment, plumbness and levelness of all columns and beams.
    - 3.6.6.2 Elevation and camber of all beams (vertical plane).
  - 3.6.7 Surveyor shall be approved by the Metra's authorized representative. Three copies of the certified survey shall be submitted to the Metra's authorized representative for his record.
  - 3.6.8 The Metra's authorized representative reserves the right to reject material at any time before final acceptance of the structure when, in the opinion of the Metra's authorized representative, materials or workmanship do not conform to specification requirements.
- 3.7 CLEANING
- 3.7.1 All rubbish and debris resulting from the work of this section shall be collected, removed from the site and disposed of legally.

**END OF SECTION 05120**

## SECTION 05990 – MISCELLANEOUS METALS

### 1 GENERAL

#### 1.1 SCOPE OF WORK

##### 1.1.1 General

1.1.1.1 Work under this Section is subject to the requirements of the Contract Documents including Supplementary Conditions.

##### 1.1.2 Furnish and Install

1.1.2.1 All miscellaneous metal work indicated on the drawings and specified, including but not limited to the following:

1.1.2.1.1 Hot dipped galvanized pan stairs, guardrails, handrails, swing gates, steel plate beam guardrails, and steel bar grates.

1.1.2.1.2 All other miscellaneous metal work not included as work specified under Section 05120 -- "Structural Steel", or specifically specified above, but as required for a complete installation of miscellaneous work.

##### 1.1.3 Related Work

1.1.3.1 Section 03300 -- "Cast-in-place Concrete"

1.1.3.2 Section 05120 -- "Structural Steel"

#### 1.2 SUBMITTALS

##### 1.2.1 Shop Drawings

1.2.1.1 Shop details for the fabrication and assembly of all miscellaneous metal work, including information covering materials, sizes and shape of members; details of joints connections, pipe sleeves, and bracket connections; ornamental fencing system.

1.2.1.2 All welding shall be indicated using AWS symbols and showing length, size and spacing (if not continuous) Auxiliary views shall be shown to clarify all welding. Notes such as 1/4" weld", and "tack weld" will not be acceptable.

##### 1.2.2 Samples

1.2.2.1 Subject to the requirements of the General Requirements.

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**1.2.3 Tests**

1.2.3.1 Subject to the requirements of the General Requirements.

**1.2.4 Guarantees**

1.2.4.1 Subject to the requirements of the General Requirements.

**1.2.5 Certification**

1.2.5.1 Subject to the requirements of the General Requirements.

1.2.5.2 Welders shall be certified by an approved testing laboratory, and a copy of certification that each operator has passed the tests must be furnished to the Metra's authorized representative when so requested.

**1.3 SPECIAL REQUIREMENTS****1.3.1 Reference Standards**

1.3.1.1 The work is subject to requirements of applicable sections of the following:

1.3.1.1.1 AISC "Code of Standard Practice for Steel Buildings and Bridges.

1.3.1.1.2 AISC "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings" and including the "Commentary of the AISC Specifications".

1.3.1.1.3 AWS "Code for Welding in Building Construction".

1.3.1.1.4 IDOT Standard Specifications: IDOT Standard Specifications for Road and Bridge Construction.

**1.3.2 Field Measurements**

1.3.2.1 Before proceeding with fabrication the miscellaneous metal work, the supplier/installer shall verify all dimensions and take such measurements as are required for proper fabrication and erection of the work.

**1.3.3 Storage of Materials**

1.3.3.1 Storage of fabricated metal at the job site shall be the responsibility of the Contractor. Materials stored at the job site shall be so placed that no members will be damaged and shall be protected against corrosion or deterioration of any kind. The

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Metra's authorized representative reserves the right to reject any material that has become damaged because of improper storage.

**1.3.4 Protection**

- 1.3.4.1 Protect materials against damage from mechanical abuse, plaster, salts, acids, staining and other foreign matter by an approved means during transportation, storage and erection and until completion of construction work. All unsatisfactory materials shall be removed from the premises, and all damaged materials replaced with new materials.

**1.4 SYSTEM PERFORMANCE REQUIREMENTS****1.4.1 Structural Performance**

- 1.4.1.1 Design, engineer, fabricate, and install the following metal fabrications to withstand the following structural loads without exceeding the allowable design working stress of the materials involved, including anchors and connections, as well as no excessive deflection. Apply each load to produce the maximum stress in each respective component of each metal fabrication.
- 1.4.1.1.1 Top Rail of Guardrail Systems: Capable of withstanding the following loads applied as indicated:
- 1.4.1.1.1.1 Concentrated load of 250 lbf applied at any point non-concurrently, vertically downward, or horizontally.
- 1.4.1.1.1.2 Uniform load of 50 lbf per linear ft. applied non-concurrently, vertically downward or horizontally.
- 1.4.1.1.1.3 Concentrated and uniform loads above need not be assumed to act concurrently.
- 1.4.1.1.2 Handrails Not Serving as Top Rails: Capable of withstanding the following loads applied as indicated:
- 1.4.1.1.2.1 Concentrated load of 200 lbf applied at any point non-concurrently, vertically downward or horizontally.
- 1.4.1.1.3 Infill Area of Guardrail Systems: Capable of withstanding a horizontal concentrated load of 200 lbf applied to 4 inch by 4 inch area at any point in the system including panels, intermediate rails balusters, or other elements composing the infill area.
- 1.4.1.1.3.1 Above load need not be assumed to act concurrently with uniform horizontal loads on top rails of railing systems in determining stress on guard.

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- 1.4.1.1.4 Treads of Steel Stairs: Capable of withstanding a uniform load of 100 lbf per sq. ft. or a concentrated load of 300 lbf on an 4 inch by 4 inch area located in the center of the tread, whichever produces the greater stress.
  - 1.4.1.1.5 Platforms of Steel Stairs: Capable of withstanding a uniform load of 100 lbf per sq. ft.
  - 1.4.1.1.6 Design stair systems to sustain the total design load with a maximum deflection of any member not exceeding the lesser of L/360 or 0.25 inches.
- 1.4.2 Safety and Accessibility Features
- 1.4.2.1 Engineer and fabricate stairs and railings to comply with requirements of International Building Code and/or Chicago Building Code, as applicable, including headroom, handrail and guardrail locations, projection, height, baluster spacing.
- 1.4.3 Lintels and Supports for Unit Masonry
- 1.4.3.1 Design, fabricate and install to support masonry with maximum L/600 deflection.

**2 PRODUCTS****2.1 MISCELLANEOUS FRAMING AND SUPPORTS**

- 2.1.1 Provide hot dipped galvanized steel framing and supports for applications indicated or which are not parts of structural steel framework, as required to complete work.
- 2.1.2 Provide shop drawings showing applicable field verified sizes, details. Coordinate with supplier of equipment or product framing is supporting, if applicable.
- 2.1.3 Fabricate units to sizes, shapes, and profiles indicated and required to receive adjacent other construction retained by framing and supports. Fabricate from structural steel shapes, plates, and steel bars of welded construction using mitered joints for field connection. Cut, drill, and tap units to receive hardware, hangers, and similar items. Equip units with integrally welded anchors for casting into concrete or building into masonry. Furnish inserts if units must be installed after concrete is placed. Except as otherwise indicated, space anchors 24 inches o.c. and provide minimum anchor units in the form of steel straps 1-1/4 inches wide x 1/4 inch x 8 inches long. Secure miscellaneous framing securely to structure by welding or anchoring as approved. Installation to withstand all applicable loadings and stresses.

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**2.2 FABRICATION OF MISCELLANEOUS STEEL**

- 2.2.1 Work under this section shall be executed only by concerns of standing, approved by the Metra's authorized representative. All exposed work shall be made perfect in materials, workmanship and finish. Fieldwork shall be done by skilled mechanics. Angles and lines shall be straight and true; surfaces shall be smooth and free from all waves and buckles. Do all cutting and drilling necessary for fitting work in place and erect all work in place in a firm, rigid and workmanlike manner.
- 2.2.2 Work under this Section shall be executed by a fabricator of established reputation who is regularly engaged in the fabrication of miscellaneous and ornamental iron work. Contractor shall submit for Metra's authorized representative approval name of fabricator that will perform the work.
- 2.2.3 Shop assembled members shall be welded. No field riveting will be permitted; field connections shall be high strength bolted or welded. All welds shall be ground smooth and flush with adjacent surfaces.
- 2.2.4 Where welding occurs, it shall be by the electric arc process in accordance with American Welding Society's Code for Arc and Gas welding in Building Construction.
- 2.2.5 Execute all welding by operators who have been qualified previously by tests as prescribed by the American Welding Society's "Standard Qualification Procedure" to perform the work required.
- 2.2.6 Provide all lugs, connections, anchors, rods, etc., necessary for complete erection.
- 2.2.7 No burning of steel will be permitted in the field. Members burned in the shop shall be finished to an acceptable appearance, equal to a sheared finish. Holes shall not be burned in either shop or field. No cutting of structural shapes shall be done in the field without the consent of the Metra's authorized representative.
- 2.2.8 Materials shall be properly marked and match-marked where field assembly is required. The sequence of shipments shall be such as to expedite erection and minimize the field handling of materials.
- 2.2.9 Use care in handling and erection to insure that steel shall not be twisted, bent or otherwise damaged, and should any difficulty be encountered, it shall be immediately reported to the Metra's authorized representative.
- 2.2.10 Connections at angles, miters and junctions which cannot be forged or welded shall be made with blind screws from the back or other concealed fastenings. Furnish and install all additional clips, angles, braces, framing and supports required for anchoring this work to the masonry or structural frame of building or for supporting other work as shown. Provide proper expansion joints in continuous metal work where

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required as approved by the Metra's authorized representative. Exposed work shall be finished smooth and even, with close joints and connections. Exterior joints and connections shall be formed to exclude water.

**2.3 STEEL PLATE BEAM GUARDRAILS**

2.3.1 Steel plate beam guardrails shall meet the requirements of Section 630 of the IDOT Standard Specifications and shall comply with Article 630.02 of the same.

2.3.2 Articles 630.06, 630.07 and 630.08 of the IDOT Standard Specifications are not applicable to this project.

**3 EXECUTION****3.1 NOT USED****END OF SECTION 05990**

## SECTION 16010

### BASIC ELECTRICAL MATERIALS AND METHODS

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. This Section includes raceways, boxes, manholes, wire, cable, and appurtenances required under Division 16, related to traction power substation work, as specified and as indicated on the Contract Drawings.

##### 1.02 REFERENCES

- A. This Section incorporates by reference the latest revisions of the following documents:
  - B. American National Standards Institute (ANSI)
    - 1. ANSI C80.1, Standard for Electrical Rigid Steel Conduit (ERSC)
  - C. ASTM International (ASTM)
    - 1. ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
    - 2. ASTM D149, Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies
    - 3. ASTM D150, Standard Test Methods for AC Loss Characteristics and Permittivity (Dielectric Constant) of Solid Electrical Insulation
    - 4. ASTM D570, Standard Test Method for Water Absorption of Plastics
    - 5. ASTM D635, Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
    - 6. ASTM D695, Standard Test Method for Compressive Properties of Rigid Plastics
    - 7. ASTM D696, Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30°C and 30°C with a Vitreous Silica Dilatometer
    - 8. ASTM D792, Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
    - 9. ASTM D2105, Standard Test Method for Longitudinal Tensile Properties of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe and Tube

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- D. National Electrical Manufacturer's Association (NEMA)
  - 1. NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum)
  - 2. NEMA FB 1, Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable
  - 3. NEMA TC 2, Electrical Polyvinyl Chloride (PVC) Conduit
  - 4. NEMA TC 3, Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing
- E. National Fire Protection Association (NFPA)
  - 1. NFPA 70, National Electrical Code
- F. Underwriters Laboratories (UL)
  - 1. UL 6, Electrical Rigid Metal Conduit – Steel
  - 2. UL 94, Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
  - 3. UL 486A-486B, Wire Connectors
  - 4. UL 514B, Conduit, Tubing, and Cable Fittings
  - 5. UL 2515, Aboveground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings
  - 6. UL 2420, Belowground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings

**1.03 COORDINATION**

- A. Cooperate with other contractors in installing work that may affect the work of other contractors.
- B. Make proper arrangements to avoid interference with other trades, and cooperate with the Commonwealth Edison Co., SBC, AT&T, Comcast, and Peoples Gas Co. in their installation of underground ducts to underground duct extension sleeves and/or openings provided under this Contract.

**1.04 SUBMITTALS**

- A. Propose products of manufacturers for consideration. Submittals shall be made to Metra's Authorized Representative for approval. Submit all data necessary for products offered for approval.
- B. Submit for approval, shop drawings and descriptive literature for conduit, fittings, spacers, support devices, anchors, and hangers.
- C. Submit certifications of compliance and samples of the fiberglass-reinforced epoxy conduit to be installed.

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- D. Cable Manufacturer's Data: Data to be supplied by the Contractor for each type of size of wire and cable provided shall include the following:
1. Number of Conductors, Materials, Stranding
  2. Voltage Rating of Insulation
  3. Temperature Rating of Insulation
  4. Insulation Material and Thickness
  5. Jacket Material and Thickness
  6. Overall Diameter
  7. Weight, lb/1000 ft
  8. Manufacturer's Test Report
  9. Tray Bonding Tie: 500 kcmil bare conductor cable as shown on the Contract Drawings.
- E. The legends of all nameplates shall be submitted to Metra's Authorized Representative for approval.

**PART 2 - PRODUCTS****2.01 GENERAL**

- A. All materials shall be new and the best of their respective kinds. The use of other than "prime" grades will not be accepted.
- B. In all cases, where a device or part of the equipment is referred to in the singular, it is intended that such reference shall apply to as many such devices as are required to complete the installation.

**2.02 CONDUIT AND FITTINGS**

- A. GRC Conduit:
1. Shall be hot-dipped galvanized steel with uniform chromate coating for added protection inside and outside.
  2. Threads, galvanized after cutting, shall be 3/4-inch taper National Pipe Thread.
  3. Each full length of conduit shall bear the UL label.
  4. Fittings shall be galvanized malleable iron or steel, and shall be UL listed.
  5. GRC conduit shall comply with the following standards:
    - a. ANSI C80.1
    - b. UL 6

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- c. Minimum  $\frac{3}{4}$  inch trade size
- B. EMT Conduit:
1. EMT conduit shall comply with the following standards:
    - a. NEMA FB 1
    - b. UL 514B
  2. Each full length of conduit shall bear the UL label.
  3. Fittings shall be galvanized malleable iron or steel, and shall be UL listed.
- C. Plastic conduit:
1. Plastic conduit shall be polyvinyl chloride (PVC) suitable for 900°C cable and for installation in direct sunlight.
  2. For concrete encasement Type I application and for normal duty above ground Type III application, conduit shall be heavy wall Schedule 40.
  3. For direct burial Type II application and for heavy duty above ground Type IV application, conduit shall be extra heavy wall Schedule 80.
  4. Conduit shall be UL listed and comply with the latest requirements of the NEMA TC 2.
  5. Fittings for plastic conduit shall be made from rigid PVC compounds, and shall comply with the latest requirements of NEMA TC 3.
- D. Fiberglass Reinforced Epoxy Conduit (RTRC)
1. Fiberglass reinforced epoxy conduit shall be lightweight, fire and ultraviolet ray resistant, and suitable for overhead installation and concrete encasement construction.
  2. Conduit shall be fiberglass-reinforced epoxy, composed of glass filaments encapsulated in an epoxy matrix. Conduit shall be filament-wound, and shall have pigment dispersed homogeneously throughout the epoxy glass matrix for ultraviolet protection.
  3. End bells, couplings, deflection couplings, adapters, bends, sweeps and other fittings shall be provided as required.
  4. Conduit and fitting shall be UL listed, and shall be durably labeled. Fiberglass reinforced epoxy conduit shall meet the following specifications:
    - a. Each conduit length shall have an integral wound-in expanded coupling. Average wall thickness shall be .070 inches.
    - b. Conduit encased in concrete or exposed shall be low-smoke type.
    - c. Size as shown on Contract Documents
    - d. Conduit and fittings in the 2-inch through 6-inch sizes, inclusive, shall have inside diameters equal to the trade size.

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- e. Conduit shall be suitable for continuous operation from - 40 degrees C to +110 degrees C without significant change in mechanical properties.
  - f. Conduit shall have a burning point in excess of 130 degrees C (124 degrees C for above ground installation) and combustion shall cease when the heat source is removed. When tested in accordance with ASTM D635, conduit shall not outgas chlorine. Other toxic gases shall not outgas in excess of 0.0015 cubic feet per square foot of material.
  - g. Conductor shall not adhere to conduit or fittings in fault conditions.
5. Conduit shall have the following minimum physical properties:
- a. Tensile strength, longitudinal: 11,000 psi, when tested per ASTM D2105.
  - b. Compressive strength, axial: 12,000 psi, when tested per ASTM D695.
  - c. Ultimate elongation: 2 percent when tested per ASTM D2105.
  - d. Modulus of elasticity in tension: 1,250,000 psi, when tested per ASTM D2105 for below ground, and 1,300,000 for above ground.
  - e. Modulus of elasticity in bending: 2,280,000 psi, when tested per ASTM D2105 for above ground, and 2,500,000 for below ground.
  - f. Thermal conductivity: 0.828 BTU/Hr./Sq.Ft./Degrees F/Inch per ASTM D335.
  - g. Coefficient of linear thermal expansion:  $1.37 \times 10^5$  Inch/Inch/Degrees F, when tested per ASTM D696.
  - h. Specific gravity 1.94, when tested per ASTM D792.
  - i. Temperature range: Minus 40 Degrees C to plus 110 Degrees C for below ground and minus 40 Degrees C to plus 124 Degrees C for above ground.
  - j. Dielectric Strength: 500 volts/mil, when tested per ASTM D149.
  - k. Dissipation factor: 0.5 percent average at room temperature, when tested per ASTM D150.
  - l. Water absorption: less than 0.175 percent (14 days at room temperature) when tested per ASTM D570.
6. The conduit shall be thoroughly cured and shall be free of any material. It shall be straight and shall have a circular bore with the inner surface smooth and free from dents, obstructions, or any other defects which would cause damage to cables. The bores shall pass freely a mandrel 36 inches in length and 1/4-inch less in diameter than the nominal diameter of the conduit.
7. The conduit shall comply with UL 2515 for above ground and UL 2420 for below ground.
8. The conduit shall have passed UL flammability test UL 94 for below ground only.
9. All conduit elbows, bends, sweeps, deflection fittings, expansion fittings, and miscellaneous fittings shall conform to NEMA TC and shall be UL listed.

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10. Each 10-foot length of conduit, sizes 2 inch through 6 inch, shall be provided with an integral end bell or factory-installed double end bell, containing a urethane seal. The other end of each 10-foot length shall be provided with a scribe mark, indicating the proper distance to which the conduits must be mated to ensure a secure (100-pound pull out), water-tight (15 psi) connection. 20-foot lengths may be used only where permitted by Metra's Authorized Representative .
  11. No threads of adhesives shall be required to ensure water-tight joints for in ground and concrete encased installations.
  12. Each length and each fitting shall be listed by the Underwriters' Laboratories, or the Canadian Standards Association, and shall be provided with an appropriate label affixed thereto.
- E. Sealing Bushings: Shall be 0Z GEDNEY, Mac Products or approved equal
- F. Flexible Conduit
1. Flexible conduit shall be liquid tight, consisting of flexible steel construction covered with an extruded jacket of neoprene or PVC. Bare "BX" type flexible conduit is prohibited.
  2. Conduit shall be American Flexible Conduit Company, Anaconda Metal Hose Div., Electric Flex Company or approved equal.
  3. Fittings for liquid tight flexible metal conduit shall be UL listed and approved for grounding.
  4. Flexible conduit above 1-1/4 inch trade size shall have grounding conductor run within the flex. Conductor must be sized on the basis of the rating of the overcurrent protective device for the circuit run within the flex, all in accordance with NFPA 70, US and any local governing codes.
  5. The use of flexible conduits shall not be allowed inside the new prefabricated substations and shall only be used in the existing Tie Breaker Station where space constraints do not allow the use of rigid Conduit
- G. Manholes:
1. Manhole construction shall include galvanized pulling irons, cable support inserts, ground straps, metal frames and covers, duct windows, galvanized ladders, and sump pits.
  2. All items in this classification, including all excavations, framing, shoring, concrete, metal reinforcement and backfill for manholes shall be determined by the Contractor.
  3. Each manhole shall be provided with one or more openings in the roof for manhole frames and covers, and in the ends or sides for duct entrances. Each duct entrance shall have the size and location determined by the Contractor.

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4. Non-metallic racks shall be provided for cable support.

**H. Underground Conduit Ducts:**

1. Provide materials and construct underground conduit ducts.
2. Ducts shall be cast in place monolith construction and shall be of reinforced construction as shown on the Drawings.
3. Concrete and metal reinforcement for ducts shall be as follows:
  - a. Peripheral reinforcing shall be No. 5 deformed bars with 20 times the diameter overlap on 10-inch centers.
  - b. Ties shall be No. 4 with minimum 12-inch overlaps 18-inch centers.
4. Conduit Spacers: For 3-1/2 inch fiberglass reinforced epoxy conduits spacers shall provide approximately a 2-inch separation between the conduits. Contractor is required to purchase at least three extra spacers to provide for breakage during construction.

**I. Inserts and Sleeves**

1. Lay out work in advance of construction of slabs or construction of walls. Provide all inserts and sleeves necessary to complete the work.
2. Wall Sleeves: Unless otherwise established by Contractor all exterior and interior wall sleeves shall be of fiberglass reinforced epoxy conduit. All exterior sleeves shall be made watertight, using watertight sealing bushings.
3. Floor Sleeves: Conduits passing through floors shall be sleeved with fiberglass reinforced epoxy conduit and shall be sealed with neoprene rope and caulk. Sleeves shall extend 1-inch above finished floor surface.

**2.03 CABLE TRAY SYSTEM****A. Aluminum Cable Tray:**

1. Aluminum cable tray and fittings shall be of standard width with approximately 4-inch deep sides.
2. Trays and fittings shall be fabricated of aluminum throughout and provided complete with required splice plates and cadmium plated bolts and nuts.
3. Aluminum cable tray system shall be UL classified for use as an equipment grounding conductor.

**B. GRP Cable Tray:**

1. GRP cable tray and fittings shall be of standard width with approximately 4-inch deep sides.

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2. Tray and fittings shall be pultruded from glass-fiber reinforced polyester resin.
3. GRP cable tray system shall be UL listed.

**2.04 WIRE AND CABLE**

- A. Provide and connect all wires and cables for substation auxiliary power, control, lighting, etc.
- B. To prevent vandalism, any exposed copper connections shall be enclosed with stainless steel.
- C. Wire and Cable Take-Offs: It is the Contactor's responsibility to provide wire and cable as specified. The Contractor is responsible for making cable take-offs for ordering sufficient wire and cable for the project requirements.
- D. Cable (600 volt and below)
  1. Wire and cable for controls, substation auxiliary power, and substation lighting shall be provided by the Contractor.
  2. Conductors, insulating and jacketing materials shall be in accordance with applicable ICEA and ASTM Standards, and shall conform to the following specifications:
  3. Multi-Conductor Cable: Multi-Conductor Cables for control and miscellaneous power shall be stranded copper conductor, No. 12 AWG minimum size, XHHW, VW 1 flame retardant moisture resistant 600 Volt, cross linked synthetic polymer insulation, rated 90°C dry, 75°C wet, flame and moisture resistant fillers, vulcanized chlorosulphonated polyethylene jacket (Hypalon).
  4. Single Conductor Wire: Single Conductor Wire for miscellaneous control and power shall be copper conductor, No. 12 AWG minimum size, stranded conductor, XHHW, VW 1 flame retardant moisture resistant 600 volt, cross linked synthetic polymer insulation, rate 90°C dry, 75°C wet. Wire shall be suitable for conduit or duct installation, wet or dry locations.
  5. Lighting Wire:
    - a. Wire for lighting feeders and branch circuits shall be single conductor, solid copper wire, No. 12 AWG or No. 10 AWG as required, with XHHW, VW 1 600 volt insulation. Minimum wire size shall be No. 12 AWG.
    - b. Fixture wire shall be type SFF 1, stranded, tinned copper, silicone rubber insulated, glass braid covering, rated 600 volts, 160°C. Use of wire nut is allowable.

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6. Color Coding:
- a. All 208 volt branch circuits shall be color coded with either colored tracers or solid colored jacketing, using black for "A" phase, red for "B" phase, blue for "C" phase and white for neutral.
  - b. All multi-conductor control cables shall be color coded as follows:

<b>Multi-Conductor Cable Color Code</b>		
<b>Conductor</b>	<b>Color</b>	<b>Print</b>
1	Black	1
2	Red	2
3	Blue	3
4	Orange	4
5	Yellow	5
6	Brown	6
7	Red/Black	7
8	Blue/Black	8
9	Orange/Black	9
10	Yellow/Black	10
11	Brown/Black	11
12	Black/Red	12
13	Blue/Red	13
14	Orange/Red	14
15	Yellow/Red	15
16	Brown/Red	16
17	Black/Blue	17
18	Red/Blue	18
19	Orange/Blue	19
20	Yellow/Blue	20
21	Brown/Blue	21
22	Black/Orange	22
23	Red/Orange	23
24	Blue/Orange	24
25	Green/Yellow	25

## 2.05 BOXES

## A. Junction Boxes

1. Where necessary to terminate, tap off, or redirect multiple conduit runs, provide appropriately designed junction boxes.
2. Unless otherwise noted, boxes not over 100 cubic inches in size shall be standard UL label pressed steel boxes.
3. Boxes over 100 cubic inches in size shall be constructed as NFPA 70 specified cabinets. Covers shall be of same thickness and material as boxes and shall be secured by brass screws or bolts. All boxes shall be hot dipped galvanized after construction.

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4. Unless otherwise noted, box sizes shall be as required by NFPA 70 or local governing code for the number of conduits and conductors entering and leaving them. Minimum acceptable junction box size shall be 4-inches square by 1-1/2-inches deep.
5. Boxes over 100 cubic inches shall be of oil tight JIC box construction, unless otherwise noted Metra's Authorized Representative with continuous hinge cover.

**B. Terminal Boxes**

1. Where necessary for conductor terminations, the provide NEMA 250 Type 12 enclosure with continuous hinged covers for indoor installations and NEMA 250 Type 4 for outdoors.
2. All terminal boxes shall be made up from No. 14 gauge galvanized steel. Boxes shall be finished with gray primer inside and outside over phosphatized surfaces.
3. Each box shall be provided with a removable No. 12 or No. 14 gauge galvanized steel panel mounted on collar studs (panels having 400 square inches of surface or more shall be No. 12 gauge). Panel shall be given one prime coat over phosphatized surface and be finished with one coat of white enamel.
4. Terminal blocks shall be suitable for the size of wire, voltage and current rating of the conductor being terminated. Blocks shall include standard terminals, mounting rails, barriers, covers, end stop insulating section and clamp, ground clamps and markers. The terminal strip used shall include a minimum of 10 percent spare terminals.

**C. Outlet Boxes**

1. Fixture, electrical device, switch and outlet boxes shall be of the cast metal type with integral threaded conduit hubs. Size shall accommodate device noted and be at least 1-1/2 inches deep.
2. Where three more devices are at one location, use multiple gang boxes. Install one device per gang unless otherwise determined by Metra's Authorized Representative.
3. Boxes shall be provided with gasketed covers. Covers shall be screw fastened.
4. Surface outlets on exterior walls and in interior locations where exposed to moisture, and where specifically established by the Contractor, shall be cast metal outlet boxes with conduit hubs and matching device plate.
5. Outlets installed back to back in the same wall shall be offset 6 inches horizontally from each other, to preclude noise transmission.

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6. Outlet boxes shall be attached to masonry or concrete construction by use of expansion anchors and to steel beams by use of clamps, bolts, etc.

**D. Pull Boxes**

1. Pull boxes shall be provided by the Contractor to facilitate conductor installation. Pull box construction details shall comply with the same specifications as for junction box construction.
2. In general, conduit runs of more than 100 feet, or with more than three right angle bends, shall have a pull box installed at a convenient intermediate location.
3. All pull box installations by the Contractor are subject to the approval of Metra's Authorized Representative and must be noted on the as-built drawings.
4. Boxes shall be supported independently of conduits entering them. Brackets, rod hangers, mounting channels or other supporting methods shall be used as approved by Metra's Authorized Representative.
5. Pull boxes shall be provided with suitable barriers where required. Vertical offset pull boxes shall contain cable supports at turns to prevent cables from resting on corners.

**2.06 WIRE CONNECTIONS AND CONNECTING DEVICES****A. Terminal Lugs:**

1. Provide solderless lugs or studs for power, control and miscellaneous cables for connections. Bolting hardware for all lugs shall be silicon bronze. The Contractor provided lugs shall be of the pressure-indented type for power and grounding cables and the crimp type for control and miscellaneous cables. Note that all lugs for control cables shall be insulated ferrule, ring tongue type (open or fork tongue are not permitted).
2. All cable lugs shall be of the compression indent type requiring the use of a special tool.
3. Cable lugs shall be UL listed or meet UL 486 heating and pullout tests for compression indent type.
4. Branch circuit conductor lugs for cable sizes No. 10 AWG and smaller, shall be ring type only with insulated barrel.
5. Branch or feeder circuit conductor lugs for cable sizes No. 8 to No. 2 AWG shall be single hole type.
6. Branch or feeder circuit conductor lugs for cable sizes No. 2 AWG and larger shall be two-hole type. Bolt hole spacing shall conform to NEMA standards.

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7. All enclosures shall be sized to accommodate the specified connectors so that conductors are bent to radii larger than that recommended by the cable manufacturer.
- B. Cable Splicing and Termination:
1. Joints in branch circuit wiring shall be made mechanically and electrically secure with UL listed solderless connectors that comply with UL 486A/486B.
  2. Terminal blocks, for control circuit interconnections external to equipment, shall be provided by this Contractor. These terminal blocks shall be heavy-duty, barrier type, 600 volt rating, 10-32 washer head screw terminals with marking strip.

**2.07 IDENTIFICATION**

- A. Cable and Wire Tags:
1. Nylon Cable Tags: 3/4 inch x 2 inch, hand marked with indelible ink characters 1/4-inch high and covered by surface film protection shall be attached to cables with nylon ties where cables are indoors or protected by equipment or enclosures.
  2. Wire Markers: Each conductor of multi conductor control cable or each individual single conductor wire, at the point of termination, shall be identified by plastic coated or colored plastic, slip on type heat shrink wire markers with factory printed numbers or letters.
    - a. The factory printed numbers or letters shall not be affected by cleaning solvent.
    - b. Wire marker designations shall conform to designations on wiring diagrams or to designations on control terminal block marking strips.
- B. Nameplates
1. Nameplates shall be laminated plastic with dull white surface and black core unless otherwise specified.
    - a. Letters shall be engraved through outer layer to expose black core.
    - b. All exposed edges shall be beveled.
    - c. Nameplates shall be fastened with machine screws. Use of self-tapping screws or adhesives will not be permitted.
  2. Each major component of equipment shall have, as a minimum, the manufacturer's name, address, and catalog number, model, style or type on a nameplate securely attached to the item in an area easily accessible to normal visual demands by maintenance and service personnel. Nameplates for electrical apparatus shall conform to the referenced standards and as specified elsewhere in the Specifications.

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3. Each switchgear assembly, circuit breaker and auxiliary unit, transformer, rectifier, transfer switch, battery charger, panelboard, terminal box, and all panel mounted and individually mounted equipment and devices shall be provided with nameplates for proper identification. Panel mounted devices shall be identified in the rear with the designations indicated on manufacturer's connection diagrams. Internally mounted devices shall be similarly identified.
4. Nameplates identifying major equipment shall have lettering two inches high, minimum. Two nameplates shall be provided, one on front, the second on the rear of the equipment.
5. Nameplates identifying ac and dc circuit breaker and auxiliary units shall have lettering 1-inch high, minimum. Inscriptions shall include circuit breaker number and service. One nameplate shall be provided on front, the second on the rear of each unit.
6. Nameplates for panelboards, terminal boxes and similar equipment shall have lettering 3/4-inch high, minimum.
7. Nameplates for panel mounted relays, meters, control and instrument switches, fuses and auxiliary devices and individually-mounted circuit breakers, disconnect switches, etc., shall have 1/4-inch, minimum, lettering. For protective and auxiliary relays, the nameplate inscription shall include device number and function. Nameplates for fuses shall note the type and rating of fuse, polarity and identify the circuit.
8. For each miscellaneous device described below, provide a nameplate, (black with white lettering), not smaller than 1 inch x 3 inches, suitably engraved with the appropriate device name or number. Nameplates shall be held in place with machine screws, not rivets or self-tapping screws. If the device itself is too small to support its nameplates, the plate shall be attached to a bracket, column or other support in reasonable proximity to the device.

**2.08 MISCELLANEOUS ITEMS**

- A. Provide and connect all miscellaneous panels, motor starters, contactors, disconnect switches, push buttons, selector switches, indicating lights, or other control devices including all mounting hardware, unless such devices are definitely specified as being furnished by an equipment supplier.
- B. Provide and connect all exhaust fans, temperature control panels, etc., as shown on the Contract Drawings.
- C. If detailed requirements are not specified, such miscellaneous devices shall be provided in NEMA type I push buttons, switches, etc. or type 1A (motor starters) enclosures for indoor service. They shall be UL labeled wherever such approved equipment is commercially available.
- D. Provide all other miscellaneous material required to complete the installation in a workmanlike manner.

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**PART 3 - EXECUTION****3.01 RACEWAY TYPE REQUIREMENTS**

- A. Conduit for 12.5 kV service: shall be galvanized rigid steel conduit (GRC)
- B. All other metallic conduit shall be thin-walled, galvanized steel EMT.
- C. Underground conduit ducts: Except where rigid metallic or PVC conduit is indicated or specified, all conduits shall be non-metallic fiber reinforced epoxy conduit.
- D. In general, plastic conduit will not be permitted on this project, except in specific cases where permitted by Metra's Authorized Representative.
- E. Flexible conduit connections, approximately 18 inches in length, shall be made to all motors and vibration-generating devices where rigid connection is not practical or advisable.

**3.02 CABLE TRAY TYPE REQUIREMENTS**

- A. Aluminum Tray: Shall be provided in areas where grounded equipment is installed.
- B. GRP Tray: Shall be provided above the rectifiers and the dc breakers.

**3.03 CONDUIT MINIMUM SIZES**

- A. Metallic conduit runs shall be no smaller than 3/4-inch trade size.
- B. Plastic conduit runs shall be no smaller than 3/4-inch trade size.

**3.04 INSTALLATION OF METALLIC CONDUIT AND FITTINGS**

- A. Conduit shall be run in straight lines parallel with or at right angles to building walls, partitions, floors and ceilings. When the location of a conduit is not shown on the Contract Drawing, or the indicated location interferes with other work in place or subsequently to be placed, work out a satisfactory location free from interferences and, subject to Metra's Authorized Representative approval, proceed on the basis of the selected location.
- B. In all cases, conduits and fittings shall be located so as to be accessible for maintenance, to permit removal or repairs to equipment to which conduit is attached and so as not to obstruct or inconvenience personnel in performance or operation and maintenance duties. High temperature or damp location shall be avoided to insure proper ventilation. Where a number of conduits are run together, they shall be grouped in a neat and logical manner.
- C. When installing metallic conduit, all conduit shall be taper threaded. Use of running threads will not be permitted, including field cut threads. Each conduit shall be threaded to its full thread length in the conduit coupling or conduit fitting hub to ensure good metallic contact for the ground return path. All conduit ends must be cut square and reamed clean of burrs.

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- D. Before conduit joints are made, the threads shall be cleaned and then coated with anti-seize, electrically conductive compound.
- E. Secure all conduits to outlet boxes, junction boxes or cabinets by placing locknuts on outside of box, and locknuts and bushings on inside of box. Conduit terminations 1-1/4 inch and larger shall be equipped with insulating bushings.
- F. Conduits and fittings shall be kept clean and dry during installation. Conduit sleeves shall be used where conduits pass through walls, partitions, floors, ceilings and foundations to prevent shear conditions.
- G. Conduit hangers and fasteners shall be made of malleable iron (galvanized or cadmium plated) appropriate in design and dimensions for the particular applications. Metallic conduits, surface mounted on walls and/or ceilings, shall be supported by means of one hole clamps and clamp backs. Conduits shall be clamped on steel work, where required, with approved clamps.
- H. All conduits penetrating building exterior walls, roofs, or membranes shall be provided with a watertight fitting, pitch pocket, flange, or membrane clamping ring to provide a watertight construction.
- I. Avoid using bends and offsets wherever possible. Field bends shall be made so as to avoid changing the internal diameter of conduit and so as not to damage its protective coating either outside or inside. Field bends shall be free from kinks, indentations, or flat surfaces and shall be made with approved conduit bending machines or devices. Individual bends shall not exceed 90 degrees and no more than 270 degrees total bend shall be allowed in any one conduit run, except where a pull box is used.
- J. Radius of curvature to the inside edge of field bends shall be a minimum of eight times the trade size of conduit.
- K. The Contract Drawings show the approximate routing of the Conduits. Exact routing and termination locations shall be determined by the Contractor in the field, subject to final approval by Metra's Authorized Representative .
- L. Empty conduits shall be plugged at both ends prior to cable installation.
- M. All conduit elbows, offsets and bends shall be uniform and symmetrical. Installation and workmanship shall be of the best quality and skill to provide a firm mechanical assembly.
- N. Conduits shall be continuous from outlet to outlet and from outlet to cabinets and junction/pull/terminal boxes with entry secure in such manner that each system shall be electrically continuous. Entry connections shall be made with two locknuts and an insulated conduit bushing or an insulated grounding bushing as required. The locknuts shall electrically connect the conduit to the cabinet or box. Exterior conduit connections to the cabinets or boxes shall be made by using insulated watertight, threaded hubs as manufactured by the Myers Electric Products, Inc. ("Scru-tite" Type), Thomas & Betts Company ("Bullet" Series 401) or OZ/Gedney (type 4Q).

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- O. Conduit systems shall be completed before conductors are drawn in. Conduits shall be firmly fastened within 3 feet of each outlet box, junction box, cabinet, offset or bend, and rigid conduit shall be supported at the maximum intervals listed below:
1. 3/4- inch:
    - a. Wall: 5 feet
    - b. Ceiling: 7 feet
    - c. Vertical: 8 feet
  2. 1 inch and larger:
    - a. Wall: 6 feet
    - b. Ceiling: 8 feet
    - c. Vertical: 10 feet
- P. Channel type metal framing systems to support conduit and/or cable systems shall be based on a channel 1-5/8 inches square, No. 12 gauge steel, and mill galvanized conforming to ASTM A653/A653M and shall be provided complete with all associated or required mounting hardware.
- Q. Expansion joints shall be provided wherever construction joints occur in the concrete slabs. Conduit runs shall be adjusted so that expansion joints are at right angles to the slab joints.

**3.05 INSTALLATION OF FLEXIBLE CONDUIT**

- A. All flexible conduits shall have a grounding conductor run inside the conduit, code sized for all circuits indicated.

**3.06 INSTALLATION OF PLASTIC CONDUIT**

- A. Plastic conduit shall be installed with plastic fittings in accordance with the conduit manufacturer's instructions. Joining method shall be solvent cement technique to provide strong watertight joints in the conduit system.
- B. Exposed plastic conduits shall be supported and clamped as shown on the Contract Drawings.

**3.07 INSTALLATION OF REINFORCED EPOXY CONDUIT**

- A. Conduit routes shown on the Contract Drawings are approximate. Exact routing and termination locations shall be determined by the Contractor in the field subject to final approval by Metra's Authorized Representative.
- B. When the location of a conduit is not given on the Contract Drawings or the indicated location interferes with other work in place, work out a satisfactory location free from interferences and, subject to Metra's Authorized Representative approval, proceed on the basis of the selected location.
- C. Conduit and fittings shall be run in straight lines parallel with or at right angles to elevated structure.

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- D. In all cases, conduits and fittings shall be located so as to be accessible for maintenance, to permit removal or repairs to equipment in which conduit is attached, and so as not to obstruct or inconvenience personnel in performance of operation and maintenance duties.
- E. Conduits and fittings shall be kept clean and dry during installation.
- F. When installing fiberglass reinforced epoxy conduit overhead, conduit fittings shall be of the same manufacture.
- G. All conduit elbows, offsets and bends shall be uniform and symmetrical. Installations and workmanship shall be of the best quality and skill to provide a firm mechanical assembly.
- H. Where aerial conduits cross alleys or streets a minimum of 14-foot-6-inch clearance must be maintained.
- I. All attachments to structure shall be drilled and bolted. No beam clamps shall be allowed.
- J. When fiberglass reinforced epoxy conduit is installed on the elevated structure for traction power cable distribution it shall be 3-inch diameter conduit supported at a maximum of 7-foot intervals.
- K. Vertical and horizontal expansion capability shall be provided at each elevated structure expansion joint.

**3.08 INSTALLATION OF MANHOLES**

- A. Provide materials and labor for the construction of manholes.
- B. Manholes shall be set on firm level earth, free of large rocks or obstructions.
- C. Before pouring the floor, the sump pit shall be installed. The floor shall slope toward the sump pit with a pitch of one inch in six feet.
- D. Before the floor is set, it shall be brushed to give an anti-skid surface.
- E. After the concrete has cured and forms are removed, the work area shall be carefully backfilled. Where ducts are to enter the manholes, the backfill shall be solidly tamped to the bottom grade of the ducts to provide a firm construction base.

**3.09 INSTALLATION OF UNDERGROUND DUCTS**

- A. Provide materials and labor for the construction of underground conduit ducts.
- B. ComEd 12,600 Vac supply lines shall be constructed with 5-inch RTRC encased in concrete unless otherwise indicated by Drawings.,
- C. All other ducts shall be constructed using 3-1/2-inch fiber-reinforced epoxy conduit encased in concrete.

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- D. Unless otherwise indicated or specified, dissimilar types of conduit shall not be mixed in any one duct, and shall be of same size.
- E. Conduits provided shall be complete with all couplings, adapters, bends and supports as required.
- F. Unless otherwise specified, all conduits entering manholes or ending inside substation spaces (walls or floors) shall be terminated using end bells.
- G. Where ducts by the Contractor will connect to existing ducts, make the required conduit connections at the construction joint.
- H. Ducts shall be laid in trenches having solid, level and undisturbed bottoms.
  - 1. Perform all excavation and backfilling, including breaking of and/or replacement of concrete necessary for the installation of its work.
  - 2. If excavation is made to a depth greater than elevation required, backfill with properly tamped CA-6 or CA-7 aggregate at its own expense to correct elevation.
  - 3. Method of conduit installation shall be in strict accordance with manufacturer's recommendations.
- I. The ducts shall have a continuous slope downward toward manholes and away from the substation buildings with a pitch of not less than 3 inches in 100 feet unless noted otherwise.
- J. Changes in direction of runs exceeding a total of 10 degrees, either vertical or horizontal, shall be accomplished by long sweep bends having a minimum radius of curvature of 25 feet, except that manufactured bends may be used at ends of short runs of 100 feet or less, and then only at or close to the end of the run.
  - 1. The long sweep bends may be made up of one or more curved or straight sections or combinations thereof.
  - 2. Manufactured bends shall have a minimum radius of 36 inches for all ducts. No more than 270 degrees total bend shall be allowed in any one run.
- K. To maintain proper spacing between the conduits in the ductbanks, provide conduit spacers.
- L. Conduit couplings shall be staggered so that no coupling is less than six inches from the coupling on an adjacent conduit row or tier so as to provide a duct line having maximum strength.
- M. To prevent duct distortion during concrete installation, the duct banks shall be strapped together with non-metallic straps of proper strength, at no more than 8-foot intervals. A sufficient number of hold down bars, shall be installed to prevent duct uplift during concrete installation.
- N. Have the fiber-reinforced epoxy-conduit manufacturer's representative advice and check on proper concrete enclosed ductbank installation procedures before

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the duct is covered with concrete. However, the fact that the manufacturer representative checked the installation and advised on procedures will not relieve the Contractor of its responsibility under the Specifications.

- O. During construction, partially completed duct shall be protected from the entrance of debris such as mud, sand and dirt, by means of suitable conduit plugs.
- P. As each section of a duct is completed, a testing mandrel not less than 36 inches long with a diameter 1/4-inch less than the size of the conduit, shall be drawn through each conduit, after which a brush with stiff bristles shall be drawn through until the conduit is clear of all particles of earth, sand or gravel, conduit plugs shall then be immediately installed.
- Q. Backfilling in areas away from the tracks shall be well compacted by means of hand or machine tampers. Backfill shall be placed in successive layers not more than 12 inches deep and each layer shall be thoroughly compacted with tampers before the next layer is placed. Backfill shall be entirely free of frozen earth, vegetation, lumber, brickbats, rocks or concrete rubble.
- R. To avoid water seepage to the substation, provide sealing bushings inside the substations. Blank sealing bushings shall be provided on all spare conduits.

**3.10 INSTALLATION OF WIRE AND CABLE**

- A. Unless otherwise noted, all wire and cable runs external to equipment assemblies shall be installed in conduit.
- B. Obtain and observe recommendations of the manufacturer as to installation, care and handling of the various cables. Minimum bending radius shall not be less than that allowed by the ICEA Standards.
- C. No splices will be permitted in any power or control cable runs. Cables must be continuous from termination to termination. No splices or joints will be permitted in lighting feeders or branches except at outlets or accessible junction boxes. Joints in branch circuit wiring for conductors not larger than No. 10 AWG shall be made mechanically and electrically secure using screw on connectors.
- D. Spare conductors shall be labeled as such and be left neatly coiled, with the ends taped and extending from the cable a minimum of 36 inches.
- E. Before pulling cables, a round test mandrel shall be pulled through the duct which is to be occupied, in order to be sure that it is cleared of all obstructions.
  - 1. The test mandrel shall be of a size especially designed for the duct being tested.
  - 2. The mandrel shall be of the rigid type not less than 12 inches in length and shall have tool steel cutting ends to remove obstructions.
- F. Conductors shall not be drawn into conduit until the conduit is free of moisture. In drawing wires into conduit, sufficient slack or lead shall be allowed to permit the connections to devices without splices.

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- G. The Contractor's cable pulling shall be in accordance with accepted modern practices so as to prevent damage to the cable.
1. Cable pulling tensions, speed, lubricants and other pertinent factors in connection with pulling and handling shall be in accordance with the cable manufacturer's recommendations, or as approved or directed by Metra's Authorized Representative.
  2. A cable protector shall be fitted in the end of the duct during pulling operation in order to prevent injury to the cable.
  3. The cable shall be fed into the duct through a flexible metal pull in guide.
  4. Where more than a single cable is being pulled in, all cable shall be pulled directly into the duct from the coil or reels on which they are received.
  5. Cables shall not be pulled off and laid on the ground prior to installation.
  6. Cable grips shall be designed for the purpose and shall not cut or otherwise damage the cable.
  7. No cable shall be pulled with ends open. A rubber tape seal shall be maintained at all times.
  8. The cable shall be continuously inspected during installation and any cuts, abrasions, or otherwise injured portions shall be brought to the attention of Metra and repaired or removed as directed.
- H. Identification:
1. Each cable shall be tagged at both ends and in each pull box or junction box where terminations are made or where the cable passes through. Each conductor of each cable shall be tagged at all terminations with its circuit or wire number.

**3.11 CABLE TRAY SYSTEM**

- A. A cable tray system shall be provided for control cable routing. System shall be complete and including fittings and accessories as may be required for workmanlike installation.
- B. Adequately protect cables in trays until all construction work is complete. If, in the opinion of Metra's Authorized Representative the cable has been damaged by falling objects, welding debris or other reason attributable to construction practices, the damaged cable shall be completely replaced at the Contractor's expense.
- C. Cable trays shall be assembled and installed in such a manner as to provide smooth inside surfaces, free from any abrasions which might cause damage to cables.
- D. Cable trays shall be adequately supported from walls or underside of roof beams to meet seismic design requirements. All trapezes, brackets, clamps, rods,

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couplings and suspension fittings, expansion shields, hardware and miscellaneous steel shall be provided to insure a complete support system in accordance with recognized high quality practice. All elements of the support system shall be hot-dip galvanized steel.

- E. Grounding conductor and tray bonding tie: 500 kcmil bare conductor cable as shown on the Contract Drawings.

### 3.12 CABLE RACK SYSTEM

- A. Provide a cable rack system for support of 600 Vdc cables within the building.
  - 1. Individual support racks shall be made up of Unistrut channel members, maple cable clamps and associated accessories as required to complete the installation in a workmanlike manner. All steel details shall be galvanized and grounded.
  - 2. Cable support racks shall be Globe, Inc. 5812 series, Unistrut Corp. P 1000 series or approved equal.
- B. Concrete anchor bolts shall be Diamond Expansion Bolt Co., IIT Phillips Drill Division, or approved equal.

### 3.13 CABLE SUPPORTS IN THE MANHOLES AND IN THE SUBWAY

- A. Unless otherwise specified or shown on Drawings, provide non-metallic cable support racks in the manholes, splicing chambers and similar other locations where cables are to be in open runs supported from racks.
- B. Cable support racks and mounting channels shall be heavy-duty construction, consisting of molded, fire retardant, non-corrosive glass reinforced nylon with high-dielectric properties.
- C. Mounting channels shall be surface type and shall be anchored to concrete with stainless steel, heavy-duty, one-piece, wedge-type concrete anchor bolts with nut and washer. Length of anchor bolts shall be long enough to exceed the minimum embedment in concrete, recommended by the anchor bolt manufacturer.
- D. Cable will be tied to the cable racks with cross wise nylon cable ties at each rack (two ties at each point of support).
- E. Cable support racks shall be "Underground Devices" Cat. No. RA20 or approved equal.
- F. Cable rack channels shall be "Underground Devices" Cat. No. CR36 or approved equal.

### 3.14 FILLING OF OPENINGS

- A. Where conduit and raceway pass through fire-rated walls, ceilings or floor, provide seals to prevent passage of fire and fume and to maintain integrity of fire-rated structure.

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- B. Close unused openings or spaces in floors, walls and ceilings. Plug or cap unused conduit and sleeves.

**3.15 IDENTIFICATION**

- A. At end of each run, use brass with stamped markings to establish identification of conduit, raceway and ducts.

**END OF SECTION**

**SECTION 16011**  
**PREPACKAGED SUBSTATION ENCLOSURE**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section covers the requirements for designing, manufacturing, testing, installing and commissioning modular (portable) thermally insulated traction power equipment enclosures (substation prefabricated building) that shall be preassembled at the manufacturer's factory and will be operated unmanned after installation except for limited activity by skilled technical personnel after equipment is energized.
- B. The substation equipment enclosure is referred to as Prepackaged Substation Enclosure (PSE).
- C. The Contractor shall serve as the single-point responsibility for furnishing and field service of all equipment in compliance with the Specifications or as shown on the Contract Drawings as well as providing warranty for all the traction power equipment and auxiliaries as specified or shown on the Drawings and to be installed within the PSE.

1.02 RELATED WORK

- A. Section 16142, Wiring Devices
- B. Section 16150, Fire Alarm System
- C. Section 16510, Lighting
- D. Section 16641, Dielectric Flooring
- E. Section 16610, Traction Power Equipment Installation
- F. Section 16611, Traction Power Equipment Testing
- G. Section 16960, Door Limit Switches

1.03 REFERENCES

- A. This Section incorporates by reference the latest revisions of the following documents:
- B. ASTM International (ASTM)
  - 1. ASTM A36/A36M, Standard Specification for Carbon Structural Steel
  - 2. ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc-Coated, Welded and Seamless

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3. ASTM A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
4. ASTM A143/A143M, Standard Practice for Safeguarding against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
5. ASTM A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
6. ASTM A384/A384M, Standard Practice for Safeguarding Against Warpage and Distortion during Hot-Dip Galvanizing of Steel Assemblies
7. ASTM D610, Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces
8. ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
9. ASTM A780/A780M, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
10. ASTM A1011/A1011M, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
11. ASTM B117, Standard Practice for Operating Salt Spray (Fog) Apparatus
12. ASTM D522/D522M, Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings
13. ASTM D523, Standard Test Method for Specular Gloss
14. ASTM D714, Standard Test Method for Evaluating Degree of Blistering of Paints
15. ASTM D968, Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
16. ASTM D1308, Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes
17. ASTM D2248, Standard Practice for Detergent Resistance of Organic Finishes
18. ASTM D2247, Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity
19. ASTM D2485, Standard Test Methods for Evaluating Coatings For High Temperature Service
20. ASTM D2794, Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)

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21. ASTM D3170/D3170M, Standard Test Method for Chipping Resistance of Coatings
22. ASTM D3359, Standard Test Methods for Measuring Adhesion by Tape Test
23. ASTM D3363, Standard Test Method for Film Hardness by Pencil Test
24. ASTM D3451, Standard Guide for Testing Coating Powders and Powder Coatings
25. ASTM D4060, Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
26. ASTM D4541, Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
27. ASTM D4585/D4585M, Standard Practice for Testing Water Resistance of Coatings Using Controlled Condensation
28. ASTM D4798/D4798M, Standard Practice for Accelerated Weathering Test Conditions and Procedures for Bituminous Materials (Xenon-Arc Method)
29. ASTM D5894, Standard Practice for Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet)
30. ASTM D6132, Standard Test Method for Nondestructive Measurement of Dry Film Thickness of Applied Organic Coatings Using an Ultrasonic Coating Thickness Gage
31. ASTM D6578/D6578M, Standard Practice for Determination of Graffiti Resistance
32. ASTM D6695, Standard Practice for Xenon-Arc Exposures of Paint and Related Coatings
33. ASTM D7091, Standard Practice for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals
34. ASTM D7803, Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Powder Coating
35. ASTM G151, Standard Practice for Exposing Nonmetallic Materials in Accelerated Test Devices that Use Laboratory Light Sources
36. ASTM G155, Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials

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- C. International Code Council (ICC)
  - 1. International Building Code (IBC)
- D. National Fire Protection Association (NFPA)
  - 1. NFPA 70E, Standard for Electrical Safety in the Workplace
- E. Society for Protective Coatings (SSPC)
  - 1. SSPC-PA 1, Shop, Field, and Maintenance Painting of Steel
  - 2. SSPC-PA 2, Procedure for Determining Conformance to Dry Coating Thickness Requirements
  - 3. SSPC-PS 13.01, Epoxy Polyamide Painting System
  - 4. SSPC-SP6, Commercial Blast Cleaning
  - 5. SSPC-SP8, Pickling
  - 6. SSPC-Paint 36, Two-Component Weatherable Aliphatic Polyurethane Topcoat, Performance Based
  - 7. SSPC-Paint 42, Epoxy Polyamide/Polyamidoamine Primer, Performance Based

**1.04 DEFINITIONS**

- A. Galvanneal: Zinc-iron alloy coating created on sheet steel by a continuous hot-dipping process followed by heat treatment in an annealing furnace.

**1.05 SUBMITTALS**

- A. Building Manufacturer Qualifications:
  - 1. Include sufficient information to allow Metra's Authorized Representative to confirm compliance with Specifications.
- B. Structural Engineering Design:
  - 1. Calculations and drawings shall be sealed by a professional engineer registered in the State of Illinois.
  - 2. Structural Engineering Calculations:
    - a. Design parameters and criteria, including the following:
      - 1) Equipment weight
      - 2) Snow, ice, and wind loading
      - 3) Seismic criteria
      - 4) Deflection criteria for the floor
      - 5) Maximum allowable bending, torsion, and flexure during installation and transportation

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- b. Calculations for sizing structural members.
  - 1) Sizing and design of lifting eyes with equipment installed.
  - 2) Identify the piece of equipment that may be moved along the floor that was used for floor calculations.
- 3. Shop Drawings:
  - a. A scaled floor plan and roof plan showing equipment outlines and weights, penetrations for conduits, ventilation ducts, door frames and openings.
  - b. Details of fabrication including the following:
    - 1) Wall and roof interlocking joints
    - 2) Wall and roof cross sections
    - 3) Joints, welds, and bolted connections
    - 4) Entry and equipment access door frames
    - 5) Indicate sizes and types of materials, welds, and fasteners
  - c. Exterior Equipment Access Doors and Hardware:
    - 1) Dimensions of doors and frames
    - 2) Details of stiffening members, if used
    - 3) Outline of equipment that must be removed through each door
  - d. Gutters and Downspouts:
    - 1) Gutter and downspout dimensioned cross sections
    - 2) Gutter and downspout materials, welds, and fasteners
    - 3) Method of securing gutters and downspouts to building
    - 4) Location of gutters and downspouts on building
- C. Seismic Design for Equipment:
  - 1. Submit shop drawings indicating how large pieces of equipment are secured to meet seismic design requirements and transportation stresses.
- D. Product Data:
  - 1. Doors:
    - a. Material, including galvanizing, finish, and thickness
    - b. Door sealing material
    - c. Insulation type and R-value
  - 2. Door hardware: Include product data for the following:
    - a. Hinges
    - b. Panic hardware
    - c. Entry handles and locks
    - d. Door closers

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3. Exterior Equipment Access Doors and Hardware:
  - a. Doors:
    - 1) Material, including galvanizing and thickness
    - 2) Door sealing material
  - b. Details of door sealing material placement
  - c. Door hardware:
    - 1) Entry handles and latches
    - 2) Hinges
    - 3) Door stop
    - 4) Padlocks
- E. HVAC System:
  1. Calculations and drawings shall be sealed by a professional engineer registered in the State of Illinois.
  2. For HVAC units, include the following:
    - a. Design data, including heat generated by each major heat-producing piece of equipment
    - b. Calculations for sizing air conditioning, ventilation and heating per the specified criteria.
  3. Shop Drawings:
    - a. For fabrication and installation of the mechanical equipment including air conditioning, ventilation, and heating.
    - b. Drawings shall include scaled plan and elevation drawings showing equipment outlines and weights, and penetrations for conduits and ducts.
  4. For the HVAC Controller, include the following:
    - a. A narrative describing operation of the controller
    - b. Product data for thermostat
- F. Coating Qualification Test:
  1. Coating Qualification Test Procedure:
    - a. Test panel quantity and material type.
    - b. Details of the test apparatus and certification that it complies with ASTM B117.
    - c. Description of preparation of the test specimens.
    - d. Proposed method of evaluation.
  2. Coating Qualification Test Report:
    - a. Photos of the test specimens after exposure and before and after processing and evaluation.

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- b. A narrative description of the evaluation process.

**1.06 MAINTENANCE MATERIAL SUBMITTALS**

- A. One quart of the exterior and interior finishing paint per PSE shall be furnished for field touch up.

**1.07 QUALITY ASSURANCE**

- A. Manufacturer of the pre-fabricated metal buildings shall be a company regularly engaged in the production of pre-fabricated galvanized steel buildings with a powder coat finish, and as approved by Metra's Authorized Representative.
  - 1. Manufacturer shall have constructed at least 50 similar buildings in the last 10 years.
  - 2. Manufacturer shall be experienced in forming galvanized conforming to ASTM A653/A653M with minimum coating weight A25.
  - 3. Once a manufacturer is approved, it shall not be discharged or otherwise replaced by the Contractor without the written approval of Metra's Authorized Representative.
- B. Personnel working on metal buildings shall be experienced, skilled, and familiar with building construction, including installing air conditioning, heating and ventilation systems.
- C. Where engineering calculations are called out, they shall be performed and sealed by a professional engineer registered in the State of Illinois.
- D. Welding shall be performed by Certified Welders.
- E. Galvanizing:
  - 1. Galvanizing firm shall be member of American Galvanizers Association Inc. (AGA).
  - 2. Inspection and Tests:
  - 3. Inspections, test and samples shall conform with ASTM Specifications and Standards.
  - 4. Inspection rights and privileges, procedures and acceptance or rejection of galvanized steel materials shall conform with ASTM A123/A123M.
- F. Shop-Applied Powder Coating Applicator Qualifications:
  - 1. Engage an experienced coating applicator with experience in properly applying the coating on the specified substrate.
  - 2. Applicator shall have quality control procedures firmly established in its shop.
  - 3. Metra's Authorized Representative may, at his option, visit the applicator's facility to confirm adherence to quality control procedures.

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**1.08 DELIVERY, STORAGE, AND HANDLING**

- A. Confirm that the overall shipping dimensions and weight meet all interstate shipping requirements to transport the PSE from the factory to the final destination.
- B. The PSE, and any applicable shipping splits, shall be delivered fully wrapped with a protective covering to prevent entrance of dust and water.
- C. Temporary bracing shall support the roof and wall structure to prevent damage during shipment.
- D. The Contractor shall be fully responsible for shipping, offloading, and placing the PSE onto the foundation on site.

**1.09 WARRANTY**

- A. The Contractor shall act as a "single point" of responsibility for all components installed in the PSE, including major assemblies, ac switchgear, rectifier transformers, rectifiers and dc switchgear. The equipment shall be guaranteed for a period of 18 months from shipment.
- B. All exterior wall and roof panel powder coated surfaces shall have a written 20-year warranty from date of shipment.

**PART 2 - PRODUCTS****2.01 DESIGN CRITERIA**

- A. The PSE design and construction, including the exterior components shall meet the environmental requirements and area classifications as follows:
  - 1. Temperature Range: -20°F to 110°F
  - 2. Wind Velocity: 125 mph
  - 3. Roof Load Snow/Ice: 80 pounds per sq ft
  - 4. Excessive Dust or Blowing Wind
  - 5. Altitude: 600 ft above sea level
- B. The enclosure shall have a UL fire rating of 2 hours minimum. The fire rating of the walls and doors of the control room inside the enclosure shall also be 2 hours UL fire rated.
- C. Check the dimensions of proposed equipment for required electrical and safety clearances front and back of all the equipment within the PSE and space for interconnection.
- D. Bolted panels with tamper-resistant fasteners shall be provided to permit removal of rectifier transformers through side of enclosure.

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1. Each panel shall not exceed 80lbs in weight
  2. Each panel shall have two handles
  3. Each panel shall be designed with guide pins to ensure water tightness after re-installation.
- E. Bolted panels with tamper-resistant fasteners shall be provided to permit Maintenance Access to rectifier through side of enclosure.
1. Each panel shall not exceed 80lbs in weight
  2. Each panel shall have two handles
  3. Each panel shall be designed with guide pins to ensure water tightness after re-installation.

**2.02 STANDARDS**

- A. All equipment housed in the PSE shall comply with currently applicable standards of ANSI, IEEE, NEMA, and NFPA.
- B. The PSE shall conform to the standards detailed in the International Building Code (IBC), including seismic design requirements, as adopted by the authority having jurisdiction.

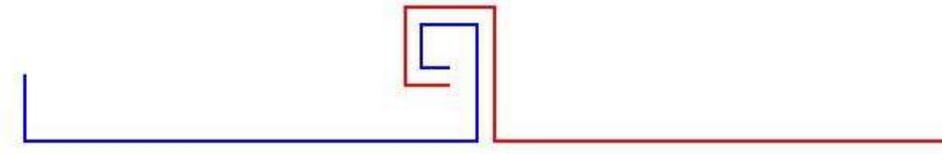
**2.03 CONSTRUCTION DETAILS**

- A. Dimensions:
1. The overall dimension of the Prepackaged Substation Enclosure shall be as shown on the Contract Drawings.
  2. Height shall be determined by the vendor.
  3. Actual dimensions will be determined by the physical size of the equipment housed in the PSE. It shall be the responsibility of the Contractor to determine the correct size of the Prepackaged Substation Enclosures, and include in the base bid any additional costs required if the PSE is different than specified.
- B. Base Construction:
1. The PSE base shall be fabricated using structural steel channels and/or wide flange beams conforming to ASTM A36/A36M, welded together to provide a rigid square and level foundation for the enclosure, and sized to meet or exceed the static and dynamic loading requirements.
  2. The base must have adequate strength so that when the enclosure is lifted there will be a deflection no greater than 1/240th of the unsupported span between and on either side of each lifting point.
  3. Contractor shall be responsible for proper fit of PSE on concrete foundation including proper level.

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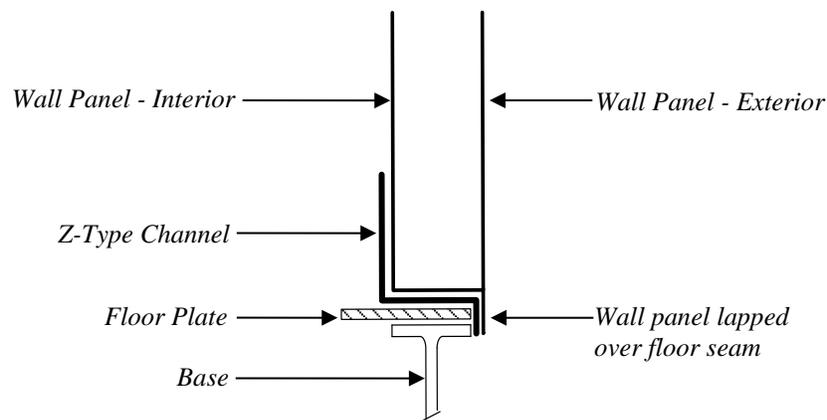
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4. Structural steel:
    - a. Hot-dip galvanize before welding in accordance with the Shop-Applied Galvanizing article, below.
    - b. Avoid using structural steel members with nonsymmetrical sections to minimize warpage and distortion during hot-dip galvanizing, as recommended by ASTM A384/A384M.
  5. Welds: Mask steel in weld areas before galvanizing to a distance of 1 inch from weld line.
  6. Provide removable lifting lugs, placed in a position to provide uniform lifting load at each lifting lug location.
- C. Floor Construction:
1. The floor shall be constructed with 1/4-inch minimum steel plates welded onto the base with adequate stiffening members.
  2. The floor shall withstand the weight of the heaviest circuit breaker, transformer or other equipment item that may have to be moved along the floor, without significant deflection.
- D. Wall Construction:
1. Exterior walls:
    - a. Material: Sheet steel panels, of a grade to be determined by Contractors structural design engineer.
    - b. Coating:
      - 1) Galvanneal meeting the requirements of ASTM A653/A653M with minimum coating weight A25.
      - 2) Galvanneal shall not be quenched by the steel manufacturer or galvanizer or chemically treated in a way that inhibits powder coating.
    - c. Thickness:
      - 1) Minimum 11-gauge.
      - 2) The specified minimum thickness shall apply to the base metal only.
    - d. Interlock adjoining panels with J-type interlocking, as indicated in Figure 1, below.
    - e. Seal seams with manufacturer recommended caulking.



**Figure 1: Cross Section Wall Panels J-Type Interlocking**

- f. At wall-panel base, provide Z-type channel and lap exterior wall panel over the floor seam to prevent drain back, as illustrated in Figure 2, below.



**Figure 2: Cross Section Wall-Panel Base Z-Type Channel, shown without insulation and interior wall**

2. Interior walls:
- a. Material: Same as exterior walls, above.
  - b. Coating: Same as exterior walls, above.
  - c. Thickness:
    - 1) Minimum 14-gauge.
    - 2) The specified minimum thickness shall apply to the base metal only.

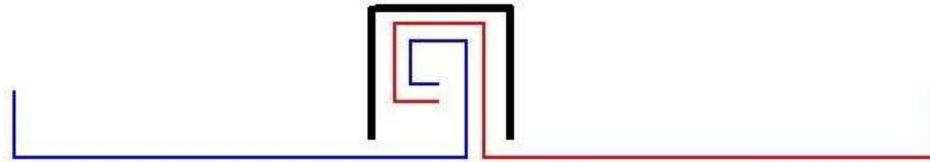
E. Roof Construction:

1. Shed type, with pitch as shown on Contract Drawings, fabricated from interlocking sheet steel panels.
  - a. Material: Same as exterior walls, above.
  - b. Coating: Same as exterior walls, above.
  - c. Thickness: Same as exterior walls, above.

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- d. Interlocking: J-type, with standing seams and rain caps over seams, as indicated in Figure 3, below.
- e. Seal seams with manufacturer recommended caulking.



**Figure 3: Cross Section Roof Panels Standing Seams With Rain Cap, shown without insulation and interior ceiling**

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2. Roof penetrations:
  - a. Shall be used only with approval of Metra's Authorized Representative.
  - b. If used, shall be minimal with each flashed and waterproofed.
- F. Shipping Splits: All required shipping splits shall be designed so that water intrusion is impossible. At a minimum every seam shall be covered with a u-shaped sheet metal cover.
- G. Fasteners: All bolting hardware shall be high tensile strength stainless steel.

## 2.04 BUILDING COMPONENTS AND MATERIALS

### A. Entry Doors

1. Quantity:
  - a. The PSE shall be equipped with three escape doors and two personnel entry doors.
2. Construction:
  - a. Material: Minimum 14 gauge sheet steel, galvanized in accordance with ASTM A653/A653 with minimum coating weight A40.
  - b. Insulation: R value in accordance with applicable energy code.
  - c. Size: Not smaller than shown on Contract Drawings.
  - d. Double doors shall be provided with a removable header panel which will increase clearance to a minimum of 10 ft.
3. Hinges: Stainless steel with stainless steel hinge pins.

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4. Door Hardware:
    - a. On the interior, provide all doors with “crash bar” panic exit devices to allow exit during emergency conditions.
    - b. On the exterior, provide lever-type handles that always remain locked. Access from the exterior shall require a key.
    - c. Personnel and exit doors shall have key locks with common master keys.
      - 1) The locks shall be mortise locksets heavy duty as manufactured by Corbin-Russwin, ML 2000 Series with a BEST® removable cylinder, or approved equal.
  5. Sealing:
    - a. Doors shall be tightly sealed with neoprene gaskets.
    - b. Secure seals to the doors so as to allow easy replacement.
    - c. Design of doors shall prevent intrusion of water around the seams
  6. Provide pneumatic door closers on the two main entrance doors with a feature to allow the door to be latched in the open position.
- B. Exterior Equipment Access Doors:
1. Provide hinged doors where shown on Contract Drawings:
    - a. Equipment doors shall allow access to the rear of the ac switchgear, transformer, rectifier, and dc switchgear from the outside of the substation for regular maintenance.
    - b. Removing the Panels shall allow removal of the rectifier transformer as a unit from the outside of the substation.
  2. Material: Minimum 11 gauge sheet steel, galvanized in accordance with ASTM A653/A653M with minimum coating weight A25.
  3. Provide stiffening members as required.
  4. The exterior equipment access doors shall meet or exceed the requirements of NEMA ICS 6 for weatherproof NEMA 250 Type 4 enclosures.
  5. Latches: Three-point, padlockable, heavy-duty stainless steel switchgear type.
  6. Hinges:
    - a. Stainless steel, with stainless steel hinge pins and hardware.
    - b. Provide a minimum of three concealed hinges.
  7. Door gaskets: Neoprene. Secure seals to doors to allow easy replacement.
  8. Door stop: Provide one for each door to hold it in the open position

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9. Padlock:
  - a. Provide padlocks with interchangeable cores to fit BEST® Locks, with common master keys.

**C. Gutters and Downspouts:**

1. Provide one gutter on each long side of the enclosure; provide one downspout at each end of each gutter, a pair for each gutter.
2. Material: 14 gauge steel
3. Coating: Same as exterior walls, above.
4. Design:
  - a. Size with sufficient capacity to handle the historical maximum volume of rain for the site. .
  - b. Coordinate location of downspouts for each location with Metra during the design of the building.

**D. Insulation**

1. The thermal insulation in the roof and walls shall be 3-inch fiberglass insulation with a minimum rating of R-13.
2. Thermal insulation shall be placed under the entire PSE.
3. All thermal insulation shall meet local, state and national codes.

**2.05 SHOP-APPLIED GALVANIZING****A. General:**

1. Wherever materials are called out as "hot-dip galvanized" or "galvanized," provide a zinc coating after fabrication in accordance with ASTM A123/A123M.
2. Hardware items such as bolts or other threaded fasteners shall be hot-dip galvanized after fabrication in accordance with ASTM A153/A153M.
3. Specified materials or products that are not readily available in the specified hot-dip finish, shall be custom hot dipped after manufacture by an independent galvanizer.

**B. Selection, Design, and Fabrication before Galvanizing:**

1. Verify with supplier or fabricator that material is chemically suitable for galvanizing.

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2. Warpage: Design assemblies as recommended in ASTM A384/A384M to limit warpage and distortion during hot-dip galvanizing.
    - a. Notify Metra's Authorized Representative of potential warpage problems that require modification in design before proceeding with steel fabrications.
    - b. Costs for alternative designs shall be performed at no additional cost to Metra.
  3. Design and fabricate assemblies requiring shop fabrication using methods recommended in ASTM A385/A385M to obtain high-quality hot-dip galvanized coating.
  4. Embrittlement: Select proper steel, design assemblies, and thermally treat before galvanizing as recommended in ASTM A143/A143M to withstand normal galvanizing operations without embrittlement.
  5. Galvanizer Coordination Drawings: Furnish shop drawings to galvanizer of non-standard fabrications, tubular fabrications, and fabrications with materials of different thicknesses.
  6. Inspect iron and steel hardware before galvanizing and verify suitability for galvanizing. Replace items that are not suitable for galvanizing.
  7. When the item to be galvanized incorporates threaded assemblies, make provisions in thread size to accommodate galvanizing and galvanize disassembled.
  8. Weld, drill, and assemble galvanized members before galvanizing.
- C. Preparation:
1. Remove welding slag, splatter, and burrs.
  2. Clean surfaces in conformance with SSPC SP6, Commercial Blast Cleaning.
  3. Pickle surfaces in conformance with SSPC SP8, Pickling.
  4. Safeguard against increasing the likelihood of steel embrittlement during pickling in accordance with ASTM A143/A143M.
  5. Mask galvanized members that are to be field or shop welded after galvanizing to a distance of 1 inch from weld line before galvanizing.
- D. Hot-Dip Galvanizing:
1. Select a galvanizer with galvanizing kettle large enough to accommodate the largest member or assembly requiring hot-dip galvanizing. Progressive dipping shall not be used.
  2. Hot-dip galvanize structural steel and metal fabrications as indicated in conformance with ASTM A123/A123M.

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3. Hot-dip galvanize bolts or other threaded fasteners after fabrication in accordance with A153/A153M.
4. Thickness of zinc coating: Conform to requirements of ASTM A123/A123M or ASTM A153/A153M, whichever is applicable.
5. Finish, uniformity, and adherence of coating: Conform to requirements of ASTM A123/A123M or ASTM A153/A153M, whichever is applicable.
6. Galvanized members on which powder coat or paint will be applied shall not be quenched by the galvanizer.
7. Galvanizer's Stamp: Galvanized materials shall be marked with the galvanizer's stamp.

E. Mechanical Galvanizing shall not be used.

**2.06 SHOP-APPLIED FINISH****A. General:**

1. Perform mechanical processing such as sawing, drilling, milling, cutting, and bending before applying shop applied coatings.
2. Coatings must be certified VOC compliant and conform to applicable regulations and EPA standards.
3. Material Compatibility:
  - a. Provide primers, finish coat, and anti-graffiti materials and related materials that are compatible with one another and the steel substrate.
  - b. Furnish documentation from manufacturer demonstrating compatibility in both application and service based on testing and field experience.
4. Material Quality:
  - a. Provide highest grade of coatings as regularly manufactured by acceptable coating manufacturers.
  - b. Materials not displaying manufacturer's identification as a best-grade product will not be acceptable.

**B. Base and floor:**

1. Primer: Polyamide epoxy, 4-6 mils dry film thickness.
2. Top Coat:
  - a. High solids, pigmented, aliphatic polyurethane, meeting requirements of SSPC Paint 36.
  - b. Dry film thickness: Minimum 4 mils.
  - c. Color: As specified, as indicated, or as directed by Metra's Authorized Representative.

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- d. Gloss: Flat or semi-gloss.
3. Anti-Graffiti Coat:
  - a. Clear, aliphatic polyurethane non-sacrificial coating designed to resist graffiti and protect the underlying substrate.
  - b. From the same manufacturer and compatible with approved top coat.
4. Application:
  - a. Prepare steel in accordance with paint manufacturer's recommendations.
    - 1) Verify with paint manufacturer that proposed surface cleaner is compatible with approved paint coating system.
    - 2) Apply paint as soon as possible after surface preparation.
  - b. Primer:
    - 1) Shop-apply in accordance with SSPC-PA 1, SSPC-PA 2, SSPC Paint 42, and manufacturer's instructions.
    - 2) Verify dry film thickness in accordance with SSPC-PA 2.
  - c. Top coat: Shop-apply in accordance with manufacturer's instructions.
  - d. Graffiti coat: Shop apply two coats in accordance with manufacturer's instructions.
5. Coat welds as follows:
  - a. Prepare surface in strict compliance with manufacturer's recommended procedures.
  - b. Provide an inorganic ethyl silicate primer containing 85 percent zinc by weight in the dry film.
  - c. Apply a single coat of 75 microns dry film thickness in strict accordance with manufacturer's application instructions.
  - d. Top coat is required only if surrounding surface is painted, or if necessary to match color of surrounding area.
  - e. Where top coating is required, provide a compatible product and apply according to manufacturer's instructions to achieve good cohesion and prevent pinholing.
  - f. Color: Match color of surrounding area.
6. The top side of the floor plates shall be painted with skid resistant paint.
7. Dielectric floor shall be provided under the dc switchgear line-up and the rectifier and shall be extended 5 feet in front and 3 feet on sides of the dc switchgear and rectifier. For dielectric floor requirements refer to Section 16641, Dielectric Flooring.
8. The underside of the structural steel base shall be given a coat of bitumastic undercoating for corrosion resistance purposes.

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## C. Walls and Roof:

1. Apply powder coat system including primer, top coat, and graffiti coat:
  - a. Powder Coat: Polyester triglycidyl isocyanurate (TGIC), thermoset color finish system based on dry, powdered resins
  - b. Primer: Compatible with powder top coat, as confirmed by powder coat manufacturer.
  - c. Top Coat: Compatible with powder primer, as confirmed by powder coat manufacturer.
  - d. Anti-Graffiti Coating:
    - 1) Permanent protection system designed to withstand numerous clean-ups.
    - 2) Suitable for cleaner available in the United States.
    - 3) Compatible with powder coat.
    - 4) Dry Film Thickness: As recommended by coating manufacturer; minimum thickness of primer and top coat 4 mils.
2. Preparation before coating:
  - a. Galvannealed per ASTM A653/A653M: Prepare surface in accordance with ASTM D7803
3. Clean surfaces to be coated as follows:
  - a. Remove all dust, dirt, and other surface debris by vacuuming, wiping dry with clean cloths or compressed air.
  - b. Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.
  - c. Allow surfaces to drain completely and allow to thoroughly dry.
  - d. Use water blasting only when necessary for extreme cases of contamination by oily residue and where hand washing is impractical.
  - e. If the above procedures do not clean the substrate surfaces, clean the surfaces with high pressure water washing.
4. Pretreatment:
  - a. Wash parts in a four stage iron-phosphate washer for steel or zinc-phosphate washer for galvanized steel, or in accordance with coating manufacturer's recommendations.
  - b. Dry parts before application of power coating.
  - c. Treatment of the substrate: ASTM D3451.
5. Application:
  - a. Edges: Treat and finish as required to ensure specified minimum dry film coating thickness is achieved. Precoating of edges may be required.
  - b. Apply primer in accordance with manufacturer's written application instructions.

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- c. Apply top coat in accordance with manufacturer's written application instructions.
  - d. Allow surfaces to cure for time period in accordance with manufacturer's cure curves.
  - e. Inspect parts after cooling.
6. Color:
- a. PSE Exterior: Color will be provided by Metra's Authorized Representative.
  - b. PSE Interior: RAL 9010, Pure White.

## 2.07 HEATING, VENTILATING AND AIR CONDITIONING

- A. The heating, ventilating and air conditioning (HVAC) system shall be wall mounted and shall be accessible for service maintenance.
- B. Each Unit shall contain an electrical heater. The use of Heat Pumps is not acceptable
- C. The units must be appropriately sized by the PSE manufacturer, taking into account the equipment and layout used, based on the following conditions:
  - 1. Substation operating at 150% of rated capacity continuously
  - 2. Outside air temperature ranges from -20°F to 110°F
  - 3. Heaters shall be sized to provide a minimum of 55°F at 0% of rated of rated capacity
  - 4. Inside air temperature as required to ensure that all equipment is capable of the specified performance for sustained periods at the maximum air ambient temperature that will be attained during weekday peak hours (6 am to 10 am and 4 pm to 8 pm).
- D. Air Conditioning Units shall be added in sufficient quantity to provide interior temperatures per the design criteria above.
  - 1. Air Conditioning Units for the Switchgear room shall be added in pairs where one unit shall be the lead unit the second unit the lag unit as determined by its controller.
  - 2. The Control Room shall be temperature controlled by a single unit which is controlled by its dedicated thermostat.
- E. Units shall be equipped with dual stage compressors
- F. Units shall be equipped with economizers
- G. Ventilation louvers shall prevent the entry of leaves, paper, etc. Inlet air filters shall be installed to minimize dust accumulation within the substation
- H. Weatherproofing: Doors, joints, walls, roof, vents and louvers shall be rainproof under conditions of 75 mile-per-hour wind from any direction.

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- I. Vandal-proofing: Enclose wall-mounted HVAC units inside a vandal-proof cage or provide an alternate means of deterring vandalism, as approved by Metra.
- J. Provide condensate drain for each unit. Condensate drain shall be discharged into the ground via an HDPE pipe or an open site-drain.
- K. HVAC Units shall be 3phase 208vac 60hz.
- L. A separate air conditioning unit shall be provided for the control room.
- M. In locations where wall-mounted units cannot be safely accessed for required maintenance, roof-mounted units may be used, as approved by Metra's Authorized Representative.
  - 1. PSE manufacturer shall provide a method to access the HVAC for service.

**2.08 HVAC CONTROLS**

- A. Each Pair of HVAC Unit shall have its own lead/lag Controller. The controller I shall be connected to the damper motors, thermostats, and the Fire Alarm Panel.
- B. The controller shall be used to distribute the run-time over the connected units, balancing the service life HVAC Units.
- C. The Control Panel shall provide Lead/Lag Functionality that can be set to alternate between two HVAC Units. The Changeover time shall be adjustable from 0....30 days and shall be set to 10 days initially.
- D. Provide one Comfort Setting substation, as specified below.
- E. The HVAC Controller shall be equipped with an internal ambient temperature sensor as well as a redundant external temperature sensor.
- F. Temperatures:
  - 1. Cooling: Air conditioning equipment shall be capable of maintaining an inside temperature of the housing of not more than 80°F.
  - 2. Heating: Thermostatically controlled heating elements shall maintain a minimum inside temperature of 55°F.
  - 3. Alarm: Provide field-adjustable alarm contacts for SCADA Indication
    - a. Low Temperature Warning (Set to 50°F)
    - b. High Temperature Warning I (Set to 95°F)
    - c. High Temperature Warning II (Set to 110°F)
- G. Operation of each heating and ventilating system shall be as follows:
  - 1. Cooling
    - a. Stage 1 Cooling

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- 1) Interior Temperature has reached Set point (SP) Default 77°F (adjustable between 65°F and 90°F) The blower of the lead unit will come on immediately If the outdoor temperature and humidity conditions are below the set point of the economizer control the lead unit economizer will operate instead of the compressor. If outdoor conditions are not acceptable for free cooling the compressor will automatically operate on compressor Stage 1 partial capacity instead of the economizer.
- b. Stage 2 Cooling
  - 1) Interior Temperature is 4°F (default setting, user selectable 2-6°F) warmer than Stage 1. On a call for 2nd Stage cooling the blower of the lag unit is turned on. If the outdoor temperature and humidity conditions are below the set point of the economizer control the lag unit economizer will operate instead of the compressor. If outdoor conditions are not acceptable for free cooling the compressor will automatically operate on compressor Stage 1 partial capacity instead of the economizer.
- c. Stage 3 Cooling
  - 1) Interior Temperature is 2°F (default setting, user selectable 2-3°F) warmer than Stage 2. On a call for 3rd Stage cooling the lead unit economizer will continue to operate as long as outdoor conditions are acceptable, and the compressor will operate on compressor Stage 1 partial capacity. If outdoor conditions are not acceptable for free cooling the lead unit compressor will automatically be operating on compressor Stage 1 partial capacity and will go to Stage 2 full capacity operation.
- d. Stage 4 Cooling
  - 1) Interior Temperature is 2°F (default setting, user selectable 2-3°F) warmer than Stage 3. On a call for 4th Stage cooling the lag unit economizer will continue to operate as long as outdoor conditions are acceptable, and the compressor will operate on compressor Stage 1 partial capacity. If outdoor conditions are not acceptable for free cooling the lag unit compressor will automatically be operating on compressor Stage 1 partial capacity and will go to Stage 2 full capacity
2. Heating
  - a. The first stage heating set point shall be entered as a dead band (db) below the first stage cooling set point (SP). The Default Setting shall be 22°F resulting in a heating set point of 55°F.
  - b. Stage 1 Heating

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- 1) The Heater of the Lag Unit shall operate
- c. Stage 2 Heating
  - 1) The Heaters of the Lead and Lag unit shall operate simultaneously.
- d. The dead band shall be adjustable from 2°F - 40°F
- 3. Comfort Mode
  - a. The unit shall be equipped with a comfort Mode. The Comfort Mode will be used if the Substation is attended.
    - 1) The Heating set-point shall increase to 68°F.
    - 2) The Cooling set-point shall decrease to 72°F
  - b. The Comfort Mode shall automatically revert back to normal operation 1 hour after its activation.

## 2.09 ENCLOSURE GROUNDING

- A. All principal members of the enclosure shall be bonded together and connected through the ground detection network.
- B. Enclosure shall be insulated from all secondary and auxiliary power and control circuits with minimum 2000 volt insulation.
- C. The dc switchgear and rectifier shall be grounded through a high resistance ground detection network.
  - 1. Insulation (NEMA Grade GPO3) shall be provided to insulate the dc switchgear and rectifier enclosures from the substation walls and floor as well as from other grounded equipment.
  - 2. Each Cathode Breaker Enclosures shall be electrically bonded to its associated Rectifier.
  - 3. Insulation shall be provided between the two Cathode Breakers.
  - 4. To prevent vandalism, any exposed copper connections shall be enclosed with stainless steel.
- D. The ground detection network shall detect a grounded structure and initiate annunciation, as specified.
- E. The ground detection network shall detect a hot structure and initiate trip and lockout of the substation, as specified.
- F. Enclosure shall be capable of withstanding a 2500 volt 60 Hz high potential insulation test to ground for 60 seconds. This factory test shall be applied upon completion of installation.

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- G. Provide a ground loop consisting of a 1/4-in x 2-in copper ground bus inside around the four walls of the substation enclosure to interconnect all components within the PSE except rectifier and dc switchgear.
- H. Provide four exterior ground pads, one at each corner of the enclosure
  - 1. Connect exterior ground pads to the inside ground bus by 4/0 AWG copper cable at four locations.
  - 2. Exposed exterior copper conductors are prohibited. The Ground Pigtail shall be inside RGS Conduit to prevent theft and vandalism.

**2.10 FIRE PROTECTION**

- A. Provide smoke detectors in the PSE with relay contacts to stop the pressurizing and air conditioning system per Section 16150, Fire Alarm System.
- B. Provide a hand held, wall mounted, UL-rated fire extinguisher near each of the main doors.

**2.11 WARNING SIGNS**

- A. A red laminated plastic tag with 1-1/2-in bold letters stating DANGER HIGH VOLTAGE shall be installed on the exterior of entry doors and hinged access doors. In addition, provide all warning signs required by NFPA 70E.

**2.12 INTERCONNECTING WIRING**

- A. Provide a 4-inch minimum internal wireway around the perimeter of the PSE
  - 1. This wireway shall be used for any 120/208 volt wiring for receptacles, switches lights and HVAC. Interconnection wiring between Equipment shall not be installed in this wireway. Installation of control wires in this wireway is prohibited.
  - 2. Any control wiring and FO Cables shall be installed in dedicated conduit runs.
- B. Interconnecting wiring between shipping halves shall be coiled, properly tagged, and supported for shipment.
- C. Switchboard wiring shall be used for all interconnecting wiring for control circuits. This wire shall have a permanent wire-marking system identifying the "from-to" wire designation.

**2.13 AUXILIARY POWER**

- A. The Contractor shall be fully responsible for properly sizing the Auxiliary Power Transformer. A 200A Feed to the existing building must be included in the Calculations.

**2.14 LIGHTING**

- A. See Section 16510, Lighting, for substation lighting requirements.

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- B. Provide exterior lighting above each door and every 10 feet on the outside building perimeter, or as needed to provide the specified lighting level. See Section 16510, Lighting, for requirements.

**2.15 WIRING DEVICES**

- A. Interior: Provide a 125 volt, 20 amp, three-wire, grounded type, duplex receptacle at each main entrance and every 15 feet around the interior of the building.
- B. Exterior: Provide GFI-protected 20 amp duplex receptacles at each main entrance and adjacent to equipment doors, or as indicated on Contract Drawings. Provide weather proof "while in use" covers as specified in Section 16142, Wiring Devices.

**2.16 FURNITURE**

- A. In each substation, provide the following:
  - 1. Desk: Minimum working area 42 x 30 in, with two file drawers and a pencil drawer.
  - 2. Chair: Non-folding with upholstered seat and back.
  - 3. File Cabinet: Free-standing, four-drawer, legal size, with lock and UL insulated file device 350°C one-hour rating.

**2.17 SOURCE QUALITY CONTROL**

- A. Factory Production Tests
  - 1. All equipment, apparatus and material furnished with the PSE shall be subject to factory tests and inspection by Metra's Authorized Representative.
  - 2. Refer to Section 16610, Traction Power Equipment Installation, and Section 16611, Traction Power Equipment Testing, for traction power equipment testing.
- B. Galvanizing: After delivery of substation, inspect galvanizing and repair if damaged.
  - 1. If damage is found, submit a repair procedure.
  - 2. Repair scratches and other damage in accordance with ASTM A780/A780M.
  - 3. If the following is performed in the field, repair in accordance with ASTM A780/A780M:
    - a. Cutting metal
    - b. Grinding metal
    - c. Welding

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4. Dry film thickness of applied repair materials: Not less than galvanized coating thickness required by ASTM A53/A53M, A123/A123M, or A153/A153M.
- C. Shop-Applied Powder Coat Testing:
1. Coating shall meet or exceed the following testing requirements and performance criteria of ASTM D3451 and other standards indicated below.
  2. Physical Properties of Powder Coating:
    - a. Measurement of film thickness: ASTM D6132 or D7091.
    - b. Abrasion resistance: ASTM D968.
    - c. Adhesion: ASTM D3359, Method B, 5B.
    - d. Elongation (flexibility): Mandrell Bending Test, ASTM D522/D522M, equal to or greater than 3 mm.
    - e. Household chemical resistance: ASTM D1308.
    - f. Detergent resistance: ASTM D2248.
    - g. Chip resistance: ASTM D3170/D3170M.
    - h. Gloss:
      - 1) Interior: 25 to 40 percent reflective gloss.
      - 2) Exterior: ASTM D523, 80 to 90 plus.
    - i. Pencil hardness:
      - 1) Interior: ASTM D3363, F minimum.
      - 2) Exterior: ASTM D3363, 4H (minimum).
    - j. Impact resistance: ASTM D2794, 80 (in/lb), no appearance of cracks.
  3. Accelerated Artificial Weathering: ASTM D6695, ASTM G151, ASTM G155.
  4. Accelerated Environmental Exposure:
    - a. Salt spray:
      - 1) Interior: ASTM B117, 250 hours, maximum undercut failure of 1/16 inch 1.6 mm at scribed test lines; no blistering.
      - 2) Exterior: ASTM B117, 500 hours, maximum undercut failure 1 mm; no blistering.
    - b. Humidity Resistance: ASTM D2247, 500 hours, maximum undercutting 1 mm, ; no blistering.
- D. Shop-Applied Paint Coating System Testing:
1. Primer shall meet or exceed the following testing requirements and performance criteria of the standards indicated below:

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2. Abrasion Resistance per ASTM D4060 (CS17 Wheel, 1,000 grams load), 1 kg Load: 200 mg loss.
  3. Adhesion per ASTM D4541: 1050 psi.
  4. Corrosion Weathering per ASTM D5894, 13 Cycles, 4,368 Hours: Rating 10 per ASTM D714 for blistering; Rating 7 per ASTM D610 for rusting.
  5. Direct Impact Resistance per ASTM D2794: 160 inch pounds.
  6. Flexibility per ASTM D522/D522M, 180 degree Bend, 1 inch Mandrel: Passes.
  7. Pencil Hardness per ASTM D3363: 3B.
  8. Moisture Condensation Resistance per ASTM D4585/D4585M, 100 degrees F, 2000 Hours: Passes, no cracking or delamination.
  9. Dry Heat Resistance per ASTM D2485: 250 degrees F.
- E. Top Coat shall meet or exceed the following testing requirements and performance criteria of the standards indicated below:
1. Abrasion Resistance per ASTM D4060, CS17 Wheel, 1,000 Cycles 1kg Load: 87.1 mg loss.
  2. Adhesion per ASTM D4541: 1050 psi.
  3. Direct Impact Resistance per ASTM D2794: Greater than 28 inch pounds.
  4. Indirect Impact Resistance per ASTM D2794: 12-14 inch pounds.
  5. Dry Heat Resistance per ASTM D2485: 200 degrees F.
  6. Salt Fog Resistance per ASTM B117 9,000 Hours: Rating 10 per ASTM D714 for blistering.
  7. Flexibility per ASTM D522/D522M, 180 Degree Bend, 1/8 Inch Mandrel: Passes.
  8. Pencil Hardness per ASTM D3363: 2H.
  9. Moisture Condensation Resistance per ASTM D4585/D4585M, 100 degrees F, 1000 Hours: No blistering or delamination.
  10. Xenon Arc Test per ASTM D4798/D4798M: Pass 300 hours.
- F. After delivery of substation, inspect all exterior surfaces for damage and repair if damaged.
1. If damage is found submit a repair procedure.

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**PART 3 - EXECUTION**

3.01 NOT USED

**END OF SECTION**

**SECTION 16019**  
**TRACTION POWER CABLE LUGS**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section includes furnishing and installing cable/wire termination lugs for traction power and control cables, as specified.

**PART 2 - PRODUCTS**

2.01 TRACTION POWER CABLE LUGS

- A. Cable lugs used for termination of traction power cables shall be either solder type or bolted compression type as specified:
- B. Solder Lugs:
1. Solder shall conform to ASTM Designation B32 Solder Metal, Alloy Grade 50A, 50 percent tin, 50 percent lead. Soldering shall be non-corrosive.
  2. Where lugs are bolted together the hardware shall be 3/4-inch brass bolts and nuts as shown on the Drawings.
- C. Bolted Compression Lugs:
1. Lugs shall be bronze with NEMA-standard tongue-drilling.
  2. Both sides of lug-tongue surfaces shall be machined smooth for good electrical contact.
  3. Provide silicon-bronze bolts, washers, and brass self-locking nuts (1/2 inch diameter for 1500 kcmil cable) for tongue-bolting the lugs to bus bars. Length of bolts to be determined in field.
- D. Crimp-Type Lugs:
1. Lugs shall be insulated eye or ring-tongue type (open or fork tongue type are prohibited).
  2. Termination lugs shall be as manufactured by T&B Corp. (STA-KON type), Burndy (small hydrant type), or approved equal.

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**PART 3 - EXECUTION**

## 3.01 GENERAL

- A. Prepare traction power cable for termination using the cable manufacturer's recommended method.
- B. Contact surfaces at terminations shall be clean and bright and free of oxide, and shall be coated with oxide inhibitor when bolted connections are made.

## 3.02 TYPE APPLICATIONS

- A. Solder-type terminal lugs shall be provided at cable connections to dc disconnect switches.
- B. Bolted compression terminal lugs shall be provided for traction power cable connection to bus bars.
- C. Control cable/wire termination lugs shall be solder-less pressure-indented (crimp) type.

## 3.03 SOLDERING PROCEDURE

- A. Cable to Straight Lug in Upright Position:
  - 1. Prepare Cable and Lug:
    - a. Cut and skin cable insulation to proper length (approximately 1/8 inch copper exposed beyond lug).
    - b. Clean cable and lug (inside) with fine wire brush or abrasive pad.
    - c. Apply non-acid flux (paste) liberally to cable and lug (inside).
  - 2. Apply Lug:
    - a. Put lug on cable (lug has a pre-drilled 1/4 inch diameter hole in top of barrel).
    - b. Tape lug and cable at connection with friction tape.
  - 3. Solder Lug to Cable:
    - a. Heat lug in center until it is hot enough to take solder in molten form at contact.
    - b. Feed string solder (50:50 ratio of tin and lead), into hole at top of barrel while constantly heating lug until it starts to overflow. Cold solder joints are not acceptable.
    - c. Remove heat from lug and continue feeding solder until molten solder stops flowing to eliminate air pockets.
  - 4. Cool and Inspect:
    - a. Let assembly air-cool.
    - b. Wait until after assembly has cooled down; remove friction tape to see if solder flowed into the bottom of the lug. If not, repeat the above steps.

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5. Clean assembly with wire brush or abrasive pad. (Make sure lug machine surfaces are clean of excess solder).
6. Provide heat-shrinkable tube (5 inches, approximately) at joint.

**3.04 CONTROL CABLE TERMINATIONS**

- A. Prepare control cable/wire for termination using cable manufacturer's and termination lug manufacturer's recommended procedures.
- B. Spare conductors shall be left neatly coiled with tie wraps and the ends taped. Spare conductors shall be minimum of 36 inches long from cable end.

**END OF SECTION**

**SECTION 16020**  
**CABLE TAGS**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. Section includes traction power and control cable tags and cable tag printer.

1.02 MAINTENANCE MATERIAL SUBMITTALS

- A. Contractor shall provide Metra a Transfer Desktop Printer at the Project Closeout.
- B. The printer shall be 600 dpi thermal transfer
1. Print speed: 4.0-in (101.6 mm) per second
  2. Media width: 4.25 in (108.0 mm)
  3. Maximum print width: 4.09 in (103.9 mm)
  4. Maximum print length: 40.00 in (1016.0 mm)
  5. Media sensor: Adjustable, gap, and black mark sensing
  6. Media handling: Die cut labels, heat shrink labels, butt cut labels, continuous tapes
  7. Media feeding: Internal roll mount, 8.20 in (208.3 mm) O.D. maximum
  8. Connectivity: USB, Ethernet, Parallel, Serial
  9. Operating system compatibility: Windows 7, Windows 8, Windows 10
  10. Manufacturer/Product: Panduit TDP46HE, or approved equal

**PART 2 - PRODUCTS**

2.01 BRASS CABLE TAGS

- A. Brass cable tags shall be 2 in x 3 in x 1/4 in for one-line or two-line designation of information, die-stamped with 1/2-inch high characters.

2.02 NYLON CABLE TAGS

- A. Nylon cable tags, 3/4 in x 2 in, hand marked with indelible ink characters 1/4-inch high, and covered by surface film protection.

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**PART 3 - EXECUTION****3.01 GENERAL**

- A. All traction power and control cables installed by the Contractor shall be tagged. Cable tags provided by the Contractor shall be either brass or nylon as described by locations listed below.

**3.02 BRASS CABLE TAGS**

- A. Brass-type cable tags shall be used in the following locations:
  - 1. Substations
  - 2. At duct-line entrances
  - 3. In manholes,
  - 4. At entrance and exit of duct openings
  - 5. At the top of conduit risers
  - 6. At similar locations where cables will be accessible for inspection and maintenance
- B. Brass cable tags shall be attached to cables with No. 14 AWG solid copper tie wires.

**3.03 NYLON CABLE TAGS**

- A. Nylon-type cable tags shall be used in the following locations:
  - 1. Switch enclosures
  - 2. Negative return bus enclosures
  - 3. Substations
  - 4. Other similar locations where cables are protected by enclosures.
- B. Nylon cable tags shall be attached to cables with nylon tie straps.
- C. For Control Wires inside the Switchgear Equipment refer to requirements listed under 16010 2.07

**END OF SECTION**

**SECTION 16125**  
**TRACTION POWER CABLES**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section includes requirements for providing 1,500 kcmil traction power cables, which are used in the traction power distribution circuit.

1.02 RELATED WORK

- A. Section 16020, Cable Tags
- B. Section 16970, Electrical Testing

1.03 REFERENCES

- A. This Section incorporates by reference the latest revisions of the following documents:
- B. ASTM International (ASTM)
  - 1. ASTM B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
  - 2. ASTM B496, Specification for Compact Round Concentric-Lay-Stranded Copper Conductors.
  - 3. ASTM D470, Standard Test Methods for Crosslinked Insulations and Jackets for Wire and Cable
  - 4. ASTM D471, Test Methods of Rubber Property-Effect of Liquids
  - 5. ASTM D747, Standard Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam
- C. Institute of Electrical and Electronics Engineers (IEEE)
  - 1. IEEE 1202, Standard for Flame-Propagation Testing of Wire and Cable
  - 2. IEEE 1210, Standard Tests for Determining Compatibility of Cable-Pulling Lubricants with Wire and Cable
- D. Insulated Cable Engineers Association, Inc. (ICEA)
  - 1. ICEA S-96-659, Non-Shielded 2001-5kV Cables
- E. International Organization of Standards (ISO)
  - 1. ISO 9001, Quality Management Systems - Requirements

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- F. Underwriters Laboratories (UL)
  - 1. UL 1072, Medium Voltage Power Cables

**1.04 SUBMITTALS**

- A. Submit shop drawings showing the cable construction details and cable ratings.
- B. Submit product data:
  - 1. Trade name of the insulation and jacket that is proposed for this Contract.
  - 2. Test data from previous tests
  - 3. Suggested cable pulling compound and storage/handling requirements
  - 4. Maximum allowable pulling tension
  - 5. Maximum allowable sidewall pressure
  - 6. Minimum bending radius
  - 7. Size of cable
  - 8. Quantity of cable in feet
  - 9. Cutting lengths in feet
  - 10. Reel size
- C. Certified Test Reports:
  - 1. Submit information on cable manufacturer's qualifications demonstrating that the requirements specified in the Quality Assurance article have been satisfied.
  - 2. Certified test reports:
    - a. Submit certified test reports demonstrating that the cable is qualified per ICEA S-96-659 and IEEE 1202.
    - b. Submit certified test report for ICEA S096-659 Electrical Tests on Completed Cables prior to the shipment of cable. These certified test reports shall include the identification number of each shipping reel and the footage on each reel.
- D. Submit a signed statement that the proposed cable insulation and jacket have been tested for, and comply with the requirements of the Specifications.

**1.05 QUALITY ASSURANCE**

- A. Cable shall be manufactured and tested under the control of a Quality Assurance program which meets the requirements of ISO 9001.

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- B. **Manufacturer's Qualifications:**
  - 1. Procure cables only from well-known experienced manufacturers engaged in regular commercial production of the specified cables with a current ISO 9001 certification.
  - 2. The manufacturer shall have not less than 10 years of practical and successful commercial field experience with the EPR insulation and low smoke, non-halogen, cross-linked polyolefin jackets.
- C. **Contractor's Qualifications:**
  - 1. The Contractor shall have had not less than seven years of practical and successful commercial field experience with the EPR insulation and low smoke, non-halogen, cross linked polyolefin jacket.

**1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Prior to shipment, cable reels shall be wrapped with cardboard or other approved wrapping complete with an overlay of 2 in by 4 in of wood lagging.
- B. Cable shall be shipped on non-returnable reels. The length of cable on each reel will be determined by the Contractor and submitted, as specified.
- C. Cables shall be shipped with the ends capped and sealed with heat shrinkable caps to exclude moisture.
- D. Each reel or coil shall carry suitable tags showing name of consignee, address, reel identity, order number, name of manufacturer, and type of cable, size, weight and length.
- E. All transportation charges, including transit insurance, to the delivery location shall be paid by the Contractor and shall be included in the Contract price.
- F. Handling or re-handling of material at the Contractor's manufacturing and storage locations prior to delivery shall be considered incidental to the Contract.

**PART 2 - PRODUCTS****2.01 GENERAL**

- A. Provide new, ethylene propylene rubber (EPR) insulated, thermoset, low-smoke, non-halogen cross-linked polyolefin jacketed cables rated for 5,000 volts, or higher, for use on the 1,500 Vdc distribution system.
- B. The cable shall have excellent heat and moisture resisting characteristics and special fire resistant characteristics.
- C. The cable shall not contain any component of metallic or semi-conducting material shielding.

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**2.02 TRACTION POWER CABLE**

- A. Type: MV-90, 90°C, 5 kV, unshielded, size as indicated.
- B. Use:
1. Cables specified in this Section are intended for use in dc traction service operated on a 1,500 Vdc nominal system subjected to additional voltages as may occur on account of switching, operation of trains, and rectifier equipment.
  2. Cables shall be suitable for use on service and feeders, indoors or outdoors, in wet or dry locations, in exposed or underground conduits, in cable trays, cable racks, direct buried or exposed. The cable shall be sunlight resistant, suitable for installation at 0°C.
- C. Standards:
1. Cables shall meet or exceed requirements of ICEA S-96-659 and UL 1072.
  2. Cable shall pass the vertical tray flame test requirements of IEEE 1202.
- D. Conductor:
1. The conductor shall be annealed, uncoated, copper conductor, Class B stranded, round or compact, concentric-lay stranded per ASTM B8 or ASTM B496.
  2. The conductor shall conform to requirements for conductors in ICEA S-96-659 and ASTM B8.
- E. Insulation:
1. Ethylene-propylene rubber (EPR); comply with physical and electrical requirements of ICEA S-96-659.
  2. No polyethylene shall be allowed as a component of the insulation and EPR insulation shall be compounded by the cable manufacturer.
  3. The insulation shall be rated for 130°C emergency overload temperature and 250°C short circuit temperature.
  4. For flexibility, the insulation compound shall have an Apparent Bending Modulus of 2600 psi or less in accordance with Standard Test Method ASTM D747.
  5. .
- F. Insulation Level: 100 percent, unless indicated otherwise.
- G. Overall Sheath Jacket: Thermosetting, low-smoke, zero-halogen, fire-resistant, cross-linked polyolefin, black in color.

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**2.03 IDENTIFICATION**

- A. Cable identification shall be printed on the jacket in accordance with NFPA 70, with the following additional information:
  - 1. Year of manufacture
  - 2. Insulation
  - 3. Jacket type
- B. The center strand of 1,500 kcmil cable shall be stamped at 6-inch intervals with manufacturer's and Metra's ID and year of manufacturing.

**2.04 SOURCE QUALITY CONTROL**

- A. Cable shall be factory-tested in accordance with ICEA S-96-659 to verify that it meets the requirements of the standard.
- B. Flame test: Completed cable shall pass the IEEE 1202 cable tray flame test and UL 1072 vertical tray flame test.
- C. Electrical tests specified for completed cables in ICEA S-96-659 shall be performed on each length of cable prior to shipment from the factory to Metra's site.
- D. If the Contractor's final certified tests results demonstrate compliance with the Specifications and are approved by Metra's Authorized Representative, the Contractor will be notified to ship the cable. The Contractor shall not ship cable without approval.

**2.05 METRA INSPECTION**

- A. Metra's Authorized Representative shall have free entry to the manufacturer's facilities at all times while work on the Contract for Metra is being performed and to all parts of the manufacturer's works which concern the manufacture of the cable.
- B. The Contractor shall afford Metra's Authorized Representative, without charge, all reasonable facilities to satisfy Metra's Authorized Representative that the cable is being furnished in accordance with the Specifications.
- C. Tests and inspections may be made at the manufacturer's plant prior to shipment. Acceptance of material by Metra's authorized representative the manufacturer's plant after inspection means that no apparent reason was found to reject the inspected material. However, Metra's Authorized Representative reserves the right to reject all material, after delivery to Metra, which does not conform to the Specifications.
- D. To accommodate the inspectors travel requirements, the Contractor shall provide the inspector at least a twenty-one working day notice prior to any scheduled testing.

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**2.06 INSPECTION COSTS**

- A. If problems develop as a result of the Contractor's negligence, necessitating additional trips, all expenses associated with these additional trips shall be borne by the Contractor.

**PART 3 - EXECUTION****3.01 INSTALLATION**

- A. General
1. The Contract requires installation of new cables in new ducts installed as part of the civil contractor's work for permanent as well as temporary work.
    - a. Obtain conduit/duct log from the civil contractor and confirm that the log matches field conditions by visually checking all runs.
    - b. Verify that all conduits have a nylon cord and a plug to seal the ends to keep ducts free of dirt and other debris.
  2. Inform Metra's Authorized Representative about any field conditions encountered which are not covered or differ substantially from those shown or specified in the Contract Documents. Perform the work in question in accordance with Metra's authorized representative instruction.
  3. Continued revenue operation of Metra's transit system during execution of this Contract is required.
    - a. Schedule and perform all work in a manner such that this basic requirement is not compromised.
    - b. Connections to existing operating equipment or circuits are prohibited without specific authorization by Metra's Authorized Representative.
    - c. All work which, in Metra's Authorized Representative opinion, affects operation of the transit system shall be performed during track/power outages or shutdowns in such a manner that the system shall be operational when the revenue service is resumed.
  4. Install dc traction power cables as shown on the Contract Drawings.
  5. Do not work on energized cables.
- B. Cleaning Ducts:
1. Use a flexible rodding device and pass it through each conduit to check for continuity and cleanliness.
  2. After rodding, mandrel the conduit as follows:
    - a. The mandrel shall be not less than 1/4-inch smaller than the inside diameter of the conduit.

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- b. Pull the mandrel through the conduit, preceded by a wire brush tied to the same string, once in each direction.
  3. If any difficulty is encountered in passage of the duct rodding device or mandrel, re-clean the conduit as follows:
    - a. A series of wire brushes shall be drawn through the conduit, once in each direction, using a trailing line.
    - b. Continue with the wire bushes until the final brush is 1/8-inch diameter less than the inside diameter of the conduit.
    - c. If the correct size cannot be passed through on the initial pull, the operation must be repeated until accomplished.
  4. If the conduit is partially or fully obstructed with mud, dirt, or gravel, the duct must be flushed clean with water using flushing nozzle which should be pushed into the conduit and applied until the duct is clear. After cleaning, follow the procedure outlined above for the rodding and wire brushing.
  5. After all obstructions have been removed and the conduits wire brushed clean, pull a nylon cord of suitable strength into each cleaned conduit:
    - a. Attach to the nearest pulling eye with a six-foot length left at each end.
    - b. Immediately upon completion of installation of the nylon cord, plug both ends of the conduit to prevent entry of foreign matter before the cables are pulled.
  6. If the duct is not cleared in spite of performing duct cleaning and rodding operations as described above, the Contractor shall immediately give written notice to Metra's Authorized Representative with the field measurements from each end to the point of blockage. Metra's Authorized Representative will advise Contractor on how to proceed.
- C. Installation and Protection of Cable
1. Pull cables only after conduits have been cleaned, rodded, mandrelled, and are free of all obstructions. Pull cables after authorization is received from Metra's Authorized Representative. Pull only one cable into each duct or conduit.
  2. Preparation:
    - a. Strip cable reels of all nails on outside edges of reel heads before pulling cable.
    - b. Conveniently locate reels for feeding cable into the duct or conduit without excessive bending or possible injury to cable by abrasion on concrete or sides of duct.
    - c. Jack reels by at least 6 inches to clear ground level before pulling of cable.
    - d. Attach pulling ropes to cables with ball bearing swivels to prevent twisting of cable during pulling.

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- e. Seal cable-ends per manufacturer's recommendations before pulling into ducts.
- f. Ream duct/conduit mouth where applicable and equip with a fair lead or duct shield to protect cable at the duct mouth.
- g. Provide timbers and flexible cable pulling tubes to guide and protect the cable, where necessary.
- h. Minimum bending radii at every point in the cable run, including cable sheaves or pulleys, shall not be less than those recommended by the manufacture, or not less than eight times the outside diameter of the cable, whichever is the larger, as measured to inside surface of the cables.

## 3. Installation:

- a. Use the installation method recommended by the cable manufacturer using an approved cable grip.
- b. Use lubricant in accordance with IEEE 1210 and as recommended by the cable manufacturer.
- c. Pull cable into ducts/conduits under moderate tension. Manufacturer's recommended maximum pulling tensions shall not be exceeded.
- d. Use sufficient personnel between the reel and the duct entrance during pulling operation to inspect, control, and direct passage of cable.
- e. Do not allow cable to chafe on the ground, concrete ,or sharp surface during pulling.
- f. Install cables with freedom of horizontal movement to accommodate expansion and contraction of the cables in the ducts.
- g. Install fair leads on the ends of all cables at duct openings.

## 4. After cable pull:

- a. The ends of cables when cut shall not be left with the insulation exposed to moisture. Protect cables until proper termination or lug is installed.
- b. Label all cables as specified in Section 16020, Cable Tags. Metra's Authorized Representative will provide cable numbers as requested.
- c. No fireproofing tape is required.

## 3.02 SPLICES

- A. The Contract does not involve substantial lengths of cables. Use single continuous runs of cables. Splices are prohibited.

## 3.03 FIELD TESTING

- A. Upon completion of the installation of each cable, test the cable insulation as specified in Section 16970, Electrical Testing, as recommended by the manufacturer, or as directed by Metra's Authorized Representative.

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**3.04 ENERGIZATION**

- A. Do not energize the cables until approved by Metra's Authorized Representative.

**END OF SECTION**

**SECTION 16128**  
**MEDIUM VOLTAGE CONDUCTORS AND CABLE**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section includes:
  - 1. Medium-voltage single-conductor cable.
  - 2. Supports, terminations, and grounding.

1.02 RELATED WORK

- A. Section 16020, Cable Tags
- B. Section 16970, Electrical Testing

1.03 DEFINITIONS

- A. Medium-voltage cable: An insulated cable rated over 2000 V.
- B. Low-voltage wire or cable: A single or multi-conductor insulated wire or cable rated 2000 V or less.

1.04 REFERENCE STANDARDS

- A. Section incorporates by reference the latest revisions of the following documents:
- B. Association of Edison Illuminating Companies (AEIC)
  - 1. AEIC CS8, Specification for Extruded Dielectric Shielded Power Cables Rated 5 Through 46 kV
- C. ASTM International (ASTM)
  - 1. ASTM B8, Specification for Concentric-Lay-Stranded Copper Conductors, Hard, or Medium-Hard, or Soft Drawn.
  - 2. ASTM B496, Specification for Compact Round Concentric-Lay-Stranded Copper Conductors.
  - 3. ASTM D747, Standard Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam
- D. Institute of Electrical and Electronics Engineers (IEEE)
  - 1. IEEE 48, IEEE Standard for Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV through 500 kV

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2. IEEE 1202, Standard for Flame Testing of Cables for Use in Cable Tray in Industrial and Commercial Occupancies
  3. IEEE 1210, Standard Tests for Determining Compatibility of Cable-Pulling Lubricants with Wire and Cable
- E. International Cable Engineering Association (ICEA)
1. ICEA S-93-639/NEMA WC 74, 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy
  2. ICEA S-97-682, Standard for Utility Shielded Power Cables Rated 5 through 46 kV
- F. InterNational Electrical Testing Association (NETA)
1. Standard for Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems
- G. International Organization of Standards (ISO)
1. ISO 9001, Quality Management Systems - Requirements
- H. National Electrical Contractors Association (NECA)
1. NECA 1, Standard Practice of Good Workmanship in Electrical Construction
- I. Underwriters Laboratories (UL)
1. UL 1072, Medium Voltage Power Cables

**1.05 SUBMITTALS**

- A. Procedures: Section 013300, Submittal Procedures.
- B. Medium-Voltage Cable Design Package
1. Submit product data for each type of medium-voltage single-conductor cable, including the following:
    - a. Manufacturer of wire and cable, and certificate of compliance.
    - b. Number and size of strands composing each conductor.
    - c. Conductor insulation composition and thickness.
    - d. Average overall diameter of finished cable.
    - e. Storage instructions.
    - f. Minimum training radius, in inches.
    - g. Instructions for stripping jacket, sheath, tape, binder, filler, and semiconducting insulation shield with minimum effort without damaging the insulation.
    - h. Recommendations for installing, terminating conductors, shielding, ground wire and sheath.

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- C. Medium-Voltage Terminations, Splices, and Seals
  - 1. Submit product data for each type of medium-voltage splicing and terminating products, including the following:
    - a. Description of all parts of the splice or termination.
    - b. Step-by-step instructions for splicing and terminating.
    - c. Submit product data on cable end seals.
- D. Medium-Voltage Cable Factory Design Testing
  - 1. Medium-Voltage Cable Factory Design Test Procedure
  - 2. Medium-Voltage Cable Factory Design Test Reports:
    - a. Submit a test report for each type of medium-voltage cable proposed, all at one time.
- E. Medium-Voltage Cable Factory Production Testing
  - 1. Submit a certified factory production test report for each reel of cable documenting production testing.

**1.06 QUALITY ASSURANCE**

- A. Cable shall be manufactured and tested under the control of a Quality Assurance program that meets the requirements of ISO 9001.
- B. Cable shall have a performance record demonstrating a minimum of 10 years successful operating experience in utility and industrial power applications.

**1.07 NOTIFICATION**

- A. Notify Engineer 48 hours before cable pulling operations.
- B. Adjust schedule as necessary to permit observation.

**1.08 DELIVERY, STORAGE, AND HANDLING**

- A. Ship each unit securely wrapped, packaged, and labeled for safe handling in shipment and to avoid damage.
- B. Deliver wires and cables to the site in unbroken standard coils or reels with attached tag bearing manufacturer's name, wire trade name, and listing information.
- C. Store wire and cable in secure and dry storage facility, in accordance with NECA 1.

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**PART 2 - PRODUCTS****2.01 GENERAL CABLE REQUIREMENTS**

- A. Conductors: Annealed, uncoated copper, round or compact, concentric-lay stranded per ASTM B8 or ASTM B496.
- B. Insulation: Ethylene-propylene rubber (EPR); comply with physical and electrical requirements of ICEA S-93-639/NEMA WC 74.
  - 1. No polyethylene shall be allowed as a component of the insulation and EPR insulation shall be compounded by the cable manufacturer.
  - 2. For flexibility, the insulation compound shall have an Apparent Bending Modulus of 2600 psi or less in accordance with Standard Test Method ASTM D747.
- C. Reels and Marking: Cables shall be reeled and marked to include manufacturer, voltage rating, conductor size and material, insulation and jacket type, and year of manufacture. Legend shall repeat at least every 3 feet.

**2.02 MEDIUM-VOLTAGE SINGLE-CONDUCTOR CABLE, 5 KV AND ABOVE**

- A. Type: MV-105, 105 degrees C, shielded, size as indicated.
- B. Use: Cable shall be suitable for use on service and feeders, indoors or outdoors, in wet or dry locations, or in raceway/duct. Cable shall be sunlight resistant and suitable for installation at 0 degrees C and installation in cable tray.
- C. Standards:
  - 1. Cables shall meet or exceed the requirements of ICEA S-97-682, ICEA S-93-639/NEMA WC 74, AEIC CS8, and UL 1072.
  - 2. Cable shall pass the vertical tray flame test requirements of IEEE 1202.
- D. Conductor Shield:
  - 1. Extruded semiconducting, thermosetting EPR applied directly over the conductor. Volume resistivity shall be no less than 10 or more than 1,000 ohm-meters at 90 degrees C.
  - 2. Shield shall strip cleanly from the conductor and be firmly bonded to the overlying insulation.
  - 3. Thickness of the conductor shield shall meet or exceed the requirements of AEIC CS8.
- E. Insulation Level: 100 percent, unless indicated otherwise, meeting requirements of AEIC CS8.
- F. Insulation Shield:
  - 1. Extruded semiconducting, thermosetting EPR compound with a volume resistivity between 10 and 500 ohm-meters.

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2. Insulation shield shall strip cleanly and have peel strength not less than 3 pounds or more than 18 pounds per 1/2-inch width. Insulation shield shall leave no conductive residue on insulation after stripping.
  3. Thickness of the insulation shield shall meet or exceed the requirements of AEIC CS8.
- G. Metal-tape Shield: Copper tape, 0.005 inch or greater in thickness, applied helically with a minimum of 12-1/2% overlap.
- H. Overall Sheath Jacket: Thermosetting chlorinated polyethylene or zero-halogen, low-smoke polyolefin jacket.
- I. Approved Manufacturer/Product: The Okonite Company, Okoguard-Okolon, as appropriate for the application.

**2.03 MEDIUM-VOLTAGE CABLE TERMINATIONS, SPLICES, AND LIVE END SEALS**

- A. Termination Kits:
1. Conforming to IEEE 48 Class 1 requirements.
  2. Consisting, as a minimum, of heat-shrink or cold-shrink stress control and outer non-tracking insulation tubings, a high relative permittivity stress relief mastic for insulation shield cutback treatment, and installation instructions.
  3. Suitable for use with proposed cable.
- B. Terminations:
1. Terminals: Compression type.
  2. Single- or double-bolted, NEMA one- or two-hole terminals as follows:
    - a. Smaller than No. 2 AWG: One-hole, except two-hole where rotation of a single bolted terminal would result in contact or unacceptable clearance with other conductors or the enclosure.
    - b. No. 2 AWG and larger: Double-bolted two-hole.
    - c. No. 4/0 AWG and larger: Long-barrel, double-compression type, double-bolted, two-hole.
- C. Acceptable Manufacturers:
1. Thomas & Betts;
  2. Burndy; or approved equal.
- D. Compression Tools: Shall apply a hexagonal compression using mechanical, electrical, or hydraulic power mechanism that ensures a complete compression cycle.

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- E. Cable End Seals:
  - 1. Pre-engineered polymeric, heat-shrink end-seals for shielded solid dielectric cables.
  - 2. End-seals shall include heat-softening adhesive to seal cable ends from environmental contaminants and incursion of moisture.
  - 3. Approved Manufacturer: Raychem, or approved equal.

**2.04 IDENTIFICATION**

- A. See Section 16020, Cable Tags.

**2.05 SOURCE QUALITY CONTROL**

- A. Factory Design Tests:
  - 1. Perform Qualification Tests in ICEA S-93-639/NEMA WC 74.
  - 2. Flame test: Completed cable shall pass the IEEE 1202 cable tray flame test and UL 1072 vertical tray flame test.
- B. Factory Production Tests:
  - 1. Perform Production Tests in ICEA S-93-639/NEMA WC 74.
  - 2. Final tests shall be performed on the cable assembly.

**PART 3 - EXECUTION****3.01 INSTALLATION**

- A. General
  - 1. The Contract requires installation of new cables in new ducts installed as part of the Contractor's work for permanent as well as temporary work.
    - a. Obtain conduit/duct log and confirm that the log matches field conditions by visually checking all runs.
    - b. Verify that all conduits have a nylon cord and a plug to seal the ends to keep ducts free of dirt and other debris.
  - 2. Inform Metra's Authorized Representative about any field conditions encountered which are not covered or differ substantially from those shown or specified in the Contract Documents. Perform the work in question in accordance with Metra's Authorized Representative's instruction.
  - 3. Continued revenue operation of Metra's transit system during execution of this Contract is required.
    - a. Schedule and perform all work in a manner such that this basic requirement is not compromised.

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- b. Connections to existing operating equipment or circuits are prohibited without specific authorization by Metra's Authorized Representative.
    - c. All work which, in Metra's Authorized Representative opinion, affects operation of the transit system shall be performed during track/power outages or shutdowns in such a manner that the system shall be operational when the revenue service is resumed.
  4. Install medium-voltage cables as shown on the Contract Drawings.
  5. Do not work on energized cables.
- B. Cleaning Ducts:
  1. Use a flexible rodding device and pass it through each conduit to check for continuity and cleanliness.
  2. After rodding, mandrel the conduit as follows:
    - a. The mandrel shall be not less than 1/4-inch smaller than the inside diameter of the conduit.
    - b. Pull the mandrel through the conduit, preceded by a wire brush tied to the same string, once in each direction.
  3. If any difficulty is encountered in passage of the duct rodding device or mandrel, re-clean the conduit as follows:
    - a. A series of wire brushes shall be drawn through the conduit, once in each direction, using a trailing line.
    - b. Continue with the wire bushes until the final brush is 1/8-inch diameter less than the inside diameter of the conduit.
    - c. If the correct size cannot be passed through on the initial pull, the operation must be repeated until accomplished.
  4. If the conduit is partially or fully obstructed with mud, dirt, or gravel, the duct must be flushed clean with water using flushing nozzle which should be pushed into the conduit and applied until the duct is clear. After cleaning, follow the procedure outlined above for the rodding and wire brushing.
  5. After all obstructions have been removed and the conduits wire brushed clean, pull a nylon cord of suitable strength into each cleaned conduit:
    - a. Attach to the nearest pulling eye with a six-foot length left at each end.
    - b. Immediately upon completion of installation of the nylon cord, plug both ends of the conduit to prevent entry of foreign matter before the cables are pulled.
  6. If the duct is not cleared in spite of performing duct cleaning and rodding operations as described above, the Contractor shall immediately give written notice to Metra's Authorized Representative with the field

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measurements from each end to the point of blockage. Metra's Authorized Representative will advise Contractor on how to proceed.

C. Installation and Protection of Cable

1. Pull cables only after conduits have been cleaned, rodded, mandrelled, and are free of all obstructions. Pull cables after authorization is received from Metra's Authorized Representative. Pull only one cable into each duct or conduit.
2. Preparation:
  - a. Strip cable reels of all nails on outside edges of reel heads before pulling cable.
  - b. Conveniently locate reels for feeding cable into the duct or conduit without excessive bending or possible injury to cable by abrasion on concrete or sides of duct.
  - c. Jack reels by at least 6 inches to clear ground level before pulling of cable.
  - d. Attach pulling ropes to cables with ball bearing swivels to prevent twisting of cable during pulling.
  - e. Seal cable-ends per manufacturer's recommendations before pulling into ducts.
  - f. Ream duct/conduit mouth where applicable and equip with a fair lead or duct shield to protect cable at the duct mouth.
  - g. Provide timbers and flexible cable pulling tubes to guide and protect the cable, where necessary.
  - h. Minimum bending radii at every point in the cable run, including cable sheaves or pulleys, shall not be less than those recommended by the manufacture, or not less than eight times the outside diameter of the cable, whichever is the larger, as measured to inside surface of the cables.
3. Installation:
  - a. Use the installation method recommended by the cable manufacturer using an approved cable grip.
  - b. Use lubricant in accordance with IEEE 1210 and as recommended by the cable manufacturer.
  - c. Provide a calibrated tensiometer that indicates pulling force in pounds at the pulling end.
  - d. Pull cable into ducts/conduits under moderate tension. Manufacturer's recommended maximum pulling tension and side wall pressure shall not be exceeded.
  - e. If used, sheaves and pulleys must limit cable sidewall pressure and bend radius to acceptable values.
  - f. Use sufficient personnel between the reel and the duct entrance during pulling operation to inspect, control, and direct passage of cable.
  - g. Do not allow cable to chafe on the ground, concrete, or sharp surface during pulling.

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- h. Install cables with freedom of horizontal movement to accommodate expansion and contraction of the cables in the ducts.
  - i. Install fair leads on the ends of all cables at duct openings.
4. Installation in Manholes and Pullboxes:
- a. Pump water out of manholes, hand holes, and pull chambers before installing cable and maintain manholes, hand holes, and pull chambers in a dry condition while cables are being pulled.
  - b. Install cables in the lowest available duct.
  - c. Route cables along the manhole or handhole walls providing the longest possible slack or in accordance with approved installation drawings. Form cables closely parallel to the walls.
  - d. Prevent cable interference with duct entrances.
  - e. Provide cable racks spaced at a maximum of 4 feet and secure cable to racks using cable ties.
  - f. Existing manholes and handholes: Where new ducts are to be terminated or where new cables are to be installed, modify the existing locations of cables, cable supports, and grounding as required to provide a properly arranged and supported installation.
5. After cable pull:
- a. The ends of cables when cut shall not be left with the insulation exposed to moisture. Protect cables until proper termination or lug is installed.
  - b. Label all cables as specified in Section 16020, Cable Tags. Metra's Authorized Representative will provide cable numbers as requested.
  - c. No fireproofing tape is required.

**3.02 SPLICES PROHIBITED**

- A. The Contract does not involve substantial lengths of cables. Use single continuous runs of cables. Splices are prohibited.

**3.03 MEDIUM-VOLTAGE CABLE GROUNDING**

- A. Ground the shielded medium-voltage cable as follows:
  - 1. At the source and load ends, solidly ground the conductor shields to the grounding electrode system.
  - 2. Establish and maintain continuity of the raceways and cable sheath, throughout the feeder system.
  - 3. Bonding and grounding connections shall be made using bolted or compression connectors.

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**3.04 FIELD TESTING**

- A. Upon completion of the installation of each cable, test the cable insulation as specified in Section 16970, Electrical Testing, as recommended by the manufacturer, or as directed by Metra's Authorized Representative.

**3.05 ENERGIZATION**

- A. Do not energize the cables until approved by Metra's Authorized Representative.

**END OF SECTION**

**SECTION 16142**  
**WIRING DEVICES**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section includes requirements for furnishing and installing wiring devices.

1.02 REFERENCES

- A. This Section incorporates by reference the latest revisions of the following documents:
- B. National Fire Protection Association (NFPA)
1. NFPA 70, National Electrical Code
- C. National Electrical Manufacturer's Association (NEMA)
1. NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum)

1.03 QUALITY ASSURANCE

- A. Devices shall be of NEMA configuration and shall bear a UL label.

**PART 2 - PRODUCTS**

2.01 GENERAL

- A. Provide wiring devices and plates as specified, indicated on Drawings, and as established by the Contractor.
- B. All devices shall be heavy duty specification grade conforming to the latest NEMA configurations.
- C. In general all devices shall be one gang wide or wider as required for heavier rated devices.
- D. All devices for wall mounting system outlets shall be supplied by one manufacturer. All device plates shall be supplied by one manufacturer.
- E. Receptacle descriptions are general in nature. Exact receptacle type, rating and configuration shall match the requirements of connected equipment.

2.02 LIGHTING SWITCHES AND TOGGLE SWITCHES

- A. Switches shall be rated 20 A, 120/277 Vac.
- B. Single-pole switches shall be selected by the Contractor.

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- C. Two-pole switches shall be 20 A, 120-277 Vac, toggle type.
- D. Three-way and four-way switches shall be 20A, 120-277 Vac, toggle type.
- E. Color: Brown or ivory as approved by Metra's Authorized Representative
- F. Manufacturer/Product:
  - 1. Single-pole: Hubbell Catalog No.1221, Pass & Seymour Catalog No. 20AC1, or Bryant Catalog No. 4521.
  - 2. Three-way: Hubbell Catalog No.1223, Pass & Seymour Catalog No. 20AC3, or Bryant Catalog No. 4523

**2.03 RECEPTACLES**

- A. Both inside and outside the substations, duplex receptacles shall be specification grade, three-wire grounding, rated 20 A, 125 Vac, straight blade (NEMA configurations 5-20R).
- B. Manufacturer/Product: Hubbell, Catalog No. CR-20, Bryant, Catalog No. CR-20, or approved equal.

**2.04 GFCI RECEPTACLES**

- A. For ground fault circuit interrupter (GFCI) duplex receptacles use 120 V, 60 Hz, 20 A with built-in test and reset buttons and ground fault trip indicator.
- B. Ensure they interrupt the circuit within 1/30 second on a 5 mA earth leakage current.
- C. Receptacles shall also trip if the receptacle is incorrectly wired or if the ground-fault sensing/tripping unit fails.
- D. Provide devices designed for end-of-run installation or with provisions for feeding through to protect other outlets on the circuit. Circuit capacity for feeding through shall be 20 A.
- E. Provide receptacles with clamp-type terminals, mounting screws, and instructions.

**2.05 SWITCH AND RECEPTACLE WALL PLATES**

- A. Plates shall be manufactured by the device manufacturer.
- B. In finished interior areas, plates shall be nylon, smooth, high-abuse; color shall match hardware in surrounding area, as approved by Metra's Authorized Representative.
- C. Exterior and wet or damp location cover:
  - 1. NFPA 70 compliant "while-in-use" cover.
  - 2. Heavy-duty, die-cast aluminum, powder coated.

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3. Listed for wet locations, rated NEMA 250 Type 3R, with neoprene gasket.
4. Padlockable.
5. Depth: Minimum 3-1/4 inches.

**PART 3 - EXECUTION****3.01 INSTALLATION**

- A. Install products in accordance with product listings, manufacturer's recommendations, relevant codes and regulations, and standard industry practice for electrical installations.
- B. Switches shall be mounted near all man doors in suitable outlet boxes in the wall or partitions except where established by Metra's Authorized Representative.
- C. Wall switches and receptacles shall be arranged singly or in gangs and **shall** have approved plates and finishes as specified.
- D. Provide equipment in strict accordance with the approved shop drawings and the equipment manufacturer's recommendations.
- E. Adjust the location of equipment to accommodate the work in accordance with field conditions encountered.
- F. Provide rust-resistant mounting hardware for wiring devices boxes.
- G. Receptacles on single outlet branch circuits shall be the same rating as the branch circuit over-current protection.
- H. Install wall switches with OFF position down.
- I. Install each convenience receptacle with the grounding pole on the bottom when mounted vertically or on the right when mounted horizontally.
- J. Provide plates for switch and receptacle outlets and blank plates on unused boxes.
- K. Each switch shall be mounted 4 feet 0 inches above the finished floor. Each receptacle shall be installed 1 foot 6 inches above finished floor.
- L. Receptacles and switches shall be side wired. Back wiring is prohibited.

**3.02 PERFORMANCE TESTING**

- A. Test the complete wiring device installations to ensure proper operation.

**END OF SECTION**

**SECTION 16150**  
**FIRE ALARM SYSTEM**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section includes furnishing, installing and connecting the fire alarm equipment required to form a complete coordinated system ready for operation.
- B. The fire alarm system shall include, but not be limited to the following, as specified and indicated on the Drawings:
  - 1. Alarm initiating devices
  - 2. Control panel
  - 3. Auxiliary control devices
  - 4. Annunciators
  - 5. Power supplies
  - 6. Wiring.

1.02 RELATED WORK

- A. Section 16010, Basic Electrical Materials and Methods

1.03 REFERENCES

- A. This Section incorporates by reference the latest revisions of the following documents:
- B. National Fire Protection Association (NFPA):
  - 1. NFPA 70, National Electrical Code (NEC)
  - 2. NFPA 72, Protective Signaling Systems

1.04 SUBMITTALS

- A. Shop Drawings: Include manufacturer's name(s), model numbers, catalog cuts, ratings, power requirements, equipment layout, device arrangement, and complete wiring point-to-point diagrams.
- B. Manuals: Submit simultaneously with the shop drawings, complete operating and maintenance manuals listing the manufacturer's name(s), including technical data sheets, with model numbers to be used indicated.

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**PART 2 - PRODUCTS**

## 2.01 GENERAL

- A. Equipment and components shall be new and the manufacturer's current model.
- B. All equipment shall be attached to ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.
- C. Fire alarm system shall comply with requirements of NFPA 72 for protected premises signaling systems, except as modified and supplemented by the Specifications. The system shall be electrically supervised and should monitor the integrity of all conductors.

## 2.02 FIRE ALARM SYSTEM

- A. Work described in this Section consists of all labor, materials, equipment and services necessary and required to complete and test the Fire Alarm System. Material not specified or shown on the Drawings, but required for proper performance and operation, shall be furnished and installed.
- B. Initiation device circuits shall be wired Class B, supervised for opens and grounds.
- C. When a fire alarm condition is detected and reported by one of the system initiating devices, the following functions shall immediately occur:
  - 1. Indicate the zone that is in alarm at the main control panel, by activating an audible and visual alarm at the main control panel.
  - 2. Provide two dry-contact signals, for both Alarm and Trouble indications. Contacts for each of the two alarm conditions shall be spare (with future optional connection to a local annunciator), and for connection to the Communications System for transmitting to Central Control Office.

## 2.03 FIRE ALARM CONTROL PANEL

- A. The FACP shall communicate with and control the following types of equipment used to make up the system:
  - 1. Smoke detectors
  - 2. Heat detectors
  - 3. Manual pull stations
  - 4. Other system controlled devices
- B. The FACP shall perform the following functions:
  - 1. Supervise and monitor all initiating device circuits and alarm-indicating circuits for trouble and alarm conditions.

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2. Detect the operation of any initiating device circuit, visually and audibly annunciate the alarm condition at the panel display, and operate all auxiliary relays required for remote indication of the alarm.
  3. Visually and audibly annunciate any trouble, supervisory, or alarm condition at the panel display, and operate all auxiliary relays required for remote indication of the alarm.
- C. The FACP shall perform the following options:
1. Alarm Verification
  2. Supervisory
  3. Silence Inhibit
  4. Disable Circuits
  5. Walk Test
- D. The Control Panel shall include the following:
1. Indicating Circuits
  2. Alarm Contacts
  3. Trouble Contacts
  4. Supervisory Contacts
  5. The required number of Initiating Device Circuits
  6. Two dry output alarm contacts
- E. The System Display shall indicate the status of the following system parameters:
1. AC Power: Green LED
  2. System Alarm: Red LED
  3. Release: Red LED
  4. Supervisory: Yellow LED
  5. System Trouble: Yellow LED
  6. Circuit Trouble: Yellow LED
  7. Alarm Silenced: Yellow LED
  8. Power Trouble: Yellow LED

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**F. System Functions:**

1. Zone Status LEDs: The alarm, supervisory, or trouble LEDs shall flash until events have been acknowledged. Any subsequent new alarm, supervisory, or trouble will flash new conditions only.
2. Zone Disable: Disable/Enable shall be accomplished using special sequences of operation of the four control switches. If a zone has been disabled, an alarm shall activate the red zone LED, but not the piezo or any output circuit.
3. Last Event Recall: Shall allow the user to display the previous panel status. Last Event Recall may be used to diagnose intermittent trouble conditions.

**G. The Control Panel shall also include the following features:**

1. Twelve zones for conventional fire alarm detecting devices.
2. Battery/Earth fault supervision.
3. Alarm verification shall be an optional selection, and shall only verify smoke detectors and no other devices on the same circuit.
4. Walk Test shall be provided, which allows a single installer to test the system without returning to the panel to reset the system.
5. Watchdog timer to supervise the microprocessor shall be provided.
6. Slide-in zone identification labels shall be provided.
7. Bell circuit disconnect switch shall be provided.

**H. Power Supply**

1. The Power Supply for the Fire Alarm Control Panel shall be integral to the Fire Alarm Control Panel itself, and shall provide all control and peripheral device power needs.
2. Input power shall be 120 Vac, 60 Hz. The power supply shall provide an integral battery charger for use with batteries up to 12 AH.
3. It shall provide 2.25 amperes of regulated 24 Vdc power for audio-visual alarm-indicating devices, four-wire smoke detector power at 24 Vdc up to 200 mA, and non-resettable power at 24 Vdc up to 200 mA.
4. The power supply shall be designed to meet UL and NFPA requirements for power-limited operation on all initiating and indicating circuits.
5. Positive-temperature-coefficient thermistors, circuit breakers, fuses, or other over-current protection shall be provided on all power outputs.

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- I. Mechanical Design: The control panel shall be housed in a cabinet designed for mounting directly to a wall or vertical surface. The panel shall be designed to meet the requirement of Section 16010, Basic Electrical Materials and Methods.
- J. System Circuit Supervision:
  - 1. The FACP shall supervise all circuits to annunciators and peripheral equipment, and annunciate loss of communication with these devices.
  - 2. Each initiating device circuit shall have individual alarm and trouble indication.
- K. Manufacturers: The fire alarm system shall be as manufactured by Autocall, Notifier, Pyrotronics, Simplex, or approved equal.

**2.04 BATTERIES**

- A. Type: 12 volt, sealed, gel-cell type, maintenance free. Liquids shall not be required; there shall be no fluid level checks, refilling, spills, or leakage.
- B. Capacity: Sufficient to power the fire alarm system for not less than 24 hours plus 5 minutes of alarm, upon a normal ac power failure.
- C. Quantity: Two required.

**2.05 SYSTEM COMPONENTS**

- A. Ionization-Type Area Smoke Detectors:
  - 1. Two wire, 24 Vdc type using a dual unipolar chamber.
  - 2. Each detector shall contain a remote LED output and a built-in test switch.
  - 3. Detector shall be provided on a twist-lock base.
  - 4. It shall be possible to perform a calibration sensitivity and performance test on the detector without the need for generation of smoke.
  - 5. Detector shall have a visual indication of alarm using dual latching LEDs on the detector that may be seen from ground level. This LED shall flash every 10 seconds, indicating that power is applied to the detector.
  - 6. The detector shall not alarm when exposed to air velocities of up to 1,200 feet per minute. The detector screen and cover assembly shall be easily removable for field cleaning of the detector chamber.
  - 7. Field wire connections shall be made to the base through the use of a clamping plate and screw.

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- B. Automatic Heat Detectors:
  - 1. Type: Low-profile, ceiling-mount, with positive indication of activation. Combination rate of rise and fixed temperature.
    - a. Rate of rise element shall consist of an air chamber, a flexible metal diaphragm, and a factory-calibrated, moisture-proof, trouble-free vent. It shall operate when the rate of temperature rise exceeds 15°F per minute.
    - b. Fixed temperature element shall consist of a fusible alloy retainer and actuator shaft.
  - 2. Temperature Rating:
    - a. 135°F where ambient temperature does not exceed 100 degrees.
    - b. 200°F where ambient temperature does not exceed 150 degrees.
  - 3. Area Rating: Smooth ceiling rating of 2,500 square feet.

**PART 3 - EXECUTION****3.01 GENERAL**

- A. All fire alarm system wiring shall be installed in conduit. Conduit shall comply with the requirements of Section 16010, Basic Electrical Materials and Methods.
  - 1. Number and size of conductors shall be as recommended by the fire alarm system manufacturer.
  - 2. Field wiring to the indicating devices shall be supervised.
- B. Wiring and installation shall comply with the requirements of NFPA 70, Article 760, Fire Alarm Systems.
- C. Cables shall be separated from open conductors of power or Class 1 circuits, and shall not be placed in a raceway or junction box containing these conductors.
- D. Boxes and cabinets shall be UL listed for their use and purpose.
- E. The Fire Alarm Control Panel shall be connected to a separate dedicated branch circuit, maximum 20 amperes. This circuit shall be labeled at the Reliable Power Distribution Panel as FIRE ALARM. Fire Alarm Control Panel Primary Power wiring shall be No. 12 AWG. The branch circuit breaker providing power to the Control Panel shall be equipped with a circuit breaker lock.

**3.02 INSTALLATION**

- A. Equipment and components shall be installed in strict compliance with manufacturer's recommendations.
- B. Installation shall be in accordance with the NFPA 70, NFPA 72, and local codes, and as shown on the Drawings.

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- C. Finished Areas:
  - 1. Conduit, junction boxes, and conduit supports shall be concealed
  - 2. Fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted
- D. Unfinished Areas:
  - 1. Conduit, junction boxes, and conduit supports may be exposed.
  - 2. Fire detection and alarm system devices, control panels and remote annunciators may be surface mounted.
- E. Smoke detectors shall not be installed before the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.

**3.03 TESTS**

- A. Provide the service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during adjustments and tests for the system.
  - 1. Before energizing wire and cable, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
  - 2. Open initiating device circuits and verify that the trouble signal actuates.
  - 3. Open short-indicating appliance circuits and verify that trouble signal actuates.
  - 4. Ground circuits and verify response of trouble signals.
  - 5. Check presence and audibility of tone at all alarm notification devices.
  - 6. Check installation, supervision, and operation.
  - 7. Verify that each initiating device alarm is properly received and processed by the FACP (Walk Test).
  - 8. Conduct tests from the FACP to verify trouble indications for common mode failures, such as ac power failure.

**3.04 FINAL INSPECTION**

- A. At the final inspection, a factory trained representative of the manufacturer of the major equipment shall perform the tests and demonstrate that the systems function properly in every respect.

**3.05 INSTRUCTION**

- A. Provide two hours of instruction to Metra's personnel. Provide "hands-on" demonstrations of the operation of all system components and the entire system.

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**END OF SECTION**

**SECTION 16410**  
**SERVICE AND DISTRIBUTION (600V AND BELOW)**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section includes panelboards, overcurrent protective devices, motor control, contactors, transfer switches, and related equipment.

1.02 RELATED WORK

- A. Section 16011, Prepackaged Substation Enclosure

1.03 REFERENCES

- A. This Section incorporates by reference the latest revisions of the following documents:
  - B. National Electrical Manufacturer's Association (NEMA)
    - 1. NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum)

1.04 SUBMITTALS

- A. The Contractor may offer products of other manufacturers than those specified for Metra's consideration. Submittals shall be made to Metra's Authorized Representative for approval. Submit all data necessary to evaluate substitutions offered for approval.
- B. Panelboard catalog cuts, outline drawings, connection diagrams, and spare parts list.
- C. Auxiliary equipment catalog cuts, single-line diagrams with circuit breakers, trip ampere ratings, number of poles, and arrangement.
- D. Submit the following equipment data for overcurrent protective devices:
  - 1. Outline dimension drawings and electrical ratings of combination starters.
  - 2. Wiring and schematic control diagrams of combination starters.

**PART 2 - PRODUCTS**

2.01 GENERAL

- A. All materials shall be new and the best of their respective kinds. The use of other than "prime" grades will not be accepted.

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- B. In all cases where a device or part of the equipment is referred to in the singular number, it is intended that such reference shall apply to as many such devices as are required to complete the installation.

**2.02 PANELBOARDS****A. General:**

1. Type: Enclosed, dead-front, surface mounting, with hinged door and locking hasp, rated 120/208 volt, three-phase, four-wire, solid neutral, UL-labeled.
2. Construction: Code-gauge steel, galvanized after fabrication, and powder coated gray paint.
3. Dimensions: Minimum inside shall be 24 in wide by 5 3/4-in deep.
4. Identification: Provide a neatly-typed circuit directory, enclosed in a steel frame with glass or celluloid covers for each panelboard.
5. Main and branch breakers:
  - a. Bolt-on, molded-case, thermal-magnetic, UL-listed.
  - b. Breakers shall have trip free toggle mechanism, positive trip indication, and common trip on multiple breakers.
  - c. Breakers shall be heavy-duty industrial type and shall have thermal magnetic trip units.
  - d. Ampere ratings, number of poles and arrangement of breakers shall be established by the Contractor
6. Panelboard bus, breaker frame, and breaker trip relays shall be as shown on the Contract Drawings.
7. Panelboard neutrals shall be insulated and grounded, so the panelboard can be used for service entrance equipment.
8. MCBs shall be supplied in sufficient quantity and properly rated to power HVAC, receptacle circuits, interior lights, the Battery Charger and supply a 200A Feed to the existing Building
9. Provide at least five 20A Spare Circuit Breakers for Future use.

**B. AC Distribution Panelboards provided as a part of the auxiliary power system shall conform to the additional requirements below:**

1. Bus connections, wire terminals, and contacts shall be silver plated.
2. Main Breaker Rating: minimum 600 amperes (Coordinate with Control Power Transformer
3. Main and branch breakers: 22,000 ampere interrupting rating
4. Manufacturer: Cutler Hammer, Square D, or approved equal.

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5. One three phase branch feeder shall be made available to supply a 200A feed to the existing Tie Breaker Station Building.
- C. Lighting Panelboards, provided as part of the lighting system, shall conform to the additional requirements below:
1. Rating: 100 amperes.
  2. Branch breakers: 10,000 ampere interrupting rating,
- 2.03 OVERCURRENT PROTECTIVE DEVICES
- A. Starter Overload Relay Heaters: Select and provide thermal overload relay heaters for motor amperes given on motor nameplates.
- 2.04 MOTOR CONTROL
- A. Fan Motor Starters:
1. Provide for each fan unit, an "across-the-line" combination non-fused disconnect switch/magnetic starter, built in accordance with the latest NEMA standards.
  2. Starter shall be rated for 208 V, three-phase, 60 Hz service, minimum Size 1, complete with three overload relays.
  3. Starter coil shall be rated 120 Vac with one leg fused. Starter enclosure shall be NEMA 250 Type 1.
- 2.05 CONTACTORS
- A. Miscellaneous Heater Contactors:
1. Provide for each heater unit, an "across-the-line" combination fused disconnect switch/magnetic contactor, built in accordance with the latest NEMA standards.
  2. Each contactor shall be rated for 208 V, three-phase; 60 Hz service, minimum Size 1. The coil shall be rated at 120 Vac with one leg fused.
  3. Contactor enclosure shall be NEMA 250 Type 1.
- B. Automatic Transfer Switches:
1. Provide automatic transfer-isolation switch to provide 120/208 volt, three-phase, four-wire, 60 Hz normal and emergency power services to substation distribution panelboard.
  2. The transfer switch assembly shall be three-phase, four-wire (with neutral bar), with 600 ampere rating, 600 volt, electrically operated and mechanically held contactor (three-pole, double-throw operation from a common operating shaft).

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3. The contactor operation shall be by means of an operator (solenoid or motor drive) and shall be housed in NEMA 250 Type 1 enclosure for wall mounting. The following operational features shall be included:
  - a. Full phase protection.
  - b. Time delay override from normal to emergency source (adjustable from 1 to 3 seconds).
  - c. Test switch
  - d. Auxiliary contacts to indicate switch position; one N.O. and one N.C. required.
  - e. Auxiliary contacts to indicate normal power source failure (operate after override delay of 1 to 3 seconds); one N.O. and one N.C. required.
  - f. LED Pilot lights to indicate switch in emergency source position (green) and normal source position (red).
  - g. Manual retransfer to normal source.
4. Switches shall be provided complete with lugs for power cable connections.
5. The switch shall have an integral bypass isolation switch for maintenance.
6. Manufacturer/Product: ASCO by Vertiv, Type 940 with optional accessory 22, or approved equal by Metra's Authorized Representative.

**PART 3 - EXECUTION****3.01 GENERAL**

- A. Provide additional fittings, conduits, and other appurtenances not shown on the Contract Drawings but required due to field conditions at no extra cost to Metra.
- B. Relocation or rearrangement of equipment within 10 feet of locations shall be done by the Contractor at no additional cost to Metra, if the foundation(s), support(s), or actual equipment items have not been permanently set in place.
- C. Installation of overcurrent protective devices, motor controls, and contactors shall be recommended by manufacturer, in compliance with appropriate codes, and approved by Metra's Authorized Representative.
- D. Cutting and patching, where required to complete electrical work specified in this Section, shall meet the requirements specified in other parts of the Specifications.

**3.02 INSTALLATION OF PANELBOARDS**

- A. Mounting Height: Locate top 6 feet, 6 inches above finished floor and the bottom not less than 12 inches above finished floor, unless indicated otherwise.
- B. Anchor in accordance with seismic design specified in Section 16011, Prepackaged Substation Enclosure.

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- C. Identification: Mount sequential numbers directly on each circuit breaker or on the cover or trim adjacent to each breaker.

**END OF SECTION**

**SECTION 16451**  
**GROUNDING**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section includes furnishing and installing a complete grounding system.
- B. The grounding system shall consist of the following:
  - 1. Ground rods
  - 2. Ground wells
  - 3. An underground ground grid outside around the prepackaged substation enclosure
  - 4. A substation interior ground bus
  - 5. Taps from the ground grid to the ground pad of the enclosure and from the ground pads to the inside ground bus.
- C. The Contractor shall furnish and install grounding as required to ground prepackaged substation enclosure, transformers, ac switchgears, motors, panels, panelboards, lighting accessories and other electrical devices.

1.02 RELATED WORK

- A. Section 16011, Prepackaged Substation Enclosure
- B. Section 16641, Dielectric Flooring
- C. Section 16610, Traction Power Equipment Installation

1.03 REFERENCES

- A. This Section incorporates by reference the latest revisions of the following documents:
- B. ASTM International (ASTM)
  - 1. ASTM B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
  - 2. ASTM B152/B152M, Standard Specification for Copper Sheet, Strip, Plate, and Rolled Bar
- C. Institute of Electrical and Electronics Engineers (IEEE)
  - 1. IEEE 80, Guide for Safety in AC Substation Grounding

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2. IEEE 142, Recommended Practice for Grounding of Industrial and Commercial Power Systems
  - D. National Fire Protection Association (NFPA)
    1. NFPA 70, National Electrical Code
- 1.04 SUBMITTALS
- A. Submit product data for grounding materials.
  - B. Submit the independent testing service company's qualifications to Metra.
- 1.05 QUALITY ASSURANCE
- A. Regulatory Requirements:
  - B. Unless otherwise specified, electrical equipment and material shall be listed and labeled for the purpose for which it is used, by the Underwriters Laboratories, Inc. (UL).
  - C. Installations shall be in accordance with NFPA 70.
  - D. Qualifications: Persons installing exothermic welds shall be trained in their installation.

**PART 2 - PRODUCTS****2.01 MATERIALS**

- A. Bare ground cable: Class B, stranded, annealed, high conductivity copper, no less than 97% IACS, meeting the requirements of ASTM B8, sizes as shown on the Contract Drawings.
- B. Ground bus: Hard drawn, high conductivity rectangular copper bus bar,, Silver plated, no less than 97.4 percent IACS, meeting the requirements of ASTM B152/B152M, UNS No. C11000.
- C. Insulated grounding cable: 90°C, stranded copper NFPA 70 Type THWN, sized as shown on the Contract Drawings.
- D. Ground rod connectors, cable to cable connectors and cable to bar connectors shall be high copper alloy cast body with silicon bronze hardware, manufacturer and type as established by the Contractor.
- E. Ground rods: 3/4 inch diameter, medium carbon steel core, copper clad by molten weld casting process, 30 feet long in 5 foot sections.
- F. Ground rods shall be complete with ground wells. Ground wells shall be high-density polyethylene type (HDPE) series 1419-18 by Carson Industries or approved equal.

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- G. Exothermic Welding System:
  - 1. Provide dual-component exothermic welds with molds and accessories of a single manufacturer.
  - 2. Approved Manufacturers:
    - a. Erico;
    - b. Thermoweld; or approved equal.

**PART 3 - EXECUTION****3.01 GENERAL GROUNDING REQUIREMENTS**

- A. Equipment ground conductor:
  - 1. It shall be distinct and separate from the system neutral ground conductor and shall not be used as a load current carrying conductor.
  - 2. It shall provide a low-impedance path for line to grounded fault currents and bond all non-current-carrying enclosures together including raceways, fixtures, receptacles, panels, controls, motors, disconnect switches, and exterior lighting.
  - 3. Where conductors are installed in a raceway, the equipment ground conductor shall be minimum No. 12 AWG copper.
  - 4. Where green insulation is not available, on large size cable, black insulation shall be used and shall be identified with green-colored tape at each junction box or device enclosure.
  - 5. The ground cable shall be continuous without joints and splices.
- B. Wiring channels, cable trays, and metallic conduit, including rigid electrical metallic conduit and flexible conduits, shall be connected at each end to the equipment ground conductor using a conduit grounding bushing.
- C. Switchgear and panel boards shall be provided with an equipment ground bus (including lug or screw terminals) securely bonded to the enclosure.
- D. Junction boxes and other enclosures (sizes above 5 inches by 5 inches) shall use an equipment ground bus or lug as required to securely bond the equipment ground conductor to the enclosure.
- E. Lighting fixtures shall be securely connected to the equipment ground conductor. A continuous row of linear metallic fixtures mechanically joined to provide good electrical contact may be considered as one fixture with the equipment ground conductor connected at only one point.
- F. Motors shall be connected to the equipment ground conductor. Bolts, nuts, and washers shall be bronze, cadmium plated steel, or other noncorrosive material.

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**3.02 INSTALLATION OF GROUNDING SYSTEM**

- A. The entire power and lighting systems shall be permanently and effectively grounded in accordance with NFPA 70.
- B. Conduit:
  - 1. Continuity of ground shall be maintained throughout conduit systems using an equipment ground conductor in the conduit system to maintain ground continuity.
  - 2. Ground bushings and jumpers shall be used wherever the normal conduit termination does not ensure continuity of ground.
- C. Ground rods shall be installed in locations and to the depths as shown on the Contract Drawings.
  - 1. Ground rod sections shall be connected using high strength bronze alloy couplings each tack welded to ground rod sections.
  - 2. Ground rods shall be installed by driving, not by drilling or jetting.
  - 3. Obtain approval from Metra's Authorized Representative before installation of ground rods begins.
- D. Grounding Connections:
  - 1. Connectors and lugs and their bolts, nuts or screws shall be furnished by the Contractor for connection to all equipment.
  - 2. Lugs, connectors and hardware shall be of material suitable for attachment of the copper ground system to the material to which it is being attached, without the possibility of attack by corrosive atmosphere or electrolytic action.
  - 3. All connections below grade shall be made with exothermic welds and insulated with epoxy. Concealed or inaccessible grounding connections shall be made with exothermic process.
  - 4. All connections above grade shall be made with bolted connectors. Accessible grounding connections shall be bolted or clamp type unless otherwise indicated.
  - 5. All connectors shall be high copper alloy cast body with silicon bronze hardware, manufacturer and type as selected by the Contractor and approved by Metra's Authorized Representative.
  - 6. Bar to bar and lug to bar, bolted connections shall be made with silicon bronze bolts, nuts and washers. All connections shall be made electrically clean. Silver plate all bar and lug connections.
  - 7. Soldered connections are prohibited in the grounding system.

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- E. Grounding conductors shall be protected from mechanical damage, and shall be supported in an approved manner.
- F. Use bonding jumpers and/or grounding bushing (set screw type) at all junction boxes, etc., to provide conduit ground continuity.
- G. Connect the ground terminal on each receptacle to the ground conductor or grounding bushing.
- H. Grounding cable runs to equipment steel or tray device shall be securely fastened at intervals not to exceed 24 inches. All hardware for fastening shall be provided by Contractor.

**3.03 SUBSTATION INTERIOR PERIMETER GROUND BUS**

- A. Provide 1/4-inch by 2-inch wide ground bus around entire perimeter of substation interior.
- B. Mounting: Support and space out from wall using spacers secured to substation wall.
- C. Mounting Height: 18 inches above finished floor.
- D. Connect interior perimeter ground bus to four substation enclosure exterior grounding pads specified in Section 16011, Prepackaged Substation Enclosure.
- E. Connect pigtail from substation ground grid to each substation ground bus.
- F. Ground ac switchgear, ac surge arresters, panelboards, and other electrical equipment to ground bus, unless grounded to a pigtail directly from the ground grid.

**3.04 AC EQUIPMENT GROUNDING**

- A. The enclosure of all metal-clad or metal-enclosed ac switchgear and transformer housing in traction power substations shall be grounded in accordance with IEEE 80 and IEEE 142.
- B. The enclosures of all other metallic objects that contain ac power wiring, such as bus work enclosures, battery chargers, ac panelboards, and light fixtures shall be grounded via copper bus tap from the perimeter ground bus, except the direct current equipment.
- C. No phase or neutral (wye) point on the secondary (rectifier side) of a rectifier transformer shall be grounded.
- D. The 120/208 volt system neutrals of the transformers shall be a white insulated current-carrying conductor over which unbalanced neutral load currents may flow. The neutral conductor shall originate at the grounded wye secondary of each transformer, which shall be grounded directly to the ground grid.

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**3.05 DC EQUIPMENT**

- A. The dc traction power equipment consisting of rectifier enclosure, dc bus enclosure and dc switchgear shall not be grounded, but shall be insulated from ground in accordance with Section 16641, Dielectric Flooring, and Section 16610, Traction Power Equipment Installation.
- B. The ungrounded equipment shall have minimum 6 feet clearance from the grounded equipment.

**3.06 LIGHTNING ARRESTOR GROUNDING**

- A. The lightning arrestors shall be directly connected to the switchgear internal ground bus.

**3.07 TRANSFORMER GROUNDING**

- A. Control circuit transformer serving 120 volt control circuits shall have one side of the secondary grounded.
- B. Transformers having neutral ground point shall be connected to the main service ground by means of a code-size grounding conductor carried back to the source in the same conduit as the feeder conductors.
- C. Traction power transformer shall be grounded in at least two places and directly connected to the ground grid.

**3.08 CONTINUOUS GROUND BUS**

- A. AC switchgear and panelboards shall have a continuous ground bus within the enclosure, bonding all sections together.
- B. The ground bus shall be connected to the ground grid as indicated in the Contract Drawings.
- C. The ground bus shall be connected to the main service ground by means of a grounding conductor run in the same conduit or raceway as the feeder conductors.

**3.09 GROUNDING SYSTEM FIELD TESTING**

- A. Ground Rod and Ground Grid System Test:
  - 1. Ground system field testing shall be witnessed by Metra's Authorized Representative. Notify Metra three days in advance before the start of testing activities
  - 2. The testing of grounding systems shall be done by an independent testing service employing the three-point fall of potential method with a null balance instrument meter such that lead resistance is rejected via null balance. Subtraction of lead resistance is not allowed (or necessary).

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3. The test meter shall be Associated Research Vibro ground test set with null balance, James A. Biddle Megger Earth Tester Null Balance, or approved equal.
4. A graph of instrument readings versus potential electrode distance shall demonstrate a "flat" portion on the graph. Failure to achieve this will require larger electrode spacing or different test method. Reading obtained on flat or horizontal portion of graph is taken as resistance to earth of ground under test.
5. Ground grid shall be isolated from electrical supply neutral during test.
6. Individual Ground Rods: When tested separately, isolate rods from all metallic connections, such as from the ground rod to other grounded structures and electrical system neutrals.
7. Multiple Ground Rod Grids: Isolate from all metallic connections, such as from grid under test to other grounded structures and electrical system neutrals.
8. A graph of resistance "vs" distance to current electrode shall be made for each grid to ensure proper distance of remote current and potential electrodes.
9. The graph shall be done when there is adequate "open earth" in vicinity of grid under test with a minimum of 10 steps to the graph. Typical current electrode spacing would be approximately 200 to 1000 feet depending on size of grid.
10. Employ the services of an independent and qualified testing service company specializing in electrical and ground system testing.
11. Test Criteria:
  - a. The maximum resistance of a driven grounding rod shall not exceed 5 ohms.
  - b. Total ground grid resistance shall not exceed 2 ohms. If this resistance rating cannot be obtained a sufficient number of additional rods or rod sections shall be installed not closer than 6 feet on centers.

**END OF SECTION**

**SECTION 16472**  
**DC DISCONNECT SWITCHES**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This section includes requirements for furnishing and installing handle-operated dc disconnect switches.

1.02 RELATED WORK

- A. Section 16473, DC Disconnect Switch Enclosures

1.03 REFERENCES

- A. This Section incorporates by reference the latest revisions of the following documents:
- B. ASTM International (ASTM)
  - 1. ASTM B152/B152M, Standard Specification for Copper Sheet, Strip, Plate, and Rolled Bar
- C. Underwriters Laboratories (UL)
  - 1. UL 363, Knife Switches

1.04 QUALITY ASSURANCE

- A. The switch shall be designed, tested and assembled in accordance with the latest applicable standards of IEEE, ANSI, UL and NEMA.

1.05 SUBMITTALS

- A. Submit the following product data on each type of switch to be supplied:
  - 1. A detailed description of the proposed switch and all components.
  - 2. Voltage rating and ampere rating.
  - 3. Certified Independent Laboratory test report stating switch has been tested for specified requirements.
  - 4. Recommended spare parts list.
- B. Shop drawings shall include switch construction details and the following data on each type of switch to be supplied:
  - 1. Principle dimensions.
  - 2. Clearance dimensions.

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- C. Certified Test Reports:
  - 1. Each certified test report shall include all factory production tests as required by this Section. Each certified independent laboratory test report shall state switch has been tested for requirements noted below.
- D. The switch manufacturer shall provide the names and telephone numbers of qualified personnel who may be contacted for technical direction as required in the field.

**PART 2 - PRODUCTS****2.01 DESIGN AND CONSTRUCTION**

- A. Type: Switch shall be quick-break, double-pole, single-throw (DPST) bolted-pressure contact switch for vertical panel mounting as shown on the Contract Drawings.
- B. Rating: 2000 Vdc, 4000 ampere continuous service.
- C. Switch blade:
  - 1. The switch blade assembly material shall be hard drawn rolled copper per ASTM B152/B152M.
  - 2. Switch blade shall travel 180 degrees from the closed to open position.
- D. Enclosure: The switch shall be designed for installation in a fiberglass enclosure.
- E. The ambient operating temperature range is --20°F to 110°F .
- F. The switch shall be handle operated connected to the switch blades with polyglass rod.
- G. Switch parts shall be adequately braced to prevent the weight of the cables from imparting twisting strains on the jaw or hinge ends and consequent misalignment of the switch.
- H. Provide terminal lugs with NEMA four-hole pads for termination of three 5 kV 1500 kcmil copper conductor insulated cables.
- I. Switch assembly shall be manufactured such that no special tools are required for its maintenance.
- J. Reverse Current Device
  - 1. In series with the switch shall be a Reverse Current Sensor which shall detect faults in the cable between new and existing Substation.
  - 2. The Reverse Current Device shall be equipped with a sufficient amount of dry contacts in order to send trip signals to new and existing Lockout Relays. Refer to Contract Drawings for details.

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3. The Reverse Current Device shall be field adjustable from 10% to 100% of the switch nominal Current.
4. The Contractor shall coordinate the setting of the Reverse Current Device with the 32 Device installed inside the Cathode Breaker.
5. For measurement of the main current, Hall Effect Sensors as well as Shunt Resistors are acceptable.
6. The device shall be designed to work with auxiliary voltage of 125VDC.

**2.02 MATERIALS AND WORKMANSHIP**

- A. The switch shall be suitably engineered, designed and constructed for safe, proper and reliable operation without maintenance difficulties.
- B. Materials and workmanship shall be of the best quality throughout. Failure to comply with this requirement shall be just cause for rejecting the proposed material.

**2.03 MANUFACTURER**

- A. Acceptable manufacturers shall be Anderson Power Products, Inc., Filnor Inc., Mac Products, Powerswitch Corp., Southern States, or equal as approved by Metra's Authorized Representative.

**2.04 SOURCE QUALITY CONTROL**

- A. The switch assembly shall be tested to verify that it complies with requirements listed below and in UL 363.
- B. Test Reports proving compliance with the requirements below may be submitted for Metra's Authorized Representative review in lieu of performing a new test.
- C. Temperature:
  1. The switch shall be capable of carrying its rated current continuously without any part showing a temperature rise of more than 30°C above a 40°C ambient temperature when mounted in an enclosure.
  2. The switch shall be mounted as in actual service, with connections made using the smallest size of cable having an ampacity equal to the current rating of the switch.
  3. Temperature readings shall be obtained using thermocouples. A temperature is considered to be constant when three successive readings, taken at 15 minute intervals, indicate no change.
- D. Overload:
  1. The test potential shall be not less than 5000 Vdc.
  2. A switch shall be mounted as in actual service, and shall be tested with direct current with a non-inductive resistance load.

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3. The switch assembly, when in the closed position, shall be capable of withstanding a short circuit current test (bolted fault-type) of 50,000 amps minimum for a 50 millisecond time duration.
  4. Tests conducted using alternating current power source are not acceptable.
- E. Dielectric Voltage Withstand:
1. A switch shall be capable of withstanding for 1 minute without breakdown, the application of 60 Hz essentially sinusoidal potential of 2000 Vdc plus twice the maximum rated voltage:
    - a. Between terminals of opposite polarity with the switch closed; and
    - b. Between line and load terminals with the switch open.
  2. The test shall be made using a 500 VA or large capacity transformer, where output voltage is essentially sinusoidal and can be varied.
    - a. The applied potential shall be increased gradually from zero until the required test value is reached, and shall be held at that voltage for 1 minute.
    - b. The increase in the applied potential shall be a uniform rate and as rapid as is consistent with the value being correctly indicated by the voltmeter.
- F. Mechanical Test:
1. The switch shall remain capable of performing its intended function when operated manually for 1000 cycles.
  2. A switch shall be electrically and mechanically operable at the conclusion of the test and not exhibit any wear, grooving, loosening of parts, misalignment or other effects that could reduce the ability of the switch to perform as intended.

**PART 3 - EXECUTION****3.01 INSTALLATION**

- A. Disconnect switch shall be mounted in the switch enclosure described in Section 16473 and as shown on the Contract Drawings.

**END OF SECTION**

**SECTION 16473**  
**DC DISCONNECT SWITCH ENCLOSURE**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section includes furnishing and installing disconnect switch enclosures.

1.02 RELATED WORK

- A. Section 16472, DC Disconnect Switches

1.03 REFERENCES

- A. This Section incorporates by reference the latest revisions of the following documents:
- B. National Electrical Manufacturers Association (NEMA)
1. NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum)

1.04 SUBMITTALS

- A. Submit detailed shop drawings of the enclosure.

**PART 2 - PRODUCTS**

2.01 ENCLOSURE

- A. Enclosure shall be rigid, weatherproof and constructed from fiberglass-reinforced polyester resins. Design shall conform in general to NEMA 250 Type 12 construction.
- B. Main portion of enclosure shall be of one-piece construction with smooth round corners.
- C. The Enclosure shall be prepared with all required openings in the factory. Provisions shall be provided to properly seal all openings in the field once cables are connected and busduct is installed. It is the Contractor's responsibility to coordinate the location and size of all openings required.
1. The Enclosure shall have openings on the floor to allow entry of 3x1500kcmil cables from the new Cathode Breaker. Refer to contract drawings for details.
  2. The Enclosure shall be designed with an opening in the top and a busduct interface into the existing buildings.
  3. There shall be no gasket joints except for neoprene memory-type door gaskets which shall ensure a tight seal.

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- D. Enclosure back panel shall be 1/2-inch thick fiberglass with a 3-inch lip around the perimeter of the enclosure and be part of the back panel.
- E. The enclosure shall have fiberglass drip shield installed to protect door hardware from dripping water, ice/snow buildup, and settling dust. Drip shield shall be attached to main enclosure using stainless steel rivets and stainless steel back-up washers.
- F. Enclosure design shall be of single door overlapping style.
  - 1. Door shall be fastened to main enclosure with continuous stainless steel hinges, 12 gauge minimum, the full length of the door.
  - 2. Hinges shall be attached using rivets with back-up washers.
  - 3. Enclosure design shall include complete hinge concealment when door is closed. Door(s) shall be capable of opening through a 180 degree minimum swing.
  - 4. Enclosure door shall include a three-point door latching assembly to ensure positive closure of door to enclosure at three points (top, middle and bottom) as shown on the Drawings. All latch assembly parts shall be insulated with a high-dielectric epoxy coating material (15 mil minimum thickness).
  - 5. Enclosure door shall have a stainless steel door locking hasp assembly, attached to door enclosure using stainless steel rivets and stainless steel back-up washers. Fiberglass reinforcing pads shall be provided where locking hasp assembly is attached.
- G. Finish:
  - 1. Enclosure exterior finish shall be Pleogen 2907 Iso-Gel, American Colors 66-20060, or approved equal coating (a polyester base material) of 18 to 20 mil thickness. Color shall be OSHA safety yellow.
  - 2. All exterior surfaces shall be treated with a graffiti preventive coating with "Polyshield" regular.
  - 3. Enclosure interior shall be finished in white fire-retardant gel coat.
- H. Signage:
  - 1. A yellow laminated plastic tag with 3-inch high white lettering labeled "DANGER 1500 VOLTS DC" shall be installed on the front door of the switch enclosure. The warning sign shall be attached to the enclosure with slotted pan head brass machine screws, nuts and washers
  - 2. A red laminated plastic tag with 2-inch high white lettering labeled "DO NOT OPERATE THE SWITCH UNLESS THE MAIN DC BREAKER IS OPEN" shall be installed on the front door of the switch enclosure. The sign shall be attached to the enclosure with slotted pan head brass machine screws, nuts and washers.

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3. Tags shall be UV protected.
- I. Switch mounting:
  1. Switches that mount in these enclosures are specified in Section 16472, DC Disconnect Switches.
  2. It shall be the Contractor's responsibility to furnish enclosures coordinated with the knife switch mounting details and switch spacing to match cable or bus entrances provided under this Contract.
  3. Enclosures shall have rugged mounting assemblies and strong supports to hold the switches with their attached cables.
  4. Where switches are ganged for connection to common bus, the Contractor shall provide copper bus bar.
  5. Enclosure shall be of sufficient height to allow closing of the front doors when switch is in open or closed position.

**2.02 WORKMANSHIP**

- A. Each fiberglass enclosure shall be suitably engineered, designed and fabricated to ensure safe, proper and reliable operation, without maintenance difficulties

**PART 3 - EXECUTION****3.01 INSTALLATION**

- A. Provide all material and hardware required for enclosure support frames.

**END OF SECTION**

**SECTION 16474**  
**FIBERGLASS NEGATIVE BUS ENCLOSURE**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section includes requirements for negative bus enclosures, including required steel and wood mounting members, bolts and nuts, specified fittings, appurtenances and all other related work associated with the installation of negative bus enclosure.

1.02 REFERENCES

- A. This Section incorporates by reference the latest revisions of the following documents:
- B. National Electrical Manufacturers Association (NEMA)
  - 1. NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum)

1.03 SUBMITTALS

- A. Submit detailed shop construction drawings of the negative bus enclosure complete with mounting assemblies.

**PART 2 - PRODUCTS**

2.01 ENCLOSURE

- A. The general arrangement and construction of the enclosure shall be as shown on the Contact Drawings.
- B. Enclosure shall be weatherproof, heavy-service construction, for railroad right-of-way installation.
  - 1. Enclosure shall be molded of polyester-resin fiberglass, not less than 1/4-inch thick, with fire retardant and good dielectric characteristics, NEMA 250 Type 3.
  - 2. Enclosure back shall be 1/2-inch thick fiberglass with 3-inch lip around the perimeter of the enclosure and be part of the back panel.
  - 3. Enclosure shall be rigid, with no racking or bonding; use stiffeners if required.
  - 4. Color: OSHA safety yellow.

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- C. Enclosure shall have two front access doors.
  - 1. Each door shall have full length stainless steel continuous hinge attached with stainless steel hardware, and doors shall be provided with stainless steel hasps and padlock.
  - 2. Door (s) shall be capable of opening through a 180 degree minimum swing and shall be capable of latching and locking open at 135 and 180 degrees swing.
  - 3. Overlapping door design shall be of tamperproof construction.
- D. Bottom of enclosure shall be solid for drilling for conduit entrances.
- E. Stainless steel louvered, screened, ventilating openings of adequate size which will not allow bugs to enter shall be provided on each side panel of each enclosure.
- F. The enclosure shall have rugged mounting assemblies and strong supports to hold the bus bars with their connected cables and shall be capable of withstanding 48,000 ampere short circuit current.

**2.02 BUSES**

- A. Provide negative and drain buses and supports in the enclosure as detailed on the Contact Drawings.
- B. Bus shall be high conductivity electrolytic tough-pitch copper bar for electrical bus bar construction, cold rolled, (hard temper), not less than 97.4% IASC conductivity.
- C. Bolted bus bar connections shall be drilled to NEMA standard spacing; joints shall be made with silicon bronze bolts, nuts, and flat washers.
- D. All contact surfaces of bus joints (bar to bar, lug to switch pad, bar to cable lug) shall be silver plated. Surfaces shall also be silver plated where bus is indicated on Contract Drawings or is being drilled to accept future cable lugs to the bus bar.
- E. Installed bus within the negative enclosure shall be adequately braced to withstand a short circuit test (bolted fault-type) of 20,000 amps minimum at 1500Vdc. Tests conducted using alternating current power source are not acceptable.
- F. Provide bronze terminal lugs for terminating negative and drain cables and bolting to the bus bars.
  - 1. For 1500 kcmil cable, terminal lugs shall have four silicon bronze bolts, nuts, and lock washers for clamping cable.
  - 2. For 500 kcmil cable, terminal lugs shall have two silicon bronze bolts, nuts, and lock washers for clamping cable

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3. Terminal lugs shall have NEMA standard tongue drilling and shall be bolted to the negative bus bars with silicon bronze bolts, nuts and flat washers.
4. Cable connections shall be such that any one cable can be disconnected without disturbing connections to adjacent cables.

**2.03 NAMEPLATE**

- A. Provide a weather proof nameplate on the exterior front reading "NEGATIVE BUS" with 3-7/8-inch high and 1-7/16-inch wide letters. The nameplate shall be attached to the enclosure with slotted pan-head brass machine screws, nuts, and washers.
- B. Mounting holes shall be fitted with a resilient grommet under a non-corrosive eyelet to prevent cracking of the enamel during the mounting application.
- C. The base metal for the nameplate shall be enameling grade 16 gauge steel with no sharp edges and all corners broken.
- D. The finished nameplate shall be flat when resting on the non-finished surface.
- E. Nameplates shall have full color coverage and shall be guaranteed for ten years, with outside usage, against fading, ultra violet effects and defects such as blisters, cracks, chipping, and pin holes.

**PART 3 - EXECUTION****3.01 INSTALLATION**

- A. Provide negative bus enclosure as shown on the Contract Drawings.
- B. Provide mounting racks and hardware for the bus enclosure.
  1. The enclosure mounted on top of the manhole shall be secured to mounting racks consisting of 4-inch hot-dip galvanized angle-iron frames, anchor bolted to the concrete.
  2. Provide wood timbers for spanning the angle iron frames, and for mounting the boxes as indicated on Contract Drawings,
    - a. Timbers shall be of dense structural grade 65 yellow pine, 4 x 4-inch, pressure treated with No. 1 creosote with a net retention not less than eight pounds per cubic foot (by gauge).
    - b. They shall be insured, warranted, or independently inspected for compliance.
    - c. Mounting hardware for this work shall be hot-dip galvanized.
  3. Anchoring to concrete shall be with stainless steel, heavy-duty, one-piece, wedge-type concrete anchor bolts with nut and washer. Length of anchor bolts sufficient to exceed the minimum embedment in concrete recommended by the anchor bolt manufacturer.

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- C. Bus Connections:
  - 1. Before connection is made to the bus, contact surfaces must be cleaned and free of oxide.
  - 2. After the bolted connections are made, coat bus bar, bus joints and cable lugs with oxide inhibitor: 3M Co., Burndy "Penetrox E", Anderson Electric joint compound Cat. #155-1Q, or equal as approved by Metra's Authorized Representative.
- D. Seal the opening between the conduit and the negative bus enclosure with duct seal.
- E. After cables are installed, close and seal all conduit openings with sealing bushings. Where cables are not installed, provide a blank sealing bushing to seal the conduit openings.

**END OF SECTION**

**SECTION 16510**  
**LIGHTING**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section includes the following:
1. The requirements for providing a complete lighting system for the prepackaged substation enclosures specified in Section 16011, Prepackaged Substation Enclosures. The lighting systems shall be furnished and installed complete by the manufacturer of the prepackaged substation enclosures, as specified in this Section. It includes the following:
    - a. Interior lighting
    - b. Exterior lighting
    - c. Cubicle lighting
  2. Requirements for indication lights provided in switchgear and other equipment.

1.02 RELATED WORK

- A. Section 16011, Prepackaged Substation Enclosures
- B. Section 16142, Wiring Devices

1.03 REFERENCES

- A. This Section incorporates by reference the latest revisions of the following documents:
- B. City of Chicago
1. Chicago Electrical Code
- C. National Fire Protection Association (NFPA)
1. NFPA 70, National Electrical Code
- D. Underwriters Laboratories (UL)
1. UL 8750, Standard for Light Emitting Diode (LED) Equipment for Use in Lighting Products

1.04 SUBMITTALS

- A. Submit the following on the traction power substation lighting systems:
1. Panelboard outline drawings, connection diagram and bills of material.

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2. Lighting fixture catalog cuts, outline drawings and parts lists.
3. Bills of material for miscellaneous lighting and wiring devices.
4. Lighting calculations demonstrating that the proposed lighting layout produces the specified lighting levels.

**PART 2 - PRODUCTS****2.01 GENERAL**

- A. All materials shall be new and the best of its respective kind. The use of other than prime grades will not be accepted.
- B. All lighting shall be LED.
- C. All LED light fixtures shall use Energy Star rated lamps if they are available.

**2.02 PERFORMANCE CRITERIA**

- A. Each substation shall have interior and exterior lighting to provide the specified minimum light levels.
- B. Minimum Lighting Levels:
  1. Interior:
    - a. 50 foot candles at 30 inches horizontal above the aisle floor in front of equipment.
    - b. 30 foot candles at floor level.
  2. Exterior: 10 foot candles, measured at ground level.
  3. Emergency Lighting: Minimum 1 foot candle at 30 inches above the aisle floor.
  4. Minimum lighting levels shall be maintained throughout the TPSS. Average lighting level shall not be used to meet this requirement.

**2.03 INTERIOR LIGHTING**

- A. LED lighting fixtures shall be used for general area lighting within the prepackaged enclosures.
  1. The lighting fixtures shall illuminate satisfactorily all vertical surfaces of the power rectifier, switchgear and miscellaneous equipment mounted on walls.
    - a. Type: Ceiling mounted, linear LED luminaire.
    - b. Length: 4 feet.
    - c. Material/Finish: Extruded aluminum with clear anodized finish or steel with powder coat finish.

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- d. Lens: Wraparound style, polycarbonate or high-impact acrylic diffuser, UV resistant, with even light distribution, secured to the housing with fasteners.
  - e. Standards: Complying with UL 8750.
  - f. Correlated Color Temperature (CCT): 5000 K.
  - g. LED Driver: Field replaceable.
  - h. MTBF: Minimum 50,000 Hours.
  - i. Acceptable Manufacturer/Product: Startek Lighting, SP-W-4-50K or equal as approved by Metra's Authorized Representative.
- 2. The lighting fixtures shall be located to avoid interferences with overhead equipment such as bus ducts and shall not be mounted directly above power rectifiers, switchgear, or transformers.
  - 3. The lighting fixtures shall be controlled from wall switches mounted adjacent to each access door.
- B. Control: Provide three-way/four-way switches located at each main entrance, and personnel doors

**2.04 EMERGENCY LIGHTING**

- A. General:
- 1. Self-contained units containing lamps, battery, battery charger, controls, test switch, and status indicator.
  - 2. UL 924 listed.
- B. Exit signage shall be compliant with Chicago Municipal Building Code Section 13-160-700 through 13-160-770.
- C. Lighting Heads: High-output 4.5 W LED MR16 lighting heads; minimum two lamps per unit.
- D. Battery:
- 1. Nickel-cadmium, 12 V, rechargeable, sealed, maintenance-free.
  - 2. Capacity: Shall supply rated lamp load for 90 minutes, minimum.
  - 3. Life expectancy: 10 years.
- E. Battery charger:
- 1. Solid-state, current-limited, temperature-compensated, short-circuit proof, and reverse-polarity protected with plus-or-minus 1 percent regulation.
  - 2. Charger shall automatically maintain battery in fully-charged float condition and be capable of providing full recharge in 12 hours.
- F. Unit controls: Shall energize lamps automatically upon failure of ac power supply and disconnect load before battery low-voltage limit is reached.

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- G. Acceptable Manufacturer/ Product: Kenall METEL-series LED, or approved equal.

**2.05 EXTERIOR LIGHTING**

- A. Exterior lighting shall be provided for security and general illumination as follows:

1. General:
  - a. Wall-mounted, vandal-resistant, LED luminaire, full cut-off type.
  - b. UL listed for 40 degrees C maximum ambient and wet locations with IP66 ingress rating.
2. Housing:
  - a. Die-cast aluminum, with a hinged door secured by captive stainless steel, tamper-resistant screw.
  - b. Housing shall incorporate cooling fins specifically design for cooling LED light source and driver.
  - c. Provide with vandal-proof housing.
3. Finish: Epoxy or polyester powder-coat paint, black, or as directed by Metra's Authorized Representative.
4. Optical:
  - a. Sealed LED compartment with anodized, mirror-finish, forward-throw reflector, high-output bright-white (5000K CCT) LED, impact resistant tempered glass or polycarbonate lens and silicone sealing gaskets.
  - b. Luminaire shall deliver at least 6000 lumens, be rated full-cutoff, and be suitable for wall-mounting 8 feet or greater above surrounding surface.
5. Electrical:
  - a. Integrated electronic LED driver with integral surge protection shall be mounted to housing for effective cooling.
  - b. Provide luminaires with integral photocontrol or a single NEMA-style, aimable photocontrol wired in luminaire circuit.
6. Acceptable Manufacturer/ Product: Startek Lighting America, type SPK-60-50K-PB-PHC-U, or approved equal.

- B. Lighting shall be controlled by a common photo-electric cell.

**2.06 CUBICLE LIGHTING**

- A. Provide lighting inside exterior access cubicles as follows:

1. General: Ceiling and side mounted, LED strip luminaire with clear, prismatic diffuser complying with UL 8750.
2. Minimum illuminance: 30 foot candles at 1.5 feet.

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3. Correlated Color Temperature: 5000-6000 K.
4. Size: 30 centimeters or 12 inches long with 12 LEDs.
5. MTBF: 50,000 Hours
6. Power source: 125 Vdc system.
7. Acceptable Manufacturer/ Product: LBFA LuxBar LED light bar, or approved equal.

**2.07 INDICATION LIGHTS**

- A. Indication lights for status indication shall be LED type.
- B. LEDs shall be plug-in replaceable with a life of 100,000 hours.

**2.08 LAMPS**

- A. Lamps of proper ratings and type shall be installed as shown on the Contract Drawings.
- B. All lamps shall be rated for 120 volt service.
- C. Lamps shall be as manufactured by Startek Lighting America, General Electric, Westinghouse, GTE or Sylvania.

**2.09 LIGHTING ACCESSORIES**

- A. Switches: See Section 16142, Wiring Devices.
- B. Photoelectric control 120 Vac with mounting base with bracket type S476-71 and photocell type NS47671 made by Fisher Pierce, or approved equal.

**PART 3 - EXECUTION****3.01 GENERAL**

- A. Conduit, fittings, boxes, brackets, clamps, supporting hardware and wiring shall be installed as required. Conduit shall be minimum 3/4-inch trade size for all conduit runs. Where flexible raceway is required, it shall be liquid-tight flexible metal conduit.
- B. The Contractor shall replace all LEDs burned out during the construction period at its own expense.

**3.02 INSTALLATION OF LIGHTING SYSTEMS**

- A. General:
  1. Installation of all lighting fixtures and appurtenances shall be in accordance with NFPA 70, Chicago Electrical Code, manufacturer's written instructions, and as specified below:

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2. Lighting fixtures shall be securely mounted to the surfaces by the Contractor.
  3. For exterior lighting, the mounting hardware shall be stainless steel.
  4. Suitable support shall be provided for each fixture.
  5. The minimum clearance between the surface mounted fixtures and concrete shall be 1/4 inch.
  6. Provide identification of luminaires in accordance with UL.
  7. All lighting fixtures including lens, diffuses and lamps shall be clean, free of dirt, oil, and grease markings, and free of dents and scratches. The Contractor shall check the lamps in all fixtures are operating prior to final acceptance.
- B. Aluminum Protection:
1. Aluminum surfaces to be placed in contact with plaster, concrete, or masonry construction shall be given a coat of alkali resistant bituminous paint before installation.
  2. Aluminum surfaces to be placed in contact with steel, except stainless steel, shall be given a coat of zinc chromate primer. Zinc chromate primer shall be allowed to dry before assembly of the parts. The steel painted with one coat of zinc chromate primer, followed by two coats of metalatex semi-gloss enamel as manufactured by Sherwin Williams or approved equal.
  3. Where aluminum is placed in contact with other dissimilar metal, contact surface shall be separated with a gasket, non-absorptive tape or coating to prevent corrosion.
- C. Lighting inside cubicles:
1. Locate on ceiling and sides to light the interior of each equipment enclosure.
  2. Provide sufficient LED strip luminaires to achieve specified light levels.
  3. Provide lights behind front and rear access doors. Lighting levels within cubicles shall be approved by Metra's Authorized Representative.
  - 4.

**3.03 FIELD TESTS**

- A. After installation, adjustment, and inspection, functional tests shall be performed for all interior and exterior lighting fixtures in the presence of Metra. The tests shall demonstrate that the fixtures have been installed properly and will function as required by the Specifications.

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**END OF SECTION**

## SECTION 16601

### GENERAL REQUIREMENTS FOR TRACTION POWER EQUIPMENT

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. This Section includes the conditions and technical requirements for installation of traction power equipment in prepackaged substation enclosure at the job site.
- B. Installation of traction power equipment shall include designing, manufacturing, testing, delivering, installing and commissioning the following:
  - 1. 15 kV ac switchgear assemblies.
  - 2. Self-cooled, dry type, indoor rectifier transformers.
  - 3. Natural convection air cooled rectifiers.
  - 4. 1500 Vdc switchgear assemblies.
  - 5. Anode bus duct.
  - 6. Negative equalizer bus and drainage board.
  - 7. Station batteries, battery chargers, distribution panel board for 125 Vdc control power and accessories.
  - 8. SCADA, Remote Terminal Unit, Fiber and Ethernet switches Cabinet.
  - 9. Telephone Terminal Box.
- C. Studies and reports for ac switchgear associated with traction substations
  - 1. Short Circuit Study
  - 2. Ac Coordination Study
  - 3. Arc Flash Hazard Analysis

##### 1.02 RELATED WORK

- A. Section 16011, Prepackaged Substation Enclosure
- B. Section 16613, Service Engineer

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**1.03 REFERENCES**

- A. This Section incorporates by reference the latest revisions of the following documents:
- B. City of Chicago
  - 1. Chicago Electrical Code
- C. American National Standards Institute (ANSI):
  - 1. ANSI Z535.4 - Product Safety Signs and Labels.
- D. Institute of Electrical and Electronics Engineers (IEEE)
  - 1. IEEE C37.2, Standard Electrical Power System Device Function Numbers, Acronyms, and Contact Designations
  - 2. IEEE C37.90, Standard for Relays and Relay Systems Associated with Electric Power Apparatus
  - 3. IEEE 1584 - Guide for Performing Arc Flash Hazard Calculations.
- E. National Fire Protection Association (NFPA)
  - 1. NFPA 70E, Standard for Electrical Safety in the Workplace

**1.04 DESIGN CONFERENCE**

- A. Within 45 days after notice to proceed of the Contract, there shall be a design conference at Metra's facility, which shall be attended by Metra, Contractors personnel, Metra's Authorized Representative and their authorized agents.
- B. Within 30 days after NTP the Contractor shall provide the following:
  - 1. Certified-outlined dimensions and weights of all major items of equipment, including the following:
    - a. AC High Voltage Switchgear
    - b. Rectifier Transformer
    - c. Anode Bus, indoor and outdoor/indoor
    - d. Rectifier
    - e. DC Switchgear Cubicles
    - f. AC Test Cabinet
    - g. Vacuum Bottle Test Cabinet
    - h. 130 Vdc Battery
    - i. Battery Charger
    - j. Battery Racks dc Distribution Cabinet
    - k. Auxiliary transformer
    - l. Remote terminal unit
    - m. Telephone terminal box
    - n. Shipping split information for prefabricated building including dimensions and weights for each split as well as instructions for assembly.

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2. A list of any and all items proposed to substitute for items listed in the Specification. Each proposed item of substitution must be supported by the following information:
  - a. Device name, catalog number, and device number as shown on the Contract Drawings.
  - b. Technical and descriptive literature of device.
  - c. Schematic diagram of device down to component level.
  - d. Reason for substitution.
3. Computer software to be used for system simulation.
4. For short-circuit and overcurrent protective device coordination study, provide
  - a. certification of compliance with IEEE 399.
5. For arc-flash hazard analysis, provide certification of compliance with IEEE 1584.
6. Submit names, contact information and qualifications including references for at least five short-circuit, coordination study and arc-flash calculations of comparable complexity within the last five years.
7. Outline of all tests to be performed in the factory or in factory of his supplier.
8. Name of testing laboratory which will perform the tests that cannot be conducted in the Contractor's or the Contractor's Supplier's factories.
9. Request for extension of any test report which cannot be submitted within 30 days after the day the test is performed.
10. A list of all issues or conditions which require clarification.
11. A list of test that Contractor proposes to substitute previous design tests for the same type of equipment which shall be subject to Metra's Authorized Representative's review and potential approval.
12. The Contractor shall submit six copies for Metra's Authorized Representative's approval, the detail minutes of the design conference including all the documents that were submitted by the Contractor during the design conference.

**1.05 SUBMITTALS**

- A. Submit evidence that manufacturer(s) meets the experience requirements of the Quality Assurance article, below:
  1. Evidence submitted shall include a list of users name, telephone number and length of time in service.

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**B. List of Materials:**

1. The Contractor shall submit a list of all materials and equipment/systems to Metra's Authorized Representative 30 days after NTP, giving names of the manufacturers of the products/materials intended to be furnished under this Contract.

**C. Shop Drawings:**

1. Submit six copies of each of the following drawings to Metra for review after notice to proceed of the Contract. Metra's review will be general and will in no way relieve the Contractor from fulfilling all of its obligations and guarantees. All equipment outlines, plans, and section drawings shall be drawn to scale.
2. Within 120 days after notice to proceed of the Contract:
  - a. Certified outline drawings indicating overall dimensions, aisle space requirements, location of control and protective devices on panels, and reference tables to furnished.
  - b. Certified floor plans showing dimensions necessary for installing equipment, equipment base details, and entrance available for main and control cables.
  - c. Certified section views of each non identical unit showing bus and equipment locations and location of outgoing power and control terminals. Drawings must be in sufficient detail to illustrate accessibility for maintenance and for adjustments while energized.
  - d. Single line diagram showing all main connections and protective devices, and the location of all current, potential, and auxiliary devices, with the devices energized by them.
  - e. Schematic diagram of transformer, rectifier, ac and dc circuit breaker controls and alarms these shall include ac schematic and dc elementary diagrams of all circuits.
  - f. Internal connection diagram of devices (as may be shown separately).
  - g. External wiring diagrams for all the equipment furnished for all the Traction power substation work
  - h. Bill of Material for all Equipment provided minimum Information must be
    - 1) Quantity
    - 2) Cross Reference to shop Drawings
    - 3) Manufacturer
    - 4) Part Number
    - 5) Serial number
3. In order to give a concise review, Metra may require additional information than what the Contractor may have included in its design submittal. Therefore, a supplement to this submittal may be required. However, the Contractor will continue forward with whatever review responses Metra provided. The submittal shall be delivered to Metra within 10 calendar days of receipt by the Contractor.

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4. Time vs. current curves for all ac and dc breakers.
  5. The Contractor shall submit a fully integrated Book of Plans for each of the substation locations. It shall incorporate all component drawings and show all interconnection wires with suitable references.
- D. Within 30 days after return of schematic diagrams marked "Approved or No Exception", "Comment as Noted- Proceed with Caution", and "Revised and Resubmit" the Contractor shall resubmit the revised drawings, including:
1. Connection diagrams of each non identical unit showing the following:
    - a. Internal wiring
    - b. Terminal arrangement and marking for each outgoing power and control terminal.
  2. Interconnection wiring diagrams showing the external connections between each piece of equipment furnished for the traction power substation work. Interconnection wiring diagrams shall show the terminal blocks of each individual unit and interconnection of each piece of equipment. The interconnection diagrams shall also show the wire cable and terminal numbers where each wire has been terminated.
  3. Equipment nameplate data.
  4. Instrument transformer ratio, phase angle and excitation characteristic curves.
  5. Provide the following reports for each substation:
    - a. Input data including completed computer program input data sheets.
    - b. Short-Circuit Study and Equipment Evaluation Reports.
    - c. Ac Coordination Study Report
    - d. Arc Flash Hazard Analysis Report.

## 1.06 QUALITY ASSURANCE

- A. Manufacturer's Experience:
1. Manufacturer must have a minimum of five years of current experience in the successful manufacture of silicon rectifier conversion equipment for rapid transit substation systems and equal experience as prime equipment Contractor for rapid transit conversion substation systems, and demonstrate, to the satisfaction of the Metra's Authorized Representative, that it has equivalent experience or knowledge.
  2. The manufacturers of the subcontracted major equipment must have a minimum of five years of current experience in successful manufacture of the generic type of equipment proposed.
  3. The major equipment must have been used successfully by the Contractor for rapid transit conversion substation systems for at least five

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years, or have evidence that this equipment is presently being used successfully in Metra substations.

4. Manufacturers may be rejected if, in the opinion of Metra, insufficient evidence is submitted to establish the experience requirements of this Section.

**PART 2 - PRODUCTS**

## 2.01 GENERAL

- A. All material and equipment furnished shall be new, of the highest quality material, design, and workmanship.
- B. All components shall be sized and selected for safe, reliable operation.

## 2.02 UTILITY SUPPLY

- A. The ac supply for the rectification equipment will be taken directly from ComEd Company's 12,600 volt, 60 Hz, three-phase ac system.
- B. The ComEd metering cubicles and ComEd incoming line breaker cubicles supplied under this Contract in 15 kV switchgear line-up are part of ComEd Company's 12,600 Vac distribution system.
- C. These 15 kV ac cubicles shall be subject to approval by ComEd Company for this service.

## 2.03 COORDINATION WITH THE PREPACKAGED SUBSTATION ENCLOSURE

- A. The substation building design requires that 15 kV switchgear line-up, rectifier transformers, rectifiers and 1500 Vdc switchgear line-up be designed in such a manner as to permit easy installation for the equipment arrangement indicated on the Contract Drawings. It also sets forth certain limiting area dimensions which shall be maintained for Metra usage exclusively and minimum clearance as required for Authority's safe operation.

## 2.04 DEVICE NUMBERS AND ABBREVIATIONS

- A. The following device numbers are used in the description below:

<b>Device Numbers and Abbreviations</b>	
<b>Device No.</b>	<b>Function</b>
1	Local control switch (START STOP PULL TO LOCKOUT)
3	Checking of interlocking relay
4	Master control relay
4X	Auxiliary master control relay
8	DC control power breaker or switch
26D1	Positive rectifier bank over temperature device -First step
26D1A	Negative rectifier bank over temperature device -First step
26D	Positive rectifier bank over temperature Device- Second step
26DA	Negative rectifier bank over temperature Device-Second step

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26H	Rectifier over temperature detector positive or negative heat bank
26X	Auxiliary to 26D and 26DA
27	Under voltage Relay 27
27B	Battery failure relay
27BC	Battery charger failure relay
30	Rectifier annunciator
32	Reverse current trip device
32P	Polarizing coil for dc reverse current trip
33	Substation door alarm
33B	Breaker truck position switch
33R	Rectifier compartment door position switch
33T	Rectifier transformer equipment door position switch
37	Undercurrent or Underpower Relay
37B	Battery low voltage alarm
43	Rectifier permissive control switch (LOCAL/REMOTE)
49T	Trans. winding over temp. device, first step
49TH	Trans. winding over temp. device, second step
52	Rectifier ac breaker
52/CS/C	Rectifier ac breaker control switch – CLOSE
52/CS/T	Rectifier ac breaker control switch – TRIP
52M	Rectifier ac breaker – Spring charge motor
52/TC	Rectifier ac breaker shunt trip coil
52/TI	AC breaker position switch - Truck interlocking
62LBB	Breaker back-up timing relay
64C	Rectifier ground relay, hot structure
64X	Rectifier ground relay, grounded structure
72	Rectifier dc breaker
74	Trouble alarm relay
80	125 Vdc under voltage relay
83	AC transfer switch Lockout relay
86	Hand reset lockout relay
86 B1	Bus 1 differential lockout relay
86 B2	Bus 2 differential lockout relay
86X	Conditional Lockout relay
87 B1	Bus 1 differential relay
87 B2	Bus 2 differential relay
95X, 95Y	Blown diode fuse indicator
99Y	Surge protection indicating relay
108	DC control power switch
108X	DC control power switch, load measuring
124	Bus tie ac breaker
127	Under voltage transfer relay
129	Contact for load measuring resistor
130	Station alarm annunciator
150	Impulse tripping relay
152	Incoming line ac breaker
164	DC switchgear ground relay, hot structure
164M	DC switchgear ground relay, grounded structure
172	DC feeder breaker
172Y	DC feeder breaker auxiliary relay
172Z	DC feeder breaker auxiliary relay
174	Station trouble alarm relay
176	Direct acting series trip device

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176LBB	Breaker back-up current sensing relay
176X	Auxiliary relay to device 176
182	Solid state dc reclosing relay
182X	Load measuring device auxiliary relay
183	Voltage measuring relay
186	DC feeder breaker cumulative lockout timing device
201	Supervisory close relay
201D	Feeder breaker Emergency
201X	Feeder master relay indication relay
237	SCADA loss of dc
243	Supervisory control switch
283	SCADA loss of ac
286	Supervisory lockout relay
294	Supervisory trip relay
351	Microprocessor relay for directional overcurrent protection. Positive-sequence voltage-polarized phase directional element with memory for directional stability during phase faults. Ground, multiple phase, negative-sequence, neutral, and residual instantaneous line protection definite-time overcurrent elements with independent pickup time dial. (ComEd Lie Protection)
551	Microprocessor relay for comprehensive overcurrent protection. Phase negative-sequence, residual ground, and neutral overcurrent protection in a compact package. Complete set of instantaneous, definite-time, and time-overcurrent elements. (Transformer and bus protection)
EC	Emergency close relay
SD	Smoke detector

## 2.05 SERVICE CONDITIONS

- A. The specified ac switchgear line-up, rectifier transformers, rectifiers and dc switchgear line-up will serve as supply for Metra's Electric Line system in parallel with the existing traction power equipment installed at other locations.
- B. Individual rectifier loads can be expected to vary from a 15 second peak near 450 percent full load current rating during peak periods to a 30 minute near zero current during off-peak periods. High voltage spikes of either polarity from train operations may be transmitted to these substations through the interconnected-systems.
- C. Ultimately the X/R ratio is expected to be 15 and the interrupting capacity 500 MVA. Supply voltage at the ac switchgear bus in the substation can be expected to vary between a minimum of 10,800 Vac and a maximum of 13,500 Vac.
- D. While it is not expected that this installation will present any harmonic or telephone interference problems, should such problems arise in the rectification equipment, Contractor shall give immediate and full engineering assistance to Metra in determining proper corrective measures including preparation of specifications for additional equipment required, if any.

## 2.06 NOISE CRITERIA

- A. The noise level at any and all points, three feet from any and all of the equipment in the enclosure covered by this Specification with any and all equipment energized for normal service, shall not exceed the following values:

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<b>Octave Band</b>	
Octave Band Center Frequency	Maximum Sound pressure Levels (dB) Business/Commercial
31.5 Hz	79 dB(A)
63 Hz	78 dB(A)
125 Hz	73 dB(A)
250 Hz	67 dB(A)
500 Hz	61 dB(A)
1000Hz	55 dB(A)
2400-4800 2000 Hz	50 dB(A)
4000 Hz	46 dB (A)
8000 Hz	43 dB (A)

## 2.07 PROPOSED CONTROL AND SUPERVISION

- A. The specified rectification equipment will normally be in continuous service. However, it shall be provided with control and supervision features that will safeguard the equipment and permit both local and supervisory control.
- B. The control schematics included in the Contract Documents must be strictly adhered to. Deviations, if any, are prohibited unless approved by Metra's Authorized Representative.
- C. Not all devices referred to are to be provided in the Contract Documents nor are all devices to be furnished listed herein.
1. These devices have been included in the description below so that the Contractor may have a better understanding of the integration of the equipment supplied with the overall control and supervision scheme.
  2. The actual equipment to be supplied under the Specifications is listed as such.
- D. Starting of rectifier shall be accomplished by energizing the auxiliary master control relay (4X). This shall be accomplished locally by operation of local control switch (1) or remotely by supervisory control through operation of supervisory control relay (201).
- E. The following shall prevent energization of auxiliary master control relay (4X):
1. Loss of control voltage
  2. Energization of hand reset lockout relay (86) or de energization of conditional lockout relay (86X)
  3. Remote lockout through operation of supervisory lockout relay (286)
  4. Local operation of local control switch (1) to the Pull to Lockout position
- F. Operation of transformer winding over-temperature device (43) to the local position shall prevent energization of auxiliary master control relay (4X) except through operation of local control switch (1).

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- G. Shut down of rectifier shall be accomplished by de-energizing master control relay (4X).
1. The rectifier shall be shut down by the operation of any of these devices regardless of the position of rectifier permissive control switch (43):
    - a. Local control switch (1),
    - b. Automatically by the operation of master control relay (4), or
    - c. Loss of control voltage and
    - d. Remotely by supervisory control through operation of supervisory lockout relay (286) or supervisory trip relay (294).
- H. Energization of 4X shall cause 48 and 62T to time and closure of 52. Closure of 72 shall follow closure of 52 and operation of 62T. If the ac breaker-52 does not close within 5 seconds, 62T will time out and block the closure of dc rectifier breaker 72. Failure of 72 to close and remain closed within a normal length of time shall cause 48 to operate which shall result in lockout. Operation of 43 to LOCAL position will prevent operation of 48 as described above.
- I. De energization of 4X shall cause opening of 52, 72, and shut down of that rectifier unit.
- J. The following safety devices shall operate 86 and cause shut down of the rectifier until 86 is hand reset. This type shut down is termed LOCKOUT. (Loss of ac control power shall not cause operation of any of these devices):
1. Open doors on rectifier diode negative switch compartment and positive 1500 V bus compartments (Device 33) or open enclosure on transformer.
  2. AC fault (Device 551).
  3. Equipment overload detected by AC relays (Device 551).
  4. Insulation failure between rectifier components and enclosure (Device 164X).
  5. Incomplete starting sequence (Device 48).
  6. Rectifier negative disconnect switch open. (Device 89N).
  7. Supervisory (Remote) control lockout (Device 286).
  8. Rectifier reverse current (Device 32).
  9. Failure of two diodes (Device 95X).
- K. The following safety devices plus all of the devices listed above shall cause shut down of 86X and shut down of the rectifier and rectifier transformer until the condition is corrected. This type shut down is termed CONDITIONAL LOCKOUT.
1. Rectifier second step diode heat sink temperature (Devices 26D and 26DA).
  2. Transformer second step high winding temperature (Device 49TH).

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3. Loss of ac power (Device 27).
- L. The following safety devices shall activate the device 74 and cause a TROUBLE ALARM only until the condition is corrected.
1. Transformer first step high winding temperature (Device 49T).
  2. Rectifier first step high diode heat sink temperature (Devices 26D1 and 26D1A).
  3. Insulation failure between rectifier enclosure and ground (Device 164M).
  4. Rectifier surge diverters' failure (Device 99Y).
  5. Loss of one diode. (Device 95Y).
- M. Local supervision shall be provided on each rectifier control cubicle in the form of a PLC Controlled touch screen HMI(Device 30) to indicate operation of all safety devices listed above, and other power rectifier criteria as may be deemed essential by the rectification equipment Contractor. Audible alarm for annunciator shall be operable only when 43 is in LOCAL position.
- N. Supervisory control will be provided to permit remote control and supervision of the following items. The Contractor shall furnish and connect the necessary contacts to terminal boards.
1. Incoming line breakers (Device 152) (Devices 201C and 201T for control and Device 152 for monitoring).
  2. Bus tie breaker (Device 152BT) (Devices 201C and 201T control and Device 152BT for monitoring).
  3. Start and shut down of each rectifier (Devices 201C and 201T for control and 4X for monitoring).
  4. Lockout shut down of each rectifier (Device 286 for control and 4 for monitoring).
- O. The supervisory shall be provided to permit remote supervision of the following items. The Contractor shall furnish and connect the necessary indicating contacts to terminal boards.
1. Rectifier dc breaker (Device 72).
  2. Rectifier ac breaker (Device 52).
  3. Trouble alarm (Device 74).
  4. Positions of permissive control switch (Device 43 for monitoring).

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5. Local supervision shall be provided on a separate wall mounted annunciator panel, which shall include the following:
  - a. One (1) Programmable Logic Controller PLC:
    - 1) General:
      - a) Monitoring and control of the traction power equipment
      - b) A self-diagnostic routine to respond promptly, safely, and predictably to detected faults within the substation
  - b. Communication:
    - 1) Provide communication to the TPS RTU via fiber optic cable
    - 2) Collect the information from devices without a communication link through a dry-type input contact
    - 3) Send out commands to devices without a communication link through a dry-type output contact.
    - 4) Monitor the integrity of the communication link and activate an alarm on the HMI if communication is lost with substation RTU.
  - c. Sampling:
    - 1) Sample input conditions at rates sufficient to detect and remedy unsafe or damaging conditions in the shortest possible time.
    - 2) Sampling rates and program execution times shall be such that the control system is not the limiting factor in response to unsafe or damaging conditions.
  - d. Time Synchronization:
    - 1) Synchronize PLC/HMI time with SCADA system time.
    - 2) Design software to ensure that the timing requirements for safety-related tasks are always met
6. One (1) HMI touch Screen:
  - a. General Requirements:
    - 1) Not Less than 1920 x 1080 pixel.
    - 2) Size: Minimum 20-inches diagonal.
    - 3) Provide a Windows-based user interface on touch screen.
    - 4) Provide connection options for external periphery units (keyboard, mouse, and laptop), e.g. via a USB interface.
    - 5) Minimum 64 bit RISC CPU.
    - 6) Minimum Configuration Memory: 256 Mbyte.
    - 7) Flush mount the HMI in the door of the rectifier control cabinet.

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- b. Screens:
- 1) Home Screen: Provide the following:
    - a) Silence Button: Manually silence the horn
    - b) Acknowledge Button: Acknowledge active alarms
    - c) Any other buttons required to operate the device
    - d) Current time and date
    - e) Manufacturer's logo
    - f) Metra's logo
    - g) Substation name
  - 2) Annunciation View:
    - a) Provide Local Annunciation (Device 30) for all required alarms. Refer to Contract Drawings for annunciation points:
      - i) Steady Green: Good Condition
      - ii) Flashed Red: New Alarm
      - iii) Steady Yellow: Acknowledged Alarm
    - b) Each annunciation window shall be at least 2 inches wide and 1.5 inches high, clearly labelled, and easily readable
  - 3) Event History: All alarms shall be entered in the event history. The device shall be capable of recording up to 2000 events (alarms/trips/switching operations). Each entry shall at a minimum provide the following information:
    - a) Date
    - b) Time
    - c) Description of the event
    - d) Status (active/acknowledged)
- c. HMI Trouble: In addition to the touch screen, an extra LED shall be provided to indicate trouble. The LED shall be illuminated every time an alarm is active (new alarm and acknowledged alarm).
- d. One alarm horn: The horn shall be 125 Vdc, surface-mounted type, and shall have 16 selectable tones. The horn, when actuated, shall be silenced automatically in 30 seconds by means of an adjustable timing relay, or manually by the silence pushbutton. The alarm horn shall be Panalarm Cat. No. NT2-24D, or approved equal.
- e. AC power supply
- 1) Control cut-off switch
  - 2) Auxiliary power transfer switches
  - 3) Battery voltage and other common functions (station alarm) (Device 174 for monitoring)
  - 4) Refer to Contract Drawings for a complete list of required annunciation points

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- f. Each of these annunciator points shall be equipped with an independent contact for auxiliary output. This contact shall open and close to follow field contact wired to terminal blocks for connections to SCADA RTU.
- P. The supervisory control shall be provided to permit remote telemetering of the following items:
- 1. Output current of each rectifier continuously (current transducer for signal).
  - 2. Total substation output current continuously (sum of rectifier transducer outputs for signal).
  - 3. DC bus voltage continuously (dc voltage transducer for signal).
  - 4. AC bus voltage and ac line current of each ComEd line.

**2.08 PROTECTIVE DEVICE COORDINATION:**

- A. The Contractor shall perform a relay coordination study and shall furnish protective devices in the traction power rectifier equipment as listed elsewhere in this part of Specification, or as may be required, to provide reliable coordinated protection for the system. All such devices shall be adjustable and shall be factory calibrated to provide the following general protective scheme.
- B. Using protective devices on ac switchgear.
- 1. Pick up of directional relay to trip ac incoming line feeder breakers on the faulted side of the incoming 12,600 Vac line. (Device 351).
  - 2. Pick up of instantaneous element on short time relay to trip rectifier ac breaker for 12,600 Vac circuit and rectifier transformer faults. (Device 551-T).
  - 3. Pick up of short time relays to trip rectifier ac breaker for rectifier transformer secondary and/or 600 Vdc feeder breakers for faults on dc feeders. It shall also provide coordination with the reverse current trip on the dc breaker of any one other rectifier operating in parallel (see Section 16605). (Device 551-T).
  - 4. Relay pick up time shall not be more than seven cycles. (Device 551-T).
  - 5. Approximately 15 seconds pickup of long time relays to trip rectifier ac breaker at 450 percent rectifier full load current (Device 551-T).
  - 6. Approximately 60 seconds pickup of long time relays to trip rectifier ac breaker at 300 percent rectifier full load current (Device 551-T).
  - 7. Two hours of long time relays to trip rectifier ac breaker at 160 percent rectifier full load current. (Device 551-T).

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- C. Using protective devices on dc switchgear:
1. Rectifier dc circuit breaker reverse current device, Device 32, shall instantaneously trip the rectifier dc and ac circuit breakers, Devices 72R, 52T, at no more than 20 percent of the rectifier rated current. Coordination of protective devices shall prevent tripping of ac circuit breakers of any rectifier operating in parallel.
- D. Using temperature devices on rectifier transformer:
1. Conditional lockout of rectifier following 150 percent of rectifier full load current for approximately 2 hours (Device 49TH).
- E. Using protective devices on rectifier:
1. Each diode shall be protected with an individual current limiting fuse selected to blow for diode shorting failure. Provide indicating lamps and diode fuse monitor required to indicate failure of either element or fuse.
  2. Pick up of thermal switches on heat sinks to trip associated ac and dc circuit breakers on heat sink high temperature due to any combination of excessive ambient temperature, reduced heat sink efficiency or excessive base load and load current including short circuits, that would result in failure of rectifier elements and/or fuses before other protective devices on ac and dc switchgear could operate (Device 26D).
- F. In addition to the above trip and alarm functions, the following devices in rectifying assemblies and dc switchgear line-up shall provide operation as follows:
1. Ground Detection of Rectifier and DC Switchgear:
    - a. Rectifiers and dc switchgear shall be installed so that their enclosures are insulated from ground and substation building structure.
    - b. For each rectifier unit and the dc switchgear enclosure, the Contractor shall provide a set of ground detection equipment, including a high resistance ground relay, Device 64 for rectifier.
    - c. Ground detection equipment shall be rated for operation on 125 Vdc.
    - d. The ground relay, monitoring relay and associated circuit components shall be rated for 2000 Vdc service, minimum.
    - e. Rectifier Ground, Device 64M: When the rectifier assembly gets grounded, it shall send a signal to local alarm and SCADA.
    - f. Rectifier Hot, Device 64X: When the rectifier assembly gets energized (above 75 volts to ground), it shall trip and lockout relay 86, which in turn will trip ac rectifier breaker 52 and dc rectifier breaker device 72.
    - g. DC Switchgear Hot, Device 164X for Cubicle -1 and Cubicle -2:
    - h. The dc switchgear enclosure for Cubicle-1 and Cubicle-2 shall be electrically bonded to their associated rectifiers and shall be monitored by the 64 relay inside the rectifier.

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- i. Switchgear Cubicle-1 and Switchgear Cubicle-2 shall be insulated from each other.
- 2. Reverse Current Relay, Device 32:
  - a. When current flows above its setting from cathode breaker to rectifier (reverse direction), it shall trip associate cathode breaker instantly.
  - b. If the breaker fails to trip, a current sensing relay 32LBB will allow the timer 62LBB to timeout to trip to trip the rectifier lockout relay.

## 2.09 RELAYS AND DEVICES

- A. The type of relays and devices used in the control and supervision of the supplied equipment shall have proved successful in similar application over at least a five-year period of use.
- B. All control and instrument switches shall be rotary type provided with properly designated black escutcheon plates, clearly marked with white letters to show operating position.
  - 1. Breaker control switches shall be spring return. Instrument switches shall have an OFF position.
  - 2. Handles shall be solid colored plastic, or approved equal. Selection of operating handles shall be as follows:
    - a. Breaker Control Pistol grip, black.
    - b. Permissive Control Oval, black.
    - c. Instrument Knurled round, black.
    - d. Pistol grip control switches shall be G.E. type SBM or approved equal.
    - e. Lockout relays shall be Electros witch Series 24 or approved equal.
    - f. All control and auxiliary relays shall be suitable for use in switchgear equipment as defined in IEEE C37.90. Operating coils for direct current relays shall be suitable for continuous operation between 90 volts and 145 Vdc and alternating current relays between 85 percent and 110 percent of nominal rating.
- C. All indicating lights shall be LED high output and shall operate with sufficient intensity between 90-145 Vdc. LED shall be visible under 50 foot candle operating floor lighting and shall not suffer premature failure from battery float or equalize voltage. LED samples of all colors used shall be furnished to Metra for evaluation and approval, prior to installation on the equipment.
- D. All indicating instruments shall be semi-flushed mounted and shall have metal scales with black figures on a white background. They shall be approximately 4-1/4 inch in size, have taut band suspension, and be of 250-degree scale design.
- E. DC control power for each circuit breaker cubicle in 15 kV ac switchgear line-up and in 1500 Vdc switchgear line-up shall be provided through sub dc distribution

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panel. It will be located in the tie breaker cubicle for the ac switchgear line-up. A separate circuit breaker from the sub dc distribution panel shall be assigned for the control, tripping, metering and relaying circuits of each breaker cubicle of ac and dc switchgear.

- F. The sub dc distribution panel shall be rated for 125 Vdc supply for a two-wire system with a short circuit rating of 10,000 amperes. The circuit breakers shall be 30 amperes, 2-pole thermal magnetic type. The main bus shall be rated at 100 amperes copper sized in accordance with UL Standard.
- G. All fuses and disconnect switches for ac and dc control circuits shall be manufactured in the United States and shall be located in such a position that they are easily and safely accessible. In dc switchgear cubicles, all 1500 volt fuses shall be mounted in enclosed fuse blocks. Minimum current interrupting capability shall be 15,000 amperes at 2000 Vdc, with an L/R ratio of 0.05 second. Minimum voltage rating shall be 600 Vdc for 125 volts and below. All control and monitoring circuits connected to 1500 Vdc system shall be rated 2000 Vdc.
- H. All devices such as fuses, meters, relays, switches and lamps shall be suitably identified by plastic tags with black letter on white background and device symbol, and in case of fuses, rating and circuit feed. Identify polarities of fuses and switches. The tags shall be mounted under device with machine screws. Use of self-tapping screws, rivets or adhesives is not permitted.
- I. Each circuit and panel mounted device shall have a suitable processed plastic laminated nameplate with black letters on white background for proper identification. Nameplate shall be of 1/16-inch thickness and type for specific use and shall be smooth with 0.003-inch Melamine covering as manufactured by Duralith Corp., or approved equal. Each circuit nomenclature will be specified later. Lettering shall be 1/4 inch in height where possible. The nameplates shall be mounted with machine screws. Use of self-tapping screws, rivets or adhesives is not permitted.
- J. Mounting holes for outdoor nameplates shall be fitted with a resilient grommet under a non-corrosive eyelet to prevent cracking of the enamel during the mounting application. All outdoor nameplates shall have full color coverage and shall be guaranteed for 10 years, with outside usage, against fading and defects such as blisters, peeling, cracks, chipping, pin holes and discoloration.
- K. Approved tags, identifying dc feeder breaker cubicles, rectifier dc breakers, ac switchgear units, rectifier transformers and rectifiers shall be provided.
  - 1. Front and back tags for dc breaker sections, rectifier dc breakers and rectifiers shall be 14 inches by 6 inches by 1/8 inch, three layers plastic with sunlight yellow surface color on both sides and black center core (black lettering).
  - 2. Front and back tags for ac switchgear units and rectifier transformers shall be 17-1/2 inches by 3-1/2 inches by 1/8 inch, three layers plastic with cardinal red surface color on both sides and white center core (white lettering).

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3. The tags shall be mounted with machine screws. Use of self-tapping screws, rivets or adhesives is not permitted.
- L. Adjustable lugs on tubular resistors of 1.125 inches diameters shall be Ohmite Manufacturing Co., double thumb screw adjustable lug, Catalog No. 2160, or approved equal. Adjustable lugs on tubular resistors of 0.438; 0.563; 0.750; 1.500; 1.625 and 2.500 diameters shall be Ohmite silver contact, bakelite knob type Catalog Nos. 2163, 2165, 2167, 2183, 2187 and 2191 respectively, or approved equal. Adjustable lugs of .313 diameter shall be Ohmite silver contact screw driver type catalog No. 2161, or approved equal.
- M. Rectifier annunciator (Device 30) shall be programmable minimum 17-inch Touch Panel; refer to Section 16603, Rectifier Transformer, for details.
- N. All sections shall include Marathon terminal blocks in addition to the GE EB-5 and Weidmueller type SAK.
- O. All sections shall include that the pistol grip control switches shall be GE type SBM, Electro Switch, or approved equal.

## 2.10 MISCELLANEOUS

- A. Bolted joints of current carrying members shall be provided with proper spring tension devices to maintain proper joint pressure under load (heat) cycles. For copper to copper joints use Everdure hardware or approved equal, for aluminum to aluminum joints use Belleville washers or approved equal.
- B. Copper to aluminum bolted joints shall not be allowed.
- C. Cable and control wires shall be copper, and shall meet the requirements of the Chicago Electrical Code.
- D. Wiring shall be clearly identified using white plastic slip on markers with etched black lettering. The marker diameter shall be consistent with the wire diameter to insure a snug fit, but yet able to be rotated for identification.
- E. Device layouts shall provide visibility of and safe, easy access to all terminal blocks, fuses, switches relays, and other devices and their associated wiring without reaching into blind spots and/or physically climbing into the enclosure. All devices such as fuses, switches, terminal blocks, etc. shall be mounted within 18 inches of the face of the cubicle accessible for operation and maintenance. All fuses and disconnects shall be mounted in rear cubicles. Any device layout which is judged not to be safely maintainable will be rejected.
- F. Serviceability under NFPA 70E rules shall be taken into consideration for equipment layout with the intent of minimizing arc blast exposure and protective clothing requirements. Furthermore, all equipment shall have appropriate arc blast warning labels attached.
- G. Transducers shall be fused separately.
- H. Equipment enclosures shall be fabricated in such fashion as to provide sturdiness, durability and neat appearance using 11 gage steel. Structures shall

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provide adequate rigidity to prevent warping, bonding and vibration of panels and doors. Where required, heavier gauge metal and/or extra stiffeners shall be used to insure that doors, panels and appurtenant mountings do not bend or rattle when being accessed for maintenance or, in case of breaker cubicles, when breakers are opened or tripped.

- I. Equipment dimensions on drawings will be shown in metrics and with inches in brackets.
- J. Wiring terminals shall be ring style compression type.

**2.11 RECTIFICATION EQUIPMENT DRAWINGS**

- A. Schematic and wiring diagrams shall be prepared using IEEE standard device symbols and nomenclature as defined and listed in IEEE C37.2 except where specified otherwise. Terminals and terminal block studs shall be clearly marked on all equipment and the markings shall agree with the drawings. All components on the drawings shall be marked to indicate size and rating.
- B. All diagrams, drawings and instruction material shall be prepared using the latest version of MicroStation® in English language and U.S. Standard system of weights and measures. All drawings and reproducible tracings shall be 24 inches x 36 inches overall. The equipment layout drawing shall be drawn to 1/4 inch = 1 foot-0 inch scale. A bar chart (graphic scale) shall be provided on all equipment layout drawings. All drawings must follow Metra's CAD standards and Metra's Electrical Color Code.
- C. The equipment manufacturer shall start detail design and drafting work for all equipment immediately upon notice to proceed of the Contract and shall process design work to completion without delay and to permit timely rectification equipment installation.

**2.12 PROTECTIVE RELAY SETTINGS AND SHORT CIRCUIT STUDY:**

- A. A study shall be provided including short circuit calculations to determine the settings and calibration of the ac and dc protective relaying system.
- B. The study shall be developed for all relays in the new substation including dc feeder relays, transformer relays, rectifier relays, bus tie relays, incoming bus and feeder relays. The relays operation criteria include but are not limited to the following:
  - 1. In case of dc catenary fault only the respective feeder relays should operate.
  - 2. In case of the above fault, the rectifier fuse should withstand the minimum size fuses recommended for this purpose. AC relays should not operate and the ac circuit breaker remains closed.
  - 3. A fault in a diode of the rectifier shall blow the fuse of the diode to protect the remainder of diodes from damage and allow the rectifier to operate.

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4. A fault within a rectifier shall operate its reverse current relay. The transformer ac relays should not operate under this condition.
  5. For a fault in the rectifier transformer, the transformer's primary relay should operate but not the incoming circuit breaker relays. The instantaneous overcurrent settings of the transformer ac relays should be set below the transformer short circuit rating to protect the transformer from damage.
  6. The time overcurrent settings of the transformer ac relays shall be set above the transformer inrush current but below the rectifier transformer damage curve.
  7. Coordination with ComEd utility upstream relays.
  8. Coordination with ComEd's protective relay philosophy and probability the incoming substation feeder failure. In the event, that the discussion with ComEd reveals a high probability of the incoming feeder outage, the incoming feeder short circuit will be calculated with one incoming line out of service. This condition will produce higher current in the remaining incoming feeder which will be used for coordination of the ac overcurrent relays.
- C. Based on the utility short circuit level at the entrance of the substation, the short circuit current will be calculated for faults at the following locations:
1. DC catenary remote from the substation.
  2. DC catenary closest to the substation.
  3. Rectifier output.
  4. Rectifier transformer secondary winding.
  5. Rectifier transformer primary winding.
  6. 12.47 kV ac switchgear main bus.
- D. Set the transformer primary ac circuit breaker phase and ground relays, the bus tie relays and feeder incoming relays to protect the facility and coordinate with each other at a minimum available short circuit current.
- E. The accelerating current versus time characteristics of the new cars will be evaluated so that the dc feeder rate of rise relay can be set. The relay shall be set so that it will not create nuisance tripping of the dc feeder circuit breaker on the train acceleration and at the same time effectively protect the catenary system during fault.
- F. Coordination curves shall be submitted electronically along with one compatible licensed software within 160 days after notice to proceed of the Contract, showing relay and direct acting trip device coordination for all furnished equipment.

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- G. Coordination curves shall include plot of rectifier design capability and shall clearly indicate actual margin of coordination (from breaker trip to design capability) at each of 150 percent, 300 percent and 450 percent full load current and short circuit, taking into account aerating due to current imbalance and loss of one leg in each phase.
- H. Final coordination will be the responsibility of the Contractor's Engineer in charge per Section 16613, Service Engineer.
- I. After final review, and prior to the construction, all drawings diagrams, material lists, recommended support parts shall be issued for construction in the latest version of MicroStation® format.

**2.13 ARC-FLASH HAZARD ANALYSIS**

- A. Perform Arc-Flash Hazard Analysis with the aid of computer software intended for this purpose.
- B. Perform analysis in conjunction with short-circuit and coordination studies.
- C. Submit the results of the analysis in a table and include device or bus identification tags, bolted fault and arcing fault current levels, flash protection boundary, distances, personal protective equipment classes and arc-flash incident energy (AFIE) levels.
- D. Perform the analysis under worst-case fault conditions, and describe in the final report where applicable, how these conditions differ from worst-case bolted fault conditions.
- E. Provide self-adhesive equipment labels in compliance with ANSI Z535.4 to document arc flash hazard and required personal protective equipment.

**PART 3 - EXECUTION****3.01 NOT USED****END OF SECTION**

**SECTION 16602**  
**15 KV AC SWITCHGEAR**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section includes detailed requirements for designing, manufacturing, testing, delivering, installing and commissioning the 15 kV ac switchgear line-up at the substation site.

1.02 RELATED WORK

- A. Section 16510, Lighting
- B. Section 16601, General Requirements for Traction Power Equipment
- C. Section 16610, Traction Power Equipment Installation
- D. Section 16611, Traction Power Equipment Testing

1.03 REFERENCES

- A. This Section incorporates by reference the latest revisions of the following documents:
- B. Institute of Electrical and Electronics Engineers (IEEE)
  - 1. IEEE C37.20.1, Metal-Enclosed Low-Voltage (1000 Vac and below, 3200 Vdc and below) Power Circuit Breaker Switchgear
  - 2. IEEE C37.20.2, Standard for Metal-Clad Switchgear
- C. National Electrical Manufacturers Association (NEMA)
  - 1. NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum)
  - 2. NEMA SG4, Alternating Current High Voltage Circuit Breakers
- D. National Fire Protection Association (NFPA)
  - 1. NFPA 70E, Standard for Electrical Safety in the Workplace

1.04 COORDINATION

- A. ComEd Company will ship the metering CTs and PTs to the rectification equipment manufacturer at the Contractor's expense upon receipt of detailed shipping instructions.

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**1.05 SUBMITTALS**

- A. Submit to Metra's Authorized Representative an experience and reliability list demonstrating that the manufacturer complies with the requirements for at least five years of successful in-service performance of vacuum switchgear of this rating.

**1.06 EXTRA STOCK MATERIALS**

- A. Furnish one quart of matching touch up paint for each assembly.

**1.07 TOOLS**

- A. Ground and Test Device: One grounding cable clamp set (grounding cluster) similar to Chance No. C6000758 shall be furnished except it shall have No. 4/0 AWG cables and cluster length sufficient to reach between phases and ground studs.
- B. The switchgear manufacturer shall furnish accessories for test, inspection, maintenance, and operation, including:
  - 1. One - Maintenance tool for manually charging the breaker closing spring and manually opening the shutter.
  - 2. One - Levering crank for moving the breaker between test , connected and disconnected position.
  - 3. One - Test jumper for electrically operating the breaker while out of its compartment.
  - 4. One - Set of rail extensions and rail clamps for removing P.T.'s out of the cubicle.
  - 5. One - "Dockable" transport dolly for moving breaker about outside its compartment.
  - 6. One - Electrical levering device.
  - 7. Channel base assemblies drilled to accept stationary unit.

**1.08 QUALITY ASSURANCE**

- A. Manufacturer's Experience:
  - 1. The manufacturer must have at least five years of successful in-service performance of its vacuum switchgear.

**PART 2 - PRODUCTS****2.01 GENERAL**

- A. The switchgear line-up shall be metal-clad, draw-out type one high deck for 12,600 volt, three-phase, 60 Hz, ac grounded neutral service.

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- B. Provide one-line diagram as per drawing ss-6.25-4001 mimicked on the front of 12 KV switchgear.
- C. Switchgear shall comply with IEEE C37.20.2 and NEMA SG4.
- D. All devices such as fuses, switches, terminal blocks, etc. shall be mounted no further than 18 inches from the face of the cubicle and easily accessible for operations and maintenance.
- E. The Manufacturer shall provide fuse in trip circuits compatible to maximum possible tripping circuits.

**2.02 RATINGS**

- A. The 15 kV ac switchgear assembly shall be rated as follows:
  - 1. Nominal Voltage: 12.6 kV
  - 2. Maximum Voltage: 15 kV
  - 3. Frequency: 60 Hz
  - 4. Insulation Level 60 Hertz withstand: 36 kV
  - 5. Insulation Level Impulse withstand: 95 Kv
  - 6. Main Bus Continuous Current: 1200 amp

**2.03 AC SWITCHGEAR STRUCTURE**

- A. Construction:
  - 1. All metal work shall be thoroughly cleaned, treated against rust and corrosion, bonderized and finished with two coats of ANSI 61 grey color by powder coat painting process. Finish shall be gloss.
  - 2. All full height hinged doors shall be provided for one high unit with a minimum of three latches, securely fastened in the closed position, and easily opened without the use of tools. For doors less than full height of the equipment, a minimum of two latches will be acceptable. Doors shall be provided with stops approved by Metra's Authorized Representative to hold them securely in the open position in a manner to allow the opening of the doors of adjacent cubicles. Latches shall be installed no higher the 6 feet from the substation floor.
  - 3. The rear and front closure of the compartments shall be hinged and lockable with a padlock.
  - 4. All interior and exterior hinged compartment doors shall include a clasp that can accept a padlock.
  - 5. Shipping splits shall be arranged so that the sections will be easily jointed in the field.

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- B. Configuration:
  - 1. The switchgear shall be arranged for bottom entrance for Metra outgoing feeders, and top entrance for the remaining outgoing feeders as shown on the Contract Drawings.
- C. Circuit Breaker Compartments
  - 1. Each circuit breaker cubicle shall have protective shutters that are forced to close and cover live high-voltage terminals as the breaker is racked out of the cubicle.
  - 2. Secondary wiring in the high voltage section of the circuit breaker cubicle shall be routed in rigid metal conduit
  - 3. The switchgear shall have the capability of racking the breakers in all positions with the door shut.
  - 4. The following interlocks shall be included:
    - a. Suitable interlocks and stops at each position to prevent the insertion or removal of a breaker element in the closed position.
    - b. Positive acting mechanical interlocks such that a breaker in the closed position cannot be disconnected from or connected to the bus.

**2.04 CIRCUIT BREAKERS**

- A. Circuit breakers shall be 15 kV class, vacuum break, draw-out type, having a nominal interrupting capacity of 500,000 kVA and close and latch rating of 37,000 amperes, symmetrical. Operating mechanisms shall be of the stored energy type and shall be suitable for operation from the 125 Vdc control voltage, as provided under this Contract, and shall be electrically and mechanically trip free.
- B. Circuit breakers shall be mechanically and electrically interchangeable.
- C. A four-digit mechanical register type operations counter shall be mounted on each removable element.
- D. Circuit breakers shall be designed to roll directly from the floor into the switchgear or from the switchgear compartment onto the floor without a need for external lifting device or dolly. Circuit breaker shall be supplied with two swivel type wheels on the front and two fixed wheels on the rear.
- E. Interrupters, operating mechanisms and equipment cubicles must be designed, tested and assembled by one manufacturer. The breaker shall be provided with a contact erosion indicator which is not influenced by mechanism wear and does not require mathematical calculations to determine the amount of contact erosion.
- F. All ac circuit breakers should be configured for control using local closing switch on housing when in test position.

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- G. Provide test cabinet complete with open and close pistol grip, switch, indicating lights, devices, terminals for connecting control power, and a multi-conductor control cable 8-feet long, complete with receptacle matching the plug on the removable breaker unit. The test cabinet shall be NEMA 250 Type 12 construction, ANSI 61 paint finish suitable for wall mounting, and shall be provided with lugs and 1-1/2-inch top and bottom entry conduit hub.
- H. Breaker auxiliary switches, whether cell mounted or mounted on removable element, shall be made up and operable when breaker is withdrawn to test position.

**2.05 SWITCHGEAR BUS**

- A. Buses shall be insulated copper bar, rated 1200 ampere capacity at 40°C and shall be supported, and braced to withstand short circuit stresses at least as great as those for which the circuit breakers are designed.
- B. The contact surfaces of bolted joints in the buses and main connections shall be silver plated for copper, nickel plated for aluminum. Removable boots shall be provided for all joints.
- C. The bus insulation shall be flame-retardant track-resistant epoxy, heat shrink; PVC insulation is prohibited.
- D. A ground bus shall be provided to engage the frame of circuit breakers in both operate and test positions. A 2 inch X 1\4 inch ground bus shall be installed through all switchgear cubicles, including breaker, auxiliary transformer and metering cubicles.

**2.06 UTILITY INCOMING SECTION**

- A. AC incoming service for the switchgear will be provided directly from ComEd Company 12,600 Vac feeders and will serve as the supply for the rectifier transformers, and auxiliary power transformers.
- B. There shall be two service feeders for the substation as shown on Contract Drawings.
- C. The switchgear shall be arranged for bottom entrance for incoming ComEd lines and Metra outgoing feeders, and top entrance for the remaining outgoing feeders as shown on the Drawings.
- D. Remote Com Ed Company Metering:
  - 1. Provide internal or external space (wherever the reading signal is strong), mounting brackets, primary wiring and terminal blocks; and make factory installation of this equipment.
  - 2. Draw-out fuse assembly for PTs (if provided) shall be complete with clips for two customer-furnished potential fuses, GE Catalog No. 6293011G 20, or approved equal. Refer to the ComEd Co. Metering Department Guide.

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- E. Compartments housing current transformers for remote ComEd Company metering shall have hinged door and hasp for padlock and seal by others.
- F. A terminal block for terminating both metering current and potential transformer secondary wiring shall be mounted inside the line current transformer compartment in a readily accessible position. No other wires shall be on this block, and no other blocks shall be in this compartment.
- G. Provide 12 kV distribution-class surge arresters inside metering compartment and ground-side connector, accessible for removal, when required.
- H. Separate compartments housing potential transformers for remote ComEd Company metering shall have hasp for padlock and seal by others.
- I. Provide an internal conduit system for complete isolation of metering potential transformer secondary wiring. Primary connection for the potential transformer shall be made on the supply side of the current transformer.
- J. Potential transformers may be mounted in any one of the three following ways:
  - 1. On draw-out carriage without sliding secondary-contacts.
  - 2. Fixed, horizontal with draw-out fuses.
  - 3. Fixed, vertical, with clearance for easy fuse-removal.

## 2.07 DETAIL EQUIPMENT

- A. General:
  - 1. The switchgear line-up shall include assorted switchgear positions and switchgear appurtenances of each of the various types listed below, and shall be incorporated into one continuous enclosure made up of compartments as required.
  - 2. Detail of each type of equipment shall be as listed below.
- B. Item 1; Units 2 and 8: Each 12,600 Vac position for ComEd Company metering shall include but not limited to the following:
  - 1. One (1) metal clad stationary unit with 1200 ampere insulated bus.
  - 2. Three (3) GE Type JKM 5 CTs Catalog No.631X20, 400 5 ampere for remote ComEd Company metering. (See note below).
  - 3. Two (2) GE Type JVM 5 PTs Catalog No. 685X43, 7200 120 volt for remote ComEd Company metering. (See note below).
  - 4. Terminal lugs for three1/c-500 kcmil, copper 15 kV EPR insulated, shielded, PVC jacketed cable.

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5. Four (4) ComEd-approved insulated grounding studs with suitable (15 kV) insulated caps for ComEd Company use in grounding phase legs and ground bus.
    - a. Locate one stud in each phase leg above cable terminators on line side of CTs and one on the ground bus.
    - b. Studs shall be 5/8-inch diameter and protrude at least 3 inches beyond insulation.
    - c. Caps may be porcelain, molded bakelite, or equivalent.
    - d. The caps shall fully cover the exposed portion of the studs and shall be removable by hand.
  6. Single lines, schematics and drawings showing equipment layout must be provided by the Contractor to ComEd Engineering and Metering Department for their approval.
  7. Three (3) distribution class 9 kV surge arresters, connected to each phase leg above cable terminators on the line side of CTs.
  8. One (1) set of space heaters.
    - a. Type: Strip Heater
    - b. Rated Voltage: 120 Vac
    - c. Minimum Wattage: 150 W
  9. Provide Interior Lights per Section 16510
  10. A hand tool removable safety screen shall be provided behind the rear door.
- C. Item 2; Units 3 and 7: Each 12,600 Vac incoming line breaker position for ComEd lines shall include; but is not limited to:
1. One (1) metal clad stationary unit with 1200 ampere insulated bus.
  2. One (1) insulated 1200 ampere 15 kV class vacuum circuit breaker removable element with 8-stage auxiliary switch. (Device 152-1 and 152-2).
  3. Six (6) line relaying current transformers 600-5 amperes, ANSI accuracy Class C100.
  4. Three (3) line relaying PTs, draw-out type with current limiting fuses, 12,000 - 120 volt, 200 VA, ANSI accuracy class 1.2, may be located in super structure compartment; connected grounded wye primary to main bus; The secondary side of PTs shall be connected grounded wye.
  5. Three (3) line relaying PTs, draw-out type with current limiting fuses, 12,000 - 120 volt, 200 VA, ANSI accuracy class 1.2. connected grounded wye primary to main bus; The secondary side of PTs shall be connected in open, grounded Delta Configuration
  6. One (1) microprocessor based solid state ground directional overcurrent relay with eight outputs and six inputs, conventional terminal blocks,

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horizontal panel flush mounted, 125 Vdc power supply, wye connected secondary input voltage, five ampere nominal input current, 125 Vdc control input voltage and standard communication protocol. SEL-351 for ComEd Line protection (Device 167 and 167N).

7. Flextest switches, as many as needed, 10-pole for six current and four potential circuits, ABB type FT-1 for switchboard mounting to be used with relay SEL-351.
  8. One (1) ac indicating ammeter, 0-600 ampere scale.
  9. One (1) ac ammeter switch, three-phase, with OFF position.
  10. One (1) ac voltmeter, 0 15 kV. Single Phase monitoring phase to phase.
  11. One (1) ac voltmeter switch, three-phase with OFF position.
  12. One (1) removable element position switch with required (minimum of six) interchangeable stages.
  13. One (1) permissive control switch (REMOTE LOCAL), REMOTE position 12 o'clock and LOCAL clockwise (Device 43).
  14. One (1) control switch with red and green indicating lamps (CLOSE- right - TRIP- left).
  15. Control circuits and contacts as required, including four NO and four NC spare contacts.
  16. Provide contacts wired to terminal blocks as required for Metra's SCADA circuits.
  17. One (1) set of space heaters.
  18. Provide Interior Lights per Section 16510
- D. Item 3, Unit 5: The 12,600 Vac bus tie breaker position shall include but is not limited to:
1. One (1) metal clad stationary unit with 1200 ampere insulated bus and 1200 ampere insulated tap.
  2. One (1) 1200 ampere 15 kV class vacuum circuit breaker removable element with eight-stage auxiliary switch (Device 52-BT).
  3. Nine (9) line relaying CTs 600-5 ampere, ANSI, accuracy class C100.
  4. Provide a switch to enable the transfer.
  5. Two (2) microprocessor based solid state high-impedance differential relay with five outputs and two inputs, conventional terminal blocks, horizontal panel flush mounted, 125 Vdc control input voltage, 5 ampere nominal input current, and standard communication protocol, SEL-587Z for bus protection (Device 587Z B1 and 587Z B2).

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6. One (1) microprocessor based solid state overcurrent relay with five outputs and two inputs, conventional terminal blocks, horizontal panel flush mounted, 125 Vdc control input voltage, and 5 ampere nominal input current, and standard communication protocol, SEL-551 for bus tie breaker overcurrent protection (Device 551-BT).
  7. Flexitest switches, as many as needed, 10-pole for six current and four potential circuits, ABB type FT-1 for switchboard mounting to be used with relays SEL-587Z and SEL-551.
  8. Two (2) electrically operated, hand-reset lockout relays, 125 Vdc coil, with sufficient NO and NC contacts, Electroswitch type Catalog No. LOR78xxD or approved equal (Device 86B1 and 86B2).
  9. Two (2) Amber LED lights connected to monitor the integrity of the trip coil in 86B1 and 86B2
  10. Two (2) white LED lights connected to monitor the status 86B1 and 86B2
  11. One (1) removable element position switch with required stages.
  12. One (1) permissive control switch REMOTE LOCAL, REMOTE position 12 o'clock, LOCAL clockwise (Device 43).
  13. One (1) control switch with red and green indicating lamps, CLOSE right - TRIP left (Device C.S.).
  14. One (1) set of space heaters.
  15. Provide Interior Lights per Section 16510
  16. Control circuits and contacts as required including four NO and four NC spare contacts.
  17. Provide contacts wired to terminal blocks as required for Metra's SCADA circuits.
  18. One (1) 125 volt sub dc distribution panel with minimum of 12 two-pole, 30 ampere circuit breakers. A separate circuit shall be provided in a sealed trough from this panel to each cubicle for control, tripping metering, and relay circuits of the breaker as well as for the control circuits for 1500 Vdc switchgear cubicles.
- E. Item 4, Units, 1, and 9: Each 12,600 Vac breaker position for the rectifier transformers includes but is not limited to:
1. One (1) metal-clad stationary unit with 1200 ampere insulated bus.
  2. One (1) insulated 1200 ampere, 15 kV class vacuum circuit breaker removable element with eight-stage auxiliary switch.
  3. Three (3) relaying current transformers 300-5 ampere ANSI accuracy Class C100.

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4. Three (3) relaying current transformers 600-5 ampere ANSI accuracy Class C100.
  5. One (1) microprocessor based solid state overcurrent relay with five outputs and two inputs, conventional terminal blocks, horizontal panel flush mounted, 125 Vdc control input voltage, 5 ampere nominal input current, and standard communication protocol, SEL-551 for rectifier transformer protection or for Metra future lines.
  6. Flexitest switches, as many as needed, 10-pole for six current and four potential circuits, ABB type FT-1 for switchboard mounting to be used with relay SEL-551.
  7. One (1) removable element position switch with required (minimum of six) interchangeable stages.
  8. One (1) permissive control switch (REMOTE LOCAL), REMOTE position at 12 o'clock and LOCAL clockwise. (Device 43).
  9. One (1) control switch with red and green indicating lamps. (CLOSE-RIGHT TRIP-left).
  10. One (1) ac indicating ammeter, 0-300 Ampere scale.
  11. One (1) ac ammeter switch, three-phase, with OFF position.
  12. Control circuits and contacts as required including four NO and four NC spare contacts.
  13. Provide contacts wired to terminals as required for use with Metra's SCADA control.
  14. Terminal lugs for 3-1/C No. 2/0 AWG Copper, 15 kV EPR insulated, shielded PVC jacketed cable.
  15. One (1) set of space heaters.
  16. Provide Interior Lights per Section 16510
- F. Item 5, Units, 4, and 6: Each 12,600 Vac breaker position for the auxiliary transformers, including but not limited to:
1. One (1) metal-clad stationary unit with 1200 ampere insulated bus.
  2. One (1) insulated 1200 ampere, 15 kV class vacuum circuit breaker removable element with eight-stage auxiliary switch.
  3. Three (3) relaying current transformers 300-5 ampere ANSI accuracy Class C100.
  4. Three (3) relaying current transformers 600-5 ampere ANSI accuracy Class C100.

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5. One (1) microprocessor based solid state overcurrent relay with five outputs and two inputs, conventional terminal blocks, horizontal panel flush mounted, 125 Vdc control input voltage, 5 ampere nominal input current, and standard communication protocol, SEL-551 for rectifier transformer protection or for Metra future lines.
  6. Flexitest switches, as many as needed, 10-pole for six current and four potential circuits, ABB type FT-1 for switchboard mounting to be used with relay SEL-551.
  7. One (1) removable element position switch with required (minimum of six) interchangeable stages.
  8. One (1) permissive control switch (REMOTE LOCAL), REMOTE position at 12 o'clock and LOCAL clockwise. (Device 43).
  9. One (1) control switch with red and green indicating lamps. (CLOSE-right TRIP-left).
  10. One (1) ac indicating ammeter, 0-300 Ampere scale.
  11. One (1) ac ammeter switch, three-phase, with OFF position.
  12. Control circuits and contacts as required including four NO and four NC spare contacts.
  13. Provide contacts wired to terminals as required for use with Metra's SCADA control.
  14. Terminal lugs for three-1/C No. 2/0 AWG copper, 15 kV EPR insulated, shielded PVC jacketed cable.
  15. One (1) set of space heaters.
  16. Provide Interior Lights per Section 16510
  17. One (1) metal clad stationary unit with 1200 ampere insulated bus.
  18. Terminal lugs for three -1/C No. 2/0 AWG copper, 15 kV EPR insulated, shielded PVC jacketed cable for the load side of the fuse assembly for connection to the remote mounted auxiliary transformer.
- G. Remote-mounted Auxiliary Power Transformer and Secondary Breaker.
1. One (1) auxiliary power transformer 225 kVA three-phase 12,600 V, 60 Hz primary with five full-capacity no-load taps consisting of three 2-1/2 percent above and two 2-1/2 percent below the nominal 12,600 volts or as otherwise specified at design conference, full capacity taps and three-phase, four-wire, 120/208 V secondary.
    - a. The taps shall be accessible from the front of the cubicle.
    - b. Provisions shall be made to ensure that taps cannot be connected incorrectly.

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- c. The auxiliary power transformers shall be mounted remote from the switchgear including the molded case circuit breaker described below.
2. Transformer shall be 80 degrees C rise, dry type or epoxy cast, self-cooled, with copper windings. Transformer shall be delta primary/gye secondary with 30 degrees phase shift. Transformer winding insulation shall be Class 220 for dry type and class 185 for epoxy cast.
3. Transformer high-voltage insulation class shall be 15 kV with BIL of 110 kV or more and low-voltage winding shall have 30 kV BIL.
4. The transformer shall have screened access plus vented door for air circulation (vent at top and bottom).
5. The transformer shall be indoor dry type Square D Sorgel type or approved equal.
6. Terminal lugs for the primaries of the transformer shall be provided for three 1/c No. 2/0 AWG copper, 15 kV EPR insulated shielded PVC jacket cable.
7. Secondary of the transformer shall be joined with the secondary breaker to form a standalone metal enclosed unit. The terminals of the secondary of the transformer shall be arranged for bolted connection through flexible bus braids to the bus bars mounted internally for connection to the secondary breaker,
8. One (1) manually operated molded case air circuit breaker, three-pole, 600 Vac, K frame with 600 ampere thermal adjustable magnetic trips set at 500 amperes.
  - a. The breaker shall be joined with the transformer to form one stand-alone metal enclosed unit.
  - b. .
  - c. Terminal lugs shall be provided on the load side of the breaker for four 1/c No. 750 kcmil, copper, 600 volt, insulated cables.

## 2.08 DETAIL EQUIPMENT ARRANGEMENT

- A. Items listed in the Detail Equipment article, above, shall be arranged as described below and shown on the Contract Drawings, and shall be provided as listed below in one continuous integral assembly.
  1. Item 1: Two (2), 12,500 Vac positions for ComEd metering incoming lines 1 and 2.
  2. Item 2: Two (2), 12,500 Vac breaker positions for ComEd incoming lines 1 and 2.
  3. Item 3: One (1), 12,500 Vac bus tie breaker position.
  4. Item 4: Two (2), 12,500 Vac breaker positions for rectifier transformer 1 and 2.

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5. Item 5: Two (2) 12,600 Vac breaker positions for auxiliary power transformers 1 and 2. The auxiliary power transformers 1 and 2 and the associated secondary breakers shall be located remote from the switchgear.

**2.09 ARRANGEMENT OF SWITCHGEAR LINE-UP**

- A. The 15 KV ac switchgear line-up shall be arranged for nine distinct vertical units, numbering 1 to 9 in ascending order, starting from left to right while facing the front of the switchgear.
  1. All Units shall one high units
  2. The switchgear units shall contain the equipment listed in the Detail Equipment article, above, and the line-up shall be arranged in the following sequential order, looking left to right from the front.
    - a. Unit 1 shall contain the equipment listed above in Item 4. The Rectifier Transformer Breaker 1 in the lower compartment. The upper compartment door shall be used for protection and control equipment.
    - b. Unit 2 shall contain the equipment listed in Item 1 above, for ComEd metering Incoming Line-1.
    - c. Unit 3 shall contain the equipment listed in Item 2 above, for ComEd Incoming Line-1.
    - d. Unit 4 shall contain the equipment listed in Item 5 above, for Auxiliary Transformer - 1.
    - e. Unit 5 shall contain the equipment listed in Item 3 above, for Bus Tie Breaker.
    - f. Unit 6 shall contain the equipment listed in Item 5 above, for Auxiliary Transformer - 2.
    - g. Unit 7 shall contain the equipment listed in Item 2 above, for Utility Co. Incoming Line -2.
    - h. Unit 8 shall contain the equipment listed in Item 1 above, for Utility Co. metering for Incoming Line - 2.
    - i. Unit 9 shall contain the equipment listed in Item 4 above. The Rectifier Transformer Breaker 2 in the lower compartment. The upper compartment door shall be used for protection and control equipment

**2.10 PROTECTIVE RELAYS**

- A. Solid state protective relays shall be provided in semi-flush mounted cases with test switches and dust tight covers.
- B. Test switches shall be ABB flexitest switch type FT-1. All output terminals of the relays shall be wired to a test switch contact, whether or not specified or shown on the Contract Drawings.

**2.11 INSTRUMENT TRANSFORMERS**

- A. Current and potential transformers shall have mechanical strength and thermal rating commensurate with rating of associated equipment.

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- B. Relaying current and potential transformer secondary leads shall be wired to terminal blocks for possible future insertion of remote metering. The current leads to these terminal blocks shall be umpired as required.
- C. Shorting type terminal blocks shall be provided for all current transformer secondary leads. No sliding contacts will be permitted on potential transformer secondary wiring.
- D. Relaying potential transformers shall have primary fuses and shall be mounted on draw out or tilt out carriages.
  - 1. Guides for both shall be structurally sound to prevent excessive vertical and horizontal play to assure reliable positive connection.
  - 2. The front of the carriage shall extend up to close the section when the transformer is in the operating position.
  - 3. Primary contacts for the draw out feature shall be designed to maintain proper contact pressure.
  - 4. Structurally reliable, visible grounding devices, when the carriage is fully withdrawn, shall be provided to make certain that the draw out carriage mounted potential transformer primary terminals are grounded when the carriage is withdrawn.
  - 5. Compartments housing the relaying potential transformers may be located above incoming line breaker cubicle.

**2.12 WIRE AND CABLE AND TERMINATIONS**

- A. Secondary and control wiring in each unit, including that on removable element, shall be ICEA Standard Type GRY SIS No. 12 AWG or larger, stranded switchboard wire, insulated for 600 Vac service unless otherwise noted.
  - 1. It shall be factory wired to screw type terminal blocks for top connection to external conductors.
  - 2. Terminal blocks shall be GE Type EB 5, Weidmueller type SAK, Marathon Series 1500, or approved equal.
- B. Cable lugs shall be provided for all power cables.
- C. Provide cable supports, such that all cables will be fully supported, and power cable terminations would not be exposed to the cable weight.
- D. The insulated terminal mounting shall be provided in rectifier, incoming line and outgoing feeder compartments to prevent circulation of current between cable and ac switchgear structure. Provide suitable insulating material and tape to insulate 15 kV service, all exposed current carrying members of the terminators and bus connections.
- E. Provide necessary terminations for the power cables connecting to the load side of the circuit breakers. The cables shall be terminated with stress cones.

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- F. Provide compression-type solderless copper lugs for each terminal block, for external control and instrumentation wires. All control wires shall be terminated using insulated ring type connectors: Burndy Cat. No. YAEV10 L 36, T&B Cat. No. C1 insulated, or approved equal.
- G. Cable markers shall be as specified in Section 16601, General Requirements for Traction Power Equipment.

**2.13 SIGNAGE**

- A. Red laminated plastic tags of the type specified in Section 16601, General Requirements for Traction Power Equipment, shall be mounted on the front and rear doors of each compartment stating "DANGER 12,600 VOLTS" and a separate tag stating "ARC FLASH". The tags shall be engraved in bold letters 1-1/2-inch high.
- B. Additionally, provide all warning signs required by NFPA 70E.
- C. Provide on each shutter an engraved plastic laminated tag with white background and 1-inch high red lettering labeled "DANGER-DO NOT OPEN" as well as warning signs as required per NFPA 70E.

**2.14 SOURCE QUALITY CONTROL**

- A. The manufacturer shall perform all ANSI and IEEE tests, including dielectric, momentary withstand and short circuit, with the breaker in the equipment cubicle.
- B. Assembled control equipment and wiring shall be subjected to a 1-minute test of 3000 Vac phase-to-ground at factory in accordance with IEEE C37.20.1.

**PART 3 - EXECUTION****3.01 INSTALLATION**

- A. See Section 16610, Traction Power Equipment Installation, for ac switchgear installation requirements.

**3.02 TESTING**

- A. See Section 16611, Traction Power Equipment Testing for ac switchgear testing.

**END OF SECTION**

**SECTION 16603**  
**RECTIFIER TRANSFORMER**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section includes the requirements for designing, manufacturing, testing, delivering, installing and commissioning Rectifier Transformers 1 and 2 for the traction power substations.

1.02 RELATED WORK

- A. Section 16010, Basic Electrical Materials and Methods
- B. Section 16510, Lighting
- C. Section 16604, 1500 Volt DC Silicon Rectifier
- D. Section 16606, Anode Bus Duct
- E. Section 16609, Traction Power Support
- F. Section 16610, Traction Power Equipment Installation
- G. Section 16611, Traction Power Equipment Testing

1.03 REFERENCES

- A. This Section incorporates by reference the latest revisions of the following documents:
- B. Code of Federal Regulations (CFR)
  - 1. 29 CFR 1910.95, Occupational noise exposure
- C. Institute of Electrical and Electronics Engineers (IEEE)
  - 1. IEEE 1653.2, Standard for Uncontrolled Traction Power Rectifiers for Substation Applications Up to 1500 V DC Nominal Output
  - 2. IEEE C57.12.00, Standard for General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
- D. National Electrical Manufacturers Association (NEMA)
  - 1. NEMA Standard TR 1, Transformers, Regulators and Reactors
- E. National Fire Protection Association (NFPA)
  - 1. NFPA 70E, Standard for Electrical Safety in the Workplace

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**1.04 SUBMITTALS**

- A. Design Calculations:
1. Submit at design conference design calculations that include, but are not limited to the following:
    - a. Voltage Regulation Curve
    - b. Temperature Rise Curve
    - c. Power Loss Curve
    - d. Efficiency - Load Curve
    - e. Resistance
    - f. Impedance
    - g. X/R Ratio
  2. Shop Drawings:
    - a. The base drawings shall clearly indicate the type of jack pads, their outline dimensions, their location from the longitudinal and transverse axes of the transformer, and the dimensions and location of the base members so as to facilitate design, by others, of the concrete foundation.

**1.05 EXTRA STOCK MATERIALS**

- A. Furnish one pint of touch-up paint with each transformer.

**1.06 QUALITY ASSURANCE**

- A. Manufacturer Experience: The VPI coils shall be fabricated in a facility with at least five years of experience in the manufacture of transformer coils for the use on rapid transit systems, Extra Heavy Traction Service.

**PART 2 - PRODUCTS****2.01 GENERAL**

- A. The rectifier transformers shall be silicon vacuum pressure impregnated (VPI), ventilated, self-cooled, dry type for indoor use.
- B. The design of each rectifier transformer shall be such as to fully coordinate with and operate in conjunction with the specific rectifier provided under Section 16604, 1500 Volt DC Silicon Rectifier.
- C. Each transformer shall have electrical and mechanical characteristics and general design features as specified.

**2.02 ELECTRICAL CHARACTERISTICS**

- A. KVA Rating:
1. Rating commensurate with rectifiers, detailed under Section 16604, Rectifier.

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2. Average winding temperature rise by resistance at a 40°C ambient shall not exceed 80°C after a 2-hour, 162 percent rms load following continuous 100 percent load-stabilized thermal conditions.
  3. Average winding temperature rise by resistance at a 40°C ambient shall not exceed 85°C after temperature stabilizes at 150 percent full load current.
  4. Maximum winding hot spot temperature rise shall not exceed 180°C in an ambient corrected to 40°C after running at 300 percent full load current for 36 minutes following stable thermal conditions at 100 percent full load current.
  5. Winding insulation shall be Class H for a total temperature of 220°C or better.
  6. The Transformer shall be able to withstand a 1,200 percent full Load Current for 12 seconds without damage.
- B. Windings:
1. All windings and connections shall be delta or wye connected copper.
  2. Primary voltage winding shall be for three-phase, 60 Hz, 12,600 Vac nominal.
  3. Transformer shall have three-phase secondary voltage copper windings delta connected, arranged in accordance with Rectifier Circuits No. 25 or 26, as defined in IEEE 1653.2, to provide 6-phase, double-way supply to the rectifier. Voltage and related characteristics shall commensurate with rectifiers detailed under Section 16604, 1500 Volt DC Silicon Rectifier.
  4. All current carrying conductors and connections shall be insulated.
- C. Taps:
1. The rectifier transformer shall be provided with no-load, full-capacity three plus 2-1/2 percent and two minus 2-1/2 percent primary voltage windings taps, complete with necessary manual tap changer mechanism. The rectifier transformer tap voltage ratings shall be as follows:
    - a. 13,545 Volts 12,600 Volts
    - b. 13,230 Volts 12,285 Volts
    - c. 12,915 Volts 11,970 Volts
  2. Removable bolted panel shall be provided for access to high-voltage strap-type connector taps for de-energized tap changing.
  3. Taps shall be arranged such that it is not possible to make any improper tap connection.

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4. No Load Losses.
  - a. No load losses for the 3,000 KW transformer at rated voltage shall not exceed 6,000 watts.
5. Impedance and Insulation Voltage Class:
  - a. Impedance shall be as low as possible consistent with good design. Exact value shall be determined by the guaranteed no-load losses and by the requirements for output voltage.
  - b. Primary voltage insulation class shall be 15 kV with BIL of 110 kV or more. Secondary voltage insulation class shall be 1.2 kV with BIL of 45 kV or more.
  - c. Stand-off insulators and bushings for all terminals shall be porcelain.
6. Primary Entrance Compartment:
  - a. The primary voltage entrance compartment shall make provisions for the top entry and heat shrink terminations similar to Raychem HVT-G/SG termination of the incoming primary voltage 15 kV shielded, 3-1/c No. 2/0 AWG non-metallic jacketed, copper conductor cable from 15 kV ac feeder breaker.
  - b. The primary entrance compartment for rectifier transformer shall include the necessary conduit termination, fittings, cable supports, and connections to the transformer studs.
  - c. Provide cable terminators as specified in Section 16010, Basic Electrical Materials and Methods, suitable insulating material and tape to properly insulate, for 15 kV service, all exposed current carrying members of terminator and transformer studs.
  - d. Provision for mounting terminals shall be provided in the compartment.
  - e. The compartment shall be physically separated via barrier from all other areas of this transformer.
7. Secondary Entrance Compartment:
  - a. Secondary voltage terminals shall be located at the top of the transformer enclosure in an air-filled terminal chamber, arranged for direct bolted connection through flexible connectors to the anode bus duct specified under Section 16606, Anode Bus Duct.
  - b. Bolted readily removable links shall be provided for connecting the bus to the transformer terminals. The terminal enclosure and the bus enclosure shall be joined by bolted connection, providing ready means of separating bus duct from the transformer.
8. Noise Level:
  - a. Noise level shall not exceed 65 decibels (A) at no load with excitation on the transformer when measured in accordance with conditions outlined in NEMA TR 1 and in accordance with 29 CFR 1910.95.

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## 2.03 MECHANICAL CHARACTERISTICS

- A. The transformers shall be so designed that all connections, tap changing devices, meters, relays and probes are easily accessible for inspection and maintenance. Devices such as fuses, switches, terminal blocks, etc. shall be mounted within 18 inches from the face of the cubicle.
- B. The enclosure shall be rodent proof and shall be substantial enough to prevent physical damage to the transformer coils.
- C. The enclosure shall be provided with an interlock system such that the transformer will not be energized when any portion of the enclosure is open. This interlock system shall be of the type that is not affected by vibration, wind or other occurrences that could cause false operations. The security of the enclosure shall be monitored by a light on the front of the enclosure.
- D. The enclosure shall be constructed of panels that are hinged so that panel may be opened in a horizontal direction. Each panel shall have a three-point latching mechanism operated by a padlockable handle.
- E. Vacuum Pressure Impregnated VPI Construction:
  - 1. The completed coil winding (primary and secondary) shall be dried at atmospheric pressure in an oven through which hot air is continuously circulated.
  - 2. After the coil is preheated and dried, it shall be vacuum pressure impregnated in silicone resin. The resin shall be cured on the coil following an established temperature vs. time baking cycle in a hot air circulating oven.
  - 3. After the resin is cured on the coil, a second coating of silicone varnish shall be applied to the impregnated coil and cured as above. The silicone resin shall completely seal the coils against moisture, dirt, and other extraneous contaminants.
  - 4. The VPI coils shall be suitable for operation in an ambient temperature range of -50°C to +50°C without degradation or cracking of the insulation system.
  - 5. The VPI coils must not absorb moisture and shall be suitable for operation at 50°C ambient temperature at 100 percent humidity. The transformers must be suitable for prolonged storage in 100 percent humidity and be capable of immediately being switched on a full voltage and load without pre-drying.
- F. There shall be no rigid mechanical connections tying the secondary and primary coils together. The primary and secondary coils shall be supported and spaced apart by epoxy bottom support blocks, epoxy space blocks, and shock absorbing top epoxy blocks to facilitate thermal expansion and contraction of the coils.

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- G. Windings:
1. The transformer coils should be of round concentric construction. The windings shall be wound without joints to provide minimum voltage stress on insulation.
  2. Secondary voltage coils shall be wound with continuous copper strip or of a helical construction. Primary voltage coils shall be of barrel wound or of continuous disc construction. Splices are prohibited. Insulation system shall be based upon the voltage rating, temperature rating and the compatibility of the insulation with epoxy resin. This includes all appurtenant materials such as ties, mounting pads, etc.
- H. Core-Construction:
1. The transformer core shall be constructed of grain-oriented, high grade non-aging silicon steel laminations with high magnetic permeability and low hysteresis and eddy current losses, stacked in the step or cruciform method to best accommodate a round coil.
  2. Magnetic flux densities shall be kept well below the saturation point. The core shall be a step-lap mitered design and clamped together with heavy steel members. All cores clamping and bolting is insulated with primary temperature insulation.
- I. Core and Coil Assembly:
1. The individual coils shall be assembled on the core so that an even compression on the coils is maintained through the warming/cooling cycles.
- J. The entire assembly shall be braced or bolted adequately to prevent displacement and distortion under all normal conditions of handling and operation under short-circuit conditions. Locking provision shall be made for all inside bolted members or connections. Serial number shall be stamped on core or core clamp in a conspicuous place.
- K. Tap changing shall be possible for one person using simple hand tools. All energized parts shall be adequately insulated. The tap arrangement shall be designed to prevent incorrect tap connections.
- L. Base:
1. The transformer shall be mounted on skids of the I-beam, sled-runner type, or approved equal. Base members shall be suitable for skidding in any direction on rails or rollers. Provide isolation pads under transformer base to eliminate any vibration to the substation structure and floor
  2. Provide jack pads and crane lifting lugs.
- M. Provide two grounding pads on diametrically opposite corners of the base of the transformer with a bolted-type terminal lug with two-bolt NEMA tongue for stranded copper ground cable with range from No. 4/0 AWG through 500 kcmil.

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- N. All exposed metal work shall be thoroughly cleaned, treated against rust and corrosion, and primed with zinc chromate. The transformer shall be finished with two coats of ANSI 61 Light Gray color by powder coat painting process.

**2.04 PROTECTIVE AND MAINTENANCE DEVICES:**

- A. Provide the rectifier transformer with the following protective and maintenance devices:
1. Two-step winding temperature indicator with contacts that close on rising temperature for transformer alarm indication and tripping. There shall be a thermocouple in the secondary voltage center winding.
  2. Door interlocks as specified.
  3. Secondary and control wiring shall be ICEA Standard Type SIS, No. 12 AWG or larger, insulated for 600 Vac service and shall be factory wired to screw-type terminal blocks for top connection to external conductors.
  4. Terminal blocks shall be GE Type EB 5, Weidmueller type SAK, Marathon Series 1500, or approved equal.
  5. Secondary and control wiring shall be in rigid conduit, galvanized inside and outside, except for short flexible connections to devices, which shall be Sealtite flexible conduit, or approved equal.
  6. Push to test indicating LED blue light shall be provided on the transformer enclosure to monitor door condition. Blue light ON shall indicate when a transformer enclosure door is open. A nameplate shall be provided above the blue light.
  7. Nameplates showing winding connections, voltages, ratings, impedance, serial number, and other information as may be required, in accordance with IEEE C57.12.00.
  8. Warning signs as required by NFPA 70E at the appropriate location.
  9. Interior Lights per Section 16510, Lighting

**2.05 DETAIL EQUIPMENT**

- A. The rectifier transformers shall be provided with winding connections as listed below.
1. Item 1: Indoor dry type VPI coil construction rectifier transformer complete with all accessories. The transformer winding connections shall be 12,600 V delta primary with secondary winding delta connected, suitable for operation with a 3,000 KW, six-phase double-way rectifier, as per IEEE 1653.2, rectifier circuit number 25.
  2. Item 2: Indoor dry type VPI coil construction rectifier transformer complete with all accessories. The transformer winding connections shall be 12,600 V wye primary with secondary winding delta connected, suitable

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for operation with a 3,000 KW, six-phase double-way rectifier, as per IEEE 1653.2, rectifier circuit number 26.

**2.06 QUANTITY OF EQUIPMENT REQUIRED**

- A. Item 1: One (1) indoor dry type VPI coil construction rectifier transformer rectifier circuit number 25, complete with all accessories as described in the Detail Equipment article, above. The transformer shall be tagged: "Rectifier Transformer No. 1."
- B. Item 2: One (1) indoor dry type VPI coil construction rectifier transformer rectifier circuit number 26, complete with all accessories as described in the Detail Equipment article, above. The transformer shall be tagged: "Rectifier Transformer No. 2".

**2.07 SOURCE QUALITY CONTROL**

- A. The manufacturer of the VPI coils shall perform factory certified tests showing that prototype coils, rated 500 KVA minimum have been subjected to temperature shock tests whereby the coils have undergone temperature changes of 100°C (minimum) in a 5-minute (maximum) time period either by heating a cold transformer or cooling a hot transformer followed by a 110 KV BIL test.
- B. Following this test, the transformers shall be examined for cracking by both visual testing and corona discharge testing.
- C. In the absence of such certified test, the Contractor shall arrange for factory witness testing of this type of shock testing. No dry type transformer design will be accepted without such certified or witnessed tests.

**PART 3 - EXECUTION****3.01 INSTALLATION**

- A. See Section 16610, Traction Power Equipment Installation, for the rectifier transformer installation requirements.

**3.02 TESTING**

- A. See Section 16611, Traction Power Equipment Testing, for the rectifier transformer testing requirements.

**3.03 SUPPORT EQUIPMENT**

- A. See Section 16609, Traction Power Support, for the rectifier transformer support equipment requirements.

**END OF SECTION**

**SECTION 16604**  
**1500 VOLT DC SILICON RECTIFIER**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section includes the requirements for designing, manufacturing, testing, delivering, installing, and commissioning indoor metal enclosed 1,500 volt, six-pole dc silicon rectifier assemblies.

1.02 RELATED WORK

- A. Section 16510, Lighting
- B. Section 16603, Rectifier Transformer
- C. Section 16605, 1500 Vdc Switchgear
- D. Section 16609, Traction Power Support
- E. Section 16610, Traction Power Equipment Installation
- F. Section 16611, Traction Power Equipment Testing

1.03 REFERENCES

- A. This Section incorporates by reference the latest revisions of the following documents:
- B. Institute of Electrical and Electronics Engineers (IEEE)
  - 1. IEEE 1653.2, Standard for Uncontrolled Traction Power Rectifiers for Substation Applications Up to 1500 V DC Nominal Output
  - 2. IEEE 730 - Standard for Software Quality Assurance Plans
- C. JEDEC Solid State Technology Association (JEDEC)
  - 1. JESD282B.01, Silicon Rectifier Diodes (formerly ANSI/EIA 282-A)
  - 2. International Electrotechnical Commission (IEC):
- D. IEC 60255-21 Electrical Relays - Part 21: Vibration, Shock, Bump and Seismic Tests on Measuring Relays and Protection Equipment:
  - 1. IEC 60255-21-1 Section One: Vibration tests (sinusoidal).
  - 2. IEC 60255-21-2 Section Two: Shock and bump tests.
  - 3. IEC 60255-21-3 Section Three: Seismic tests.

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4. IEC 61000-4-3 Electromagnetic Compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test.
5. IEC 61131-2 Programmable Controllers - Part 2: Equipment Requirements and Tests

**1.04 SUBMITTALS**

- A. Submit at design conference complete design calculations, which shall include, but not be limited to, the following:
  1. Voltage Regulation Curve.
  2. Power Factor - Load Curve.
  3. Efficiency - Load Curve.
  4. Harmonic Amplitude - Load Curve for 5th, 7th, 11th and 13th harmonics.
  5. Commutation Reactance for  $X/R = 15$ .
  6. Momentary Peak and Sustained Short Circuit Current.
  7. Fuse Rating Calculations
- B. Submit at design Conference
  1. Product Data for HMI and PLC
  2. Submit full-scale color views of each display View
  3. Logic diagrams, for Rectifier Operation

**1.05 EXTRA STOCK MATERIALS**

- A. Furnish one quart of matching touch-up paint with each assembly.

**PART 2 - PRODUCTS****2.01 GENERAL**

- A. The rectifiers will be copper bussed directly from the rectifier transformers specified in Section 16603, Rectifier Transformer, and will serve as the source of supply for the dc switchgear specified in Section 16605, 1500 Vdc Switchgear. Rectifier circuits shall be IEEE 1653.2, circuit 25 or 26.
- B. The rectifiers, using outside air under ambient conditions, shall be designed for parallel, non-attended operation and shall function as integrated units with associated transformers and switchgear.

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**2.02 RATING AND CONFIGURATION**

- A. Each complete rectification package (including rectifier transformer, rectifier and anode bus) shall have a continuous full load output rating of 3000 kW at 1,500 Vdc at a maximum ambient-room temperature for 40°C (104°F).
- B. After constant temperature rise is reached following continuous full load, they shall be capable of operating guaranteed overload equal to base overload of 150 percent full load current for 2 hours and superimposed cycle overload consisting of five periods of 1 minute each of 300 percent full load current, followed by one period of 450 percent full load current for 15 seconds, spaced throughout the 2-hour period, in accordance with IEEE 1653.2, extra heavy traction service.
- C. Each complete rectifier package (including rectifier, transformer and anode bus) shall have a full load overall efficiency of not less than 97.5 percent, a displacement power factor above 90 percent lagging and a regulation or voltage characteristic based on 500 MVA ac supply capacity and X/R ratio of 15 such as to provide output voltage within the limits set forth below when ac system voltage at no load corresponds to transformer tap voltage. These limits shall be met on all transformer taps. All dc values shall be based on use of averaging type meters.

<b>Output Current</b>	<b>Output Voltage DC</b>
0.5 percent Full Load	1,603 to 1,590
100 percent Full Load	1,525 to 1,500
150 percent Full Load	1,485 to 1,455
300 percent Full Load	1,363 to 1,323
450 percent Full Load	1,250 to 1,188

- D. Each complete rectifier package (including rectifier transformer, rectifier and anode bus and ac and dc switchgear) shall be capable of withstanding a bolted short circuit on the rectifier output terminals without damage to any component, including protective fuses and rectifier elements immediately following the 2-hour overload period specified above.

**2.03 PROTECTIVE DEVICES**

- A. The rectifiers shall be designed so that damage to the rectifier elements and fuses is prevented by current time overload relays.
- B. Thermal devices on heat sinks shall take rectifier out of service and prevent rectifier operation under any combination of excessive ambient temperature, reduced heat sink efficiency and/or excessive load such that the rectifier elements and fuses are no longer afforded complete protection by the current time overload relays.
- C. Each thermal device shall be mounted and wired to the terminal blocks to permit easy removal.

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**2.04 SILICON DIODES**

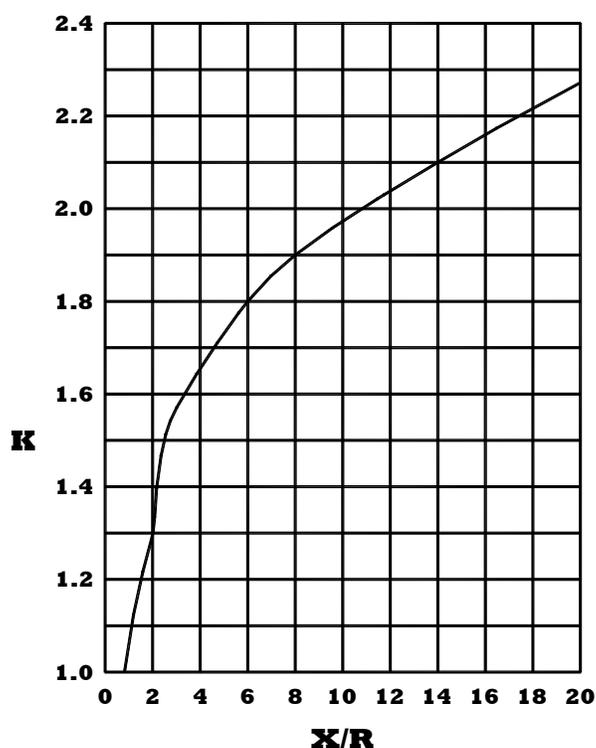
- A. The manufacturer shall provide a sufficient number of diodes per phase, polarity to fulfill all the requirements of this Section, but in no case shall the number of diodes provided per phase polarity be less than the number "D" determined by the following calculations:
1. Let D = Minimum quantity of diodes per phase leg.
  2. Let C = Published diode peak surge current rating in amperes (maximum peak value of rated non-recurrent one cycle sinusoidal current on a 60 Hz basis). Must conform to JESD282B.01.
  3. Let X/R = Overall reactance-to-resistance ratio, including alternating current supply system, transformer, bus duct, and rectifier.
  4. Let K = 2.12 for X/R = 15
  5. Let Es = Rectifier transformer low-voltage winding voltage, line-to-line, at no load
  6. Let Iss = Average dc sustained short circuit current with rectifier output terminals bolted, with 500 MVA supply system at 12.6 kV, and

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$$Z = \sqrt{R^2 + X^2} \text{ and } I_{ss} = \frac{1.35(Es)}{(\sqrt{3})(Z)}$$

$$\text{Then } D = \left[ \frac{0.74(I_{ss}) + \left(\frac{C}{\sqrt{2}}\right)\left(\frac{1}{K}\right)}{\left(\frac{C}{\sqrt{2}}\right)\left(\frac{1}{K}\right) - 0.0074(I_{ss})} \right] + 1$$

**Transient RMS Factor K as Related to the System X/R Ratio****2.05 RECTIFIER ASSEMBLY**

- A. Rectifier assemblies shall include interchangeable diodes, fuses, and interconnecting links throughout the rectifier section to permit interchangeability without affecting current balance compliance.
- B. The rectifier assembly shall include one section containing the devices required for control and supervision as specified or shown on Contract Drawings.
  1. Normal control equipment and circuits shall be physically accessible, and so connected as to permit convenient testing and maintenance of relays and control circuitry.

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2. All devices such as fuses, switches, terminal blocks, etc. shall be mounted within 18 inches from the front of the cubicle.
- C. The rectifier assemblies shall be of the indoor, freestanding, metal enclosed type with hinged doors having rubber gasketed transparent safety glass panes, on the rectifier section and hinged doors on the auxiliary and/or control sections.
1. Provisions shall be made to prevent energizing the rectifier while any door on rectifier section is open.
  2. All doors shall be securely fastened in the closed position with a minimum of three latches and easily opened without the use of tools.
  3. All doors shall have edge stripping and be lockable with a padlock.
- D. The rectifiers shall have jacking and lifting pads. The manufacturer shall design lifting provisions at the base of the rectifier where straps and spreaders can be attached to crane to hoist it.
- E. Rectifier assemblies 1 and 2 will be joined with dc switchgear cubicles 1 and 2 to form a continuous line-up. While facing the front of the line-up, the arrangement from left to right shall be as follows: rectifier -2 assembly, dc switchgear cubicle-2, dc switchgear cubicle-1, and rectifier -1 assembly.
- F. The back of the rectifier panels shall have thumb-style bolts.
- G. A 1/4-inch thick boxed micarta or fiberglass section shall be provided for the entire width and height between rectifier assemblies and dc switchgear cubicles and between dc switchgear cubicles 1 and 2 to electrically isolate from each other.
- H. The incoming copper terminals of the rectifier shall be located at the top of the enclosure in an air filled terminal chamber and shall be arranged for bolted connection to the anode bus rated for 3,000 amperes.
1. The anode bus will be connected to the low-voltage terminals of the rectifier transformer.
  2. Flexible bus braids shall be used for terminating the anode bus at both ends. Bolted removable links shall be provided for connecting anode bus to the rectifier terminals.
  3. The rectifier supplier shall coordinate with the transformer supplier for mounting details and method of termination at the rectifier as well as at the transformer end.
  4. The terminal lugs and all the miscellaneous hardware for mounting and terminating the anode bus at both ends shall be supplied by the rectifier supplier.

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- I. The outgoing positive terminals of the rectifiers shall be arranged for bolted connection to the copper interconnecting bus bars (cathode bus) rated for 3,000 amperes and mounted internally in the rectifier cubicles.
  1. Bolted removable links shall be provided for connecting cathode bus to the rectifier terminals.
  2. The cathode bus will be connected to the line terminals of the main dc circuit breakers in the dc switchgear.
  3. Flexible bus braids shall be used for terminating the cathode bus at both ends. The cathode bus and bus braids shall be furnished by the rectifier manufacturer.
  4. The rectifier supplier shall coordinate with the dc switchgear supplier for mounting details and method of termination at the rectifier as well as at the dc switchgear end.
  5. The terminal lugs and all the miscellaneous hardware for mounting, supporting and terminating the bus bars at both ends shall be supplied by the rectifier supplier.
  
- J. The outgoing negative terminals shall be copper, located at the top of the enclosure in an air filled terminal chamber.
  1. The 1,500 kcmil solderless removable type terminal lugs shall be provided for each of the three negative cables for each rectifier.
  2. The solderless type lugs shall a Penn Union type V V L or approved equal.
  
- K. The secondary control and supervisory control wiring shall be ICEA Standard Type SIS No. 12 AWG or larger stranded switchboard wire, insulated for 2,000 Vdc service, or similar to BOSTRAIL AAR S501 car wire, 2 kV, extra flexible, XLPO insulation, soft annealed copper stranded conductor, as manufactured by DRAKA USA.
  1. Cables shall be factory wired to screw-typed terminal blocks for connection to external conductors.
  2. The terminal blocks shall be GE Type EB-5, Weidmuller type SAK, Marathon Series 1500 or approved equal.
  
- L. The dielectric floor under rectifier assemblies and dc switchgear cubicles shall be prepared from plastic resin cement Amazite or approved equal, 3/8-inch thick, to insulate the rectifiers and dc switchgear cubicles from the building structure.
  1. The rectifiers and dc switchgear cubicles shall be secured to the insulated epoxy floor with approved insulated anchors.
  2. The plastic resin floor area shall extend 3 feet past the lineup on all sides, unless Drawings indicate otherwise.

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- M. All metal work shall be thoroughly cleaned, treated against rust and corrosion, bonderized, and finished with two coats of ANSI 61 light gray color by powder coat painting process.

**2.06 DETAIL EQUIPMENT**

- A. The equipment to be provided shall be for use in the coordinated system shown on the Contract Drawings and shall be in accordance with the following.
- B. One (1), 3,000 kW, 1,500 Vdc silicon rectifier indoor units with rectifier circuit number 25 shall be provided to the substation site.
- C. One (1), 3,000 kW, 1,500 Vdc silicon rectifier indoor units with rectifier circuit number 26 shall be provided to the substation site.
- D. Each 1,500 Vdc indoor, self-cooled metal enclosed silicon rectifier assembly shall be incorporated into one continuous enclosure and made up of compartments including but not limited to the following:
1. One (1) set of current limiting fuses in the connections to each silicon diode that will protect all remaining diodes in the event of any diode failure, complete with one (1) diode fuse monitor.
    - a. Fuse monitoring system shall consist of target type fuses that are clearly visible in illuminated enclosure with internal lights and panel switch.
    - b. Opening of one fuse in each phase polarity shall not reduce specified capacity nor adversely affect ability to withstand short circuit.
  2. Each individual silicon diode shall be hermetically sealed and mounted on adequate air-cooled heat sink for maximum heat dissipation. Provide twelve (12) circuit opening on rising temperature, bimetallic thermal devices, mount on diode heat sinks, and connect as follows:
    - a. Three thermal devices shall be connected to provide rectifier positive first-step high temperature alarm (the contacts wired to relay 26D1 located in the auxiliary cubicle).
    - b. Three thermal devices shall be connected to provide rectifier negative first-step high temperature alarm (the contacts wired to relay 26D1A located in the auxiliary cubicle).
    - c. Three thermal devices shall be connected to provide rectifier positive second-step high temperature trip (the contacts shall be wired to relay 26D located in the auxiliary cubicle).
    - d. Three thermal devices shall be connected to provide rectifier negative second-step high temperature trip (the contacts shall be wired to relay 26DA located in the auxiliary cubicle).
  3. Provide reactors of sufficient size, or other equivalent means, to maintain current balance between diodes in each phase polarity and hold individual diode currents within guaranteed capability under all load

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conditions up to and including 450 percent full load current with one fuse per phase polarity open.

- a. Unless they are completely interchangeable, the reactors or other devices shall be keyed or otherwise mechanically matched to ensure that they are always inserted in the proper location.
  - b. With any diode fuse open at any and all rated loads, the current in any other paralleled diode in the same phase polarity shall not exceed its pro rata share by an amount greater than 20 percent.
  - c. The pro rata share is defined as the total rated phase polarity current divided by the number of paralleled diodes in that phase polarity. The use of matched diodes will not be acceptable for this purpose.
  - d. The diodes shall have a minimum repetitive peak inverse rating of 5,400 volts. Each individual silicon diode shall be hermetically sealed and mounted on adequate air cooled heat sink for maximum heat dissipation.
  - e. The diode shall be as manufactured by Westcode.
4. The surge protective devices shall limit the repetitive reverse voltage surges, induced during lightning, faults, and switching, or by operation of trains across the diode, to within 75 percent of the peak reverse voltage (PRV) rating of the diodes.
- a. Two sets of surge protectors shall be provided; one set each for ac and dc portion of the rectifier.
  - b. The surge protectors rating shall be based on the calculated short circuit current of the system.
  - c. Failure of surge protector resulting in a blown fuse shall be annunciated by means of an auxiliary relay.
5. Each rectifier shall be able to withstand a transient surge voltage of 3000-volt crest and 1.5 X 40 microsecond full-wave shape of either polarity applied to all rectifier terminals, including cathode terminal while operating at rated current and full rated temperature.
- a. In addition, the rectifier shall withstand lightning surges of 75-kV crest and 1.5 X 40 microsecond wave shape applied to the rectifier output terminals.
  - b. Surge diverter micro switches shall be wired to an auxiliary relay (Device 99Y) its failure shall be annunciated on the HMI.
6. One (1) set of the interlock switches (Device 33) designed to de-energize the rectifier when the rectifier access door(s) are opened, exposing live parts.
- a. The interlock contacts shall trip device 86.
  - b. The switches shall be of the type that would keep the door open in the bypass position without tripping device 86.
  - c. This procedure is to be accomplished by turning the rectifier off first, then placing the switch in bypass position, and after the

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- rectifier door is opened, the rectifier shall be able to be energized without tripping.
- d. The bypass position will be used only during maintenance testing.
7. One (1) manual negative lead disconnecting switch (Device 89N), single pole, 2,000 Vdc, 3,000 ampere.
    - a. The switch shall be operable by an insulated handle and mounted inside the rectifier enclosure.
    - b. The switch shall be Pringle by Eaton, or approved equal.
  8. One (1) auxiliary control compartment isolated from primary portion of the rectifier by suitable barrier, including the following:
    - a. One local control switch (CLOSE right TRIP left), (Device 1).
    - b. One master control relay, (Device 4).
    - c. One auxiliary master control relay, (Device 4X).
    - d. One lockout relay with hand reset, (Device 86).
    - e. One conditional lockout relay, (Device 86X).
    - f. One push to test blue indicating light for device 86 integrity monitoring.
    - g. One permissive control switch (REMOTE-LOCAL with REMOTE position at 12 o'clock and LOCAL clockwise), (Device 43).
    - h. One incomplete sequence relay, (Device 48).
    - i. Other low control devices.
  9. One (1) set ground detection equipment, including adjustable relays, associated devices and semiconductor rectifier type auxiliary dc power supply to furnish continuous supervision of insulation of rectifier enclosure from station ground, railway negative, and rectifier components.
    - a. The positive potential 75 volts on the rectifier enclosure shall cause lockout and de-energization of the rectifier (Device 164M).
    - b. Loss of insulation to ground or railway negative shall cause alarm (Device 164X).
    - c. Ground detection equipment must function without damage on structure potential up to 2,000 volts above ground potential.
    - d. The alarm voltage and sensitivity shall be adjustable.
    - e. The structure ground relay shall be high-resistance Swartz type 64.
  10. One (1) dc voltmeter 0-2,000 Vdc scale.
  11. One (1) Programmable Logic Controller PLC
    - a. General
      - 1) Monitoring and control of the traction power equipment
      - 2) A self-diagnostic routine to respond promptly, safely and predictably to detected faults within the Substation
    - b. Communication

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- 1) Provide Communication to the TPS RTU via Fiber optic Cable
  - 2) Collect the information from devices without a communication link through a dry-type input contact
  - 3) Send out commands to devices without a communication link through a dry-type output contact.
  - 4) Monitor the integrity of the Communication Link and activate an Alarm on the HMI if Communication is lost with Substation RTU.
- c. Sampling:
- 1) Sample input conditions at rates sufficient to detect and remedy unsafe or damaging conditions in the shortest possible time.
  - 2) Sampling rates and program execution times shall be such that the control system is not the limiting factor in response to unsafe or damaging conditions.
- d. Time Synchronization:
- 1) Synchronize PLC/HMI Time with SCADA System Time.
  - 2) Design software to ensure that the timing requirements for safety-related tasks are always met
12. Separate terminal blocks shall be provided within the rectifier enclosure to accommodate all wiring from the incoming alarms
13. One (1) HMI touch Screen
- a. General Requirements
- 1) Not Less than 1920 x 1080 pixel
  - 2) Size: minimum 20 inches diagonal
  - 3) Provide a Windows-based user interface on touch screen.
  - 4) Provide connection options for external periphery units (keyboard, mouse, and laptop), e.g. via a USB interface.
  - 5) Minimum 64 bit RISC CPU.
  - 6) Minimum Configuration Memory: 64 Mbyte
  - 7) Flush mount the HMI in the Door of the Rectifier Control Cabinet.
- b. Screens
- 1) Home Screen Provide the following Information
    - a) Silence Button           Manually Silence the Horn
    - b) Acknowledge Button   Acknowledge Active Alarms
    - c) Any other Buttons required to operate the Device
    - d) Current Time and Date
    - e) Manufacturer's Logo
    - f) Metra's Logo
    - g) Substation Name

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- 2) Annunciation View: Provide Local Annunciation (Device 30) for all required alarms. Refer to contract Drawings for annunciation points
  - a) Steady Green Good Condition
  - b) Flashed Red New Alarm
  - c) Steady Yellow Acknowledged Alarm

Each Annunciation Window shall be at least 2 inches wide and 1.5 inches high. Clearly labelled and easily readable
- 3) Event History: All Alarms shall be entered in the Event History. The device shall be capable of recording up to 2000 Events (Alarms/Trips/Switching Operations). Each entry shall at a minimum provide the following information
  - a) Date
  - b) Time
  - c) Description of the Even
  - d) Status (Active/Acknowledged)
14. HMI Trouble: In addition to the touch screen, an extra LED shall be provided to indicate Trouble. The LED Shall be illuminated every time when an Alarm is active (New Alarm and Acknowledged Alarm).
15. One alarm horn. The horn shall be 125 Vdc, surface mounted type and shall have 16 selectable tones. The horn when actuated shall be silenced automatically in 30 seconds by means of an adjustable timing relay or manually by the silence pushbutton. The alarm horn shall be Panalarm Cat. No. NT2-24D, or approved equal.
16. One (1) Flexitest switch, 10-pole ABB type FT-1 for
  - a. 32 Protection Trip
  - b. 32P Protective Trip
  - c. 64HS from Tie Breaker Station.
  - d. 186 trip from Tie Breaker Station.
17. One (1) rectifier positive first-step alarm relay (Device 26D1).
18. One (1) rectifier negative first-step alarm relay (Device 26D1A).
19. One (1) rectifier positive second-step high-temperature conditional lockout trip relay, (Device 26D).
20. One (1) rectifier negative second-step high-temperature conditional lockout trip relay, (Device 26DA).
21. One (1) auxiliary to devices 26D and 26DA (Device 26X).
22. One (1) surge protection monitoring relay (Device 99Y).
23. One (1) lot ac and dc control power disconnect devices with overload protection, all rated 600 volts, (Devices 8 and 8R).

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24. One (1) set of terminal blocks with 10 percent, but not less than four spare terminals.
25. One (1) stainless steel nameplate per IEEE 1653.2.
26. Interior Lights per Section 16510, Lighting
27. Fuses used inside the Rectifier in 1,500 V dc Circuits shall be equipped with a striker Pin Similar to SIBA 90 081 10.xx

**2.07 QUANTITY OF EQUIPMENT REQUIRED**

- A. Two (2), 3,000 kW, 1500 Vdc silicon rectifier units; one with rectifier circuit number 25 and one with rectifier circuit number 26. Each rectifier shall be equipped as detailed in the Detail Equipment article, above, and shall be arranged for assembly as shown on the Drawings and tagged as follows:
  1. "Rectifier No.1" for circuit 25
  2. "Rectifier No.2" for circuit 26

**PART 3 - EXECUTION****3.01 INSTALLATION**

- A. See Section 16610, Traction Power Equipment Installation, for the silicon rectifier installation requirements.

**3.02 TESTING**

- A. See Section 16611, Traction Power Equipment Testing, for the silicon rectifier testing requirements.

**3.03 SUPPORT EQUIPMENT**

- A. See Section 16609, Traction Power Support, for the support equipment requirements.

**END OF SECTION**

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**SECTION 16605**  
**1500 VOLT DC SWITCHGEAR CUBICLES**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section includes requirements for designing, manufacturing, testing, delivering, and commissioning indoor metal enclosed draw-out type 1500 Vdc switchgear for two rectifier circuit breaker cubicles, 1 and 2.
- B. Rectifier breaker cubicles 1 and 2 will be supplied directly from 3000 kW, 1500 Vdc rectifiers 1 and 2, respectively, and will serve as the dc traction power supply to the existing 1500 Vdc switchgear lineup located in the adjacent tie breaker station building

1.02 RELATED WORK

- A. Section 16601, General Requirements for Traction Power Equipment
- B. Section 16604, 1500 Volt DC Silicon Rectifier
- C. Section 16609, Traction Power Support
- D. Section 16610, Traction Power Equipment Installation
- E. Section 16611, Traction Power Equipment Testing
- F. Section 16641, Dielectric Flooring.

1.03 REFERENCES

- A. This Section incorporates by reference the latest revisions of the following documents:
- B. National Electrical Manufacturer's Association (NEMA)
  - 1. NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum)
- C. National Fire Protection Association (NFPA)
  - 1. NFPA 70E, Standard for Electrical Safety in the Workplace
- D. Institute of Electrical and Electronics Engineers (IEEE)
  - 1. IEEE Std C37.20.1 IEEE Standard for Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear
  - 2. IEEE Std. C37.14 IEEE Standard for DC (3200 V and below) Power Circuit Breakers Used in Enclosures

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**1.04 EXTRA STOCK MATERIALS**

- A. Furnish one quart of matching touch-up paint.

**1.05 TOOLS**

A.

- B. Provide the following accessories for each substation.

1. Accessories for handling removable components in the switchgear assembly, including the following:
  - a. Two breaker racking handles
  - b. Two maintenance closing devices
  - c. Fork-lift type breaker handling dolly (or wheeled removable element)
  - d. Arc chute removing device
2. All accessories shall be designed for reasonable handling of removable components by one person of average strength.
3. A centering device may be required for the racking handle if the handle has difficulty in engaging the racking mechanism.

**PART 2 - PRODUCTS****2.01 GENERAL**

- A. Circuit breaker cubicles 1 and 2 shall be joined together with rectifier assemblies 1 and 2 to form a continuous line up. While facing the front of the line-up, the arrangement from left to right shall be as follows: rectifier -2 assembly, circuit breaker cubicle- 2, circuit breaker cubicle-1, and rectifier -1 assembly
- B. Combination fuse disconnects shall be fully enclosed. The fuses shall be installed in enclosed fuse blocks and shall be draw-out or removable type.
- C. Current shunts, impulse transformers, transducers and other such equipment shall be accessible for testing and maintenance with the bus energized. All transducers shall be separately fused.
- D. The circuit breaker control circuit shall be arranged for both local and remote control and indication wired to suitable terminals for the top connection to an external control equipment.

**2.02 SWITCHGEAR ENCLOSURE**

A. Doors:

1. Eleven gage Hinged doors shall be provided at front of each circuit breaker unit, suitable for mounting relays, meters, instruments and control devices.

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2. Doors shall be formed of sheet steel and shall be properly reinforced against distortion by suitable flanges and stiffening members.
  3. Hinges shall be heavy duty of a type approved by the Metra's Authorized Representative.
  4. Full height doors shall be securely fastened in the closed position with a minimum of three latches and easily opened without the use of tools.
  5. For doors less than the full height of the equipment, a minimum of two latches will be acceptable.
  6. Doors shall be provided with two stop positions, 90 degrees and 110 degrees to hold them securely in the open position. Door stops shall be approved by Metra's Authorized Representative.
  7. With the front door of any compartment in the 90 degree open position it shall not prevent the adjacent compartment door from being opened and its breaker completely removed from its housing.
- B. Warning Signs:
1. Provide an engraved plastic laminated tag with white background and 1-inch high red lettering labeled "DANGER-DO NOT OPEN" and a warning sign as required by NFPA 70E on each shutter.
- C. Finish: Metal work shall be thoroughly cleaned, treated against rust and corrosion, primed, bonderized, and finished with two coats of ANSI-61 light gray color by powder painting process.
- D. Circuit Breaker Cubicle:
1. The switchgear shall have the capability of racking the breakers into the connected position from the test position with door closed.
  2. Breaker must be arranged so personnel are guarded from contact with energized parts while racking the circuit breaker into or out of the connected position.
  3. Structurally reliable automatic shutters shall be provided to prevent accidental personnel contact with current-carrying parts when the removable element is in the test, disconnect, or completely withdrawn position.
  4. The secondary disconnect, test and wiring within the cubicle shall be accessible from the front of the cubicle.
  5. A centering device may be required for the racking handle, if the handle has difficulty in engaging the racking mechanism.
  6. The control equipment and circuits, whether mounted on the compartment door or other portion of the stationary unit structure, must be physically accessible and so connected as to permit testing and/or

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maintenance of relays and control circuitry in de-energized condition while the circuit breaker is in its normal operating position

7. The circuit breaker cubicles shall be arranged for bottom entrance of all outgoing power circuits. Three 1500 kcmil solderless removable type terminal lugs (Penn Union type VVL, or approved equal) shall be provided for each breaker.

E. Control Wiring:

1. A separate circuit shall be provided to each breaker cubicle for control, tripping, metering, and relay circuits from 125 Vdc sub distribution panel located in the tie breaker section of 15 kV ac switchgear.
2. The secondary and control wiring in each circuit breaker cubicle including that on removable element shall be ICEA Standard Type GRY SIS, No. 12 AWG or larger standard switchboard wire, insulated for 2000 Vdc service or similar to BOSTRAIL AAR S-501 car wire, 2 kV, extra flexible, XLPO insulation, soft annealed copper stranded conductor, as manufactured by DRAKA USA.
3. Circuit breaker control circuit in each cubicle shall be separately fused.
  - a. Fuse holders shall be ultra-safe type similar to Ferraz Shawmut fuse holder, where energized parts are not exposed until fuse is disconnected from the circuit.
  - b. Fuses shall be rated 2000 Vdc.
  - c. Switches rated 2000 Vdc shall also be provided to disconnect each breaker control circuit. In addition, each circuit breaker close circuit shall be protected by a secondary set of fuses to prevent opening of main fuses (and loss of trip ability) on close circuit faults.
  - d. Fuse sizes shall be of appropriate current rating with 20,000 ampere dc (minimum) interrupting rating. All necessary fuses shall be provided with the equipment.
4. Frames of relays and other devices mounted on energized breaker frame and operated on 125 Vdc shall be insulated for 2000 Vdc from the frame
5. Circuits requiring external connections shall be factory-wired to screw-type terminal blocks for connections to field wiring.
  - a. Terminal blocks shall be General Electric Company, type EB-5, (Weidmueller Type SAK, Marathon Series 1500) or approved equal.
  - b. Wiring terminations shall be ring style compression type, and shall be accessible from the front of the cubicle.

## 2.03 RECTIFIER CIRCUIT BREAKERS 1 AND 2

- A. Type: 1500 Vdc, single pole, air break, draw-out type without negative disconnecting device; semi-high or high-speed classification; suitable for

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operation on a system load bus supplied directly from two 3000 KW, 1500 Vdc rectifiers operated in parallel.

- B. The circuit breakers shall either be capable of withstanding a fault until ac relays switch off the rectifiers, or tripping a device which will protect the circuit breaker from damage under the fault conditions.
- C. The operating mechanism shall be suitable for operation from the 125 Vdc supply and shall be electrically and mechanically trip free.
- D. A register type operations counter shall be mounted on the removable element.
- E. The tripping devices shall be furnished as required to provide reliable coordinated protection for the system. They shall have operating characteristic and adjustable ranges such as to trip for faults as outlined in Section 16601, General Requirements for Traction Power Equipment. Range of trip settings shall be as specified in detail Specifications and calibration scales shall be calibrated covering full range of adjustable setting with breaker in cubicle.
- F. Circuit breakers that are magnetically latched shall be latched by flux produced from control power and tripped by interaction between this flux and flux produced by circuit breaker primary current.
  - 1. The magnitude of latch flux shall be at least 200 percent of the minimum value required for successful closing of the circuit breaker without primary current.
  - 2. The circuit breaker tripping arrangement may be responsive to rate of rise of reverse current by use of inductive shunts or other means as approved by Metra's Authorized Representative. The control power current for the magnetic latch shall not exceed 500 mA.
- G. Mechanical and Electrical Interlocks:
  - 1. Positive-acting mechanical and electrical interlocking system shall be provided so that a breaker in the closed position cannot be disconnected from or connected to the bus.

**2.04 RATINGS**

- A. The circuit breakers shall have peak current, momentary current, short time current and short circuit current ratings required for operation in a substation with two 3000 kW rectifiers of the type specified in Section 16604, 1500 Volt DC Silicon Rectifier, when supplied from a 12.46 kV, 60 Hz system capable of delivering 500 MVA with an X/R ratio of 15. The specified short circuits are those applied to the load terminals of the existing dc feeder circuit breakers at the tie station and to the load terminals of the rectifier main dc circuit breakers, and negative of the rectifiers.
- B. High-speed dc circuit breakers which limit peak value of short circuit current shall have short circuit current rating equal to or greater than the maximum available prospective peak short circuit current and maximum available rate of rise of short circuit current under the short circuit conditions specified. The short circuit rating

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of the circuit breaker with delayed tripping shall not be less than 100,000 amperes.

- C. Semi-high-speed dc circuit breakers which do not limit peak value of short circuit current shall have short circuit current rating equal to or greater than the maximum available short circuit current during short circuit interruption under the short circuit conditions specified.
- D. The dc circuit breakers shall either be capable of withstanding a fault on the 1500 Vdc bus until ac relays trip the rectifier transformer feeder breaker at the ac switchgear, or shall have a tripping device that shall protect the circuit breaker from damage under bus fault conditions.
- E. The dc circuit breakers shall have momentary current rating which is equal to or greater than the maximum available peak circuit breaker current with a short circuit at the load terminals of the circuit breaker. The momentary current rating is defined as the peak value of current which the closed circuit breaker can withstand without impairing the circuit breakers ability to meet its continuous current rating.
- F. The dc circuit breakers shall have short time current rating which is equal to or greater than the maximum rms value of available circuit breaker current during a period of 250 ms following application of short circuit to the load terminals of the circuit breaker. The rated short time current is defined as the designated limit of available rms current which the circuit breaker can carry for a period of 250 ms, without impairing the circuit breakers ability to carry rated current without thermal runaway.
- G. The dc circuit breakers shall be rated to successfully dissipate the maximum value of energy stored in system inductance during circuit breaker arcing under the short circuit conditions up to 2.5 miles distant and greater than 60 ms circuit time constant.

## 2.05 PROTECTIVE DEVICES

- A. Circuit breakers shall be provided with an undervoltage trip device which is magnetically held by flux produced by control power current that mechanically trips the circuit breaker upon reduction of control power voltage to 70 Vdc.
- B. Circuit Breakers shall be equipped with a direct acting trip device that senses reverse Currents (Device 32). The Direct acting device shall mechanically trip the Breaker and must not require control power to operate The Trip Device shall be adjustable from 10% to 100% of rated Current.
- C. A Multilevel protective Relay shall be installed for redundant reverse current protection (Device 32). This trip arrangement shall independently sense magnitude of circuit breaker current and will use control power for their tripping arrangement but shall have their own separate electrical component and shall not share any common electrical components with the first overcurrent and reverse current arrangement. The Trip Device shall be adjustable from 10% to a 100% of rated Current. At a minimum be equipped with the following functions.
  - 1. Acceptable Manufacturers: Siemens, VG-Controls, or approved equal.

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2. Reverse Current Trip
  3. Instantaneous Forward Current Trip
  4. Low Level Fault Forward Current Trip and associated time delay.
  5. Rate of Rise Trip
  6. FO TCP/IP Communication Interface compatible to communicate directly with the QEI RTU. Dedicated Communication Gateways may be used if required and as approved by Metra's Authorized Representative.
  7. Protection Functions 2-5 shall be temporarily disabled during commissioning. METRA will enable these functions at a later point in time to collect experience during revenue service.
- D. One of the two tripping arrangements may use the undervoltage trip device for circuit breaker tripping.
1. The discriminating trip equipment will not be acceptable as the second tripping arrangement specified above.
  2. However, the discriminating trip equipment may use a current sensor and trip coil in common with either of the required redundant instantaneous overcurrent (reverse current) trip arrangements and may use the undervoltage trip device to cause circuit breaker tripping.
  3. The discriminating trip device shall have a separate counter. Each of the redundant instantaneous overcurrent (reverse current) trip arrangements shall provide the overall coordination as outlined in Section 16601, General Requirements for Traction Power Equipment.
- E. If a high-speed trip box is provided with the breaker, the coil and sensor monitoring circuits shall be provided with the high-speed trip box. High-speed trip devices shall not use high-voltage capacitors to store energy.
- F. The second reverse current tripping arrangement is required, unless it can be established that the reverse current trip is fail safe. It may be a polarized solid state device, a current sensing polarized relay that shunt trips or undervoltage trips the circuit breaker, or other arrangement in conformance to these Specifications which is approved by Metra.
- G. Fuses used in 1,500 Vdc Circuits shall be equipped with a striker Pin Similar to SIBA 90 081 10.xx
- 2.06 DC SWITCHGEAR BUS
- A. The line side of terminals of circuit breaker cubicles 1 and 2 shall be arranged for bolted connection to the copper interconnecting bus bars (cathode bus) rated for 4000 amperes and mounted internally in the dc switchgear.
  - B. This cathode bus shall be connected to the rectifier through a shunt. Flexible bus braids shall be used for terminating the bus at both ends.

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**2.07 NEGATIVE SWITCH**

- A. Circuit breakers 1 and 2 shall have a Kirk key interlock and shall be interlocked with their corresponding negative switch mounted in the rectifier cubicle so that the negative switch cannot be operated unless its corresponding breaker is open.
- B. The Kirk key interlock will be provided by the rectifier supplier. The dc switchgear breaker cubicle manufacturer shall coordinate with the rectifier supplier for receiving the lock and installing it in the breaker cubicle.

**2.08 TEST CABINET**

- A. The circuit breaker close and trip circuit leads shall be wired through a plug-in type disconnect device mounted on the removable element arranged to isolate normal local and remote control, including the dc source, from the breaker mechanism and permit local breaker operation from a plug-in type control station mounted on a remote test cabinet.
- B. Provide the test cabinet complete with open and close pistol grip, switch, indicating lights, devices, terminals for connecting control power, and a multi-conductor control cable 12 feet long, complete with receptacle matching the plug on the removable breaker unit. The test cabinet shall be NEMA 250 Type 12 construction, ANSI 61 paint finish suitable for wall mounting and shall be furnished with lugs and 1.5-inch top and bottom entry conduit hub.

**2.09 DETAIL EQUIPMENT**

- A. The equipment to be furnished shall be 24-inches wide for each circuit breaker cubicle and be arranged as shown on the Contract Drawings and shall be in accordance with the following:
  - 1. Each rectifier breaker cubicle 1 and 2 shall include but is not limited to:
    - a. One (1) metal enclosed stationary unit with 1500 Vdc bus.
    - b. One (1) circuit breaker cell, 4000A
    - c. One (1) circuit breaker, drawout single pole, 1500 Vdc, 4000 Amp direct acting reverse current trip, direct acting undervoltage trip, reverse current auxiliary switch 32X shunt trip coil rated 125 Vdc, 125 Vdc control, control switch, local/remote permissive switch, breaker status lights, kirk key interlock.
    - d. One (1) ammeter, switchboard type, 0-3 amp movement, 0-8000 A full scale, GE/YEW type AB-40 or approved equal.
    - e. One (1) dc current transformer, 4000/1 amp ratio with dual auxiliary transformers for meter and relaying output, excitation voltage 120 V, 60 Hz auxiliary transformer metering ratio 1:1 amp, auxiliary transformer relay ratio 1:15 amp.
    - f. One (1) flexitest switch, 10 pole potential, ABB type FT-1, Catalog No: 129A501G01 or approved equal.
    - g. One (1) back-up time delay pick-up relay, 0.5-5 second timing range, 125 Vdc coil, with instantaneous contact, Agastat type 7012 or approved equal, Device-62 LBB.

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- h. One (1) plug in relay, 125 Vdc coil, DPDT output contacts for 11-pin socket mounting with socket, Potter and Brumfield type KRPA or approved equal, Device 80.
  - i. One (1) ac overcurrent relay, time adjustable 0.2 to 10 seconds, trip adjustable 40-120% of rated voltage, 120 Vac control power, Basler type BE4-51 or approved equal, Device-32 LBB.
  - j. One (1) set of 125 Vdc red and green indicating lights for close and trip circuits, GE type ET-16 or approved equal.
  - k. One (1) 120 Vac white LED indicating light for dc control undervoltage condition.
  - l. Control circuits and contacts as required including four NO and four NC spare contacts.
  - m. Provide contacts wired to terminals as required for use with Metra's SCADA circuits.
  - n. Terminal lugs on the line side of the breaker, for bolted connection to the 3000 ampere copper inter-connecting bus bars mounted internally for connection to the rectifier.
  - o. Terminal lug on load side of breaker for 3-1/c-1500 kcmil copper conductor, 5 kV insulated shielded, PVC jacketed cable.
  - p. (1) set of thermostatically controlled space heaters.
    - 1) Shall be connected to an isolated Power supply rated 120VAC
    - 2) Provide heating strips in each cubicle. Operating voltage for heating strips shall not exceed 50 percent of heater rated voltage.
    - 3) Provide an individual thermostat to control heaters in each cubicle. Locate in a general
  - q. area such that cool air in the lower portion of the cubicle can be sensed by the
  - r. thermostat.
- B. Auxiliary relays, fuses, resistors and all other devices required for a complete and operating system.

**PART 3 - EXECUTION****3.01 INSTALLATION**

- A. The floor area for installation of the dc breaker cubicles shall comply with Section 16641, Dielectric Flooring, and other insulation and general installation shall comply with Section 16610, Traction Power Equipment Installation.

**3.02 TESTING**

- A. See Section 16611, Traction Power Equipment Testing, for the dc switchgear testing requirements.

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**3.03 SUPPORT EQUIPMENT**

- A. See Section 16609, Traction Power Support, for the dc switchgear list of support equipment.

**END OF SECTION**

**SECTION 16606**  
**ANODE BUS DUCT**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section includes the requirements for designing, manufacturing, testing, delivering and installing pre-assembled anode bus duct to be provided for connecting traction power transformers to rectifiers.
- B. It consists of sections of 1500 Vac bus duct complete with flanges, taps, elbows, off sets, terminal connectors and associated accessories.

1.02 RELATED WORK

- A. Section 16610, Traction Power Equipment Installation
- B. Section 16611, Traction Power Equipment Testing

1.03 REFERENCES

- A. This Section incorporates by reference the latest revisions of the following documents:
- B. Institute of Electrical and Electronics Engineers (IEEE)
  - 1. IEEE C37.20.1, Metal-Enclosed Low-Voltage (1000 Vac and below, 3200 Vdc and below) Power Circuit Breaker Switchgear

1.04 EXTRA STOCK MATERIALS

- A. Two quarts of matching touch-up paint shall be shipped with each bus duct assembly.

**PART 2 - PRODUCTS**

2.01 BUS DUCT ASSEMBLY

- A. Each bus duct assembly shall be metal enclosed, ventilated, non-segregated phase type, conforming to IEEE C37.20.1, except that an approved low-impedance type bus duct may be applied as the anode bus, providing such requirement is dictated by the design of the transformer and rectifier package.
- B. The enclosure shall be fabricated from high-strength, corrosion-resistant aluminum. Removable covers shall be provided to allow access to the bolted bus connections and insulators for cleaning and inspection. Removable covers shall be secured with bolts to the frame.

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- C. Grounded bus enclosures shall be insulated from the high-resistance grounded rectifier enclosure by installation of boxed micarta or fiberglass section in the vertical portion at the rectifier, providing a minimum of 6-inches clearance between the metal enclosure of bus and nearest metal on rectifier. Alternate arrangement is insulated section in horizontal bus run, providing a minimum of 2-feet clearance between the metal bus enclosure and the nearest metal connected to the rectifier.
- D. Metalwork shall be carefully finished to remove sharp edges and burrs. All surfaces shall be thoroughly cleaned and treated with rust inhibiting phosphatized coating prior to painting, then finished with two coats of semi-gloss ANSI 61 grey color by powder coating process.
- E. Bus duct assemblies shall be supplied complete with connection flanges, taps, elbows, insulated housing sections, offsets, splicing plates, terminal connectors, and associated accessories and in length as required by the final approved arrangement drawings.
- F. The shipping section shall be pre-assembled in the factory so that minimum installation is required at site. It is the responsibility of the Contractor to furnish the equipment as specified and shown on the Contract Drawings so that they can be installed as a system without any modifications or requiring additional materials and labor at site, except to carry out the manufacturer's installation instructions.
- G. All hardware required to make the field connections between sections and terminations to the equipment shall be furnished in sufficient quantity.
- H. Suitable support of bus enclosures shall be provided as may be required to ensure rigid structure and workmanlike installation of the system.
- I. The bus duct assembly shall be compatible in design and construction with the provisions made at the transformer and rectifier and shall operate as an integral unit when assembled.

**2.02 BUS BARS**

- A. Bus bars shall be of high conductivity rectangular copper with round edges finished to required size by cold rolling or drawing.
- B. Bus bars shall have uniform shape and dimensions, free from defects in material and workmanship.
- C. Bus bars shall be individually insulated, properly supported, and braced to each other and to the enclosure with approved, high-quality, high-strength, non-tracking insulators to withstand short circuit stresses to be encountered in use.
- D. Bus taps and connections shall be tightly bolted. Contact surfaces of bolted joints shall be factory silver plated. Bus connections and taps shall have an ampacity equal to that of the bus ampacity, and fabricated so that there will be no loss of conductivity, during the life of the bus.

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- E. Buses shall be rated to carry continuously the current of associated rectifier transformer and rectifier operated at 160 percent of rated full load. The temperature of the bus bars shall not exceed maximum limit of 105°C under these loading conditions.
- F. The temperature rise of bus bars at the hottest spot for the specified duty shall not exceed 65°C over an ambient of 40°C, thus limiting the maximum operating temperature of bus conductors to 105°C.
- G. The bus shall be designed and braced to safely withstand equipment short circuit currents without damage to either the conductors or the enclosures. Busway shall have an insulation system that will withstand 2200 volts, 60 Hz for 1 minute, after being thoroughly wetted, between each bus bar and between each bus bar to enclosure. It shall then have a minimum of one mega ohm resistance.
- H. At both transformer and rectifier, flexible bus terminations shall be provided. The termination details shall be fully coordinated with the rectifier transformer and rectifier.

**2.03 QUANTITY OF EQUIPMENT REQUIRED**

- A. Two (2) sets of 1500 Vac metal-enclosed, ventilated, non-segregated anode bus duct to carry 162 percent of rectifier transformer and rectifier full load current.

**PART 3 - EXECUTION****3.01 INSTALLATION**

- A. See Section 16610, Traction Power Equipment Installation, for the anode bus installation requirements.

**3.02 TESTING**

- A. See Section 16611, Traction Power Equipment Testing, for the anode bus testing requirements.

**END OF SECTION**

## SECTION 16607

### STATION BATTERIES AND ASSOCIATED ACCESSORIES

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. This Section includes the requirements for manufacturing, testing, and delivering indoor station batteries, battery chargers and battery racks.
- B. The batteries will serve as the primary source of 125 Vdc control power for the rectifiers, ac and dc switchgear, and SCADA, as well as miscellaneous control and relay panels.

##### 1.02 REFERENCES

- A. This Section incorporates by reference the latest revisions of the following documents:
- B. Institute of Electrical and Electronics Engineers (IEEE)
  - 1. IEEE 1188, Recommended Practice for Maintenance, Testing, and Replacement of Valve-Regulated Lead-Acid (VRLA) Batteries for Stationary Applications
- C. Underwriters Laboratories (UL)
  - 1. UL 94, Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

##### 1.03 SUBMITTALS

- A. For each battery, battery performance tables and curves shall be submitted. The curves may be obtained by test or by calculation. An IEEE sizing calculation shall be provided.
- B. Manufacturer to provide a minimum of four complete sets of installation and maintenance manuals with the battery.
  - 1. The instruction manual shall provide a detailed description of the battery installation procedure.
  - 2. It shall include the manufacturer's recommended torque for connector bolts.

##### 1.04 RECYCLING SERVICES

- A. The manufacturer must provide recycling services to properly dispose of spent lead-acid batteries.

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- B. These services must include proper instructions for the packaging, transportation, and beneficial recycling as required to meet EPA guidelines (or other applicable agencies) for the safe handling of lead-acid batteries.

**1.05 WARRANTY**

- A. The manufacturer shall provide a one-year full warranty covering battery repair and replacement. The balance of the warranty shall be pro-rata.

**PART 2 - PRODUCTS****2.01 BATTERY SIZING**

- A. The batteries shall supply the high discharged rates necessary to close both ac and dc switchgear after it has supplied the lower discharge rates demanded by indicating lights and relay coil loads with ac bus dead for 8 hours.
- B. The batteries sizing shall be based upon the following:
  1. Charger failure with substation in full operation.
  2. Startup after ac voltage failure with the line breaker open and which must be closed before voltage to charger is restored.
  3. 500 watts emergency lighting load and 200 watts continuous supervisory load.
  4. Continuous load of 15 amperes.
  5. 20 percent derating factor for aging of battery and temperature effects.
  6. Substation operation from 55°F to 104°F.
  7. Battery discharged to 1.75 volts/cell.
- C. The Contractor shall calculate battery required for 8-hour reserve but in no event shall battery size be less than 200 AH to 1.75 volt per cell at an 8-hour rate.

**2.02 BATTERIES**

- A. The valve regulated lead acid station batteries shall be six cell module Absolyte GP type 6-90G as manufactured by GNB Industrial Power - a division of Exide or approved equal. All cells within the battery string shall be of the same manufacturer and model.
- B. The cells shall be sealed, non-spillable, valve-regulated, lead acid, absorbed glass mat separator, reduced maintenance type. The batteries shall consist of 10 modules; each module shall contain 6 cells.
- C. Cycling Characteristics: The batteries shall provide 1200 cycles to 80 percent depth of discharge (DOD) at the 8-hour discharge rate at 77°F (25 degrees C). Cycle capabilities must be confirmed through independent lab testing.

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- D. Deep Discharge: Following an equalization charge, the batteries shall be capable of being recharged to rated capacity from a discharge down to zero volts per cell.
- E. Float Voltage: Float voltage shall be 2.23-2.27 volts per cell at 25°C (77°F) and shall remain stable (+/- 0.05 V from average) throughout the battery life. When the battery is floated at this voltage, the battery shall not require any scheduled equalization charge. If required, the equalization voltage shall be 2.30-2.35 volts per cell at 23°C (77°F).
- F. Recombination Efficiency: Recombination efficiency shall be 99 percent, or greater, when operated at 25°C (77°F) and at the specified float voltages. Water additions shall not be required under normal battery operating conditions.
- G. Recharge Rate: The batteries shall be capable of a 90 percent recharge within 12 hours when adhering to the manufacturer defined recharging parameters.
- H. Operating Temperatures: The batteries shall be capable of operating in temperatures ranging from -40°C to +40°C. The batteries shall withstand hard freezing without damage to the alloy, plates, or cell containment assembly.
- I. Coup de Fouet: Initial voltage drop during discharge (Coup de Fouet) shall not fall below the manufacturer specified end voltage.
- J. Life Expectancy: Cells shall have a design life of 20 years when operated in float service.
- K. Gassing: No special ventilation shall be required during the battery operation. No specialized battery room shall be required to house the battery unit.
- L. Battery Orientation: The batteries shall have front accessible terminals with clear, removable covers to facilitate visual inspections and allow ease of service.
- M. Self-Discharge: The batteries shall have a maximum self-discharge rate of 0.5-1.0 percent per week at 25°C (77°F).

**2.03 BATTERY CONSTRUCTION**

- A. Plates:
  - 1. Valve-regulated type batteries shall be lead-acid, flat pasted-plate type with lead alloy grids.
  - 2. The positive grid alloy shall be constructed of a lead calcium-tin-silver grid or equivalent, and shall be capable of deep cycle operation with low-gassing, low corrosion rate, and low water-loss characteristics.
  - 3. The negative grid shall be constructed of a lead-calcium alloy.
- B. Separator:
  - 1. The positive and negative plates shall be separated by a low-resistance, absorbent, micro-porous glass-fiber mat to immobilize and retain the battery electrolyte.

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2. The positive plate shall be individually wrapped, allowing maximum active material utilization.
  3. The separator shall be compressed sufficiently to maintain separator to plate contact throughout the life of the cell.
- C. Electrolyte:
1. The electrolyte shall be introduced to the cell through a computer controlled fill-by-weight process with a deviation not to exceed +/- 1.00 percent.
  2. The electrolyte specific gravity of a fully charged cell shall be 1.310 +/- 0.010.
- D. Posts:
1. The cell posts shall have a threaded integral solid-copper insert to directly accept the intercell connector bolt.
  2. Post seals shall be formed by either fusing the lead bushing to the lead post or by using the same heat seal method incorporated into the jar/cover seal.
  3. The cell post shall be designed to carry a 1-minute current rating without damage.
- E. Container and Cover:
1. Valve-regulated cell containers shall be impact and heat resistant polypropylene, or equivalent.
  2. The cover shall be attached to the container using a heat-based double-sealing process.
  3. The heat-seal bead shall be smoothed to increase the cover-container bond strength.
  4. The containers and cover shall be constructed of fire resistant materials conforming to UL 94 VO class requirements.
- F. Pressure Relief Valve:
1. Each cell shall have a self-resealing safety valve that operates under a nominal pressure of 6 psi (maximum of 10 psi).
  2. A flame arrester shall be incorporated in the valve design.
  3. The valve assembly shall be removable and replaceable.
- G. Housing:
1. Cell shall be housed in a protective modular 12 gauge steel tray that provides thermal management attributes.

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2. Each cell shall be compartmentalized to maintain consistent compression throughout the life of the battery, and to simplify single cell removal and replacement.
3. The trays shall facilitate the direct dissipation of heat and provide structural integrity for the operating battery.
4. The trays shall maintain cell compression without requiring adjustments by the user.
5. Tray/Cell Assembly must be capable of being stacked up to 10 units high. No separate racks shall be required.

**H. Floor Supports:**

1. The standard battery support structure shall be constructed of steel I-beams.
2. The supports shall facilitate easy assembly and provide an effective means to elevate and anchor the battery assembly to the floor.
3. Modular steel trays shall be supported by a non-conductive, floor mounted pedestal system. The floor supports shall be designed to electrically insulate the battery stack from the floor.
4. The rack shall be designed with seismic anchoring and bracing to meet seismic design requirements specified in Section 16011, Prepackaged Substation Enclosure. Include battery rack in seismic design submittal required for equipment in Section 16011.

**I. Product Identification Label:**

1. The batteries shall have a self-adhering label identifying the product manufacturer, model and nominal Amp/Hour capacity.
2. The label must be readily visible from the front of the battery.

**2.04 BATTERY ACCESSORIES****A. The batteries shall be furnished with the following accessories:**

1. The battery system shall include the necessary intercell and intermodule connectors and terminal plates. The connectors shall be lead-tin plated copper and shall include stainless steel hardware.
2. Module lifting straps.
3. No-Ox-Id grease.
4. One set of numerals (one numeral per cell) suitable for permanent attachment to cells.
5. Assembly drawings.
6. Material Safety Data Sheets.

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7. Each module shall include an easily removable transparent "snap on" safety shield to cover all electrical connections.
8. Shims for battery leveling.

## 2.05 BATTERY CHARGER

- A. The battery charger shall be of the silicon diode constant-voltage rectifier type, complete with voltmeter and ammeter, rated according to associated battery size at 133 Vdc to fully recharge the battery in 20 hours or less, but in no case less than 50 amperes at 133 Vdc.
- B. DC voltage shall be maintained within +/-1 percent at any load from no load to full load with +/- 10 percent variation in the ac input voltage and 57 to 63 Hz while floating rated number of cells, minus one or plus one.
- C. Unit shall be equipped with equalizing charger timer 0-72 hours, to terminate a manually set equalized charger, and low-voltage alarm relay to indicate ac and dc failures. Equalizing charger for 60 cell battery shall be nominal 141 Vdc adjustable +/- 10 percent.
- D. The battery charger shall be current limiting, adjustable down to 90 percent and up to 115 percent; factory set to 110 percent.
- E. AC voltage shall be single-phase 208 volts, and shall have a low-voltage battery alarm.
- F. It shall include a current and voltage indicating meter.
- G. The meters, breakers, and timer dial shall be accessible from front of charger without the need of panel removal or door opening.
- H. The battery charger shall have both an ac circuit breaker for the input and a dc circuit breaker for the output.
- I. The low-voltage battery alarm shall be on the load side of the dc circuit breaker monitoring the voltage of the batteries, with indicating lights for low-voltage battery alarm, set to alarm to SCADA when battery voltage falls below 121 volts, reset above 127 volts.
- J. The battery charger shall be provided with a surge arrestor, similar to GNB Model V46JE0121 or approved equal with a stand GNB Model V46JE0121 or approved equal.
- K. The battery charger shall be furnished with a ground detecting relay similar to V46EJ0089.
- L. The battery charger shall be silicon controlled rectifier GNB type SCR 200.

## 2.06 SOURCE QUALITY CONTROL

- A. Capacity Testing: Each cell shall be capacity tested at the manufacturing facility and shall be required to meet a minimum of 90 percent of the published 8-hour rate prior to shipment.

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- B. Leak Detection: Integrity of the container and post seals shall be verified using an automated helium leak detection process at a 10 psi pressure differential.
- C. Duty Cycle Verification: After an equalizing charge per IEEE 1188, and with the battery charger(s) disconnected, the battery shall be capable of supplying the duty cycle specified. The voltage throughout the duty cycle shall not be less than the final string voltage specified.

**PART 3 - EXECUTION****3.01 INSTALLATION**

- A. The battery shall be installed as indicated on the assembly drawings and as specified in the accompanying instruction manuals.

**END OF SECTION**

**SECTION 16608**  
**DC DISTRIBUTION PANEL**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section includes the requirements for manufacturing and delivering a dc distribution panel.

1.02 SUBMITTALS

- A. Panelboard Schedule
- B. Panelboard Product Data
- C. Circuit Breaker Product Data

**PART 2 - PRODUCTS**

2.01 PANELBOARD

- A. DC distribution panelboard shall be rated for 125 Vdc for a two-wire service with a short circuit rating of 10,000 amperes minimum.
- B. The DC distribution panelboard shall be ANSI 61 grey
- C. Main bus shall be of 225 ampere copper sized in accordance with UL to limit temperature rise in any current carrying part to a maximum of 65°C above an ambient of 40°C maximum.
- D. Interiors shall be completely factory assembled devices. They shall be designed such that switching and protective devices can be replaced without disturbing adjacent units and without removing the main bus connectors.
- E. Trims for the panelboards shall be supplied with a hinged door over all circuit breaker handles.
  - 1. Doors in panelboards trims shall not uncover any live parts.
  - 2. Doors shall have a semi flush cylinder lock and catch assembly.
  - 3. Doors over 48 inches in height shall have auxiliary fasteners.
- F. Panelboard trims shall cover all live parts. Switching device handles shall be accessible.
- G. Surface trims shall be same height and width as box. Flush trims shall overlap the box by 3/4 inch on all sides.

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- H. A directory card with clear plastic cover shall be supplied and mounted on the inside of each door. The directory card shall be neatly typed with destination clearly identified for each circuit.
- I. The panelboard shall be as manufactured by one of the following:
  - 1. Cutler-Hammer, Type CDP with Type EHB (100A frame) and JB (225A frame) breakers;
  - 2. Square D Type QMB with Type KA (225A frame) breakers; or
  - 3. Approved equal.

**2.02 CIRCUIT BREAKERS**

- A. Circuit breakers shall be two-pole thermal-magnetic type with a minimum of 10,000 ampere dc interrupting relay
- B. Breakers for each circuit shall be bolt-in type, heavy-duty, quick-make, quick-break, two-pole, with toggle handles that indicate when unit has tripped.

**2.03 FACTORY ASSEMBLY**

- A. The panelboard shall be factory assembled and furnished with two-pole feeder or branch circuit breakers with the following trip rating:
  - 1. One (1) - 125 ampere breaker
    - a. Battery Charger dc Output
  - 2. Three (2) - 60 ampere breakers.
    - a. Control Voltage 172-R1
    - b. Control Voltage 172-R2
    - SPARE
  - 3. Eight (8) - 30 ampere breakers.
    - a. 12.6kV Incoming Line Breaker 1
    - b. 12.6kV Rectifier Transformer Breaker 1
    - c. 12.6kV Auxiliary Transformer Breaker 1
    - d. 12.6kV Bus Tie Breaker
    - e. 12.6kV Incoming Line Breaker 2
    - f. 12.6kV Rectifier Transformer Breaker 2
    - g. 12.6kV Auxiliary Transformer Breaker 2
    - h. SPARE
  - 4. Four(4) - 20 ampere breakers.
    - a. Transformer 1
    - b. Transformer 2
    - c. SPARE
    - d. SPARE

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5. Four (4) - 15 ampere breakers.
  - a. Rectifier 1
  - b. Rectifier 2
  - c. RTU
  - d. SPARE

**PART 3 - EXECUTION**

3.01 NOT USED

**END OF SECTION**

**SECTION 16609**  
**TRACTION POWER SUPPORT**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section includes requirements for furnishing the support for traction power equipment specified in Sections 16602 thru 16608.

1.02 REFERENCES

- A. This Section incorporates by reference the latest revisions of the following documents:
- B. International Electrotechnical Commission (IEC)
1. IEC 61850, Communication networks and systems for power utility automation
  2. IEC 61850-9-2, Communication networks and systems for power utility automation - Part 9-2: Specific communication service mapping (SCSM) - Sampled values over ISO/IEC 8802-3

1.03 SUBMITTALS

- A. Submit at the time of delivery a detailed list of recommended support parts and/or devices. The prices shall be furnished with this list along with names of suppliers and catalog numbers for such parts if they are not originally manufactured by this Contractor. The parts included in this list shall not be part of the original Contract price. The prices in the list shall be valid for 1 year. Metra will have the option to add the recommended items to the Contract by the change order process. The parts listed in Paragraph 1.04 shall be furnished as a part of this Contract and included in the Contract price.
- B. Submit outline of proposed training program and final copy of all course materials.

1.04 SPARE PARTS

- A. Furnish at the time of delivery of equipment the following items of rectification equipment to reduce down-time on the system due to unit failure:
1. Transformer Rectifier Unit
    - a. Four (4) of each of diodes, diode fuses and diode commutating capacitors used in the rectifiers.
    - b. Two (2) surge arrester assemblies for each type used.
    - c. One (1) diode fuse monitor.
    - d. One (1) rectifier transformer 49 device.
    - e. Two (2) lightning arresters.

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- f. One (1) Rectifier bimetallic thermal device and accessories, one first-step and one second-step.
  - g. One (1) ten pole test switch
  - h. One (1) of each of the various types of relays
  - i. For each type of fuses supplied for traction power equipment, furnish minimum of 10 percent but not less than four spares.
  - j. One of each of the various types of transducers
2. AC Switchgear
- a. Two (2) complete sets of main contacts, arcing contacts and arc chute assemblies. In case of vacuum breaker, furnish three complete sets of vacuum interrupters (bottles).
  - b. Two (2) of each type of electromotive devices integral to the breaker used for closing and tripping, two control switches of each type, two solid state reclosing systems (if supplied), including but not limited to, closing coils, closing motors, spring charging motors, trip coils or holding coils, two electronic tripping devices and test set.
  - c. One (1) SEL-351
  - d. One (1) SEL-551.
  - e. Two (2) complete sets of main current carrying disconnect assemblies, two complete sets of auxiliary control disconnect assemblies, and two sets of auxiliary contacts.
  - f. One (1) spring used in each type of breaker furnished.
  - g. One (1) of each of the various types of relays
  - h. One (1) set primary and two sets of secondary rectifier power transformer bushings and/or standoff insulators.
  - i. For each type of fuses supplied for traction power equipment, furnish minimum of 10 percent but not less than four spares.
  - j. One data courier SEL 4391, with cable to connect to SEL relays Part No.C245A, ac power supply Part No.230-0601, USB to SD card reader Part No. 240-4050
  - k. For each type of fuses supplied for traction power equipment, furnish minimum of 10 percent but not less than four spares.
  - l. One of each of the various types of transducers
3. Miscellaneous
- a. One (1) station control battery charger
4. DC Switchgear
- a. One (1) spare DC Rectifier breaker 4000 ampere. The breaker element shall not be incorporated in the dc switchgear line-up but shall be furnished loose. The Spare Breaker shall be a complete assembly with wheels primary and secondary contacts required to operate immediately.
  - b. For each type of fuses supplied for traction power equipment, furnish minimum of 10 percent but not less than four spares
  - c. Four (4) lamps for indicating lights.

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- d. One of each of the various types of transducers

**1.05 EXTRA STOCK MATERIALS**

- A. Provide a reasonable number of parts to ensure adequate supply for installation and testing of the various components of equipment furnished and installed under this Contract for traction power substation work.
- B. Such parts shall be delivered at the time and with the equipment to which it applies. These parts shall include but not be limited to the following:
  1. Power fuses
  2. Control and instrument fuses
  3. Installation hardware such as bolts, nuts, and other special devices.

**1.06 TOOLS**

- A. Furnish all necessary installation and maintenance tools such as wrenches, threading devices, etc., for all fittings that do not conform to U.S. screw, bolt and pipe standards.
- B. Furnish at the time of delivery of equipment the following tools for testing to reduce down-time on the system due to unit failure:
  1. One universal protective relay test set with selectable voltage and ampere outputs and with 115 Vac, 50/60 Hz three-phase input; with a digital metering, memory ammeter and sufficient power for testing electro-mechanical protective devices.
    - a. The relay tester shall have PC control software and shall have the capability to transfer test results to a PC.
    - b. The relay test set shall have capability per IEC 61850, IEC 61850-9-2.
    - c. The carrying case and all testing accessories shall be included.
    - d. Provide a laptop with all the requirement software installed.
  2. One megger micro-ohmmeter, Model MOM200A, Catalog No. BD-11190, 115 volt single-phase, 200 amps output current. Carrying case and all testing accessories including 33 feet of each current and sensing cable, Catalog No.GA-03103 and calibration shunt rated at 200 amps/20 mV, Catalog No.BD-90022
  3. One Portable DC Hi-Pot test module for vacuum testing of bottle of 15 kV switchgear.
    - a. The modules shall be fail safe or self-checking, and be capable of testing vacuum bottle without removal from breaker or use of hand tools.
    - b. Input voltage 120 volts single-phase, 60 Hz.
    - c. The tester shall be Hipotronics, Model No. 815PL-A, furnished with 6-foot input line cord, 25-feet each return and high-voltage output cable.

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4. Provide additional test set and software to set, test, and calibrate all electronic relays, load measuring, 150,164 or 64C and X, SEL-551, annunciator, etc. Schweitzer AC SELerator QuickSet SEL5030 software.

**PART 2 - PRODUCTS****2.01 TRAINING**

- A. Furnish five-day, 40-hour courses to 30 Metra personnel with no more than five people per class, in Chicago. The courses shall cover circuit theory operation, maintenance, and trouble-shooting procedures.
- B. Furnish complete instruction manuals (including schematics and wiring diagrams showing all internal solid state components) for all personnel at least one week in advance of each course.
- C. The intent and general approach of the training shall be as follows:
  1. The intent of the training program shall be to provide Metra personnel with adequate classroom and practical training necessary to operate and maintain the Traction Power Substations.
  2. This training program shall consist of both Classroom and Practical (Field) Training.
  3. The Training shall include at a minimum the following items
    - a. External Interfaces
      - 1) Transfer Trip Overview and Operation
      - 2) SCADA Overview and Operation
      - 3) Connections into Existing Tie Breaker Station
    - b. Sequence of Operation for the new Prefab
      - 1) Overall Functionality in sequential fashion
    - c. Detailed Equipment Training (Maintenance and Troubleshooting)
      - 1) 12.6kV Switchgear
      - 2) Transformer Rectifier Units
      - 3) DC Breaker Cubicles
      - 4) AC Aux Power Distribution System
      - 5) DC Aux Power Distribution System incl Battery Charger and Batteries.
      - 6) SCADA RTU and Remote I/O units
      - 7) SEL Relays
      - 8) DC protective Relay.

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At a minimum the training program shall also encompass maintenance procedures, problem setups and troubleshooting exercises. Maintenance sequence and frequency shall also be presented. Standardized training methods, acceptable to the industry shall be applied.

- D. Sequence of Learning Objectives:
1. Sequence of learning objectives shall be to provide a safe overview followed by general electrical technical knowledge, print reading, symbols and abbreviations. Once general knowledge has been developed with the students, the course shall be site specific concentrating on single-line diagrams, theory of operations, and control schematics.
  2. Upon completion of the classroom theory sessions the training course shall concentrate on details of each specific piece of equipment and its function for the following: ac switchgear, dc switchgear, rectifier/transformer, rectifiers, meters, relays and control devices.
  3. Once the technical aspect of the Traction Power Substation has been established and understood, the course shall start training by hands on applications, testing, troubleshooting and maintenance. These elements of the training course shall be conducted in the field.
- E. The training schedule for the date and time will be coordinated with Metra's Authorized Representative. Metra will supply the facility for the training, both classroom and at the site of the Traction Power Substation.

**PART 3 - EXECUTION**

- A. Not Used

**END OF SECTION**

**SECTION 16610**  
**TRACTION POWER EQUIPMENT INSTALLATION**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section includes requirements for installation of traction power equipment specified in Sections 16602 thru Section 16608 at the locations shown on Contract Drawings.

1.02 RELATED WORK

- A. Section 16010, Basic Materials
- B. Section 16125, Traction Power Cables
- C. Section 16472, DC Disconnect Switches
- D. Section 16473, DC Disconnect Switch Enclosure
- E. Section 16606, Anode Bus Duct
- F. Section 16607, Station Batteries
- G. Section 16611, Traction Power Equipment Testing,

**PART 2 - PRODUCTS**

2.01 NOT USED

**PART 3 - EXECUTION**

3.01 GENERAL INSTALLATION REQUIREMENTS

- A. Installation shall be as follows:
  - 1. Installation of 15 kV ac power cables shall be in accordance with ComEd Engineering Department requirements.
  - 2. Installation of dc traction power cables shall be in accordance with Section 16125, Traction Power Cables.
  - 3. Installation of dc traction power disconnect switches shall be in accordance with Sections 16472, DC Disconnect Switches, and 16473, DC Disconnect Switch Enclosure.
  - 4. Low-voltage power and control wiring installation including installation of conduit and fittings, cable trays, junction, pull and terminal boxes and related materials shall be in accordance with Section 16010, Basic

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Materials. The completed installation shall provide fully coordinated and fully operational electrical system.

- B. Take every precaution in handling, setting, aligning and assembling the equipment to avoid distortion of frame. Become completely familiar with the manufacturer's instructions before attempting to handle, install and operate the equipment. Ensure that all personnel working with the equipment fully understand the operation of the various components to avoid mis-operation, damage to equipment, and possible personal injury.
- C. Make all equipment assembly connections between shipping units, including all bolted connections to mechanically assemble the units and installation of all splice plates, connecting bases and throats.
- D. Make all electrical connections between shipping units, including all bolted bus connections and connections of control and auxiliary circuits.
- E. Routing of installations of 13.8 kV ac circuit cable and conduits and dc traction positive and negative return cables are shown on Contract Drawings.
- F. Determine the basic routing of conduits and cables for control and auxiliary circuits for interconnecting equipment and devices based on the specific application of these cables to satisfy all control, indication, supervisory and auxiliary functions specified. Installation of cables shall be in accordance with Metra's Authorized Representative's approved cable schedule prepared by the Contractor and the Contract Drawings.
- G. Make all ground connections to the equipment from the ground buses in the substations.
- H. Current carrying bolted connections as well as bolted ground connections shall be torqued per manufacturer's specification.
- I. Apply marking paint on all bolted connections similar to DYKEM Cross-Check.
- J. Test and check out completed installations in accordance with Section 16611, Traction Power Equipment Testing, and as specified in other applicable sections of the Specifications.

**3.02 DETAILED INSTALLATION REQUIREMENTS**

- A. AC Switchgear
  - 1. Fully assemble and completely install the 15,000 Vac switchgear in accordance with the manufacturer's instructions at the location shown on the Contract Drawings.
  - 2. Provide switchgear base channels in the floor in accordance with the manufacturer's instructions. Anchor the switchgear units to the base channels with sufficient number of bolts to withstand impact resulting from breaker operations and seismic events.
  - 3. Assemble switchgear units in such a manner as to ensure proper leveling, proper alignment between the various shipping groups and for proper

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placements of all the required primary circuit conduits that are required for equipment interconnection.

4. Provide breaker test cabinet at the location shown on Contract Drawings. Provide a clear space of minimum 1/4 inch between the back of the cabinet and the wall. Fasten steel channels or straps, or equal, of suitable thickness to the wall and drill and tap for mounting the test cabinets using galvanized bolts.
5. After completion of switchgear installation, ensure that all doors and draw out fuse and PT carriages operate freely and the breaker removable elements can be moved into and removed from the housings without encountering the change of elevation from within the housing to the floor. Correct all misalignments to the satisfaction of Metra's Authorized Representative.

**B. Rectifier Transformer**

1. Fully assemble and completely install rectifier transformers in accordance with the manufacturer's instructions at location shown on Contract Drawings.
2. In locations where the transformer is shown directly next to the AC Switchgear the Contractor shall closely couple the AC Switchgear and the transformer through properly designed openings in the side wall.
3. In locations where the transformer is not directly next to the AC Switchgear the 15 kV cables shall run in a dedicated RGS conduit between AC Switchgear and transformer.
4. Connect high-voltage terminals to 15 kV shielded cables for connection to ac feeder breaker cubicle in the 15 kV ac switchgear.
5. Connect low-voltage terminals of the transformers to the anode bus duct specified in Section 16606, Anode Bus Duct.

**C. Rectifiers and Accessories**

1. Fully assemble and completely install rectifier units in accordance with Metra's Authorized Representative approved manufacturer's drawings at locations shown on Contract Drawings.
2. Provide insulated anchors in the floor in accordance with the manufacturer's instructions and plans approved by Metra's Authorized Representative. Cover the floor area at the rectifier units with a dielectric flooring per section 16641, to insulate the rectifier enclosure from the building floor. Take care that the insulated floor area is not scraped or otherwise damaged during installation. After completion of the installation, ensure that the rectifier enclosure is completely insulated from the building structure.
3. Connect rectifier units to the rectifier transformer via the ac anode bus duct and to the rectifier dc main circuit breaker in the dc switchgear

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cubicles as shown in the Contract Drawings, either through the internal bus or external cables. Connect rectifier negative to the negative and drainage bus located in negative enclosure by means of cables.

**D. DC Switchgear Cubicles**

1. Fully assemble and completely install dc switchgear cubicles in accordance with Metra's Authorized Representative's approved manufacturer's drawings at location shown on Contract Drawings. Insulate the dc switchgear cubicles from each other and from the rectifier assemblies by means of minimum 1/4-inch thick insulated material.
2. Provide insulated anchors in the floor in accordance with manufacturer's instructions. Cover the floor area at the dc switchgear cubicles with dielectric flooring per section 16641 to insulate the switchgear enclosure from the building floor. Take care that the insulated floor area is not scraped or otherwise damaged during installation. After completion of the installation, ensure that the dc switchgear cubicles are completely insulated from the building structure.
3. Assemble the switchgear cubicles in such a manner as to ensure proper leveling, proper alignment for placement of all the conduits that are required for equipment interconnection.
4. Connect the rectifier main circuit breakers to the rectifiers by means of an internal bus, as shown on Contract Drawings.
5. Install the breaker test cabinet on the insulated floor, completely isolated from the wall, at the location shown on Contract Drawings or as directed by Metra's Authorized Representative. Provide a clear space of minimum 1/4-inch between the back of the cabinet and the wall. Fasten fiberglass channels or straps, or equal, of suitable thickness to the wall and tap and drill for mounting the test cabinet using insulated bolts.
6. After completion of the installation, ensure that the doors operate freely and the breaker removable elements can be moved into and removed from the housings without encountering the change of elevation from within the housing to the floor. Correct all misalignments to the satisfaction of Metra's Authorized Representative.

**E. Anode Bus Ducts**

1. Fully assemble and completely install the bus ducts interconnecting rectifier transformers to the rectifier assemblies in accordance with Metra's Authorized Representative's approved manufacturer's drawings and as shown on Contract Drawings.
2. Provide bus duct with suitable mounting hangers supported from the ceiling, or as directed by the Metra's Authorized Representative. Provide all trapezes, brackets, rods, clamps, suspension fittings and miscellaneous steel to provide a complete, firm and rigid support system for the bus ducts under all operating conditions and during short circuits.

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Design and install supports in a manner to minimize induced circulating currents and induced magnetic heating and seismic requirements.

3. All ferrous elements of the support system shall be hot-dip galvanized. Provide hanger supporting ungrounded portions of anode buses with approved insulators to insulate the bus enclosures from the building structure.
4. Assemble bus ducts in such manner as to ensure proper alignment between the shipping sections and the equipment they connect. After alignment and leveling, bolt the bus enclosure to the equipment and then attach the enclosure splice plates and securely fasten.
5. Provide insulated bus enclosure sections in the rectifier anode bus runs to isolate the rectifier enclosure from its transformer.
6. Before connections are made, wipe clean all contact surfaces (sandpaper or abrasive tools shall not be used) and cover with a thin coat of approved grease.
  - a. Joints in bus conductors shall be made using splice plates on each side of the conductor.
  - b. Connections to equipment terminals shall be made with flexible connectors as specified.
  - c. Joints shall be made with a minimum of four 1/2-inch by 13 tpi high-tensile-strength silicon bronze bolts and nuts.
  - d. Nuts shall be provided with approved locking devices.
  - e. All bolts shall be tightened to the torque of 40 foot-pounds, or as directed by Metra's Authorized Representative, using an accurate torque wrench.
7. After completion, all joints shall be covered by die-molded, flame retardant polyvinyl chloride boots, or approved equal, providing full voltage insulation for the joint. These boots shall be easily removable for inspection of the joint without destruction of the boot.

F. Station Batteries, Charger and Accessories

1. Provide station batteries on a suitable rack. The configuration, number of tiers, and structural details of the rack shall be as shown in the Contract Drawings.
2. Install battery rack at location shown on Contract Drawings. Assemble battery rack in modular 12-gauge steel tray stacked up to 10 units high. Number each cell on the rack with approved, clearly visible numerals. Numbers shall start from battery negative end and finish with number 60 at the positive end of the battery terminal.
3. Compartmentalize each cell to maintain constant compression. Scrape current carrying surfaces bright and clean and cover with a thin film of approved grease. Tighten bolts to proper tension and wipe off surplus grease. After completion of all connections, check the polarity of each cell with a voltmeter.

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4. Remove the battery cells from shipping and inspect each cell for damage.
  5. Install the battery charger units at locations shown on Contract Drawings or as directed by Metra's Authorized Representative.
  6. After the completed installation is tested and checked out in accordance with the manufacturer's installation recommendations and all applicable portions of Section 16607, Station Batteries, give the battery a freshening charge to ensure that all cells are fully charged when the charging cycle is completed and the float voltage is the proper level.
- G. DC Distribution Panel
1. Install the dc distribution panel at the location shown on Contract Drawings. Provide a clear space of minimum 1/4 inch between the back of the panel and the wall. Fasten steel channels or straps, or equal, of suitable thickness to the wall and drill and tap for mounting the panel using galvanized machine bolts.
  2. Neatly type the circuit directory, identifying the destination and cable number for each circuit as well as identifying the spare circuits.

**END OF SECTION**

**SECTION 16611**  
**TRACTION POWER EQUIPMENT TESTING**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section includes the requirements for factory and field testing of the traction power equipment described in Sections 16602 thru 16606.
- B. All traction power equipment provided under this Contract shall be subject to the specified test program. Testing shall include tests at a manufacturer's facility and in the field.

1.02 REFERENCES

- A. This Section incorporates by reference the latest revisions of the following documents:
- B. Institute of Electrical and Electronics Engineers (IEEE)
  - 1. IEEE 1653.2, Standard for Uncontrolled Traction Power Rectifiers for Substation Applications Up to 1500 V DC Nominal Output
  - 2. IEEE C37.09, Standard Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis
  - 3. IEEE C37.14, Standard for DC (3200 V and below) Power Circuit Breakers Used in Enclosures
  - 4. IEEE C37.20.1, Standard for Metal-Enclosed Low-Voltage (1000 Vac and below, 3200 Vdc and below) Power Circuit Breaker Switchgear
  - 5. IEEE C57.12.91, Standard Test Code for Dry-Type Distribution and Power Transformers
  - 6. IEEE C57.18.10, Standard Practices and Requirements for Semiconductor Power Rectifier Transformers
  - 7. IEEE C57.98, Guide for Transformer Impulse Tests
- C. JEDEC Solid State Technology Association (JEDEC)
  - 1. JESD282B.01, Silicon Rectifier Diodes (formerly ANSI/EIA 282-A)
- D. National Electrical Manufacturers Association (NEMA)
  - 1. NEMA SG4, Alternating Current High-Voltage Circuit Breakers
  - 2. NEMA SG5

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**1.03 SUBMITTALS**

- A. Submit certified copies of test reports for all the tests conducted at the factory and in field for Metra's Authorized Representative's approval. Submit test reports to Metra's Authorized Representative within seven days after completion of tests. Test reports shall contain the characteristics curves, etc. where required for interpretation of results.

**1.04 CONDITIONS FOR TESTS****A. General Conditions**

1. Prior to testing of any equipment specified in this Section, fulfill all of the conditions below.
2. All shop drawings of the equipment to be tested have been approved by Metra.
3. Submit a step-by-step test procedure including pass-fail criteria to Metra six weeks in advance of the commencement of the test. Metra reserves the right to add, delete and make necessary changes in the test procedure. Arrange to conduct all tests per Metra approved procedure.
4. Give a minimum of four weeks advance notification to Metra on the scheduled date of tests to enable Metra to witness tests.
5. Testing shall not commence without an approved test procedure from Metra's Authorized Representative.

**B. Witnessing Tests**

1. Metra will witness complete testing of all equipment unless a waiver is granted.
2. If a waiver is granted, test reports of equipment shall be submitted for review and approval to obtain clearance for packing and shipping. Waiver of witnessing tests on equipment shall not be construed as a waiver for all remaining equipment either of the same type or different type.

**C. Responsibility**

1. Formulate overall test program of the equipment, which shall include but not be limited to the tests specified in this Section, and elsewhere in the Contract Specifications to ensure equipment compliance with the relevant standards, the Specifications, and satisfactory and reliable performance in intended operation.
2. Assume full responsibility during the factory and field testing of all equipment and installation provided.
3. Should there be any loss or damage to such equipment, materials or the building or personnel injury as result of these tests, the Contractor shall be fully responsible for replacing the damaged equipment and repairing

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the building and responsible for adjudicating any results of personnel injuries.

4. Replacement of damaged equipment shall include all costs, including but not limited to, transportation of, testing and installation of replacement equipment.

D. Rejection and Retesting

1. Failure of equipment to successfully pass the tests or to meet ratings shall be sufficient grounds for rejection of equipment.
2. Any equipment rejected shall be retested in presence of Metra's Authorized Representative after modification.
3. If the modifications or changes are such as to affect any of the drawings, diagrams or any other documents submitted and accepted by Metra's Authorized Representative, revised drawings or diagrams shall be submitted, showing proposed changes and Metra's Authorized Representative's approval obtained before changes or modifications are made on the equipment.
4. Modifications or changes that do not warrant revision of any drawing shall be furnished to Metra's Authorized Representative along with notice of retesting.
5. If it is not possible to modify rejected equipment, new equipment shall be manufactured and the requirements of the drawings and design calculations of the original unit shall be applicable for the new unit.
6. The entire cost of modification or a new unit shall be borne by the Contractor, including retesting and cost of witnessing retesting.

**PART 2 - PRODUCTS****2.01 FACTORY TESTS**

- A. Tests at the factory shall include but not be limited to the following:
  1. Manufacturer's standard tests.
  2. Tests per currently applicable NEMA, IEEE, and ANSI Standards.
  3. Other tests to ensure satisfactory performance of the traction power equipment.

**2.02 DETAILED REQUIREMENTS FOR FACTORY TESTS**

- A. General:
  1. If facilities for conducting any of the tests listed below are not available to the Contractor, these tests shall be conducted elsewhere by the

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Contractor or by an independent agency as approved by Metra's Authorized Representative.

**B. AC Switchgear:**

1. Perform the following tests listed in IEEE C37.09 as Design Tests on one 15 kV class representative circuit breaker:
  - a. Rated maximum voltage test
  - b. Rated voltage range factor test
  - c. Rated frequency test
  - d. Rated continuous current carrying tests
  - e. Short-circuit rating tests
  - f. Rated standard operating duty tests
  - g. Rated permissible tripping delay tests
  - h. Rated interrupting time tests
  - i. Rated reclosing time tests
  - j. Dielectric withstand tests
    - 1) Low frequency withstand voltage test
    - 2) Impulse withstand voltage tests
  - k. Low current switching tests
  - l. Radio influence voltage tests per NEMA SG4
2. Perform the following tests listed in IEEE C37.09 as Production Tests at the manufacturer's facility on each and every 15 kV class circuit breaker:
  - a. Current and linear coupler transformer tests
  - b. Nameplate check
  - c. Resistors, heaters, and coil check tests
  - d. Control and secondary wiring check tests
  - e. Clearance and mechanical adjustment check tests
  - f. Mechanical operation tests
  - g. Timing tests
  - h. Stored energy system tests
  - i. Electrical resistance of current path test
  - j. Low frequency withstand voltage tests
3. Perform the following tests listed in IEEE C37.20.1 as Design Tests on the 15 kV metal clad ac switchgear assembly:
  - a. Dielectric tests
    - 1) Power Frequency withstand tests
    - 2) Impulse withstand test
    - 3) Test of bus bar insulation
  - b. Rated continuous current tests
  - c. Momentary current tests
  - d. Mechanical operation tests
  - e. Flame-retardant tests

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4. Perform the following tests listed in IEEE C37.20.1 as Production Tests at the manufacturer's facility on the 15 kV metal clad ac switchgear assembly:
  - a. Mechanical operation tests
  - b. Grounding of instrument transformers cases test
  - c. Electrical operation and control wiring tests
    - 1) Control wiring continuity test
    - 2) Control wiring insulation test
    - 3) Polarity tests
    - 4) Sequence tests
5. In lieu of Design Tests specified above for ac circuit breakers and ac switchgear assembly, test certificates from the manufacturer or an independent agency conducted on similar circuit breakers and similar switchgear assemblies are acceptable, provided test certificates meet the Specification requirements in the opinion of Metra's Authorized Representative.

## C. Rectifier Transformer

1. Following tests listed in IEEE C57.12.91 shall be conducted at the manufacturing facility on each and every rectifier transformer to be provided in this Contract:
  - a. Cold resistance measurement test on all windings on the rated voltage connections and at all taps per IEEE C57.12.91. Pass/Fail Criteria:
 
$$\left[ \frac{3(R_{max} - R_{min})}{R_1 + R_2 + R_3} \right] \times 100 \leq 5\%$$
  - b. Polarity and phase relation test at rated voltage connection. Pass/Fail Criteria per IEEE C57.12.91.
  - c. Ratio test on the rated voltage connection and at all taps, per IEEE C57.12.91. Pass/Fail Criteria: All taps tolerance within 0.5 percent.
  - d. No load loss and excitation current test at 90, 100, and 110 percent rated tap voltage per IEEE C57.12.91. Pass/Fail Criteria 5.1 kW for 2808 kVA and 6.0 kW for 3370 kVA.
  - e. Load loss and impedance voltage test at 90, 100, and 110 percent rated tap voltage. Pass/Fail Criteria per IEEE C57.12.91.
  - f. Dielectric test:
    - 1) Insulation resistance test per IEEE C57.12.91. Pass/Fail Criteria: All windings  $\geq 1000$  Mohm, Core  $\geq 100$  Mohm.
    - 2) Insulation power factor test: Pass/Fail Criteria per IEEE C57.12.91.
    - 3) Applied voltage (H1-Pot) test per IEEE C57.12.91. Pass/Fail Criteria: No change in measuring current

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- 4) Induced voltage level test (To be performed after impulse test) per IEEE C57.12.91. Pass/Fail Criteria: No abrupt current change.
  - g. Impulse test consisting of reduced, two chopped, and full wave applied to high- and low-voltage winding per IEEE C57.12.91. Pass/Fail Criteria: per IEEE C57.98.
  - h. Partial discharge test. Corona inception and extinction levels on all primary terminals. Pass/Fail Criteria: Corona inception shall not occur at less than 125 percent above the highest voltage connection (maximum winding). Extinction must be at least 15 percent above the highest voltage connection.
2. Following tests shall be conducted at the manufacturer's facility on one representative transformer of each size. Tests shall be performed on delta primary unit:
- a. Temperature rise test to determine that the temperature rise of the windings are within the permissible limit after delivering full load continuously and fulfilling the rectifier-transformer duty cycle. For the purpose of this test, readings will be considered to have stabilized when the rate of temperature rise is less than 2°C during a consecutive 3-hour period. The test shall be performed per IEEE C57.12.91 in the following sequence:
    - 1) Step 1:
      - a) Temperature stabilized at 100 percent continuous load at lowest voltage and highest current tap. This temperature will be used as a base line for the remaining temperature rise test.
      - b) Record data at shut down.
    - 2) Step 2:
      - a) Re-stabilize the temperature at 100 percent continuous load.
      - b) Apply 300 percent full load current for 36 minutes.
      - c) Record data at shut down.
      - d) Pass/Fail Criteria: Hot spot temperature shall not exceed 180°C in an ambient corrected to 40°C.
    - 3) Step 3:
      - a) Re-stabilize the temperature at 100 percent continuous load
      - b) Apply 162 percent full load current for 2 hours.
      - c) Record data at shut down.
      - d) Pass/Fail Criteria: The temperature rise shall not exceed 80°C in an ambient corrected to 40°C.

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- 4) Step 4:
    - a) Re-stabilize the temperature at 150 percent continuous load.
    - b) Record data at shut down.
    - c) Pass/Fail Criteria: The temperature rise shall not exceed 85°C in an ambient corrected to 40°C.
  - 5) Step 5:
    - a) Following Step 4, apply 1,200 percent full load current for 12 seconds.
    - b) Pass/Fail Criteria: No physical or electrical damage should occur.
  - b. Audible sound level test in accordance with IEEE C57.12.91. The transformer shall be connected for and energized at rated voltage and frequency at no load. Pass/Fail Criteria less than 65 dB (A).
- D. Rectifier:
1. Perform the following tests listed in IEEE.1653.2 at the manufacturing facility on each and every rectifier provided under this Contract.
    - a. Dielectric voltage test per IEEE.1653.2. Pass/Fail Criteria: No momentary flashover to ground, no external flashover to ground, no excessive noise and no excessive leakage current.
    - b. Rated voltage test. The test shall be performed with 110 percent of rated input voltage applied for 5 minutes per IEEE.1653.2. Pass/Fail Criteria: Recorded Vac values between R1, R2 and R3 match expected value of the ac voltage.
    - c. Rate current test per IEEE.1653.2. Pass/Fail Criteria: The rectifier conducts 110 percent of its rated current without any incident. The temperature should be the same as recommended for regular service.
    - d. Power factor test per IEEE 1653.2.
    - e. Current balance test at 150 percent full load current. With 150 percent full load applied and temperatures stabilized measure temperature of ambient air-in and air-out, temperature of each of four selected diodes and their associated heat sinks (use same positions on each unit) and current in each diode.
      - 1) Increase current by 7 percent waveform and conduction angle adjustment factor to compensate for loading by short circuit.
      - 2) Pass/Fail Criteria: Maximum current unbalance between parallel connected individual diodes in a leg and between legs shall not exceed +/- 10 percent.
    - f. The following certified test or manufacturer's certified test data for the diode (per device) units of the rectifier shall be furnished to Metra's Authorized Representative:

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- 1) Average forward current rating, per JESD282B.01.
- 2) Peak forward current rating.
- 3) Maximum surge current rating.
- 4) Forward voltage drop.
- 5) Threshold voltage.
- 6) Differential resistance.
- 7) Crest working voltage.
- 8) Working peak reverse voltage rating, per JESD282B.01.
- 9) AC rms voltage rating.
- 10) DC voltage blocking rating, per JESD282B.01.
- 11) Repetitive peak reverse voltage rating, per JESD282B.01 (PRV rating).
- 12) Non-repetitive peak reverse voltage rating, per JESD282B.01.
- 13) Initial reverse voltage.
- 14) Forward power loss.
- 15) Reverse power loss.
- 16) Temperature derating.
- 17) Positive non-conducting period.
- 18) Surge forward current rating per JESD282B.01.
- 19) Operating temperature rating, per JESD282B.01.
- 20) Thermal fatigue rating, per JESD282B.01

## E. DC Switchgear

1. Perform the following test listed in IEEE C37.14 as Design Tests on one representative dc circuit breaker of each rating:
  - a. Dielectric withstand test
  - b. Continuous current test
  - c. Short-circuit current interrupting test: The short-circuit test value shall be as calculated for the substation with the equivalent of two 3000 KW rectifiers feeding the line side of the dc breaker. Primary ac system available fault capacity shall be taken as 500 MVA at 12.6 kV and X/R Ratio 15. The fault shall be between the load side terminals of the dc breaker and the nearest negative bus of the substation. The dc power source shall preferably be from silicon rectifiers. Metra's Authorized Representative's approval shall be obtained prior to testing if other sources of supply are to be used. Previous test certifications are not acceptable.
  - d. Endurance test:
    - 1) Electrical endurance test
    - 2) Mechanical endurance test
2. Perform the following tests listed in IEEE C37.14 as Production Tests at the manufacturer's facility on each and every dc circuit breaker.
  - a. Calibration tests on the individual direct acting trip device prior to final assembly
  - b. Control and secondary wiring check test
  - c. Dielectric withstand test

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- d. Mechanical operation test
  - e. Calibration test:
    - 1) Direct acting trip devices
    - 2) Undervoltage trip device
  - f. Manufacturer's standard tests not included in the above tests.
3. Perform the following tests listed in IEEE C37.20.1 as Design Tests on one of the dc switchgear cubicles:
- a. Dielectric tests
  - b. Mechanical operation tests
  - c. Electrical operation and control wiring tests:
    - 1) Control wiring insulation tests
    - 2) Polarity tests
    - 3) Sequence tests
- F. Bus Ducts:
- 1. Perform the following tests at the manufacturer's facility on one unit as specified under Design Tests in IEEE C37.20.1 for metal-enclosed bus:
    - a. Dielectric tests:
      - 1) Power frequency withstand
      - 2) Impulse withstand
    - b. Temperature rise tests
    - c. Momentary tests
  - 2. In addition, perform temperature rise test described below on one of the anode bus ducts:
    - a. Measure temperature rise of conductors in 40°C ambient at continuous 150 percent rated load, load shall be applied until all readings have stabilized.
    - b. For the purposes of this test, readings will be considered to have stabilized when the rate of temperature rise is less than 2°C during a consecutive 3-hour period.
  - 3. Perform power frequency withstand test at the manufacturer's facility on each and every shipping length as specified under Production Test in IEEE C37.20.1 for metal-enclosed buses.
- G. Auxiliary Transformers:
- 1. In addition to the test normally performed by the manufacturer and tests called for in the applicable IEEE, ANSI, and NEMA standards, perform a prototype test on one auxiliary transformer unit.
  - 2. The test shall consist of measurement by the resistance method of the average temperature rise of the windings following continuous 100

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percent rated load at 40°C ambient, load shall be applied until all readings have stabilized.

**PART 3 - EXECUTION****3.01 FIELD TESTS**

- A. Tests in the field shall include but not be limited to the following:
1. Manufacturer's standard tests
  2. Test as per currently applicable NEMA and ANSI Standards.
  3. Complete visual inspection of all assemblies and sub-assemblies
  4. Dielectric testing for all high-voltage cables provided.
  5. Dielectric testing for all control wires provided between new and old Substation.
  6. ODTR test on all fibers of fiber optic cables provided between new and old Substation.
  7. Rain Test
  8. Complete electrical sequence test for the entire TPS including interfaces to the existing dc switchgear
  9. SCADA I/O Test end-to-end. Simulation of signals is prohibited unless specifically requested and approved by Metra's Authorized Representative.
  10. Other tests to ensure satisfactory performance of the traction power equipment.
  11. IEEE 1653.2 for dc traction power system field testing and acceptance criteria for systems up to 1500 Vdc.

**3.02 FIELD TEST PROCEDURE**

- A. Formulate a complete Field Test procedure for all equipment to be provided under this Contract. Test procedure shall be comprehensive and shall include the required tests as specified in relevant standards of ANSI, NEMA and IEEE, supplementing the Factory Test Procedure.
- B. Submit the test procedure to Metra's Authorized Representative for review and approval well in advance to the commencement of field tests.
- C. Metra's Authorized Representative reserves the right to add, delete or make necessary changes in the test procedure.
- D. Arrange to conduct all the field tests as per the Metra's Authorized Representative's approved procedure.

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- E. Since the Contractor is responsible for the performance and installation of the equipment provided under this Section, it shall, therefore, prior to testing, verify that the installation is proper and in accordance with all applicable installation instructions as specified.

**3.03 DETAILED REQUIREMENTS FOR FIELD TESTS****A. General**

1. Perform the following field tests on all equipment specified in this Section after installation of the equipment, and after all 15 kV cable installation is complete.
2. Perform field tests to supplement factory tests and to ensure proper operation of equipment and proper calibration and coordination of protective devices.
3. Furnish and set up all special equipment required for the tests, including relay tests set, switches, properly calibrated indicating instruments, timing devices, shorting devices, loading devices and other associated appurtenances as may be required.
4. The work includes furnishing labor, material, test instruments and services necessary to perform required testing and checking of electrical equipment installation.
5. All tests shall be successfully completed to show that the installation meets the Specification requirements and that the equipment and devices operate as intended, before final acceptance by Metra.
6. Tests and checkouts shall be conducted in accordance with Metra's Authorized Representative's approved test procedure and in NFPA 70, and applicable standards and specifications of IEEE, NEMA, etc.
7. Furnish properly qualified personnel who shall be responsible for supervising, coordinating, and performing all the electrical field testing and checking work and who shall maintain a written record of tests conducted.
8. Testing and checkouts shall be performed in the presence of Metra's Authorized Representative.
9. Furnish four copies of all tests results to Metra's Authorized Representative. Result sheets shall include date of test, personnel involved, items tested, type of tests and test data.
10. Any equipment or material damaged due to improper test procedure or test apparatus handling shall be replaced or restored to original condition by Contractor at its expense.
11. Safety devices including but not limited to rubber gloves and blankets, screens and barriers, danger signs, flashing safety lights, padlocks, etc., shall be used to protect and warn all personnel in the vicinity of the tests.

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12. Test instruments used shall have a certified calibration sticker showing last date of calibration and expiration date. All test instruments shall have a current certified calibration.
- B. Perform the following field tests:
1. Complete visual inspection shall ensure that all equipment, tools and other debris from construction and installation have been removed and the equipment is clean, free of dirt, and ready for Metra's inspection. During this test each and every ac and dc circuit breaker shall be thoroughly inspected and certified by the Contractor's engineer.
  2. Perform continuity and dielectric test to prove the correctness of circuitry.
  3. Manufacturer's standard tests shall ensure that the equipment was shipped and installed without causing damage to any of the components inside the substation. This test must be conducted before any control voltage is applied to the equipment.
  4. Dielectric testing for all high-voltage cables provided inside the new prefabricated enclosure as well as all cables exterior connecting the new substation to the old tie breaker station.
  5. Dielectric Testing for all control wires provided between new and old Substation only.
  6. ODTR Test on all fibers of fiber optic cables provided between new and old substation.
  7. Rain test for outdoor low-voltage switchgear: Perform on each complete substation with all equipment and exterior lighting and devices installed in accordance with IEEE C37.20.1. An existing design test will not be accepted; this test will not be waived. In addition to IEEE C37.20.1 requirements, address HVAC systems as follows:
    - a. Test first with HVAC systems installed but not operating.
    - b. If HVAC systems have louvered openings that open when the system is in operation, retest with all such openings in the fully open position.
    - c. Replace IEEE C37.20.1 "satisfaction of test" requirements with the following: the enclosure shall have satisfactorily met the requirements of this test if during the visible inspection no water is found.
  8. Complete Electrical Sequence Test for the entire TPS including interfaces to the existing dc switchgear. The test shall include exercising all protective functions and shall verify the proper reaction. Overcurrent relays shall be tested via current injection to prove secondary wiring is correct on each phase and picks up the relay. It is mandatory that all tests listed above have been conducted and signed off by the Contractor's engineer.

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9. Perform phantom load tests on ac switchgear protective devices to ensure calibration as outlined in Section 16601, General Requirements for Traction Power Equipment.
10. Calibration test also shall be performed on the following:
  - a. Both 1500 Vdc, 4000 A air circuit breaker cubicles
  - b. Spare 1500 Vdc air circuit breaker
11. Before any of the transformers inside the new station are energized, enter all protective settings into the relays and verify against the relay coordination study. Once this step is complete, energize all transformers and measure and verify the output voltage against the nameplate.
12. SCADA I/O Test end-to-end. Simulation of signals with a service laptop is prohibited unless specifically requested and approved by Metra.
13. Other tests to ensure satisfactory performance of the traction power equipment.
14. IEEE 1653.2 for dc traction power system field testing and acceptance criteria for systems up to 1500 Vdc
15. Check relay and trip devices settings and coordination.

## 3.04 TESTING TABLES

Transformer Tests					
Test Description	Standard	Pass/Fail Criteria	Routine	Design	Notes
Commutating Reactance	IEEE C57.18.10			X	
Resistance of all windings at all taps	IEEE C57.12.91			X	
Resistance of all windings at all taps	IEEE C57.12.91	Imbalance < or = 5.0 percent	X		
Polarity and phase relation at nominal voltage tap	IEEE C57.12.91	Per IEEE C57.12.01	X	X	
Turns Ratio of all windings at all taps	IEEE C57.12.91	Per IEEE C 57.12.01 Tolerance +/- 0.5 percent all taps	X	X	
No load loss and excitation current @ 90, 100, and 110 percent of nominal tap voltage	IEEE C57.12.91	5.1 kW for 2808 KVA 6.0 kW for 3370 KVA	X	X	
Impedance voltage of all windings at all taps	IEEE C57.12.91	Per IEEE C 57.12.01		X	
Load loss of all windings at all taps	IEEE C57.12.91	Per IEEE C 57.12.01		X	
Load loss of all windings at nominal voltage tap and tap extremes	IEEE C57.12.91	Per IEEE C 57.12.01	X		

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Transformer Tests					
Test Description	Standard	Pass/Fail Criteria	Routine	Design	Notes
Impedance voltage of all windings at nominal voltage - tap and tap extremes	IEEE C57.12.91	Per IEEE C 57.12.01	X		
Insulation Resistance H.V.-L.V. & earth ground L.V.-H.V. & earth ground Core – Earth ground	IEEE C57.12.91	Windings > 1000Mohm Core > 100Mohm	X	X	
Insulation Power Factor	IEEE C57.12.91	Per IEEE C57.12.91	X	X	
Applied voltage	IEEE C57.12.91 IEEE C57.12.01	No change in measured current	X	X	
Induced Voltage (Performed after impulse test)	IEEE C57.12.91 IEEE C57.98				LV winding at 2X rated voltage
Temperature Rise at 100 percent at lowest voltage, highest current tap	IEEE C57.12.91 Section 16603	No specified value		X	Used as a baseline for the remaining temperature rise tests
Temperature Rise at 150 percent at lowest voltage, highest current tap	IEEE C57.12.91 Section 16603	85°C		X	Corrected to 40 deg. C ambient
Temperature Rise at 162 percent at lowest voltage, highest current tap	IEEE C57.12.91 Section 16603	80°C		X	Corrected to 40 deg. C ambient
Temperature Rise at 300 percent at lowest voltage, highest current tap	IEEE C57.12.91 Section 16603	Hot spot < 145 deg. C for epoxy, 180 deg. C for VPI		X	Corrected to 40 deg. C ambient
1200 percent short circuit withstand at highest voltage, lowest current tap	Section 16603	No Damage		X	
Impulse (H.V. winding), Reduced, chopped and full wave. Minimum winding, highest tap.	IEEE C57.12.91 IEEE C57.12.01 IEEE C57.98	IEEE C57.98	X	X	110 kV BIL
Impulse (L.V. winding), Reduced, chopped and full wave	IEEE C57.12.91 IEEE C57.12.01 IEEE C57.98	IEEE C57.98			
Partial Discharge (Corona Inception/Extinction)	IEEE C57.12.91	PD < 10 pC	X	X	
Audible Noise	IEEE C57.12.91	< 65 d.b.a.		X	
Thermal Shock	Section 16603			X	Cast Coil Only

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<b>Rectifier Tests</b>					
<b>Test Description</b>	<b>Standard</b>	<b>Pass/Fail Criteria</b>	<b>Routine</b>	<b>Design</b>	<b>Notes</b>
Dielectric strength	IEEE 1653.2	No flashover	X	X	
Rated Voltage	IEEE 1653.2	No failure	X	X	
Rated Current	IEEE 1653.2	Diode junction temperature shall not to exceed maximum rating	X	X	
Efficiency	IEEE 1653.2	Per Section 16604		X	
Voltage Regulation (At 0.5, 25, 50, 75, 100, 150, 300, and 450 percent load)	IEEE 1653.2	Per Section 16604		X	
100 percent Current Balance (N diodes)	IEEE 1653.2	+/- 10 percent maximum		X	
150 percent Current Balance (N diodes)	IEEE 1653.2	+/- 10 percent maximum	X	X	
Power Factor	IEEE 1653.2			X	
Harmonic Amplitude	IEEE 1653.2	THD < 5 percent		X	
Commutation Reactance Constant	IEEE 1653.2	Individual < 3 percent		X	
150 percent Diode Temperature	IEEE 1653.2			X	

END OF SECTION

## SECTION 16612

### IN-LINE TEST ON RECTIFICATION EQUIPMENT AND SURGE AND DESTRUCTIVE TEST ON DIODES

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. This Section includes requirements for in-line test on rectification equipment and surge destructive test on diodes.

##### 1.02 REFERENCES

- A. This Section incorporates by reference the latest revisions of the following documents:
- B. Institute of Electrical and Electronics Engineers (IEEE)
  - 1. IEEE 1653.2, Standard for Uncontrolled Traction Power Rectifiers for Substation Applications Up to 1500 V DC Nominal Output
- C. JEDEC Solid State Technology Association (JEDEC)
  - 1. JESD282B.01, Silicon Rectifier Diodes (formerly ANSI/EIA 282-A)

#### PART 2 - PRODUCTS

##### 2.01 DETAILED REQUIREMENTS FOR IN-LINE TEST

- A. General
  - 1. If facilities for conducting the in-line tests are not available to the manufacturer, these tests shall be conducted elsewhere by the Contractor or by an independent agency as approved by Metra's Authorized Representative.
- B. Rectifier surge voltage and short-circuit tests:
  - 1. Following test shall be conducted on one rectifier package, including transformer, rectifier, and interconnecting anode bus assembled in line and subjected to the following tests to ensure compliance with Specification requirements.
  - 2. Test set-up shall include the following:
    - a. Primary supply system having minimum 150 MVA capacity
    - b. Switchgear having operating characteristics equivalent to actual switchgear specified
    - c. Protective devices having operating characteristics equivalent to actual devices specified and which have been adjusted to provide

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- pick-up values and operating times conforming to those proposed for final installation
- d. Shunt, properly calibrated meters, shorting devices, loading devices and other associated appurtenances as may be required
3. Open-circuit test to ensure ability to withstand transient surge voltages in steps as follows:
    - a. Energize transformer and rectifier at rated voltage with no load.
    - b. De-energize transformer and rectifier by tripping ac supply breaker.
    - c. Record voltage waveforms and amplitudes at transformer and rectifier output terminals and at critical points in surge protection network during close and trip operation.
    - d. Repeat test a minimum of 10 times to ensure maximum transient.
    - e. Maximum crest of transient surge impressed on rectifier shall not exceed 75 percent of the voltage withstand of the diodes in a phase leg.
  4. Short circuit test to determine short circuit current in steps as follows:
    - a. Energize transformer and rectifier at rated voltage with no load.
    - b. Short rectifier output terminals with shorting device.
    - c. Clear short (bolted fault) by tripping the ac supply breaker through equivalent ac switchgear protective devices.
    - d. Record current waveform and amplitude at rectifier output terminals during shorting operation.
    - e. Calculate theoretical values of peak and sustained short circuit currents for rated voltage fault on a 500 MVA system having X/R ratio of 15. Calculate theoretical transformer over-voltage and test supply system X/R ratio required to obtain a minimum of these values on actual test set-up.
    - f. Repeat short circuit test with transformer energized at theoretical over-voltage and the X/R ratio of the test supply system adjusted to the value calculated above. Continue to adjust voltage until calculated peak and sustained values of current are realized.
- C. Rectifier Current Balance and Load Test:
1. Following test shall be conducted on one rectifier package, including transformer, rectifier and interconnecting anode bus assembled in line and subjected to the following tests to ensure compliance with the Specification requirements.
  2. Test setup shall include necessary supply and loading systems including the following:
    - a. Switchgear and protective devices
    - b. Ventilation system equivalent to actual system in final installation, as specified, with temperature controlled at 104°F
    - c. Shunts, thermocouples, properly calibrated meters, and associated appurtenances as may be required

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- d. 125 Vdc control power shall be provided to the control circuits of the rectifier in order to keep thermal devices energized during the test.
  - e. Reduced-voltage/reduced-capacity supply system will be acceptable for certain portions of these test providing currents specified are increased by 7 percent waveform and conduction angle adjustment factor to compensate for loading by short circuit.
3. Individual silicon diode junction temperatures shall not exceed design values established, in Contractor's load and short circuit calculations as determined from actual case temperature using junction versus case temperature data.
  4. Current balance test to ensure compliance with requirement for current balance between diodes sharing current of same polarity in steps as follows:
    - a. Attach six thermocouples, one per leg and apply 100 percent full load current and measure all diode currents in each phase polarity. After stabilization of temperature, repeat test for 150 percent (N diodes).
    - b. Remove one diode fuse in each phase polarity to create maximum diode current unbalance; then apply 150 percent full load current and measure remaining diode currents in each phase polarity, after stabilization of temperature.
  5. Efficiency measurement test: The test shall be performed on each rectifier at 100 percent rated load per IEEE 1653.2. Efficiency shall be determined by calculation based on measured losses on 100 percent rated load, for rated voltage, current and frequency.
  6. Voltage regulation test shall be performed at 0.5 percent load, 25 percent load, 50 percent load, 75 percent load, 100 percent load, 150 percent load, 300 percent load and 450 percent load per IEEE 1653.2.
  7. Harmonic amplitude per IEEE 1653.2.
  8. Load current test to ensure compliance with rectifier current rating (thermal capability) and ability of rectifier to withstand short circuit under load in steps as follows:
    - a. With one diode fuse removed in each phase polarity as in test above, apply 100 percent full load current until constant diode temperature is reached. Measure and record current and temperature of two diodes, which had maximum current.
    - b. Apply 150 percent full load current for two hours immediately after completion of the 100 percent full load current test above.
    - c. Superimpose five 1-minute overloads of 300 percent full load current followed by one, 15-second overload of 450 percent full load current spaced equally throughout the 2-hour period. (Current values specified shall continue for the full interval of each superimposed overload.)

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- d. Apply short circuit current, obtained in the short circuit test for the operating time of the short time relays plus ac breaker opening time in cycles immediately after completion the test above. A time interval of 1 second is allowed between the 450 percent overload and the application of short circuit.
- e. Record load current, ambient air temperature, supply air temperature, discharge air temperature, transformer winding hot spot temperature and diode case temperature of diode having maximum current unbalance as determined in the current balance test at sufficiently close time-intervals to provide accurate current-time-temperature relationship.
- f. Monitor rectifier commutation with Astromed Dash 8 recorder during test-loadings set forth in test above to ensure normal operation. If possible, trace rectifier input-voltage wave forms.
- g. Failure of equipment to withstand tests or to meet ratings shall be sufficient grounds for rejection of equipment.

## D. Communication Reactance:

1. Determine the commutation reactance and resistance of the rectifier package (transformer, rectifier and anode bus) using any one of the following three propositions so that the equipment voltage regulation may be calculated ( $E_D = E_{DO} - E_{TH} - E_X - E_R = \text{average dc voltage}$ ) under load to ensure compliance with output-voltage characteristics set forth in the Specifications.
2. Proposition 1:
  - a. Transformer, bus duct, and rectifier connected in-line.
    - 1) Ambient of entire package adjusted and maintained at 40°C.
    - 2) With rectifier dc output terminals shorted, adjust and maintain transformer primary current while at 12,600 volt tap at 100 percent IP at 60 Hz until the hottest spot winding temperature stabilizes (not more than 2°C rise in a consecutive 3-hour period).
    - 3) Measure input watts "P", ac amperes "I<sub>p</sub>", ac volts "V", dc amperes "I<sub>d</sub>" and the voltage across the shorting strap "V<sub>d</sub>."
    - 4) Determine X for Package as follows:

$$X \text{ sec} = \frac{\sqrt{(\sqrt{3}VI_p)^2 - P^2}}{3I^2} \left(\frac{E_S}{E_P}\right)^2 \left(\frac{\text{ohms}}{\text{phase}}\right)$$

- 5) Determine R for Package as follows:

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$$R = \frac{[P - I_a(V_d + 2E_{TH})]}{3I_p^2} \left(\frac{E_s}{E_p}\right)^2 \left(\frac{\text{ohms}}{\text{phase}}\right)$$

## 3. Proposition 2:

a. Transformer at 12,600 volt ac taps set up for certified heat run.

- 1) Measure primary and secondary resistances at any ambient. Note ambient temperature (T1).
- 2) With transformer secondary open circuited, energize primary of transformer at rated voltage and frequency until individual winding temperature stabilizes. Measure average winding temperature by resistance method. Determine temperature rise  $T_e$ .
- 3) With transformer secondary short circuited, circulate rated full load current in primary until transformer winding temperature rises do not change more than 2°C during a consecutive 3-hour period.
- 4) Measure input watts "P", ac amperes "I<sub>p</sub>", and ac volts 'V.'
- 5) Shut down and quickly measure dc resistance of primary and secondary windings. Record elapsed time between instant of shut-down and each resistance measurement. All reading must be completed within 4 minutes of shut-down. Otherwise the temperature test should be resumed until temperature is normal again, after which the remaining readings will be taken.
- 6) Determine temperature rise of copper winding and correct R for 40°C ambient.

Let

R<sub>1</sub> = resistance (step a) at copper temperature t<sub>1</sub>.R<sub>2</sub> = resistance at 100 percent I<sub>p</sub> continuous and test ambient.t<sub>2</sub> = copper temperature at 100 percent I<sub>p</sub> continuous and test ambient.R<sub>3</sub> = resistance at 100 percent I<sub>p</sub> continuous and 40°C ambient.t<sub>3</sub> = copper temperature at 100 percent I<sub>p</sub> continuous, normal excitation on the core and 40°C ambient.

$$t_3 = t_3 + (40 - \text{Test Ambient}) + T_{\bar{c}} - T_c$$

$$T_{\bar{c}} = T_c \left[ 1 + \left(\frac{T_e}{T_c}\right)^{1.25} \right]^{0.8}$$

Where

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$T_e$  = individual stabilized winding temperature rises measured immediately following the run with normal excitation on the core.  
 $T_c$  = individual stabilized winding temperature rises measured immediately following full load current flowing in one winding with the other winding short circuited.

$$t_2 = (234.5 + t_1) \left( \frac{R_2}{R_1} \right) - 234.5$$

$$R_3 = R_1 \left[ \frac{234.5 + t_3}{234.5 + t_1} \right]$$

- 7) Determine X from volt-amperes and watts measured in step 5 as follows:

$$x = \frac{\sqrt{(\sqrt{3}VI_p)^2 - P^2}}{3I_p^2} \left( \frac{E_s}{E_p} \right)^2 \left( \frac{ohms}{phase} \right)$$

- 8) Calculate  $I_p^2 R_2$  loss.  
 9) Subtract  $I_p^2 R_2$  from watts measured (in step 5) to get stray losses at copper winding temperature  $t_2$ .  
 10) Calculate  $I_p^2 R_3$  losses.  
 11) Stray losses at  $t_3$

$$t_3 = \frac{234.5 + t_2}{234.5 + t_3} (\text{Stray Losses at } t_2)$$

- 12) Total watts loss for purpose of determining effective R will be  $I_p^2 R_3 +$  stray losses at  $t_3$

$$R(40^\circ\text{C Ambient}) = \frac{\text{Total}}{3I_p^2} \left( \frac{E_s}{E_p} \right) \left( \frac{ohms}{phase} \right)^2$$

- b. Bus duct and rectifier connected in line.

- 1) Rectifier inlet air maintained at 40°C.  
 2) With rectifier dc output terminals short circuited, adjust rectifier output current to 107 percent  $I_d$ . Note temperatures and measure bus duct input watts "P", ac amperes " $I_s$ ", ac volts "V", dc amperes " $I_d$ ", and voltage across shorting strap " $V_d$ ".

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- 3) Calculate rectifier R as follows:

$$R = \frac{P - I_d(V_d + 2E_{TH})}{3I_s^2}$$

- 4) Calculate X of bus duct and rectifier combined using measured values volt-ampere and input watts (step b.2 above).
- 5) The X and R of package are respectively the sum of X and R of transformer, bus duct and rectifier.

4. Proposition 3:

- a. Transformer as in Proposition II.  
b. Bus duct alone.

- 1) With bus duct at ambient temperature between 15°C and 40°C adjust bus duct current for 100 percent, with its output shorted. Measure input watts, ac amperes, ac volts and note ambient temperature.
- 2) Determine X of bus duct using measured values of volt amperes and input watts (step b.1 above).
- 3) Determine R of bus duct using measured input watts.

c. Rectifier alone

- 1) With inlet air maintained at 40°C and rectifier dc output terminals shorted adjust rectifier output current to 107 percent "Id".
- 2) Measure input watts "P", ac amperes "Is", ac volts "V", dc amperes " Id", and voltage across shorting strap "Vd".
- 3) Calculate rectifier R as follows:

$$R = \frac{P - I_d(V_d + 2E_{TH})}{3I_s^2}$$

- 4) Determine X using measured values of volt-amperes and input watts (step C.2 above).

- d. The X and R of package are respectively the sum of X and R of transformer bus duct, and rectifier.

5. Definitions:

- a. Where  $E_{DO} = 1.35E_S$
- b. Where  $E_s$  = no load RMS voltage of transformer secondary measured line to line at transformer secondary terminals with transformer on rated tap and voltage  $E_p$  applied to primary terminals.
- c. Where  $E_{th}$  = voltage axis intercept of line drawn through two points on instantaneous forward voltage versus instantaneous forward current curve of the diode. The points chosen shall be

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25 percent and 100 percent rated diode current with junction temperature at 50°C.

$$\text{Where } \Delta E_x = \frac{3X_c I_d}{\lambda}$$

- d. Where  $X_c$  - Total ohms reactance of rectifier transformer plus interconnecting bus duct on a transformer secondary line to neutral base with transformer on rated tap. See Proposition 1, 2, and 3 for determination.
- e. Where  $I_d$  = Total current (average value) through load connected to rectifier.
- f. Where  $I_p$  = Line current (RMS) to transformer primary terminals on rated tap.
- g. Where  $E_p$  = Rated line-to-line RMS voltage of transformer primary at rated tap.

$$\text{Where } \Delta E_R = 2I_d R_c$$

- h. Where  $R_c$  = Total ohms resistance of rectifier transformer plus rectifier plus interconnecting bus duct on a transformer secondary line to neutral base with transformer on rated tap.
- i. Where  $V_D$  = Voltage drop across rectifier dc output terminals shorting strap.
- j. Where  $I_s$  = Current in bus duct. (RMS)

## 2.02 SURGE AND DESTRUCTIVE TEST ON DIODES

### A. General

1. Prior to diode testing, demonstrate that the test equipment to be used is capable of providing 10,000 amperes (minimum) over the rated forward surge current; that the test equipment is capable of providing sufficient power to destroy the diode, should the diode's limits be exceeded, and that the equipment can safely detect diode failure.
2. Three sets of 10 percent or no less than five diodes that have been subject to all in-line tests called for in this Section will be selected by Metra's Authorized Representative. These diodes will be removed from their heat tank assemblies for the test.

### B. Surge Test On Diodes

1. The surge test shall be conducted on one set of five diodes out of the group of three sets, per JEDEC standard as follows:
  - a. One-hundred applications of forward current equal to the non-repetitive surge forward current rating under the following conditions:
    - 1) The rectifier diode is operating at its rated working peak reverse voltage, forward current and case temperature prior to surge.

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- 2) The rectifier diode is required to support its rated working peak reverse voltage during the surge and, following the surge, it must support the rated forward current specified in JESD282B.01 and non-repetitive leak reverse voltage for one-half cycle and then working peak reverse voltage.
  - 3) Successive surges may not be applicable until the rectifier diode has returned to the operating conditions specified in JESD282B.01.
  - 4) The one-half-cycle (1/120 of a second) surge forward current consists of a single-phase half-wave 60 Hertz sinusoidal pulse. The peak surge forward current consists of the peak of the half-wave pulse current flowing through the rectifier diode during the surge period. This is required JEDEC registration data.
  - 5) The surge current four times greater than one cycle consists of a series of half-wave pulses for a specified period of time.
  - 6) Each diode failure will require complete retest of same amount additional diodes as initial test, selected by Metra's Authorized Representative.
2. An acceptable diode failure is defined as a failure resulting from the failure of hydraulics on the diode test press, an electrical power surge resulting from some in-plant anomaly outside of this testing, or an electrical power surge resulting from the Utility supply system. Human error or negligence toward the test procedure will not be an acceptable cause for a diode failure.
- C. Destructive Test On Diodes:
1. The destructive test on diodes shall be conducted as follows:
    - a. Repeat the surge test described above except the forward surge current application is increased by 3,000 amperes.
    - b. The surviving diodes shall be tested to destruction by increasing forward surge current applicable in 3,000 amperes increments applied as in step above, noting number surviving for each 3,000 ampere test series.
    - c. Provide 15 identical replacement diodes in rectifier from which subject diodes were removed at no extra charge to Metra.

<b>In-Line Tests</b>					
<b>Test Description</b>	<b>Standard</b>	<b>Pass/Fail Criteria</b>	<b>Routine</b>	<b>Design</b>	<b>Notes</b>
Commutating Reactance and Resistance	Section 16612			X	Proposition 1, 2 or 3
100 percent Current Balance (N diodes)	IEEE 1653.2	+/- 10 percent max unbalance and diode junction temp < max value		X	@ 40°C ambient

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<b>In-Line Tests</b>					
<b>Test Description</b>	<b>Standard</b>	<b>Pass/Fail Criteria</b>	<b>Routine</b>	<b>Design</b>	<b>Notes</b>
150 percent Current Balance (N diodes)	IEEE 1653.2 Section 16612	+/- 10 percent max unbalance and diode junction temp < max value		X	@ 40°C ambient
100 percent Current Balance (N-1 diodes)	IEEE 1653.2 Section 16612	+/- 20 percent max unbalance and diode junction temp < max value		X	@ 40°C ambient
150 percent Current Balance (N-1 diodes)	IEEE 1653.2 Section 16612	+/- 20 percent max unbalance and diode junction temp < max value		X	@ 40°C ambient
Efficiency	Section 16612	> 97.5 percent		X	@ 40°C ambient
Displacement Power Factor	Section 16612	>90 percent lagging		X	@ 40°C ambient
Voltage Regulation	Section 16612	Per Section 16604		X	@ 40°C ambient
100 percent Rated Full Load Current Temperature Rise	Section 16612	n/a		X	@ 40°C ambient Used as a baseline for determining stability
150 percent Temperature Rise	Section 16612	Per Section 16603		X	@ 40°C ambient
IEEE 1653.2 Overload Test	Section 16612	No electrical failures and no temperatures above max allowable values		X	@ 40°C ambient
Short Circuit Test	Section 16612	No physical damage, electrical failures, or fuse openings		X	Immediately following IEEE 1653.2 Overload Test
Harmonic Analysis	IEEE 1653.2			X	
Transient Voltage Surge Test	IEEE 1653.2	< 75 percent of diode withstand rating		X	

**PART 3 - EXECUTION**

3.01 NOT USED

**SECTION 16613**  
**SERVICE ENGINEER**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section includes requirements for furnishing a Service Engineer to ensure that the purchasing, installation, and testing of the correct electrical equipment, as well as details of field work are properly carried out, and that the testing is performed in accordance with the various manufacturer requirements and approved testing procedures.

1.02 RELATED WORK

- A. Section 16601, General Requirements for Traction Power Equipment

1.03 SUBMITTALS

- A. Copy of the service engineer's resume of past and present employment must be submitted to Metra's Authorized Representative for review and approval.

1.04 QUALITY ASSURANCE

- A. Qualifications of Service Engineer:
1. The Service engineer must be a qualified English-speaking, factory trained engineer with the following experience:
    - a. Minimum 15 years of certified dc traction power engineering, and commissioning experience
    - b. 10 years of project management
    - c. SCADA system experience
  2. The Service Engineer shall be knowledgeable of alternating and direct current systems installed on structures where induced voltage, stray current, track to earth voltages and corrosion are possible.
  3. The Service Engineer shall be completely familiar with all aspects of electrical safety codes, standards and their application toward life safety and equipment operations in these conditions.
  4. To prevent conflict of interest, the service engineer must be independent and must not hold any current employment position with the equipment's manufacturer or supplier.

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**PART 2 - PRODUCTS****2.01 GENERAL**

- A. The cost of the Service Engineer's special services, including salary, transportation, lodging and other expenses, shall be included in the Contract Price.
- B. The Service Engineer's services shall be available until the project is completed, including the miscellaneous work by Metra.
- C. The service engineer's work will be validated as complete only when the following tasks are completed as determined by Metra's Authorized Representative:
  - 1. Commissioning of the new substation.
  - 2. All specified tests and requirements are fulfilled.
  - 3. The substation is energized and on line.

**2.02 SCOPE OF PROJECT**

- A. The system installed under this project includes the 12.5 KV switchgear, traction power rectifiers, transformers, and 1500 Vdc switchgear cubicles.
- B. All equipment shall perform as one integrated electrical system.
- C. The Service Engineer shall be responsible for ensuring that the electrical systems installed under this project by the Contractor and Metra's forces provides for safe train movement, public and employees' safety, equipment protection, including all relays coordination for a proper control, and utility power service properly coordinated.

**2.03 SERVICE ENGINEER RESPONSIBILITIES**

- A. To be in compliance with the provisions of this Section, the Contractor shall have a professional electrical engineer licensed in the State of Illinois for the duration of the project.
- B. The Service Engineer shall bear the accountability for adhering to Division 16 of the Specifications, including the following:
  - 1. Equipment approval
  - 2. Coordination and short circuit studies
  - 3. Develop a Test Plan for Factory Testing and Field Testing with a resource loaded schedule
  - 4. Shall Lead all factory and Field Acceptance Tests per the Test Plan

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5. Substation commissioning and integration into Metra's existing traction power system, including the following
  - a. Grounding system
  - b. Electrician, test personnel and passenger safety
  - c. SCADA system
  - d. Relaying protection coordination and settings
  - e. ComEd incoming lines protection coordination
  - f. All other electrical systems not mentioned above
  
- C. The Service Engineer's other responsibilities as described in the paragraphs below include but are not limited to the following:
  1. Reviewing RFIs.
  2. Approving the electrical submittals of shop and installation drawings.
    - a. Metra will have the authority to review the electrical submittals from the Owner's standpoint.
    - b. Comments on submittals will be discussed with the service engineer.
    - c. The Service Engineer shall have no authority to approve any electrical RFI or submittals without taking Metra's comments into consideration.
    - d. For each stamped review submittal and RFI, the service engineer shall describe his/her decision for accepting or rejecting them, make a statement that they are according to the specifications and shall also make recommendations to Metra.
  3. Certifying the material and equipment installed by Contractor and Metra.
  4. Assessing personnel safety in respect to the energized equipment.
  5. Providing a licensed-software-based study of substation grounding, catenary structures, bonding and negative returns circuit, and impedance bonds in the area of the project, as described below.
  6. Integrating all equipment installed by Contractor and Metra.
  7. Providing technical advice to Metra's forces in sizing and installing the catenary equipment.
  8. Final planning and conducting of commissioning, testing, and functioning with existing Metra system.
  9. Review and issue Test Reports for all Factory and Field Tests
  
- D. The safety of electrical maintainer and passengers will be the responsibility of the engineer with respect to testing at the job commissioning.
  
- E. The inspection and testing of the equipment shall be recorded including the nameplate data, test procedure and certification of acceptable results.

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- F. The Service Engineer shall develop detailed test procedures for factory and field acceptance testing and commissioning, for approval by Metra's Authorized Representative.
  - 1. The commissioning procedure and testing shall include instructions, forms and results used by Contractor and Metra labor forces, describe all the methods to verify the appropriate function of the relaying protection, integration in Metra's SCADA system, etc.
  - 2. The Engineer shall evaluate the touch-and-step potential in the area of projects to determine that they are within acceptable limits. A written report shall be provided for Metra's records.
- G. The Service Engineer shall work with the Contract Drawings and promptly redline changes in the field and add missing details.
  - 1. The Service Engineer is fully responsible to provide an accurate As-Built Drawing Set with all details required for a complete operating system.
  - 2. Engineering costs associated with absence of specification or drawing detail shall be Contractor's responsibility.
- H. Prior to beginning construction, the Service Engineer shall survey site conditions and identify the systems and circumstances that may be affected by construction.
- I. The Service Engineer shall be responsible for instructing Metra employees in the proper use and maintenance of the equipment installed.
- J. The Service Engineer shall provide to Metra a licensed-software-based study of the substation grounding, catenary structures, bonding and negative returns circuit, and impedance bonds in the area of the project.
  - 1. The service engineer shall study if an unintentional path exists for signal circuits that may result in false signal indications.
  - 2. Readings from the running rails within the area of the substation shall be measured by the service engineer for Arc stray current.
  - 3. An electric model for the area system shall be provided to Metra's Authorized Representative that will analyze the current return paths.
  - 4. Also the study shall contain information on the available energy discharge to evaluate the proper size of the surge protectors.
  - 5. The model software shall be Metra's property at the end of project and the cost of it shall be included in the Contract price.
- K. The Service Engineer shall verify the protection relaying and review the short circuit coordination study (see Section 16601, General Requirements for Traction Power Equipment) developed by the equipment manufacturer for all the project equipment. The service engineer shall also verify the settings of all relays, circuit breakers, etc. as per the study, prior to energizing the substation.

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**PART 3 - EXECUTION****3.01 TESTING AND COMMISSIONING**

- A. The Service Engineer, as the sole responsible person for commissioning the substation installation, shall plan and conduct the start-up, testing, equipment adjustments and any work required for safe operation of the new substation functionality, and coordinate with the other existing traction power system and Metra's Authorized Representative.
- B. The final testing shall be conducted after Metra's forces have installed their part of the system.
- C. The Service Engineer shall be responsible for the approval of all electrical equipment and materials, calculations, equipment and methods of work including the ones selected and installed by Metra.
- D. Before testing and energizing a system, all necessary precautions shall be taken to ensure the safety of the personnel and equipment. Insulation resistance of conductors shall be measured and approved by the Service Engineer with all safety considerations included in testing.

**END OF SECTION**

**SECTION 16641**  
**DIELECTRIC FLOORING**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section includes dielectric flooring and related appurtenances required under Division 16.

1.02 QUALITY ASSURANCE

- A. The dielectric flooring shall be produced by a single manufacturer, including recommended primers (if any), base coat, top coat materials. See Drawings for location of dielectric flooring.
- B. The dielectric floor must be dead level flush with floor; no inclines are permitted.
- C. Applicator Qualifications: Certified or licensed by dielectric flooring materials manufacturer.

1.03 SUBMITTALS

- A. Manufacturers Data, Dielectric Flooring:
  - 1. For information only, submit copies of manufacturer's technical data and installation instructions.
  - 2. Transmit a copy of the installation instruction to the applicator.
- B. Maintenance Instructions, Dielectric Flooring:
  - 1. Submit copies of manufacturer's written instructions for recommended maintenance practices.

**PART 2 - PRODUCTS**

2.01 DIELECTRIC FLOORING SYSTEM

- A. Resin: Manufacturer's standard.
- B. Aggregate: Manufacturer's standard; clean, dry, and containing no foreign matter.
- C. Manufacturers offering products to comply with the requirements for dielectric flooring include the following:
  - 1. Amazite Co.
  - 2. Hallemite Industrial Products.

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**PART 3 - EXECUTION**

## 3.01 JOB CONDITIONS

- A. Maintain substrate temperature and room temperature before, during and after installation in accordance with dielectric flooring material manufacturer's instructions. Provide adequate ventilation during application and curing periods.

## 3.02 PREPARATION

- A. Apply dielectric flooring only after finishing operations, including painting, have been completed and heating system is available. Air temperature and relative humidity must be within limits recommended by manufacturer.
- B. Sub floors: Prior to start of applying dielectric flooring, scarify metal floor with steel brushes to aid in adherence of dielectric flooring to metal floor. Broom-clean or vacuum surface to be covered and inspect the sub floor.

## 3.03 APPLICATION

- A. Apply material as recommended by manufacturer.
- B. The dielectric floor shall be installed, per manufacturer's instructions, to obtain an insulation resistance of at least 7.5 megohms.
- C. The top surface must be level 1/8 inch in 10 feet.
- D. The edge between dielectric floor and steel floor shall be beveled so that breaker trucks can be moved with ease and without damaging the floor.
- E. The remainder of the floor and the dielectric floor shall be a minimum of 3/8-inch thick.
- F. The dielectric floor shall be installed under and extended beyond the dc switchgear cubicles and new rectifier assemblies as shown on the Contract Drawings.

## 3.04 CLEANING AND PROTECTION

- A. Remove any surface blemishes from the installed surfaces using neutral cleaners and procedures as recommended by the dielectric flooring manufacturer. Protect installed flooring from damage by use of heavy Kraft paper or other covering.
- B. Finishing: After completion of the project and just prior to the final inspection of the work, thoroughly clean floors and apply a final top coat, if required, over scuffed or worn areas in accordance with manufacturer's recommendation.

## 3.05 FIELD TESTING

- A. Insulation Test:
  - 1. Prior to installation of dc switchgear cubicles or rectifier assemblies, the dielectric floor shall be tested by means of 5000 Vdc megger. One lead of the megger shall be attached to a copper plate (4 inches by 4 inches

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by 1/2 inch), the other lead connected to the station ground bus (or cable).

2. A salt solution made up of 1/3 salt and 2/3 water (by volume) shall be used as a conductive medium between the copper plate and the dielectric floor. After completion of tests, the floor surface shall be thoroughly cleaned from salt residue.
3. One insulation resistance reading shall be taken for each 3 by 3 foot area of the dielectric floor. The total insulation resistance for the dielectric floor shall be the average of the insulation resistance readings for all the 3-by-3-foot area readings.

B. Dielectric Withstand Test:

1. In addition to the insulation test, a dielectric withstand test shall be conducted after the dc traction power equipment is installed on the dielectric floor to determine the integrity of the floor insulation.
2. The high-resistance ground detection devices shall be disconnected from ground prior to commencing the test.
3. The dielectric test shall be 3.5 kV and shall be applied between the equipment and ground for 1 minute. The test shall be deemed successful if there is no breakdown in the insulation or leakage current exceeding 50 micro amps.
4. Metra's Authorized Representative shall witness all floor and wall dielectric testing.
5. Test Method:
  - a. The floor shall be tested using a 12-in x 12-in 11-gauge steel plate.
  - b. The conductive gel or ionized water shall be used to reduce the resistance between the plate and the insulated floor.
  - c. Voltage shall be applied using a hi-pot connecting the positive lead to the steel plate and the negative lead to the substation ground.
  - d. The test shall be repeated over the entire area of the insulated floor.
6. Wall insulation shall be tested similar to the insulated floor to determine the integrity of the insulation.

**END OF SECTION**

**SECTION 16704**  
**SUPERVISORY CONTROL EQUIPMENT**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section includes equipment and operational requirements for a Remote Terminal Unit (RTU) to be used on a Supervisory Control and Data Acquisition (SCADA) System.
- B. The equipment proposed in response to the Specifications shall be based on the protocol matching the existing Metra SCADA equipment as Supplied by QEI.

1.02 REFERENCES

- A. This Section incorporates by reference the latest revisions of the following documents:
- B. Institute of Electrical and Electronics Engineers (IEEE)
  - 1. IEEE 802.3, Standard for Ethernet
  - 2. IEEE C37.90.1, Standard for Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus
- C. International Organization for Standardization (ISO)
  - 1. ISO 9001, Quality management

1.03 PROJECT MANAGEMENT

- A. Project Administration
  - 1. The Vendor shall submit a project implementation plan that will ensure timely and coordinated integration, testing, and delivery of a working system. The project implementation plan must include a detailed project schedule demonstrating how the proposed delivery will be met, and identify any critical responses required of the owner to maintain the schedule.
  - 2. Immediately after receiving a Notice to Proceed, the Vendor shall assign a dedicated Project Manager and System Engineer to establish a clear chain of responsibility for all commercial and technical aspects of the Contract, and to coordinate design, programming, manufacturing, documentation, factory testing, installation, and start-up of the system. Metra's Authorized Representative will be Metra's single point of contact for information, coordination, and resolution of any issues for the duration of the Contract.

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- B. Project Schedule & Review Meetings
1. The Project Manger shall submit a project schedule showing dates for project submissions, review, and approval. The project schedule shall establish critical path scheduling of interrelated activities essential to timely completion of the project. Regular progress review meetings (telephone conference calls or in-person as required) shall be held to review critical path scheduling of all activities, and to ensure the resource allocations required to meet the project schedule.
- C. As a minimum the project Schedule shall identify the following phases of the project:
1. Initial project definition meeting
  2. Approval submittals
  3. Design and procurement schedule
  4. Database generation and entry
  5. Staging and testing of the system
  6. Training schedule
  7. Delivery of documentation
  8. Factory acceptance test
  9. Delivery and start-up
  10. Final Acceptance

**1.04 SUBMITTALS**

- A. Submittal Drawings:
1. The Vendor's designated System Engineer shall evaluate Metra's specifications, design the system, and will submit drawings and documentation to Metra's Authotized Representative for review and approval.
  2. Documentation submitted for approval shall include but not limited to:
    - a. System drawings showing the physical layout, interconnection cables, and Metra's connection points for all equipment to be provided under this Contract.
    - b. Parts lists and specifications for all hardware and software products to be used in the system.
    - c. Detailed information on the requirements of the equipment to be supplied: Spacing, cabling, environmental controls, power, and communication circuits.
    - d. Hardware, catalog cuts, software, and operation manuals for all hardware and software products to be used in the system.

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- e. A training schedule and training course syllabuses.
  - f. Vendor's factory acceptance test procedures.
- B. The Vendor shall provide documentation that completely and accurately describes all hardware and software components that comprise the delivered RTU system.
- C. The Vendor shall provide a Manual showing all major hardware and software components of the RTU system including a block diagram in sufficient detail to show the interrelationship and interconnection of all components. The system manual shall clearly identify all deliverable hardware, software, and documentation: Remote stations, spare parts, test equipment and all documentation manuals and drawings.
- 1. Remote Station Hardware Drawings and Manuals
    - a. The Vendor shall provide drawings for the Remote Terminal Unit, which clearly show the mechanical layout of the RTU equipment, details of all component module interconnections, and external connections for all communication connections, power terminations, and discrete I/O terminations (status, accumulator, analog, control points).
    - b. The Vendor shall provide Remote Terminal Unit hardware manuals, which include as a minimum the following:
      - 1) Functional block diagrams
      - 2) Modular theory of operation
      - 3) Installation and startup instructions
      - 4) Layout drawings and interconnect drawings
      - 5) Instructions for expansion of the RTU
      - 6) Maintenance and trouble-shooting guidelines
      - 7) Schematics of each RTU module
      - 8) Replacement parts list
  - 2. Remote Terminal Unit Configuration Software Manual
    - a. The Vendor shall provide RTU configuration software manuals, which clearly describe use of the Vendor's configuration software to define an RTU's communication ports, IED, and point mapping between RTU I/O panels, and Master Station Server.
    - b. The topics covered shall include as a minimum the use of RTU Configuration Software to perform the following:
      - 1) Define Communication Port
      - 2) Define a Master Station Server Port
      - 3) Define I/O Panel
      - 4) Define the IED Port
      - 5) Map Client & Server Points
      - 6) Upload, edit and download configuration files to/from the RTU central processor.
      - 7) View and print the configuration data for each section of the RTU database.

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- 8) Export RTU Configuration Files as an ASCII file, which can be read into industry standard Word Processor or Spread Sheet applications.

**1.05 SPARE PARTS**

- A. The Vendors shall propose a list of spare modules sufficient for Metra to maintain the remote station equipment on a module replacement basis. The quantity proposed shall include a minimum of 20 percent of the total number of each type module used in the RTU. The parts included in this list shall not be part of the original Contract price. The prices in the list shall be valid for 1 year. Metra will have the option to add the recommended items to the Contract by the change order process.

**1.06 QUALITY ASSURANCE**

- A. All aspects of the Vendor's manufacturing process, from system design to material procurement, production, product assembly, testing, and shipping shall be performed under the guidelines of a certified ISO 9001 Quality Management procedure designed for early detection of any deficiencies and effective corrective action. The vendor shall own a current ISO 9001 Certificate.
- B. The complete process shall result in documented test reports, which confirm that all system components and functions are thoroughly tested in a methodical and organized manner in accordance with a written test procedure.
- C. All equipment and work performed shall be subject to inspection and tests to confirm that it is in compliance with the Specifications.
  1. Any items found not to be in compliance with the specification shall be replaced, repaired, or upgraded as necessary to correct the noted deficiencies.
  2. After correction of a deficiency, the items shall be re-tested as necessary to ensure compliance with the Specifications.
  3. No deliverables shall be shipped until all inspections and tests have been completed, any deficiencies have been corrected, and Metra's Authorized Representative has approved all software and hardware items for shipment.

**1.07 WARRANTY & SUPPORT**

- A. General:
  1. The SCADA Vendor's Customer Service Department shall be Metra's Authorized Representatives single point of contact for all system maintenance and shall be and follow ISO 9001 certified procedures to maintain the highest level of service quality.
  2. All customer contacts shall be entered into a computerized tracking system and closely managed and monitored for quick and effective responsiveness.

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3. The Vendor shall offer maintenance contracts options including both hardware and software maintenance agreements with telephone/modem technical support, onsite technical assistance, printed circuit board repair.
- B. Remote Terminal Unit Maintenance Contract
1. The remote station hardware shall carry a one year renewable maintenance contract consisting of a return to factory warranty. The Cost for this maintenance contract shall be included in the overall contract price.
  2. It is the intent of Metra to maintain the remote stations using the stock of spare modules provided with the system.
  3. The Vendor's offering shall include sufficient spare parts and training to enable the owner's personnel to maintain the remote station.
  4. As a minimum the RTU Hardware maintenance contract proposed shall include the following:
    - a. Unlimited repair of any failed units (FOB factory) including parts, labor, check out and recalibration, as needed.
    - b. Telephone assistance for a customer isolating malfunctioning vendor hardware.
    - c. Discounted on-site field service, if required.
- C. Website Services
1. The Vendor shall maintain a website that provides access to product documentation and manuals, a means for the Vendor and customers to exchange application notes, communication with the Vendor's Customer Service Department, and company contact information.

**PART 2 - PRODUCTS****2.01 VENDOR'S RESPONSIBILITIES**

- A. Design, document, upgrade existing system one line / block diagram and deliver a fully integrated RTU system. Supply all hardware and software needed to meet the requirements of this specification.
- B. All wiring from field for status, analog and all control wiring from field circuits shall be terminated in the RTU.
- C. Provide Control I/O Modules for each ac and dc breaker, rectifier, transformer, where required as indicated in Contract Drawings. The DIO modules shall receive digital control signals from the RTU and provide relay contact control outputs to the breakers. The modules shall also receive dry contact signals from the breakers and send the corresponding digital signals to the RTU.

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- D. Provide Metra's Authorized Representative with documentation for review and approval including: equipment lists, hardware and software designs, system drawings, hardware & software manuals, and acceptance test procedures.
- E. Provide Metra's Authorized Representative with detailed information on the requirements of the equipment to be supplied: Space, cabling, environmental controls, power, and communication circuits.
- F. Develop an implementation plan covering installation, testing, and startup of the system.
- G. Configure the substation RTU Central Processor databases.
- H. Provide training courses covering RTU maintenance and configuration. Make courses available at Metra's facilities.
- I. Provide configuration and development of the RTU database (master & IED communication ports and local I/O data points), based on SCADA Point list provided by Metra. Contractor shall create and develop the Point Assignment Chart and submit for Metra's approval.
- J. Perform a customer-witnessed factory acceptance test, with all equipment supplied staged in an integrated functioning system. Provide Metra with certified test data of these tests.
- K. Provide onsite technical assistance as specified during system start-up and testing.
- L. Provide maintenance support and spare parts as specified throughout the warranty period.
- M. Provide update of the required changes in the SCADA Master Station database points, communication lines, Substation Displays, Overview Map, population of the display with system points and generations of reports.
- N. Upgrade existing tie station to match the requirements as specified for a Remote Terminal Unit (RTU) to be used on a Supervisory Control and Data Acquisition (SCADA) System. Upgrade cost shall be included in the bid price.

**2.02 REMOTE TERMINAL UNIT**

- A. General Description
  - 1. Remote Terminal Unit (RTU) shall be general-purpose microprocessor based unit capable of securing select-check back control, exception-report status and analog monitoring, pulse accumulation, and serial interface to intelligent remote station devices.
  - 2. The remote shall be based on a flexible, programmable microprocessor technology and shall match existing Master Unit protocol as supplied by QEI.

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3. The RTU shall be the latest ePAQ-94XX and Sim 94XX manufactured by QEI, or approved equal, and shall support as a minimum the following features:
  - a. Digital status inputs with momentary change-of-state detection and reporting
  - b. Analog inputs with exception reporting dead bands
  - c. Highly secure select-check back controls with programmable execute durations
  - d. Analog set point controls
  - e. SOE Sequence of Event time tagging
  - f. Programmable calculations and stand-alone control algorithms
  - g. Support both byte and bit oriented protocols
  - h. Serial and/or IP communication compatible with substation electronic control, instrumentation, and metering IEDs QEI protocols.
  - i. All the control and status relays in SCADA cabinet shall have LEDs.
  - j. The remote terminal unit shall incorporate a modular architecture with maximum simplicity of expansion. All logic and communication functions required shall be supported by the hardware included in a single integrated central processor card. Field wiring termination shall be made at the RTU Cabinet. Expansion of the RTU shall require only the addition the required I/O panels: status input, control output, analog input.
- B. Central Processor
  1. The RTU central processor shall be based on a 32-bit arithmetic, parallel microprocessor unit that executes the service programs stored in an Erasable, Programmable, and Read-Only-Memory (EPROM).
  2. Acquired data (status, analogs, etc.) shall be stored in, and retrieved from, a Random Access Memory (RAM). Downloaded information shall be stored in EEPROM memory.
  3. The RTU address, communication parameters, and point size shall be easily modified by means of a standard Windows PC set of editing tools.
  4. Communication options shall be available for the RTU central processor to support a minimum of the following:
    - a. Front panel USB maintenance port for Windows based diagnostic and configuration software
    - b. Irig Time interface
    - c. 10/100baseT Ethernet LAN
    - d. A minimum of eight RS232 or RS485 (bit or byte protocol support)
- C. All communications ports shall have LEDs and a dedicated output to report and indicate communications and health status via SCADA.

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- D. Master and IED Communication and Data Concentrator Functions:
1. The RTU Central Processor software shall be structured to provide manageable mapping of data points between the Master Stations served by the RTU and an RTU database of Intelligent Electronic Device (IEDs) data, local discreet I/O panel data, and locally calculated data points.
    - a. Mapping of data points between the RTU Databases of various IEDs and I/O panels and the RTU master station Server Databases shall be programmable using a standard Windows PC set of editing tools.
    - b. The RTU shall have the ability to export ASCII files of its configured IED point data, which can be uploaded directly into the Master Station SCADA system database.
  2. Server software licenses shall be available to support RTU communication with Master Stations from the QEI protocol QUICS.
  3. The RTU shall be capable of communication with multiple Schweitzer Engineering Lab Relays using DNP3 protocols as well as over a single RS232 client port for each relay to access any operational data points available in the Relays.
    - a. The RTU shall also be capable of communication with SEL relay using DNP3 protocol.
    - b. The RTU configuration software shall include facilities to automatically configure the RTU with data point and communication parameters directly uploaded from SELRelays.
    - c. In addition, the RTUs shall be capable of interleaving over the same RS232 port communication routed from SEL engineering analysis and relay configuration application software running at a remotely located site and communicating with the RTUs Master Station Ethernet WAN interface.
- E. Network Interface Option
1. The RTU network option shall be capable of supporting communication with the Master Station, collection of data from IEDs, Web Browser access to data in the substation, and remote diagnostics and configuration of the RTU central processor. The RTU network option shall also be capable of providing a virtual path "connection" between "servers" and corresponding field devices.
  2. As a minimum the RTU network interface option shall include the following:
    - a. Embedded 32-bit communication processor
    - b. 10baseT (RJ45)
    - c. 100baseTX or 100baseFX (multi-mode)
    - d. RS232 PPP communication port and RS232 diagnostic port
    - e. USB maintenance port for Windows based diagnostic and configuration software

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- f. Compliant with IEEE 802.3 10baseT and 100base ports Ethernet standard
  - g. Communicate over TCP/IP or UDP/IP
  - h. BSD compliant IP stack
  - i. Support FTP, Telnet and WEB server
  - j. Support all byte oriented protocols offered on the RTU central processor
- F. Status Input Section:
- 1. The status input section of the central processor shall be capable of addressing two status input modules each capable of interfacing with 64 status points: a total capacity of 128 status inputs.
- G. Control Section:
- 1. The control matrix section of the central processor shall provide momentary signals to interposing relays for the purpose of opening or closing circuits at a Remote Station. A fail-safe select-check-before-operate circuit shall be employed. Any selected interposing relay shall be checked for correct addressing before being energized. In addition, the control matrix shall employ an over current detection circuit that deactivates the control signal, prior to execution, if more than one relay is energized due to a hardware malfunction.
  - 2. The Control Section shall use a micro-processor based sub-system, designated as Control Output Module, which receives control commands from the RTU central processor via communication port, and provides control circuitry for the Relay Output Panels. The Relay Output Panels in turn provide relay contacts to control externally connected field devices. The Control Output Module shall include a "Local/Remote" switch to disconnect the relay coil voltage during maintenance of the system.
  - 3. LEDs on the Control Output Module shall be provided for the following diagnostics as minimum:
    - a. Communications ports TX and RX indication
    - b. Microprocessor health and power supply condition
    - c. Local/Remote indication
    - d. Control Command from RTU central processor execution
  - 4. The control section shall be capable of addressing 128 relays (56 open and 56 close) for time intervals which can be downloaded from the master on a per point basis. Power for the relay energization shall be supplied by an isolated power source.
- H. Analog Inputs Section:
- 1. The Analog-to-Digital Converter circuit shall provide conversion of analog data into binary equivalent data with a resolution of 24 bits including sign.

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2. Each Analog Input module provides the interface between the external system analog signals (currents or voltages from transducers) and the RTU central processor.
  3. The analog input module shall scan the analog signals and communicates the data back to the RTU using a specialized A/D circuitry and a micro-processor based sub-system.
  4. The Analog Input section shall be capable of addressing 2 analog input modules each capable of multiplexing 32 analog points: a total capacity of 64 analog inputs.
- I. Importing or Exporting Point Name and Description Fields
1. The remote station shall support Importing or Exporting Point Names and Descriptions to an Excel® spreadsheet. This feature shall be used to speed up configuration of these fields.
  2. This feature shall utilize a standard Laptop computer and Excel® spread sheets as an Integrated Development Environment (IDE) to define, view, edit, the Point Name and Description Fields in the RTU central processor.
- J. Status Input Modules
1. The remote station shall be equipped with digital status input modules that provide plug-in compression terminal blocks (5,08mm type) for field wiring, optical isolation meeting the IEEE SWC isolation; and high speed bus multiplexing of the monitored status to the central processor board. The Vendor shall state the incremental modularity of status inputs and the maximum expansion possible in the proposed RTU cabinets.
  2. Supervision of digital status input points shall be performed on a continuous basis. The RTU shall respond to exception polls by sending only the status values that have changed. Each status change-of-state shall reset only when the master station acknowledges receipt of the RTU'S exception message. A built in change-of-state (COS) memory shall store up to seven changes of state and send each as independent changes in response to exception polls from the master.
  3. A sequence of events (SOE) with minimum resolution of 1 millisecond within the RTU using the standard status input circuitry shall be provided.
  4. All inputs shall be optically isolated and require less than 10 mA of drive current. The remote station shall include a 24 Vdc wetting supply to power the status inputs from dry contact inputs.
  5. Status point input optical coupling shall meet the IEEE C37.90.1 Surge Withstand Capability test.
  6. The Communication Interface between RTU and DIO shall be constantly monitored. A communication failure shall be displayed locally and transmitted to SCADA.

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## K. Relay Output Modules

1. The remote station shall be equipped with relay output modules which provide plug-in compression terminal blocks (5,08 mm type) for field wiring, and plug-in momentary control relays. Control bus connections between the Control Output Module and Relay Output Panels shall be made with prefabricated flat ribbon multi-conductor cables. The Vendor shall state the incremental modularity of control outputs and the maximum expansion possible in the proposed RTU cabinets.
2. Controls shall be performed on a single point select-checkback-execute basis. In addition, simultaneous activation of more than one control relay shall be sensed and prevented by an overcurrent sensor that trips all control relay power before the output contacts can make.
3. Control outputs in the form of momentary relay pairs shall be available on a per point basis. The execute duration of momentary control relays shall be programmable on a per point basis at the master station. Control outputs shall consist of two sets of form C contacts per relay, rated at a minimum of 10 amps at 28 Vdc or 240 Vac
4. All outputs shall meet the IEEE C37.90.1 Surge Withstand Capability Test.

## L. Analog Input Modules:

1. The remote station shall be equipped with differential analog input modules that provide plug-in compression terminal blocks (5,08 mm type) for field wiring, noise isolation meeting the IEEE SWC isolation specification; and solid state analog multiplexing circuits. The Vendor shall state the incremental modularity of analog inputs and the maximum expansion possible in the proposed RTU cabinets.
2. Supervision of analog input points shall be performed on a continuous basis. The RTU shall respond to exception polls by sending only the analog values that have changed more than a defined deadband percentage.
3. The remote station central processor panel shall include an A/D converter with a resolution of 12 bits (11 bits plus sign) for an input range of +/- 5 Vdc. The modular analog input modules shall include field wiring plug-in compression terminal blocks; high accuracy scaling resistors for 0 to 1 ma, or 4 to 20 ma inputs; a solid state analog multiplexer and connection to the central processor board through high-speed backbone communication port. The overall system conversion accuracy shall be 0.1 percent or better. Noise rejection shall be better than 60 dB at 60 Hz common mode and differential mode.
4. All analog inputs shall meet the IEEE C37.90.1 Surge Withstand Capability Test.

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## M. Power Requirements:

1. The Contractor shall provide the normal dc power supplies at the remote station ends of the supervisory control system. The normal power supplies at remote station ends of the supervisory control systems shall be from local 120 volts, 60 Hz, ac source, then transformed and rectified to 48 Vdc by semiconductor constant voltage type rectifiers provided within the RTU cabinets, by RTU supplier. The rectifiers shall be of sufficient rating and quality to ensure long life. Sufficient filtering shall be furnished to provide good quality dc power. Monitor points for loss of ac, high-dc and low-dc shall be supervised by master station.
2. The 48 Vdc emergency power supply for the substation RTU will be from 125 Vdc substation battery, via dc/dc converter within RTU cabinet.
3. The Contractor shall be responsible for converting and distributing the dc power as necessary to operate the remote SCADA equipment. The dc/dc converter shall conform to the following technical requirements:
4. Outputs shall be fully isolated from the inputs so that no ground can be imposed on the battery.
5. Both inputs shall be fused and opened with a single on/off 4 PDT switch.
6. Input shall meet IEEE SWC standard test
7. Adequate filtering shall be provided on the input so that the chopping noise of the converter is not imposed on the battery.
8. Indicating lamps shall be provided which light only if converter output is energized.
9. Overvoltage and undervoltage protection on the outputs to prevent the logic from being damaged due to a single component failure in the converter.

## N. Distributed I/O:

1. All Installed protective Relays shall be integrated so they communicate directly with the RTU provided by QEI. Refer to the Contract Drawings Station Control and SCADA Architecture.
2. All protective Relays shall utilize onboard inputs and outputs to provide all required SCADA Signals as listed in
  - a. APPENDIX\_A\_STATUS\_DATABASE
  - b. APPENDIX\_B\_CONTROL\_DATABASE
  - c. APPENDIX\_C\_ANALOG\_DATABASE
3. For Cubicles without intelligent protective relays or PLCs, the contractor shall foresee Standalone distributed I/O Modules Dedicated to one Cubicle which will be connected to dry contacts within the substations.

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4. The Vendor shall provide remote control of the breakers by the Master Station using a Distributed I/O (DIO) technology where required. The Master Station control commands shall be received by the Substation RTU, which shall execute the control through the Distributed I/O modules using a DNP3 protocol. The RTU shall receive breaker status from the DIO modules and transmit the data back to the Master Station through the communication network.
  5. Distributed I/O modules shall be provided for each ac and dc breaker, rectifier, transformer, where requested as indicated in Contract Drawings. The modules shall receive digital control signals from the RTU and provide relay contact control outputs to the breakers. The modules shall also receive dry-contact signals from the breakers and send the corresponding digital signals to the RTU. DIO modules shall be powered using 125 Vdc supply at the switchgear.
  6. The I/O modules shall provide status monitoring with 1 millisecond Sequence of Events (SOE) time tagging, and a highly secure select-before-operate controls. The I/O modules installed in ac and dc switchgear, rectifiers, and transformers shall be DIO 9100/9110 or the latest series, as shown in the Contact Drawings, and shall be QEI manufactured in self-contained enclosures hardened to withstand environmental, shock conditions and suitable for surface mounting, 19-inch rack mounting, or DIN rail mounting. The I/O modules shall provide front panel LED indicators for all status inputs, all controls, and all communication port transmit/receive.
  7. Fiber/Copper Ethernet switches RS 900 and RSG2200 as required manufactured by RuggedCom or approved equal shall be installed in the field equipment where required, as indicated in the Contract Drawings, to connect all the Fiber optic connections from the several DIO modules with the RTU. The Network Switches must be rated for a power supply of 125VDC.
- O. Windows Configurability:
1. The software provided shall run on a standard Windows® PC, with Windows 7, 8 or 10, and shall provide drag & drop menus to configure communication ports; status, alarm and control points; RTU communication servers; and local calculations and standalone control algorithms.
  2. The module configuration shall require secure login with a user ID and pass-word login and shall maintain all attempted log-ins (dated, time-stamped) and all operational and configurable changes to the module database in a log file.
- P. Communications:
1. Multiple I/O modules shall be equipped and easily configured to communicate with a single RTU on a multi-drop line or in a communication loop using RS485, RS232, serial data over multimode

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fiber optic, 10/100baseTX Ethernet, or 10/100baseFX Ethernet multimode fiber optic.

2. Each I/O module shall be configurable to translate between media by retransmitting data received on any media on any of the other media. As a minimum, the modules shall support communication using DNP3 or Modbus protocols.
3. Fibre optic Multimode Cable shall be used between the new and the existing building. Refer to Contract Drawings for details.

## Q. Controls:

1. Trip/close relay pairs shall execute controls with secure, multi-step handshaking with a DIO consisting of receiving a point selection message, responding with a "checkback" message, receiving a control execution message, and responding with an execution acknowledgment message.
2. Failsafe control circuits in the I/O module shall ensure that only one relay can be energized at a time, and execute duration shall be configurable per point from 50 milliseconds to 10 seconds.
3. Control relay outputs shall consist of one form-C contact rated 10-amp at 28 Vdc/120 Vac, or one form-A contact rated 10-amp "make" at 130 Vdc. Termination shall be made to removable terminal blocks secured with screws to the I/O modules.

## R. Status Inputs:

1. Each switchgear Control I/O module shall monitor a minimum of 16 status inputs with Sequence of Events (SOE) recording accurate to 1 millisecond.
2. The modules shall respond to rapid polls for changes only, and shall retain all changes until the RTU acknowledges receipt of those changes. Each I/O module shall buffer and report a minimum of seven changes of state occurring between polls for each status point.
3. In addition, the I/O modules shall store up to 25 time-stamped events per-point in files that can be retrieved by a Laptop Test Set. Status inputs shall be optically isolated to meet IEEE C37.90.1 Surge Withstand Capability test.
4. Each status inputs shall be configurable for 5 millisecond to 1 second de-bounce, and for 24 Vdc keying voltage. Termination shall be made to removable terminal blocks secured with screws to the I/O module.

## 2.03 RTU TEST &amp; CONFIGURATION SOFTWARE

- A. The Vendor shall provide two F1M36UT#ABA portable remote station test sets with a rugged protective carrying case. The test set shall include a keyboard, LED display, hard disk with installed software, program, serial port cable for

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connection to the remote station test port, ac power input, and an internal battery backup.

- B. The Contractor shall provide SCADA master station and four worldview software licenses, update and configuration. Update of the required changes in the SCADA master station database taking into account of the RTU shall include all database points, communication lines, Substation Display, Overview Map, population of the display with system points and generation of reports.
- C. The RTU test set shall provide a Windows® based editing tool with a drag-and-drop, user interface to prompt the technician through the steps required to configure the RTU central processor:
- D. As a minimum the RTU configuration software shall support the following functions:
  - 1. Definition of local discrete I/O status, accumulator, analog, and control points.
  - 2. Definition of port characteristics and communication protocol for each Master Station Server communication port.
  - 3. Definition of port characteristics, IED type, IED data selection, and IED protocol for each IED communication port.
  - 4. Mapping of the data points between the RTU's Master Station communication Server and the RTU's local I/O panel and IED communication.
  - 5. Built in default parameters sufficient for the initial operation of a typical RTU.
  - 6. Upload and edit and download configuration files to/from the RTU central processor.
  - 7. Online help notes that appear when the cursor is placed over specific window buttons or data entry points.
  - 8. A Print Window to examine the configuration data for each section of the RTU database, and to print the results.
  - 9. Export of the final RTU Configuration File as a comma delimited ASCII file that can be read into industry standard word processor or spreadsheet applications.

**2.04 SOURCE QUALITY CONTROL**

- A. A Factory Acceptance Test (FAT) shall be performed by the Vendor, prior to shipping:
  - 1. The FAT must demonstrate the operation of the complete, integrated system in accordance with a written test specification developed by the Vendor and approved by Metra's Authorized Representative.

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2. The Vendor shall perform the FAT, and Metra's Authorized Representative shall witness the FAT and perform hands on tests as desired to ensure conformance with this specification.
3. Complete records of all factory acceptance tests, keyed to the test procedures, shall be maintained by the Vendor and delivered to Metra.
4. Each time a variance from this specification is detected, the Vendor shall generate a variance report documenting the date, the variance and protective action to be taken.
5. As a minimum the Factory Acceptance Test procedures shall include the following:
  - a. Visual inspection and inventory details and description of all RTU equipment for conformance to the specification and to the system documentation.
  - b. Demonstration of all RTU client and server communication interfaces and protocols using hardware to be provided under this Contract, test units provided by Metra, or certified simulation devices.
  - c. Demonstration of the RTU test port and configuration software using a test RTU database or RTU configuration files generated by Metra.
  - d. Demonstration of proper functioning of RTU I/O: status inputs, accumulator inputs, analog inputs, control outputs, and simulation of IED data changes.
  - e. Demonstration of the RTU battery backup system.
  - f. Verification that all hardware and software documentation.
  - g. Verification of all spare parts, test equipment, and system spare and expansion capacity.
6. Factory Inspection Cost:
  - a. In the event the FAT fails to meet Metra's reasonable expectations, Contractor will rerun the FAT under the same conditions at the Contractor's expense.
  - b. If problems develop as a result of the Contractor's negligence necessitating additional trips, the expenses of these additional trips shall be borne by the Contractor.

**PART 3 - EXECUTION****3.01 INSTALLATION & TECHNICAL SUPPORT**

- A. The Vendor shall provide a knowledgeable field service engineer as required to support Metra with onsite technical assistance during the installation and startup of the RTUs.
- B. The SCADA Interface in the existing Building shall remain in place. The Contractor is required to include QEI's Services to modify the existing RTU in

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order to send all newly added Signals through the existing communication Interface.

**3.02 FIELD QUALITY CONTROL****A. Field Acceptance Tests**

1. Following the initial Field Acceptance Tests, Metra will perform a complete test of the system including communication with IEDs that were simulated in the FAT and point-to-point verification of RTU functions from the field terminations to the Master Station database and operator interface displays.
2. The RTU Vendor shall make available a knowledgeable field service engineer for onsite support for the duration of the final Field Acceptance Tests.

**3.03 TRAINING****A. General**

1. The Vendor shall provide comprehensive training on the use of the system including database generation, operation, general maintenance, and failover/startup recovery.
2. Training shall be at Metra's facilities.
3. Training shall be based on an 8 hour work day (6.5 hours classroom time) and shall be conducted during the normal work day, Monday through Friday.
4. The bid price shall include all training costs:
  - a. The cost of instruction
  - b. Students' manuals
  - c. Instructor's travel and living expenses
5. Training shall be conducted by employees of the Vendor who are experienced trainers and engaged full time in technical training on the products proposed in the Vendor's offering.
6. Course syllabuses shall be included in the Vendor's offering.

**B. RTU Configuration and Maintenance Training Course**

1. Remote Station training course shall provide hands-on instruction covering RTU theory of operation; RTU trouble shooting and repair on a board-swap level basis, and configuration of the RTU central processor point database and communication servers and clients using the Vendor's PC configuration software.
2. As a minimum, the course shall cover the following topics and activities:
  - a. RTU Theory of Operation

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- b. Card & Panel Descriptions and Strapping
  - c. Card Level Trouble Shooting & Repair
  - d. Use of RTU Configuration Software:
  - e. Communication Port Configuration
  - f. Server Database Configuration
  - g. Client Database Configuration
  - h. Client/Server Point Mapping
3. RTU configuration and maintenance training shall consist of a minimum of two full days of instruction. The cost of the RTU training course shall be included in the base bid price.

**3.04 APPENDICES**

- A. At the end of this Section Appendices A, B, and C are included showing the preliminary list of the point of addresses for Status, Control and Analog system.
- B. These appendices are included for the benefit of the Contractor to have a better understanding of the integrated supervisory control system for this project. The Contractor shall prepare the final list of points based on the Contract Drawings and Metra's requirements.

**END OF SECTION**



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# APPENDIX A STATUS POINTS

Switchgear	Unit#	Cubicle Name	SCADA NAMETAG
AC 15kV		1 52-T1	52-T1 BREAKER OPENED/CLOSED
AC 15kV		1 52-T1	52-T1 SPARE
AC 15kV		1 52-T1	52-T1 SPARE
AC 15kV		1 52-T1	52-T1 SPARE
AC 15kV		1 52-T1	52-T1 RELAY FAILURE
AC 15kV		1 52-A1	52-A1 BREAKER OPENED/CLOSED
AC 15kV		1 52-A1	52-A1 143 LOCAL/REMOTE
AC 15kV		1 52-A1	52-A1 RELAY FAILURE
AC 15kV		1 52-T1	52-T1 SPARE
AC 15kV		1 52-T1	52-T1 SPARE
AC 15kV		3 52-L1	52-L1 AC BUS 1 UNDER VOLTAGE IND
AC 15kV		3 52-L1	52-L1 BREAKER OPENED/CLOSED
AC 15kV		3 52-L1	52-L1 SPARE
AC 15kV		3 52-L1	52-L1 SPARE
AC 15kV		3 52-L1	52-L1 143 LOCAL/REMOTE
AC 15kV		3 52-L1	52-L1 RELAY FAILURE
AC 15kV		3 52-L1	52-L1 TRIP COIL FAILURE
AC 15kV		3 52-L1	52-L1 BREAKER FAILURE
AC 15kV		3 52-L1	52-L1 CECO BACKFEED
AC 15kV		3 52-L1	52-L1 SPARE
AC 15kV		3 52-L1	52-L1 SPARE
AC 15kV		3 52-L1	52-L1 SPARE
AC 15kV		4 52-BT	52-BT BREAKER OPENED/CLOSED
AC 15kV		4 52-BT	52-BT SPARE
AC 15kV		4 52-BT	52-BT SPARE
AC 15kV		4 52-BT	52-BT SPARE
AC 15kV		4 52-BT	52-BT 143 LOCAL/REMOTE



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# APPENDIX A STATUS POINTS

Switchgear	Unit#	Cubicle Name	SCADA NAMETAG
AC 15kV		4 52-BT	52-BT RELAY FAILURE SEL-551
AC 15kV		4 52-BT	52-BT RELAY FAILURE SEL-587-B1
AC 15kV		4 52-BT	52-BT RELAY FAILURE SEL-587-B2
AC 15kV		4 52-BT	52-BT LOCKOUT RELAY 86B-1
AC 15kV		4 52-BT	52-BT LOCKOUT RELAY 86B-2
AC 15kV		4 52-BT	52-BT SPARE
AC 15kV		4 52-BT	52-BT SPARE
AC 15kV		5 52-L2	52-L2 AC BUS 2 UNDER VOLTAGE IND
AC 15kV		5 52-L2	52-L2 BREAKER OPENED/CLOSED
AC 15kV		5 52-L2	52-L2 SPARE
AC 15kV		5 52-L2	52-L2 SPARE
AC 15kV		5 52-L2	52-L2 SPARE
AC 15kV		5 52-L2	52-L2 143 LOCAL/REMOTE
AC 15kV		5 52-L2	52-L2 RELAY FAILURE
AC 15kV		5 52-L2	52-L2 TRIP COIL FAILURE
AC 15kV		5 52-L2	52-L2 BREAKER FAILURE
AC 15kV		5 52-L2	52-L2 CECO BACKFEED
AC 15kV		5 52-L2	52-L2 SPARE
AC 15kV		5 52-L2	52-L2 SPARE
AC 15kV		5 52-L2	52-L2 SPARE
AC 15kV		7 52-T2	52-T2 BREAKER OPENED/CLOSED
AC 15kV		7 52-T2	52-T2 SPARE
AC 15kV		7 52-T2	52-T2 SPARE
AC 15kV		7 52-T2	52-T2 SPARE
AC 15kV		7 52-T2	52-T2 RELAY FAILURE
AC 15kV		7 52-A2	52-A2 BREAKER OPENED/CLOSED
AC 15kV		7 52-A2	52-A2 143 LOCAL/REMOTE
AC 15kV		7 52-A2	52-A2 RELAY FAILURE
AC 15kV		7 52-T2	52-T2 SPARE



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# APPENDIX A STATUS POINTS

Switchgear	Unit#	Cubicle Name	SCADA NAMETAG
AC 15kV		7 52-T2	52-T2 SPARE
AC 15kV		7 52-T2	52-T2 SPARE
AUX EQUIP exist.		AUX	AUX BATT CHARGER AC PWR FAILURE
AUX EQUIP exist.		AUX	AUX STATION BATTERY
AUX EQUIP exist.		AUX	AUX STATION BATTERY
AUX EQUIP exist.		AUX	AUX ENTRY ALARM
AUX EQUIP exist.		AUX	AUX FIRE ALARM
AUX EQUIP exist.		AUX	AUX COMMUNICATION LINK FAILURE
AUX EQUIP new		AUX	AUX BATT CHARGER AC PWR FAILURE
AUX EQUIP new		AUX	AUX STATION BATTERY
AUX EQUIP new		AUX	AUX STATION BATTERY
AUX EQUIP new		AUX	AUX TRANSF #1 OVERTEMP WARNING
AUX EQUIP new		AUX	AUX TRANSF #1 OVERTEMP TRIP
AUX EQUIP new		AUX	AUX TRANSF #2 OVERTEMP WARNING
AUX EQUIP new		AUX	AUX TRANSF #2 OVERTEMP TRIP
AUX EQUIP new		AUX	AUX ATS LINE1/LINE2
AUX EQUIP new		AUX	AUX ENTRY ALARM
AUX EQUIP new		AUX	AUX FIRE ALARM
AUX EQUIP new		AUX	AUX HVAC Failure
DC SWGR		1 172-R1	172-R1 SPARE
DC SWGR		1 172-R1	172-R1 SPARE
DC SWGR		1 172-R1	172-R1 BREAKER OPENED/CLOSED
DC SWGR		1 172-R1	172-R1 SPARE
DC SWGR		1 172-R1	172-R1 SPARE
DC SWGR		1 172-R1	172-R1 SPARE
DC SWGR		1 172-R1	172-R1 43 LOCAL/REMOTE
DC SWGR		1 172-R1	172-R1 BREAKER RACKED IN/OUT
DC SWGR		1 172-R1	172-R1 STRUCTURE HOT LOCKOUT
DC SWGR		1 172-R1	172-R1 STRUCTURE GROUNDED



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# APPENDIX A STATUS POINTS

Switchgear	Unit#	Cubicle Name	SCADA NAMETAG
DC SWGR		1 172-R1	172-R1 REVERSE CURRENT TRIP
DC SWGR		1 172-R1	172-R1 LOSS OF CONTROL POWER
DC SWGR		1 172-R1	172-R1 SPARE
DC SWGR		1 172-R1	172-R1 SPARE
DC SWGR		2 172-R2	172-R2 SPARE
DC SWGR		2 172-R2	172-R2 SPARE
DC SWGR		2 172-R2	172-R2 BREAKER OPENED/CLOSED
DC SWGR		2 172-R2	172-R2 SPARE
DC SWGR		2 172-R2	172-R2 SPARE
DC SWGR		2 172-R2	172-R2 SPARE
DC SWGR		2 172-R2	172-R2 43 LOCAL/REMOTE
DC SWGR		2 172-R2	172-R2 BREAKER RACKED IN/OUT
DC SWGR		2 172-R2	172-R2 STRUCTURE HOT LOCKOUT
DC SWGR		2 172-R2	172-R2 STRUCTURE GROUNDED
DC SWGR		2 172-R2	172-R2 REVERSE CURRENT TRIP
DC SWGR		2 172-R2	172-R2 LOSS OF CONTROL POWER
DC SWGR		2 172-R2	172-R2 SPARE
DC SWGR		2 172-R2	172-R2 SPARE
DC SWGR		3 174	174 BREAKER OPENED/CLOSED
DC SWGR		3 174	174 BREAKER LOCAL/REMOTE
DC SWGR		3 174	174 BREAKER VOLTAGE SENSING
DC SWGR		4 175	175 BREAKER OPENED/CLOSED
DC SWGR		4 175	175 BREAKER LOCAL/REMOTE
DC SWGR		4 175	175 BREAKER VOLTAGE SENSING
DC SWGR		5 177	177 BREAKER OPENED/CLOSED
DC SWGR		5 177	177 BREAKER LOCAL/REMOTE
DC SWGR		5 177	177 BREAKER VOLTAGE SENSING
DC SWGR		6 176	176 BREAKER OPENED/CLOSED
DC SWGR		6 176	176 BREAKER LOCAL/REMOTE



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# APPENDIX A STATUS POINTS

Switchgear	Unit#	Cubicle Name	SCADA NAMETAG
DC SWGR		6 176	176 BREAKER VOLTAGE SENSING
DC SWGR		T TRANSFER	TRANSFER BREAKER OPENED/CLOSED
DC SWGR		T TRANSFER	TRANSFER BREAKER LOCAL/REMOTE
DC SWGR		T TRANSFER	TRANSFER BREAKER VOLTAGE SENSING
DC SWGR			DC BUS GROUND FAULT
DC SWGR			DC BUS HOT
DC SWGR			DC BUS LOCKOUT
DC SWGR			DC LOSS OF 120V AC
DC SWGR			LOSS OF DC (32P) CONTROL VOLT
DC SWGR			TRF TRIP NORTH LOCKOUT
DC SWGR			TRF TRIP SOUTH LOCKOUT
DC SWGR			TRF TRIP NORTH RECEIVER ALARM
DC SWGR			TRF TRIP SOUTH RECEIVER ALARM
DC SWGR			TRF TRIP BYPASS NORTH TO SOUTH
DC SWGR			TRF TRIP BYPASS SOUTH TO NORTH
DC SWGR			LOSS OF NORMAL 120V AC SUPPLY
DC SWGR			LOSS OF EMERG 120V AC SUPPLY
DC SWGR			LOSS OF COMMUNICATION CH 1
DC SWGR			LOSS OF COMMUNICATION CH 2
DC SWGR			DC T-BUS 1 ENERGIZED
DISC. SWITCH		1 P-SWITCH1	P-SWITCH1 SWITCH OPENED/CLOSED
DISC. SWITCH		1 P-SWITCH1	P-SWITCH1 33P DOOR OPEN
DISC. SWITCH		1 P-SWITCH1	P-SWITCH1 32P REVERSE CURRENT TRIP
DISC. SWITCH		2 P-SWITCH2	P-SWITCH2 SWITCH OPENED/CLOSED
DISC. SWITCH		2 P-SWITCH2	P-SWITCH2 33P DOOR OPEN
DISC. SWITCH		2 P-SWITCH2	P-SWITCH2 32P REVERSE CURRENT TRIP
REC		1 RECTIFIER#1	RECTIFIER#1 TRANSF 49T-2 HIGH TEMP TRIP
REC		1 RECTIFIER#1	RECTIFIER#1 AC GROUND FAULT
REC		1 RECTIFIER#1	RECTIFIER#1 DC GROUND FAULT



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# APPENDIX A STATUS POINTS

Switchgear	Unit#	Cubicle Name	SCADA NAMETAG
REC		1 RECTIFIER#1	RECTIFIER#1 95-X1 DIODE FUSE TRIP
REC		1 RECTIFIER#1	RECTIFIER#1 86 LOCKOUT RELAY
REC		1 RECTIFIER#1	RECTIFIER#1 86X CONDITIONAL LOCKOUT (27-1 OR 49TX OR 26RT)
REC		1 RECTIFIER#1	RECTIFIER#1 4 MASTER CONTROL RELAY
REC		1 RECTIFIER#1	RECTIFIER#1 4X AUX MASTER CONTROL RELAY
REC		1 RECTIFIER#1	RECTIFIER#1 TRANSF 49T-1 HIGH TEMP ALARM
REC		1 RECTIFIER#1	RECTIFIER#1 TRANSF 33T-1 DOOR OPEN
REC		1 RECTIFIER#1	RECTIFIER#1 1 CTL SWITCH PULL TO LOCK
REC		1 RECTIFIER#1	RECTIFIER#1 64-X1 HOT STRUCTURE
REC		1 RECTIFIER#1	RECTIFIER#1 64-GROUNDED STRUCTURE
REC		1 RECTIFIER#1	RECTIFIER#1 26RT-1 DIODE TEMPERATURE TRIP
REC		1 RECTIFIER#1	RECTIFIER#1 33R-1 DOOR OPEN TRIP
REC		1 RECTIFIER#1	RECTIFIER#1 89NX-1 NEG DISC SWITCH OPENED/CLOSED
REC		1 RECTIFIER#1	RECTIFIER#1 48-1 INCOMPLETE SEQUENCE
REC		1 RECTIFIER#1	RECTIFIER#1 43L/R LOCAL/REMOTE CTL SW
REC		1 RECTIFIER#1	RECTIFIER#1 74 TROUBLE RELAY
REC		1 RECTIFIER#1	RECTIFIER#1 1 CTL SWITCH LOCAL
REC		2 RECTIFIER#2	RECTIFIER#2 TRANSF 49-T2 HIGH TEMP TRIP
REC		2 RECTIFIER#2	RECTIFIER#2 AC GROUND FAULT
REC		2 RECTIFIER#2	RECTIFIER#2 DC GROUND FAULT
REC		2 RECTIFIER#2	RECTIFIER#2 95-X1 DIODE FUSE TRIP
REC		2 RECTIFIER#2	RECTIFIER#2 86 LOCKOUT RELAY
REC		2 RECTIFIER#2	RECTIFIER#2 86X CONDITIONAL LOCKOUT (27-1 OR 49TX OR 26RT)
REC		2 RECTIFIER#2	RECTIFIER#2 4 MASTER CONTROL RELAY
REC		2 RECTIFIER#2	RECTIFIER#2 4X AUX MASTER CONTROL RELAY
REC		2 RECTIFIER#2	RECTIFIER#2 TRANSF 49T-1 HIGH TEMP ALARM
REC		2 RECTIFIER#2	RECTIFIER#2 TRANSF 33T-1 DOOR OPEN
REC		2 RECTIFIER#2	RECTIFIER#2 1 CTL SWITCH PULL TO LOCK
REC		2 RECTIFIER#2	RECTIFIER#2 64-X1 HOT STRUCTURE



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# APPENDIX A STATUS POINTS

EXHIBIT R  
SECTION 16704

Switchgear	Unit#	Cubicle Name	SCADA NAMETAG
REC		2 RECTIFIER#2	RECTIFIER#2 64-GROUNDED STRUCTURE
REC		2 RECTIFIER#2	RECTIFIER#2 26RT-1 DIODE TEMPERATURE TRIP
REC		2 RECTIFIER#2	RECTIFIER#2 33R-1 DOOR OPEN TRIP
REC		2 RECTIFIER#2	RECTIFIER#2 89NX-1 NEG DISC SWITCH OPENED/CLOSED
REC		2 RECTIFIER#2	RECTIFIER#2 48-1 INCOMPLETE SEQUENCE
REC		2 RECTIFIER#2	RECTIFIER#2 43L/R LOCAL/REMOTE CTL SW
REC		2 RECTIFIER#2	RECTIFIER#2 74 TROUBLE RELAY
REC		2 RECTIFIER#2	RECTIFIER#2 1 CTL SWITCH LOCAL



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# APPENDIX B CONTROL POINTS

Switchgear	Unit#	Cubicle Name	SCADA NAMETAG
AC 15kV		1 52-A1	52-A1 OPEN BREAKER
AC 15kV		1 52-A1	52-A1 CLOSE BREAKER
AC 15kV		1 52-T1	52-T1 SPARE
AC 15kV		1 52-T1	52-T1 SPARE
AC 15kV		1 52-T1	52-T1 SPARE
AC 15kV		1 52-T1	52-T1 SPARE
AC 15kV		1 ALL BREAKERS	ALL BREAKERS MASTER TRIP
AC 15kV		3 52-L1	52-L1 OPEN BREAKER
AC 15kV		3 52-L1	52-L1 CLOSE BREAKER
AC 15kV		3 52-L1	52-L1 SPARE
AC 15kV		3 52-L1	52-L1 SPARE
AC 15kV		3 52-L1	52-L1 SPARE
AC 15kV		3 52-L1	52-L1 SPARE
AC 15kV		4 52-BT	52-BT OPEN BREAKER
AC 15kV		4 52-BT	52-BT CLOSE BREAKER
AC 15kV		4 52-BT	52-BT SPARE
AC 15kV		4 52-BT	52-BT SPARE
AC 15kV		4 52-BT	52-BT SPARE
AC 15kV		4 52-BT	52-BT SPARE
AC 15kV		5 52-L2	52-L2 OPEN BREAKER
AC 15kV		5 52-L2	52-L2 CLOSE BREAKER
AC 15kV		5 52-L2	52-L2 SPARE
AC 15kV		5 52-L2	52-L2 SPARE
AC 15kV		5 52-L2	52-L2 SPARE
AC 15kV		5 52-L2	52-L2 SPARE
AC 15kV		7 52-A2	52-A2 OPEN BREAKER
AC 15kV		7 52-A2	52-A2 CLOSE BREAKER
AC 15kV		7 52-T2	52-T2 SPARE
AC 15kV		7 52-T2	52-T2 SPARE



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# APPENDIX B CONTROL POINTS

AC 15kV	7 52-T2	52-T2 SPARE
AC 15kV	7 52-T2	52-T2 SPARE
DC SWGR	1 172-R1	172-R1 SPARE
DC SWGR	1 172-R1	172-R1 SPARE
DC SWGR	1 172-R1	172-R1 SPARE
DC SWGR	1 172-R1	172-R1 SPARE
DC SWGR	1 172-R1	172-R1 SPARE
DC SWGR	1 172-R1	172-R1 SPARE
DC SWGR	2 172-R2	172-R2 SPARE
DC SWGR	2 172-R2	172-R2 SPARE
DC SWGR	2 172-R2	172-R2 SPARE
DC SWGR	2 172-R2	172-R2 SPARE
DC SWGR	2 172-R2	172-R2 SPARE
DC SWGR	3 174	174 OPEN BREAKER
DC SWGR	3 174	174 CLOSE BREAKER
DC SWGR	4 175	175 OPEN BREAKER
DC SWGR	4 175	175 CLOSE BREAKER
DC SWGR	5 177	177 OPEN BREAKER
DC SWGR	5 177	177 CLOSE BREAKER
DC SWGR	6 176	176 OPEN BREAKER
DC SWGR	6 176	176 CLOSE BREAKER
DC SWGR	T TRANSFER	TRANSFER OPEN BREAKER
DC SWGR	T TRANSFER	TRANSFER CLOSE BREAKER
DC SWGR	ALL FEEDER BREAKERS	ALL FEEDER BREAKERS DC MASTER TRIP-ALL
DC SWGR	175 177	175 177 DC MASTER TRIP NORTH
DC SWGR	174 176	174 176 DC MASTER TRIP SOUTH
DC SWGR	175 177	175 177 TRF TRIP NORTH LOCKOUT RESET
DC SWGR	174 176	174 176 TRF TRIP SOUTH LOCKOUT RESET
DC SWGR		LOCAL MASTER TRIP SWITCH



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## APPENDIX B CONTROL POINTS

EXHIBIT R  
SECTION 16704

REC	1 RECTIFIER#1	RECTIFIER#1 201 ON
REC	1 RECTIFIER#1	RECTIFIER#1 294
REC	1 RECTIFIER#1	RECTIFIER#1 SPARE
REC	1 RECTIFIER#1	RECTIFIER#1 SPARE
REC	1 RECTIFIER#1	RECTIFIER#1 SPARE
REC	1 RECTIFIER#1	RECTIFIER#1 SPARE
REC	2 RECTIFIER#2	RECTIFIER#2 201 ON
REC	2 RECTIFIER#2	RECTIFIER#2 294
REC	2 RECTIFIER#2	RECTIFIER#2 SPARE
REC	2 RECTIFIER#2	RECTIFIER#2 SPARE
REC	2 RECTIFIER#2	RECTIFIER#2 SPARE
REC	2 RECTIFIER#2	RECTIFIER#2 SPARE



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# APPENDIX C ANALOG DATA

Switchgear	Unit#	Cubicle Name	SCADA NAMETAG
AC 15kV		1 52-T1	52-T1 PHASE A CURRENT
AC 15kV		1 52-T1	52-T1 PHASE B CURRENT
AC 15kV		1 52-T1	52-T1 PHASE C CURRENT
AC 15kV		1 52-T1	52-T1 KW
AC 15kV		1 52-T1	52-T1 KVAR
AC 15kV		3 52-L1	52-L1 KVAR
AC 15kV		3 52-L1	52-L1 KW
AC 15kV		3 52-L1	52-L1 PHASE A BUS1 VOLTAGE
AC 15kV		3 52-L1	52-L1 PHASE B BUS1 VOLTAGE
AC 15kV		3 52-L1	52-L1 PHASE C BUS1 VOLTAGE
AC 15kV		4 52-BT	52-BT SPARE
AC 15kV		4 52-BT	52-BT SPARE
AC 15kV		4 52-BT	52-BT SPARE
AC 15kV		5 52-L2	52-L2 KVAR
AC 15kV		5 52-L2	52-L2 KW
AC 15kV		5 52-L2	52-L2 PHASE A BUS2 VOLTAGE
AC 15kV		5 52-L2	52-L2 PHASE B BUS2 VOLTAGE
AC 15kV		5 52-L2	52-L2 PHASE C BUS2 VOLTAGE
AC 15kV		7 52-T2	52-T2 PHASE A CURRENT
AC 15kV		7 52-T2	52-T2 PHASE B CURRENT
AC 15kV		7 52-T2	52-T2 PHASE C CURRENT
AC 15kV		7 52-T2	52-T2 KW
AC 15kV		7 52-T2	52-T2 KVAR
AUX EQUIP exist.		AUX	AUX RTU POWER SUPPLY VOLTS
AUX EQUIP exist.		AUX	AUX RTU POWER SUPPLY VOLTS
DC SWGR		1 172-R1	172-R1 RECTIFIER CURRENT
DC SWGR		1 172-R1	172-R1 RECTIFIER VOLTAGE
DC SWGR		2 172-R2	172-R2 RECTIFIER CURRENT



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# APPENDIX C ANALOG DATA

EXHIBIT R  
SECTION 16704

DC SWGR	2 172-R2	172-R2 RECTIFIER VOLTAGE
DC SWGR	3 174	174 DC AMPS
DC SWGR	3 174	174 DC VOLTS
DC SWGR	4 175	175 DC AMPS
DC SWGR	4 175	175 DC VOLTS
DC SWGR	5 177	177 DC AMPS
DC SWGR	5 177	177 DC VOLTS
DC SWGR	6 176	176 DC AMPS
DC SWGR	6 176	176 DC VOLTS
DC SWGR	T	T DC AMPS
DC SWGR	T	T DC VOLTS

**SECTION 16960**  
**DOOR LIMIT SWITCHES**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section includes all door limit switches required for traction power substation.

1.02 RELATED WORK

- A. Section 16011, Prepackaged Substation Enclosure

1.03 SUBMITTALS

- A. Propose products of manufacturers for consideration. Submit all data necessary to evaluate products offered for Metra's Authorized Representatives approval.

**PART 2 - PRODUCTS**

2.01 GENERAL

- A. All materials shall be new and the best of their respective kinds. The use of other than prime grades will not be accepted.
- B. Where a device or part of the equipment is referred to in the singular, it is intended that such reference shall apply to as many such devices as are required to complete the installation.

2.02 DOOR LIMIT SWITCHES

- A. Provide security alarm door limit switches at each personnel entry door and for exterior equipment access doors for supervisory monitoring of open door alarms.
- B. Door limit switches shall be industrial wide gap surface mount magnetic Contact, rated 0.5 amperes ac or dc at 100 Vdc.
- C. The contact shall be a hermetically sealed reed switch with matching actuating magnet. Contact and magnets shall be in sealed housing.
- D. Each contact shall connect to three feet of flex stainless steel conduit which shall be permanently attached to it. The contact shall contain a single-pole single throw reed contact.
- E. Door limit switches shall be front operated, normally open contact,.

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**PART 3 - EXECUTION****3.01 INSTALLATION**

- A. Installation shall be complete with supports, junction boxes with terminal blocks, conduit, wire and associated specialties as may be required to complete the security system in a workmanlike manner.
- B. Design limit switch mounting plates, and provide door hardware required to operate the limit switch when the door swings open or when the door rolls up to open.
- C. When doors are closed, the limit switch contact shall be closed. When a door opens, its limit switch contact shall open and provide a substation security indication to the supervisory system. This security circuit shall be connected to a terminal point in supervisory control cabinet
- D. Attended/Unattended:
  - 1. Provide one Attended/Unattended selector switch in each substation, as specified in Section 16011, Prepackaged Substation Enclosure. This switch is also used by the HVAC controls.
  - 2. Door limit switches at the substation shall be wired in series with each other and with the Attended/Unattended selector switch, open in Attended position.

**END OF SECTION**

**SECTION 16970**  
**ELECTRICAL TESTING**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section includes the tests and checks that shall be made on all electrical equipment and wiring related to traction power substation work to ensure compliance with the applicable codes and standards.

1.02 REFERENCES

- A. This Section incorporates by reference the latest revisions of the following documents:
- B. Institute of Electrical and Electronics Engineers (IEEE)
1. IEEE 400, IEEE Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems Rated 5 kV and Above
  2. IEEE 400.2, IEEE Guide for Field Testing of Shielded Power Cable Systems Using Very Low Frequency (VLF)(less than 1 Hz)
- C. National Electrical Testing Association (NETA)
1. NETA ATS, Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

**PART 2 - PRODUCTS**

2.01 INSTRUMENTS AND METERS

- A. Instruments and meters for testing work, as described in this Section, shall be provided by the Contractor.

**PART 3 - EXECUTION**

3.01 FIELD TESTING

- A. General:
1. Make electrical tests and check and inspect the following cables and equipment provided, related to the traction power substation work under this Contract.
    - a. Traction power cables.
    - b. Auxiliary power and control cables.
    - c. Hand operated switches.

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- d. Motors.
  - e. Panelboards.
  - f. Heating, Ventilating and Air Conditioning Equipment.
  - g. Lighting equipment
  - h. Receptacles
- 2. Assume full responsibility during the testing of all equipment and materials provided.
    - a. If there is any loss or damage to such equipment as a result of these tests, the Contractor shall be fully responsible for replacing the damaged equipment.
    - b. Replacement of damaged equipment shall include all costs, including but not limited to, removal of damaged equipment, furnishing, transportation, and installation of replacement equipment.
  - 3. Whenever possible, make all checks and tests just prior to energizing the equipment or circuits and coordinate with the field schedule and field conditions.
- B. Testing**
- 1. Before testing and energizing a system, take all necessary precautions to ensure the safety of personnel and equipment.
    - a. Conductors and electrical equipment shall be properly insulated and enclosed.
    - b. Enclosures for conductors and equipment shall be properly grounded.
    - c. Insulation resistance measurements must have been made and approved on all conductors and energized parts of electrical equipment.
  - 2. The following tests are required but shall not be limited to this list. Tests will be supervised and witnessed by Metra's Authorized Representative.
    - a. Proper phase rotation.
    - b. Short circuits.
    - c. Improper grounds.
    - d. Resistances
    - e. Power and control circuits for circuit continuity and function test.
    - f. Traction power getaway system continuity test.
  - 3. Provide all meters, instruments, cable connections, equipment or apparatus necessary for performing tests.
- C. 15 kV Switchgear**
- 1. Test ComEd's 15 KV metering PT's and CT's per ComEd requirements.
  - 2. Review current transformer performance curve to verify that the CT's will not be saturated under the short circuit conditions.

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- D. Auxiliary System:
1. Check and test all transformers, power panels, feeders, power and control cables, connections and motors to ensure correct phase sequence and rotation.
  2. Phase sequence shall be A B C and follows top to bottom, left to right and front to rear when facing protective or disconnecting mechanism.
- E. Miscellaneous Requirements:
1. After wires and cables are in place and connected to devices and equipment, test the system for short circuits, improper grounds, and other faults. If a fault condition is present, rectify the trouble and retest the wiring system.
  2. If phase conductors are shorted, grounded, or at fault, remove and replace them and retest the wiring system.
  3. Perform a voltage test at each lighting panel, distribution panel and at the last outlet on each circuit. If drop in potential exceeds 1 percent, correct the condition by locating the ground or high-resistance connection and retest.
  4. If any wiring device, electrical apparatus, or lighting fixture is grounded or shorted on any integral live part, remove the device and rectify the trouble by replacing the defective parts or materials.
  5. Upon completion of the electrical work, place the entire installation in operation, test for proper function, and show that the systems and equipment are free of defects.
    - a. Motors and driven equipment shall not be operated until properly lubricated.
    - b. Pumps shall not be operated until the necessary water process fluid supply has been connected and turned on.
    - c. Test and record motor maximum load amperage and terminal voltage when uncoupled and coupled for each motor.
  6. Metra's Authorized Representative will conduct from time to time such tests as may be required to any part of the equipment to determine if it is installed in accordance with the Contract Drawings and Specifications. Extend to Metra's Authorized Representative all facilities required to this end and furnish at no additional cost to Metra, any skilled or unskilled help required to perform the testing.
  7. All tests shall be witnessed by Metra's Authorized Representative, and three copies of the verified test results shall be given in electronic format to Metra's Authorized Representative promptly upon completion of a test.
  8. Furnish assistance to the various equipment manufacturers' field engineers as required in the testing and adjusting of the electrical power

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and control equipment. Cooperation of the Contractor shall be such that a minimum of time is required for equipment testing.

9. Maintain a log for all tests. This log shall be certified before completion of the job, both as to test value and date of test. All major equipment such as switchgear and motors shall be initially energized in the presence of Metra's Authorized Representative.
10. Any faults in the work performed by this Contractor or in materials or equipment furnished and installed by this Contractor shall be corrected or replaced promptly by this Contractor at its own expense. Any faults in materials or equipment furnished by the Contractor which are the result of careless, incompetent, or improper handling or installation by this Contractor shall be corrected or replaced promptly by this Contractor at its own expense.
11. All tests shall be made at the Contractor's expense and certification of the tests shall be submitted to Metra's Authorized Representative. If any failures occur during the tests, the Contractor shall replace the cable, wire and failed equipment.

F. Wire And Cable Testing (600 volts):

1. The 600 volt insulated wires and cables shall be factory tested prior to shipment in accordance with ICEA standards for the installation specified.
2. The 600 volt wires and cables shall be tested after installation but before final connections are made up.
3. For the above-listed wires and cables, a dc high potential test voltage, as specified in ICEA, shall be applied for a period, as specified in the Standard, between all conductors in the same conduit and between each conductor to ground or to structure when installed above ground on the elevated structures.

G. Traction Power Cables:

1. After cable installation, and immediately before the terminal lugs are applied, remove the protecting caps or tape and immediately test each length of cable exposed with a portable megohm measuring instrument having a range to 10,000 megohms.
  - a. These insulation resistance tests shall be made to earth ground for surface or underground installation, where ground is a temporary rod electrode driven for connection to the megger instrument.
  - b. The remote ends of cable (other end from test location) shall be open during this test.
  - c. Termination of cables shall proceed immediately after testing, provided insulation resistance exceeds the following minimum values, which are based on 500-foot cable length or less, and are adjusted to allow for lower readings that could be caused by high ambient-temperature and/or high relative-humidity.

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2. The minimum insulation resistance shall be as follows:
  - a. 1,500 kcmil: 20 meg ohm mile
  - b. 500 kcmil: 20 meg ohm mile
3. If the insulation resistance is lower than the minimum megohms listed above, report the condition to Metra for determination of appropriate remedial procedures.
4. After all lugs are applied, but before the connection are made to apparatus, contact rails, and other equipment, test each continuously connected length of cable again with the megohm measuring instrument specified above.
  - a. If the insulation resistance of a wire or cable so measured is less than the permissible megohms of resistance set forth in the following table for cable being tested, determine the cause of the defect and correct to the satisfaction of Metra
  - b. The cost of such remedial work shall be borne by the Contractor.

<b>Minimum Insulation Resistance, Megohms to Ground, for range of cable length</b>			
<b>Cable Size</b>	<b>Up to 500 feet</b>	<b>500 ft to 1000 ft</b>	<b>1000 ft to 1500 ft</b>
500 kcmil	650	650 to 325	325 to 215
1,500 kcmil	500	500 to 250	250 to 170

5. Keep a record of the insulation tests and forward the required copies to Metra's Authorized Representative for examination and approval.
- H. Medium-Voltage Cable:
1. Before connecting cables, perform dc insulation-resistance test in accordance with NETA ATS, IEEE 400, and IEEE 400.2:
    - a. Testing organization shall be NETA certified with ten years of documented experience in testing of medium-voltage power cables as required below.
    - b. Testing and safety procedures shall conform to recommendations of IEEE 400, cable manufacturer, test equipment manufacturer and testing organization.
  2. Continuity Tests:
    - a. Check continuity from point to point and check for shorts to ground with an ohmmeter.
    - b. Perform tests after splicing is complete.
  3. Wire and Cable Insulation Resistance Tests:
    - a. Measure insulation resistance with a 1000 Vdc megohmmeter. Insulation resistance measurement may be made with the VLF test set if equipment is suitable for that purpose.
    - b. Measure insulation resistance between conductor and ground.

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- c. Test cables after splices and terminations are complete but before cable is terminated on equipment.
  4. Cable Insulation Tests:
    - a. Test cables with very low frequency (VLF) test equipment.
    - b. Test in accordance with the recommendations of IEEE 400.2 at 0.1 Hz. The following tests shall be performed in the order given.
      - 1) Dissipation factor ('tan-delta' or loss angle) measurements shall be taken at 10-second intervals over a period of 60 seconds at 0.5U<sub>0</sub> (10 kV) steps from 0.5 U<sub>0</sub> to 2.0 U<sub>0</sub>.
      - 2) Voltage withstand test shall be run for a period of 60 minutes at the voltage recommended by IEEE 400.2 for 15 kV cable.
    - c. Include the following in the final field test report:
      - 1) Calculated tan-delta stability at U<sub>0</sub>
      - 2) Calculated differential tan-delta (delta-tan-delta or tip up) between 0.5 U<sub>0</sub> and 2.0 U<sub>0</sub>
      - 3) Mean tan-delta reading at U<sub>0</sub>
      - 4) Results of VLF voltage withstand test
  5. Perform visual and mechanical inspection of cable in accordance with NETA ATS.
- I. Hand Operated Switches:
  1. Before traction power cables are connected, perform the following inspections and tests on the switches.
  2. Test insulation resistance to ground employing megger with test ground electrode. If insulation resistance is less than 50 megohms, make required corrections to the satisfaction of Metra's Authorized Representative without cost to Metra.
  3. Inspect blade and clip parts of switch for proper alignment. Clean and dry contact surfaces. Operate the switch, checking switching action, wipe, and action of quick break mechanism.
  4. Inspect switch terminal pads for clean, dry surfaces for electrical connections.
  5. Before connecting traction power cables, perform continuity tests to ascertain whether the correct traction power cable is in place for connection.
  6. After cables are connected, test the clamping force of bolted electrical connections with an accurate torque wrench and mark each bolt with black indelible marking pen. Bolted electrical connections shall be tested for the following torques:

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<b>Minimum Torque (Lb-In)</b>		
<b>Bolt Size</b>	<b>Hardware Not Lubricated</b>	<b>Hardware Lubricated</b>
3/8 inch - 16	240	170
1/2 inch - 13	480	300
3/4 inch - 10	840	720

**END OF SECTION**

**SECTION 16980**  
**MAINTENANCE EQUIPMENT**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section includes requirements for furnishing and installing miscellaneous maintenance equipment for the substation.

1.02 REFERENCES

- A. This Section incorporates by reference the latest revisions of the following documents:
  - B. American National Standards Institute (ANSI)
    - 1. ANSI/ISEA Z89.1, Industrial Head Protection
  - C. National Fire Protection Association (NFPA)
    - 1. NFPA 70E, Standard for Electrical Safety in the Workplace®

1.03 SUBMITTALS

- A. Submit products data for each item specified including brochures, samples and manufacturers' standard finishes for approval by Metra's Authorized Representative.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Maintenance equipment and accessories shall be adequately protected during delivery to prevent scratches, stains, discoloration, or other causes. Damage to any surface during fabrication, handling, shipment, storage, and installation shall be remedied by the Contractor at Contractor's own expense.

**PART 2 - PRODUCTS**

2.01 GENERAL

- A. If color of finish is not designated, Metra's Authorized Representative will select from standard colors or finishes available.

2.02 MAINTENANCE EQUIPMENT TO BE PROVIDED

- A. DC voltage detector. Highline Utility Supply # RCDC1000U 2kV Digital Voltmeter, or approved equal
- B. Vacuum bottle tester
- C. DLRO Megger DLRO 600 Digital Micro-ohmmeter or approved equal.

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- D. Megger Tester MEGGER MIT 1025 or approved equal
- E. One voltage detector and current tracer. Detector for 30-122,000 volts. Amprobe Model TIC 300 Pro non-contact, AC volt detector with carrying case accessories:
  - 1. One 48-inch Amprobe Hot Stick for voltages up to 46 KV, Model TIC410A.
  - 2. One Omicron CMC-356 relay tester with integrated network for testing IEC 61850 IEDs
- F. Two pairs of lineman's seamless dielectric rubber gloves meeting NFPA 70E and OSHA regulations for protection against electrical shock and arc flash hazard Class 3, 16-inches long, similar to Salisbury SK-a00. Two pairs leather protectors to be worn over gloves. 13-inches long for glove Class 3, 16-inches long similar to Salisbury ILP series. Glove and leather protectors' size shall be determined by the Metra.
- G. Two hard hats meeting NFPA 70E and OSHA regulations for protection against electrical shock and arc flash hazard, consisting of the following components:
  - 1. Helmet: Protective, HI-VIS yellow, MSA "V-GARD" two reflective strips, custom logo, adjustable ratchet suspension (MSA FAS-TRAC), slotted, standard size, complies with ANSI Z89.1, Type I, Class E.
  - 2. Faceshield: Arc shield visor with chin guard, 10 CAL ATPV rating, tinted green, for use with MSA faceshield helmet bracket and MSA VGARD standard Metra hardhat.
  - 3. Frame: Face shield, for attachment of faceshield to MSA V Gard hard hats. For use with faceshield Item # 1959211.
- H. Two insulating arc suppression blankets Type 1/natural rubber, Class 2/20 KV. Similar to "Salisbury" EDP/cat. No. 0202 300, black color.
- I. Two protective jackets meeting NFPA 70E and OSHA regulations for protection against electrical shock and arc flash hazard similar to Salisbury 11CAL/cm2 hooded jacket Cat #JSHV1132BL-L with overpants Cat #ACP1130BI-L, in large size.
- J. Portable Air Compressor:
  - 1. Furnish portable air compressor at the substation as detailed. The compressor shall be equipped with oil-lubricated pump, regulator gauge, low oil-level protection; automatic condensate trap; totally-enclosed belt guard; dual-control, including pressure switch; and valve hose connections. The compressor shall be complete with spring vibration isolators.
  - 2. The air compressor shall be rated at 7.0 cfm minimum at 90-psig discharge. The tank shall be ASME coded 20 gallon capacity.
  - 3. The compressor shall be equipped with 30 feet of industrial grade air hose.

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4. The compressor shall be equipped with a safety air gun. It shall have an adjustable air volume knob and a hanging hook.
- K. One Midtrinsics Model CMA7000 Battery Conductance Test System complete with dual contact clamps, dual contact probes, A087 printer with A090 power supply, including an extra battery, an extra charger and a carrying case.
- L. One Remote Racking Device for 15 kV ac medium-voltage breakers.
- M. One Thermal Imager with a 1280x960 detector and a thermal sensitivity of 30mK, TiX660 Thermal Imager, capable of delivering high resolution images for the smallest temperature differential. VOx Uncooled Microbalometer, IR-Fusion, Video as manufactured by TRS Environmental or equal as approved by Metra's Authorized Representative.

**PART 3 - EXECUTION****3.01 INSTALLATION**

- A. Prior to placing the substation in service, all maintenance equipment and accessories shall be assembled and placed at Metra's direction ready for use.
- B. Install when required maintenance equipment and accessories to comply with manufacturer's instructions and recommendations.
- C. Arrange deliveries to provide continuity of installation for any phase of work.

**3.02 CLEANING AND ADJUSTING**

- A. Adjust parts to proper operational condition prior to completion of project.

**END OF SECTION**



350 PFINGSTEN ROAD, SUITE 106  
NORTHBROOK, ILLINOIS 60062  
TELEPHONE: 847-559-0085  
FAX: 847-559-0181

August 6, 2010

Mr. Frank Machara  
Laramore, Douglass and Popham  
332 South Michigan Avenue, Suite 400  
Chicago, IL 60604

*RE: Subsurface Exploration For The Proposed Metra Electric Equipment House To Be Constructed At 95<sup>th</sup> Street And Cottage Grove Avenue In Chicago, Illinois- GEC Job No 10046.*

Dear Mr. Machara:

The subsurface exploration for the proposed electric equipment house at 95<sup>th</sup> Street and Cottage Grove Avenue has been completed. Two soil borings were performed to a depth of 20 feet and the logs of these borings, along with the location diagram, are attached.

#### Project Description

The proposed electric equipment house will be a one story pre-fabricated structure. The column loads for the building will be on the order of 50 kips. Within the interior, transformers will be situated on the slab and each transformer will have a load of approximately 20 tons.

The ground surface slopes downward away from the Metra tracks approximately 3 to 4 feet so a low level retaining wall will be constructed adjacent to the Metra tracks so that the slab of the building can be constructed at the same elevation.

#### Subsurface Exploration Procedures

The soil borings were originally planned to be extended to a depth of 15 feet below grade. However, low strength soils were encountered at depths ranging from approximately 10 to 15 feet so the soil borings were extended to 20 feet below grade. Representative soil samples were obtained using split barrel sampling procedures in accordance with ASTM Specification D-1586. In this procedure, a 2" OD split barrel sampler is driven into the ground by means of an automatically operated 140 pound hammer with a 30" drop. The number of blows to advance the sampler 12" are called the standard penetration test (SPT) values. These SPT values are shown on the boring logs.

The soil samples were returned to the offices of Ground Engineering Consultants, Inc. for further examination and testing. Wherever cohesive soil samples were obtained, hand penetrometer and water content tests were performed. The results of these tests are also shown on the boring logs.

The soil samples were visually reclassified according to the Unified Soil Classification System. The appropriate group symbol according to this system of classification is included in parentheses following the textural description of the soil on the boring logs.

### Subsurface Conditions

The subsurface profile can be divided into three somewhat distinct soil strata. This includes:

- Fill deposits – Fill is present in both borings to depths ranging from 9 to 13 feet below ground surface. The majority of fill is classified as either a silty clay with topsoil or a mixture of cinders and clay. The SPT values in the fill are generally on the order of 4 to 9 blows per foot indicating a loose condition.
- Low strength natural soil – At B-2, a dark gray silty clay containing trace amounts of topsoil is present at a depth of 13 to 14.5 feet below ground surface. The unconfined compressive strength is only 1.0 tsf. This could be fill material or the upper surface of the natural soil deposit.
- Hard Clay – Below depths of approximately 10 feet at B-1 and 15 feet at B-2, a hard silty clay soil deposit is present. The unconfined compressive strengths are on the order of 4 to 4.5 tsf. The natural water contents are on the order of 15 to 17 percent indicating a deposit of relatively low compressibility.

### Water Level Observations

Ground water was encountered at a depth of 14.5 feet below ground surface in B-2. After completion of the drilling, the borehole was found to be dry. No water was also encountered in boring B-1. In impervious soils such as are present at the site, an extended period of time is required for the water to seep into the borehole and come to an equilibrium position. Both boreholes were plugged immediately after completion for safety purposes.

Based upon the available information, it is concluded that the current static water table is situated at a depth of 14.5 feet below existing ground surface. Fluctuations in the position of the water table should be anticipated throughout the year with variations in precipitation and the amount of surface runoff.

### Foundation Recommendations

Because of the presence of the deep fill and lower strength natural soils immediately below the fill, it is recommended that the building foundations and the transformer foundations be supported by means of drilled piers. The drilled piers should be extended to the hard clayey soils which are present below depths of approximately 12 to 15 feet below existing ground surface. For drilled piers supported on silty clays with an unconfined compressive strength of 4 tsf, the drilled piers should be designed on the basis of a maximum net allowable bearing pressure of 8000 psf. This is a somewhat conservative bearing pressure but the borings did not extend deeper than 20 feet below grade and it is not known if the hard clay continues with increasing depth.

### Lateral Load Resistance

Lateral forces will be resisted by the fill deposits adjacent to the drilled piers as well as some sliding below the base of the floor slab. Within the fill material, a coefficient of horizontal subgrade reaction of 5 tons per cubic foot divided by the square root of the diameter of the drilled pier can be used for calculating the lateral resistance. Within the very stiff to hard clays below a depth of approximately 15 feet, a coefficient of horizontal subgrade reaction of 150 tons per cubic foot divided by the square root of the diameter of the drilled pier shaft can be used for design.

Some sliding resistance will also be provided at the base of the floor slab. A coefficient of sliding resistance of 0.35 multiplied by the vertical gravity forces can be used for calculating the sliding resistance.

### Floor Slab Support

The fill material extends quite deep below grade and it is not practical to remove all of the fill material. If some settlement of the slab can be tolerated, it is recommended that the upper two feet of the fill material that extends below final subgrade be undercut. The exposed fill surface should then be proofrolled by a fully loaded dump truck making multiple passes over the area. The proofrolling will tend to densify the upper portion of the remaining fill as well as to determine if any overly soft pockets are present. Soft pockets will be revealed by deep rutting or weaving and sponginess in the subgrade. Any soft areas should be undercut. The excavation should then be replaced with a compacted crushed stone meeting IDOT CA-6. This material should be placed in lifts not exceeding 9 inches in loose thickness and compacted to a minimum of 90% of ASTM D-1557 density. Some reinforcing steel should also be added into the concrete slab to hold together any cracks that might occur due to long-term differential movement.

### Construction Considerations

The main difficulty with the installation of drilled piers is the unknown nature of the fill that has to be penetrated. There could be large sized pieces of broken concrete at some locations which could cause some refusal to drilling operations.

It will be necessary to install temporary steel casing through the fill deposits to prevent the fill from caving as the drilled shaft is extended in depth. This temporary casing can be removed after the bearing stratum is reached and concrete placed within the shaft.

It would be preferable to use straight shaft drilled piers because at some locations, fill and/or low strength natural soils extend down to the top of the bearing stratum. Some caving of these deposits could occur if a bell were to be formed.

Prior to start of construction, it is recommended that some settlement and lateral displacement observation points be installed adjacent to the existing Metra tracks. These observations points should then be monitored during construction to confirm that there is no movement or settlement of the Metra tracks as work is underway.

General Qualifications

The analysis and recommendations presented herein are based upon the two borings that were drilled at the site. There is always the possibility that the type, strength, and depth of the fill deposits could vary between boring locations. For this reason, it is recommended that all of the foundation installations be monitored at the time of construction. If you wish, we welcome the opportunity to arrange for these services for you.

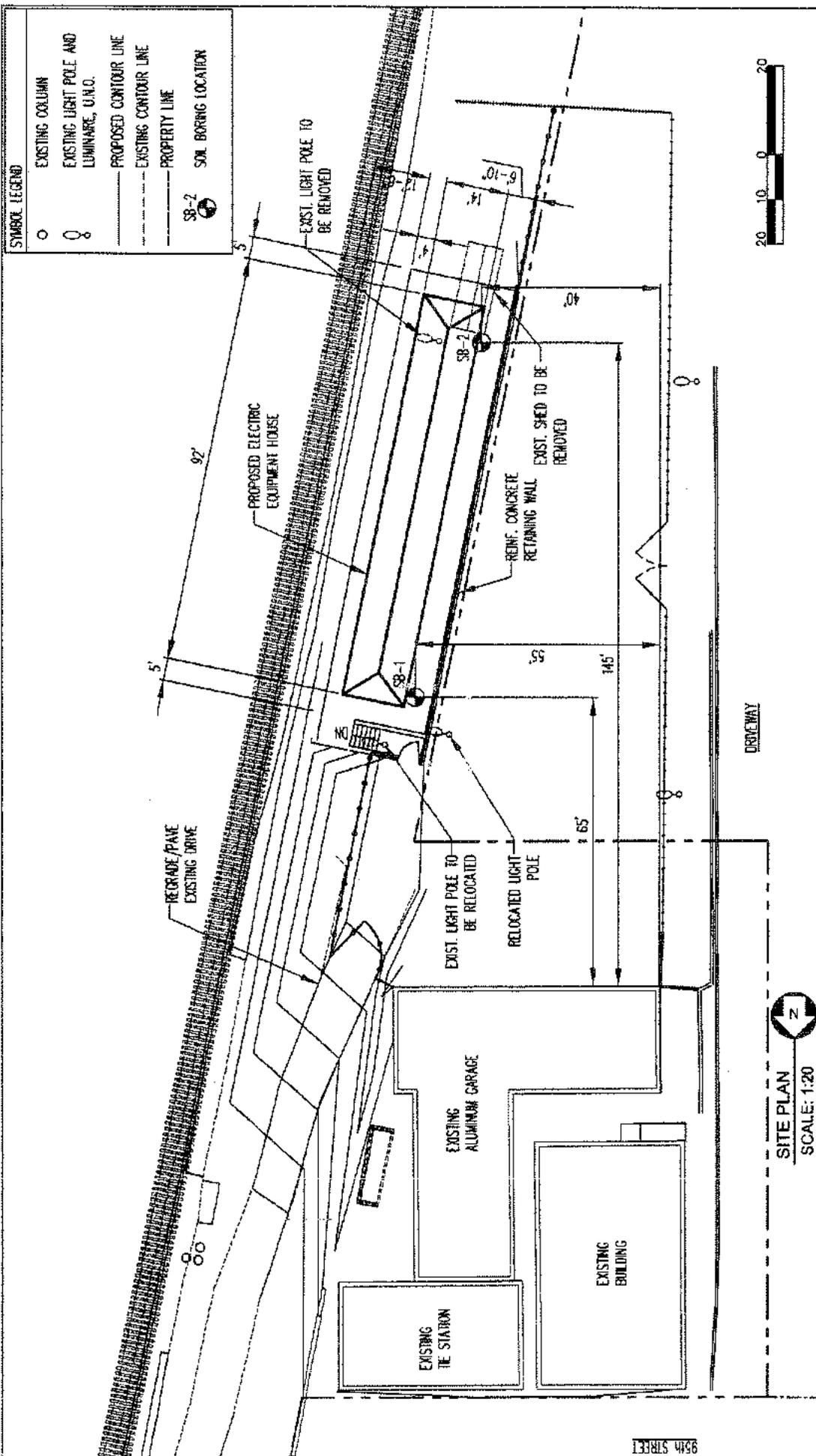
If there are any questions with regard to this report, or if we can be of further service to you in any way, feel free to contact us.

Sincerely Yours,

Ground Engineering Consultants, Inc.

  
Robert G. Lukas, P.E.  
Consultant





**SYMBOL LEGEND**

- EXISTING COLUMN
- ⊙ EXISTING LIGHT POLE AND LUMINAIRE, U.I.O.
- PROPOSED CONTOUR LINE
- - - EXISTING CONTOUR LINE
- PROPERTY LINE
- SB-2 SOIL BORING LOCATION



**SITE PLAN**  
SCALE: 1:20



95TH STREET TIE-STATION

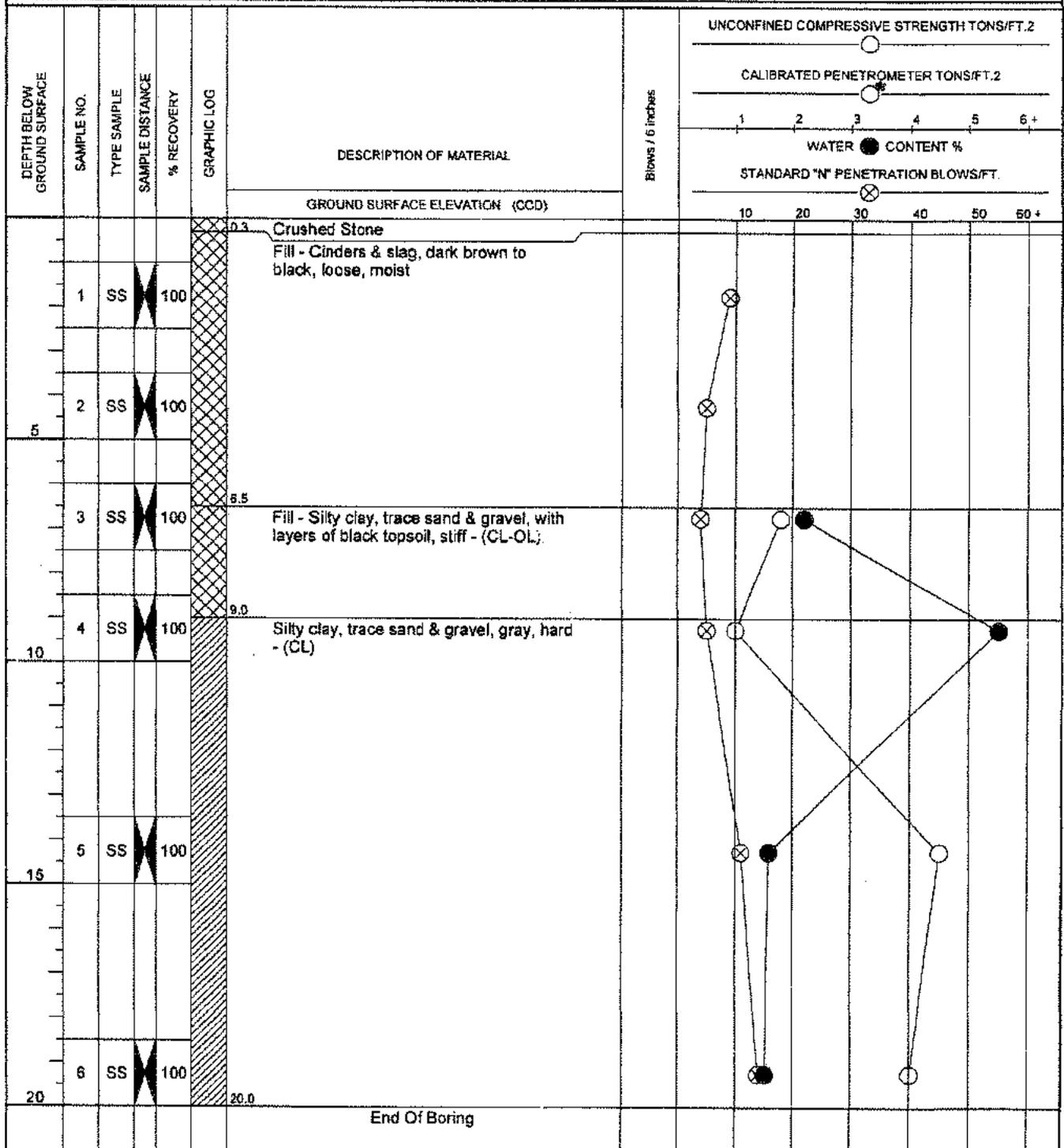
EXHIBIT A - SITE PLAN

Scale: AS NOTED Date: 05/04/10 KMI No.: 21002

Drawing No. SK-1 of 1

**Katsouni Mehdi, Inc.**  
ARCHITECTS & ENGINEERS  
407 South Dearborn St., Suite 200  
Chicago, IL 60605  
Tel: 312-987-9800; Fax: 312-987-9892  
E-Mail: KMI@kmi-chicago.com

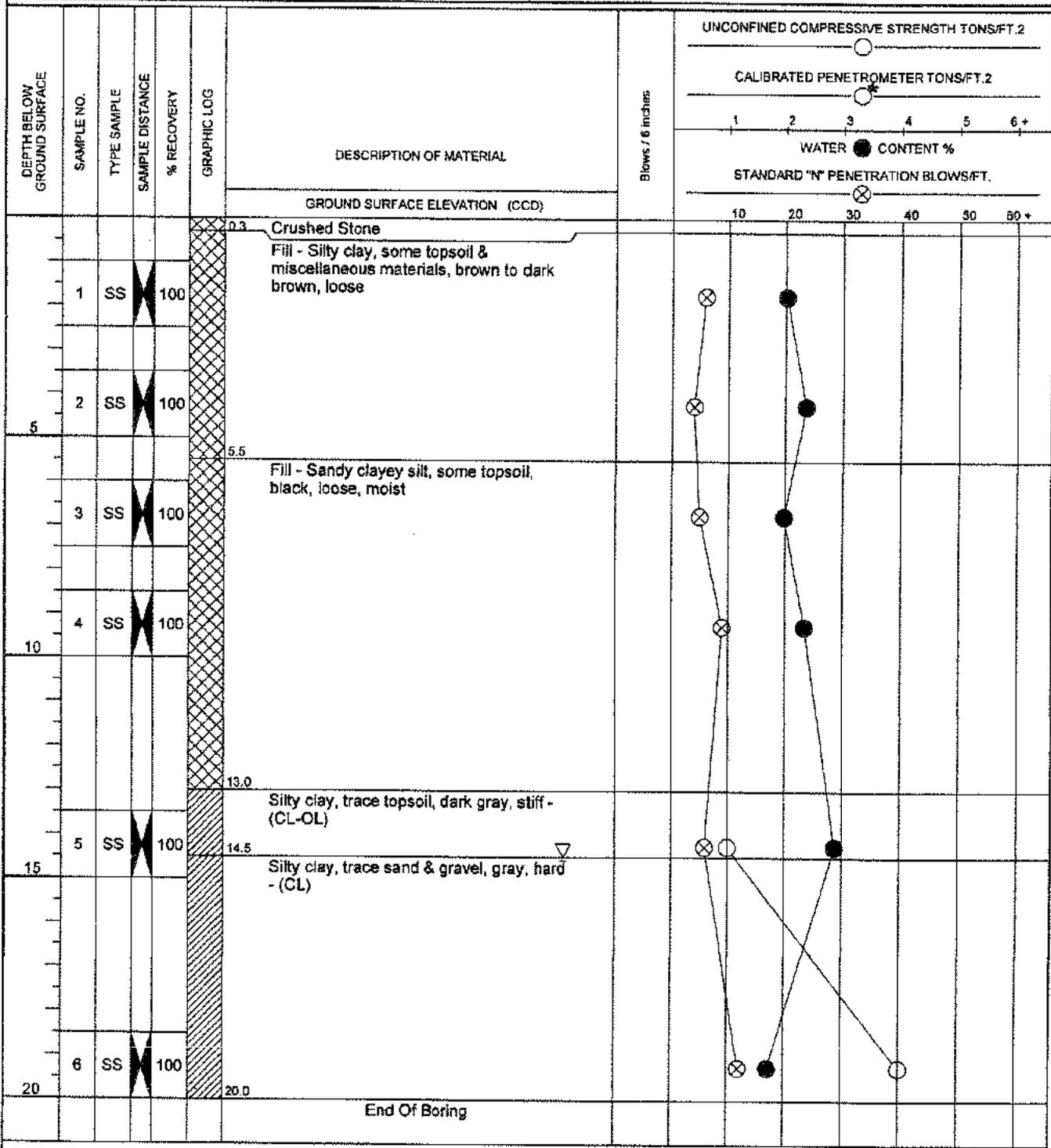
GEC Job # 10046	LOG OF BORING NO. B-1	SHEET 1 OF 1
CLIENT: Laramore Douglass & Popham	PROJECT: Proposed Metra Electric Equipment House	
STATION:	LOCATION: 95th St. & Cottage Grove St. Chicago, Illinois	



<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <th colspan="2">WATER LEVEL OBSERVATIONS</th> </tr> <tr> <td style="width:10%;">W.L.</td> <td style="text-align: center;">Dry</td> </tr> <tr> <td>W.L.</td> <td style="text-align: center;">▼</td> </tr> <tr> <td>W.L.</td> <td style="text-align: center;">▼</td> </tr> </table>	WATER LEVEL OBSERVATIONS		W.L.	Dry	W.L.	▼	W.L.	▼	<p><b>Ground Engineering Consultants, Inc.</b></p> <p>350 Pfingsten Road, Suite 106 Northbrook, Illinois 60062 Tel: (847) 559-0085 Fax: (847) 559-0181</p>	<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td>BORING STARTED</td> <td style="text-align: right;">7/22/10</td> </tr> <tr> <td>BORING COMPLETED</td> <td style="text-align: right;">7/22/10</td> </tr> <tr> <td>BORING DRILLED BY</td> <td style="text-align: right;">FOREMAN</td> </tr> <tr> <td>GROOF</td> <td style="text-align: right;">TDH</td> </tr> </table>	BORING STARTED	7/22/10	BORING COMPLETED	7/22/10	BORING DRILLED BY	FOREMAN	GROOF	TDH
WATER LEVEL OBSERVATIONS																		
W.L.	Dry																	
W.L.	▼																	
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BORING STARTED	7/22/10																	
BORING COMPLETED	7/22/10																	
BORING DRILLED BY	FOREMAN																	
GROOF	TDH																	

GEC Job # 10046 **LOG OF BORING NO. B-2** SHEET 1 OF 1

CLIENT: Laramore Douglass & Popham PROJECT: Proposed Metra Electric Equipment House  
 STATION: LOCATION: 95th St. & Cottage Grove St. Chicago, Illinois



WATER LEVEL OBSERVATIONS		<b>Ground Engineering Consultants, Inc.</b> 350 Pfingsten Road, Suite 106 Northbrook, Illinois 60062 Tel: (847) 559-0085 Fax: (847) 559-0181	BORING STARTED	7/22/10
W.L.	14.5 WD		BORING COMPLETED	7/22/10
W.L.			BORING DRILLED BY	FOREMAN
W.L.			GROOF	TDH



350 PFINGSTEN ROAD, SUITE 106  
NORTHBROOK, ILLINOIS 60062  
TELEPHONE: 847-559-0085  
FAX: 847-559-0181

August 6, 2010

Mr. Frank Machara  
Laramore, Douglass and Popham  
332 South Michigan Avenue, Suite 400  
Chicago, IL 60604

*RE: Supplemental Subsurface Exploration For The Proposed Metra Tie Breaker Station To Be Constructed At 212 West 141<sup>st</sup> Street In Riverdale, Illinois -GEC Job No 29032-A*

Dear Mr. Machara:

The initial subsurface exploration at the site was completed in October, 2009. Two soil borings were performed to a depth of 15 feet. However, relatively low strength soils were encountered throughout the full 15 feet of the soil profile, so an additional boring B-2A was completed in July 2010 so as to provide information for design of a drilled pier foundation. The logs of the original borings plus the supplemental borings are attached.

#### Project Description

The proposed building will be a one story structure. Because of the proximity of the building to the Metra tracks, it is planned to use deep foundations to support the building. The column loads for this building will be on the order of 50 kips. Grade beams will span between the caissons. The one story building will be supported on top of the grade beams. The space beneath the grade beams will be open to the air.

#### Subsurface Exploration Procedures

The soil borings were completed by Groff Testing Corporation, Inc. Representative soil samples were obtained in the conventional borings using split barrel sampling procedures in accordance with ASTM Specification D-1586. In this procedure, a 2" OD split barrel sampler is driven into the ground by means of an automatically operated 140 pound hammer with a 30" drop. The number of blows to advance the sampler 12" are called the standard penetration test (SPT) values. These SPT values are shown on the boring logs.

The soil samples were returned to the offices of Ground Engineering Consultants, Inc. for further examination and testing. Wherever cohesive soil samples were obtained, hand penetrometer and water content tests were performed. The results of these tests are also shown on the boring logs.

The soil samples were visually reclassified according to the Unified Soil Classification System. The appropriate group symbol according to this system of classification is included in parentheses following the textural description of the soil on the boring logs.

### Subsurface Conditions

The subsurface profile can be divided into three somewhat distinct soil strata. This includes:

- Low Strength Clayey Soils – Around a depth of 22 feet, a stiff to occasionally very stiff gray silty clay soil deposit is present. The unconfined compressive strengths are typically on the order of 1 to 1.5 tsf. The natural water contents are on the order of 24 to 25 percent indicating a compressible deposit.
- Very Stiff Clay – Below 22 feet and extending to a level of approximately 28 feet below ground surface, a very stiff gray silty clay soil deposit is present. The unconfined compressive strengths are on the order of 2.8 tsf.
- Dense Deposits – Below 28 feet and extending to the end of the boring at 50 feet, either a hard gray silty clay or a very dense silt and fine sand deposit is present. In the clayey soils, the unconfined compressive strengths are on the order of 5 to 5.5 tsf and in the granular soil, the SPT value is 61. The natural water contents are on the order 15 to 16 percent indicating a deposit of relatively low compressibility.

### Water Level Observations

Ground water was encountered at B- 2 at a depth of 4.5 feet below grade and at B-2A at a depth of 38 feet below grade. The shallow water level reading represents a perched water table condition wherein water accumulates within the upper soil deposits following periods of precipitation and downward percolation is retarded . The deep water table reading is the water that is present in the silt and fine sand deposit within the depth range of 38 to 42 feet below ground surface.

In impervious soils such as are present at the site, an extended period of time is required for the water level to enter the borehole and come to an equilibrium position. It has been our experience that the long term position of the water table is generally located at the depth where the color of the soil changes from brown and gray to totally gray. The brown color is attributed to past partial desiccation of the soil mass which necessarily occurs above the long term position of the water table. This transition took place at a depth of approximately 8 feet below ground surface at this site.

Fluctuations in the position of the water table should be anticipated throughout the year with

variations in precipitation and the amount of surface runoff.

#### Foundation Recommendations

For support of the proposed building and structural slab, it is recommended that drilled piers be used. The drilled piers should be extended to the hard clayey soils which are present below depths of 28 feet below existing ground surface. At this depth, the drilled piers can be designed on the basis of a maximum net allowable bearing pressure of 12000 psf. If necessary, it should be possible to form bells to enlarge the bearing areas since the soils immediately above the bearing stratum possess moderate to high strength.

It will be necessary to use a temporary surface steel casing to prevent the upper surface soils from caving. Below this level, the soils possess sufficient strength so squeezing of the shaft is not anticipated. The temporary steel casing can be removed after the concrete has been placed to up to cutoff level.

For the magnitude of the loads involved, settlement of the drilled pier foundations is anticipated to be less than 1/2 inch.

#### Lateral Load Support

Lateral loads that are transmitted to the foundations will be resisted by the soil formations adjacent to the drilled pier foundations. In the stiff clay soils above a depth of 22 feet, a horizontal subgrade reaction modulus of 10 tons per cubic foot divided by the square root of the diameter of the drilled pier can be used for design. In a depth range of 22 to 28 feet below ground surface, a horizontal subgrade reaction of 150 tons per cubic foot divided by the square root of the diameter of the drilled pier shaft can be used for design.

#### Construction Considerations

It should be possible to drill the shafts and form bells with the drilled piers without difficulty. The drilled piers should not be extended below depths of about 35 feet below ground surface since a water bearing silt and fine sand formation is present in the depth range of 38 to 42 feet. The existing ground surface is sloping so it will be necessary to provide a more nearly level surface for the drill rig to gain access to the proposed locations for the drilled piers.

Since construction will occur adjacent to the existing Metra tracks, it is recommended that vertical and lateral deformation observation points be established prior to construction and monitored during construction.

#### General Qualifications

The analysis and recommendations presented herein are based upon the one deep soil boring that was drilled adjacent to soil boring location B-2. There is always the possibility that the soil classifications and the depth to the bearing stratum could vary over the other portions of the proposed building site. For this reason, it is recommended that all of the foundation installations

be monitored at the time of construction. If you wish, we welcome the opportunity to arrange for these services for you.

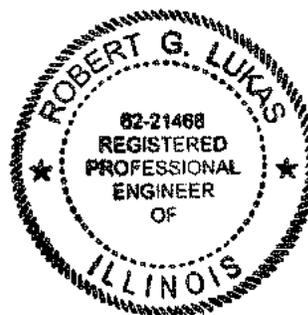
If there are any questions with regard to this report, or if we can be of further service to you in any way, feel free to contact us.

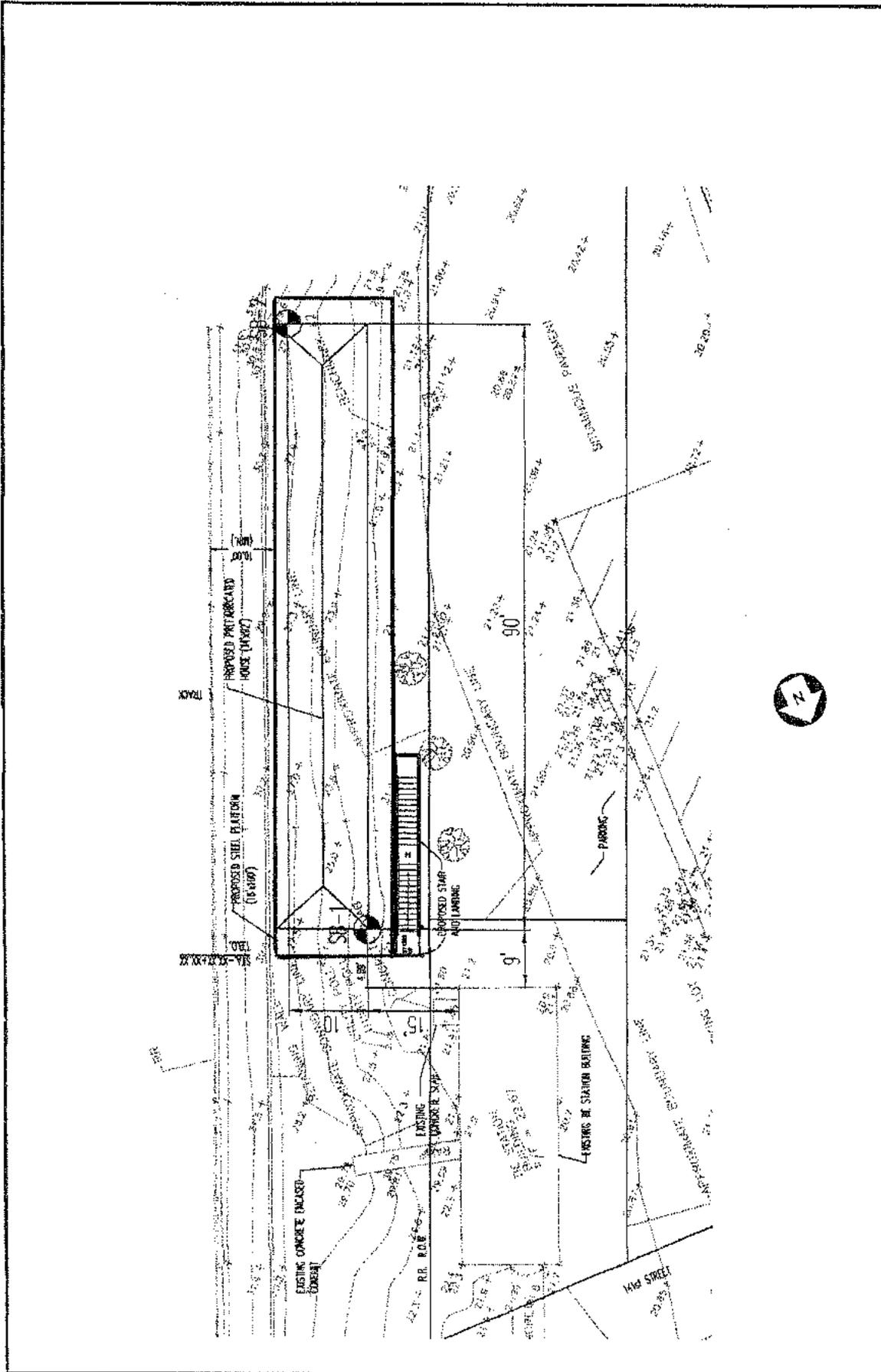
Sincerely Yours,

Ground Engineering Consultants, Inc.



Robert G. Lukas, P.E.  
Consultant



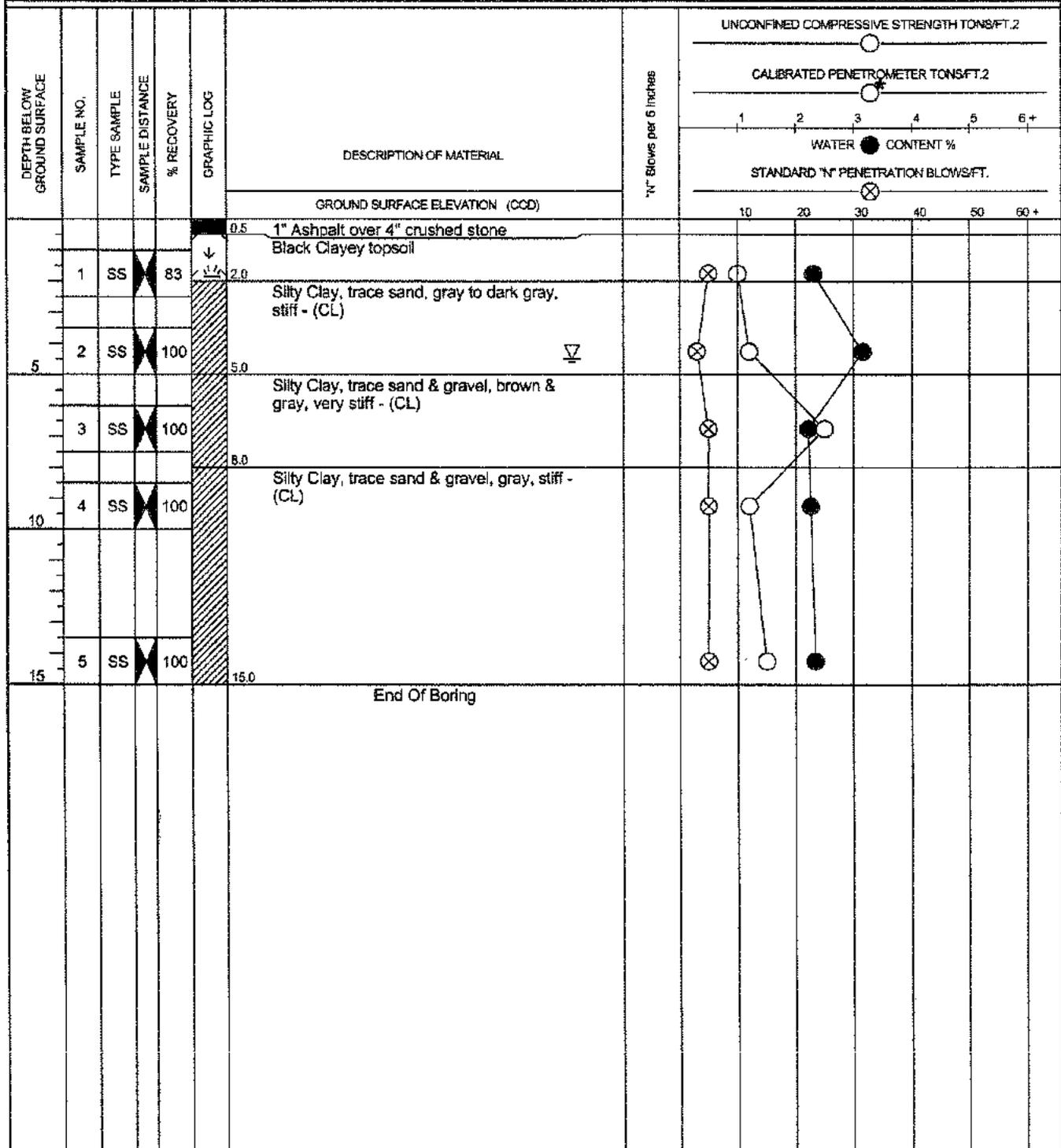


<b>Kaltsouni Mehdi, Inc.</b> ARCHITECTS ■ ENGINEERS 407 South Dearborn St., Suite 200 Chicago, IL 60605 Tel: 312-987-9800; Fax: 312-987-9892 E-Mail: KM@kmcchicago.com	RIVERDALE, CHICAGO ILLINOIS		Drawing No. SK-4 of 5
	SOIL BORING LOCATION		Scale: N.T.S.      Date: 04/24/09      KMI No.: 2812

GEC Job # 29032-A		LOG OF BORING NO. B-1			SHEET 1 OF 1										
CLIENT: LARAMORE, DOUGLASS, & POPHAM				PROJECT: Proposed Metra Tie Station											
STATION:				LOCATION: 212 W. 141 Street Riverdale, Illinois											
DEPTH BELOW GROUND SURFACE	SAMPLE NO.	TYPE SAMPLE	SAMPLE DISTANCE	% RECOVERY	GRAPHIC LOG	DESCRIPTION OF MATERIAL	"N" Blows per 6 inches	UNCONFINED COMPRESSIVE STRENGTH TONS/FT.2		CALIBRATED PENETROMETER TONS/FT.2		WATER CONTENT %		STANDARD "N" PENETRATION BLOWS/FT.	
								GROUND SURFACE ELEVATION (CCD)							
					1.2	Crushed stone									
	1	SS		100	↓	Black clayey topsoil		⊗		●					
					3.0			⊗		●					
	2	SS		100	/ / / /	Silty Clay, trace sand & gravel, gray and brown, very stiff - (CL)		⊗		●					
5					/ / / /			⊗		●					
	3	SS		100	/ / / /			⊗		●					
					/ / / /			⊗		●					
	4	SS		100	/ / / /	Silty Clay, trace sand & gravel, gray, stiff - (CL-CH)		⊗		●					
10					/ / / /			⊗		●					
	5	SS		100	/ / / /			⊗		●					
15					/ / / /			⊗		●					
					15.0	End Of Boring									

WATER LEVEL OBSERVATIONS			<b>Ground Engineering Consultants, Inc.</b> 350 Pfingsten Road, Suite 106 Northbrook, Illinois 60062 Tel: (847) 559-0085 Fax: (847) 559-0181	BORING STARTED 10/5/09	
W.L.	DRY	▽		BORING COMPLETED 10/5/09	
W.L.		▽		BORING DRILLED BY FOREMAN	
W.L.		▽		K+S Engineering John	

GEC Job # 29032-A	LOG OF BORING NO. B-2	SHEET 1 OF 1
CLIENT: LARAMORE, DOUGLASS, & POPHAM	PROJECT: Proposed Metra Tie Station	
STATION:	LOCATION: 212 W. 141 Street Riverdale, Illinois	



WATER LEVEL OBSERVATIONS		
W.L.	4.5 WD	▽
W.L.		▽
W.L.		▽

**Ground Engineering Consultants, Inc.**  
 350 Pfingsten Road, Suite 106  
 Northbrook, Illinois 60062  
 Tel: (847) 559-0085 Fax: (847) 559-0181

BORING STARTED	10/5/09
BORING COMPLETED	10/5/09
BORING DRILLED BY	FOREMAN
K+S Engineering	John

GEC Job # 29032-A **LOG OF BORING NO. B-2A** SHEET 1 OF 1

CLIENT: PROJECT: Proposed Metra Tie Station  
 STATION: LOCATION: 212 W. 141 Street  
 Riverdale, Illinois

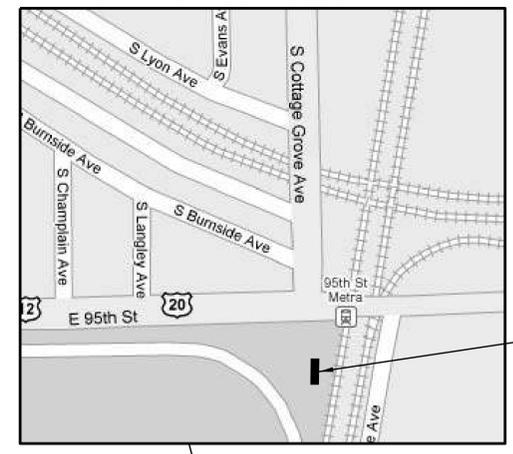
DEPTH BELOW GROUND SURFACE	SAMPLE NO.	TYPE SAMPLE	SAMPLE DISTANCE	% RECOVERY	GRAPHIC LOG	DESCRIPTION OF MATERIAL	Blows / 6 inches	UNCONFINED COMPRESSIVE STRENGTH TONS/FT.2		CALIBRATED PENETROMETER TONS/FT.2		WATER CONTENT %		STANDARD "N" PENETRATION BLOWS/FT.	
								1	2	3	4	5	6+	10	20
						No Sampling									
8.5															
10	1	SS	X	100		Silty Clay, trace sand & gravel, gray, stiff - (CL)		⊗	○	●					
15	2	SS	X	100				⊗	○	●					
20	3	SS	X	100				⊗	○	●					
22.0															
25	4	SS	X	100		Silty Clay, trace sand & gravel, gray, very stiff - (CL)		⊗	○	●					
28.0															
30	5	SS	X	100		Silty Clay, trace sand & gravel, gray, hard - (CL)				●					
35	6	SS	X	100						●					
38.0															
40	7	SS	X	100		Silt & fine sand, gray, very dense, wet - (ML-SM)									⊗
42.0															
45	8	SS	X	100		Clayey silt, trace sand & gravel, gray, hard - (ML-CL)				●					⊗
50	9	SS	X	100						●					⊗
50.0						End Of Boring									

WATER LEVEL OBSERVATIONS		
W.L.	38 WD	▽
W.L.		▽
W.L.		▽

**Ground Engineering Consultants, Inc.**  
 350 Pfingsten Road, Suite 106  
 Northbrook, Illinois 60062  
 Tel: (847) 559-0085 Fax: (847) 559-0181

BORING STARTED	7/22/10
BORING COMPLETED	7/22/10
BORING DRILLED BY	FOREMAN
GROOF	TDH

95TH. STREET SUBSTATION



SUBSTATION



95th STREET SUBSTATION

DRAWING LIST

CS-11.9-1000	COVER SHEET
SS-11.9-1001	TOPOGRAPHICAL SURVEY
SS-11.9-1001G	GENERAL NOTES
SS-11.9-1017	SITE PLAN
SS-11.9-1018	FRAMING PLAN AND DETAILS
SS-11.9-1019	DETAILS
SS-11.9-1050	SUBSTATION EQUIPMENT LAYOUT PLAN
SS-11.9-1070	ELECTRICAL SITE PLAN
SS-11.9-1071	DUCTBANK LAYOUT
SS-11.9-1072	DUCTBANK PROFILES
SS-11.9-1073	DUCTBANK DETAILS
SS-11.9-1074	NOT USED
SS-11.9-1075	SUBSTATION GROUNDING LAYOUT
SS-11.9-1080	ELECTRICAL NOTES & SYMBOLS
SS-11.9-1081	ELECTRICAL DETAILS
SS-11.9-1082	NEGATIVE AND DRAIN ENCLOSURES
SS-11.9-1085	TIE STATION INCOMING FEEDER & CONTROL CABLES PLAN & SECTIONS
SS-11.9-4001	12.5KV AC SINGLE LINE DIAGRAM
SS-11.9-4002	NOT USED
SS-11.9-4003	TRACTION POWER ONE LINE DIAGRAM
SS-11.9-4004	NOT USED
SS-11.9-4005	NOT USED
SS-11.9-4006	TRANSF'S, RECTIFIERS & DC SWGR SINGLE LINE DIAGRAM
SS-11.9-4101	12.5KV AC THREE LINE DIAGRAM, SHEET 1 OF 3
SS-11.9-4102	12.5KV AC THREE LINE DIAGRAM, SHEET 2 OF 3
SS-11.9-4103	12.5KV AC THREE LINE DIAGRAM, SHEET 3 OF 3
SS-11.9-4104	NOT USED
SS-11.9-4105	12.5KV AC SCHEMATIC DIAGRAM INC. LINE BKRS. 152-1 & 152-2
SS-11.9-4106	12.5KV AC SCHEMATIC DIAGRAM BUS TIE BKR. 52BT
SS-11.9-4107	12.5KV AC SCHEMATIC DIAGRAM RECT. TRANSF. BKR. 52-T1 & 52-T2
SS-11.9-4108	NOT USED
SS-11.9-4109	NOT USED
SS-11.9-4110	12.5KV AC SCHEMATIC DIAGRAM BUS-1 DIFFERENTIAL LOCKOUT
SS-11.9-4111	12.5KV AC SCHEMATIC DIAGRAM BUS-2 DIFFERENTIAL LOCKOUT
SS-11.9-4201	1500V DC SCHEMATIC DIAGRAM RECTIFIER-1 POWER & AUXILIARIES
SS-11.9-4202	1500V DC SCHEMATIC DIAGRAM RECTIFIER-1 CONTROLS & ANNUNCIATOR
SS-11.9-4203	NOT USED
SS-11.9-4204	1500V DC SCHEMATIC DIAGRAM RECTIFIER-2 POWER & AUXILIARIES
SS-11.9-4205	1500V DC SCHEMATIC DIAGRAM RECTIFIER-2 CONTROLS & ANNUNCIATOR
SS-11.9-4206	RECTIFIER PLC LOGIC DIAGRAM SHEET 1
SS-11.9-4207	RECTIFIER PLC LOGIC DIAGRAM SHEET 2
SS-11.9-4208	RECTIFIER PLC LOGIC DIAGRAM SHEET 3
SS-11.9-4209	RECTIFIER PLC LOGIC DIAGRAM SHEET 4
SS-11.9-4210	1500V DC SCHEMATIC DIAGRAM RECTIFIER-1 BREAKER 72-1
SS-11.9-4211	1500V DC SCHEMATIC DIAGRAM RECTIFIER-2 BREAKER 72-2
SS-11.9-4226	1500V DC SCHEMATIC DIAGRAM DC SWITCHGEAR GROUND RELAY
SS-11.9-4300A	1500V DC SWITCHGEAR DC FDR BKR SEC. 134 CUB. NO. 8 SCHEMATIC DIAGRAM
SS-11.9-4301A	1500V DC SWITCHGEAR DC FDR BKR SEC. 135 CUB. NO. 3 SCHEMATIC DIAGRAM
SS-11.9-4302A	1500V DC SWITCHGEAR DC FDR BKR SEC. 136 CUB. NO. 7 SCHEMATIC DIAGRAM
SS-11.9-4303A	1500V DC SWITCHGEAR DC FDR BKR SEC. 137 CUB. NO. 4 SCHEMATIC DIAGRAM
SS-11.9-4304A	1500V DC SWITCHGEAR DC FDR BKR SEC. 138 CUB. NO. 6 SCHEMATIC DIAGRAM
SS-11.9-4305A	1500V DC SWITCHGEAR DC FDR BKR SEC. 139 CUB. NO. 1 SCHEMATIC DIAGRAM
SS-11.9-4306A	1500V DC SWITCHGEAR DC FDR BKR SEC. 140 CUB. NO. 5 SCHEMATIC DIAGRAM
SS-11.9-4307A	1500V DC SWITCHGEAR DC FDR BKR SEC. 141 CUB. NO. 2 SCHEMATIC DIAGRAM
SS-11.9-4308A	1500V DC SWITCHGEAR DC FDR BKR SEC. T-BKR CUB. #10 SCHEMATIC DIAGRAM
SS-11.9-5000	STATION CONTROL ARCHITECTURE NEW BUILDING AND INTERFACES
SS-11.9-5001	STATION CONTROL ARCHITECTURE EXISTING BUILDING AND INTERFACES

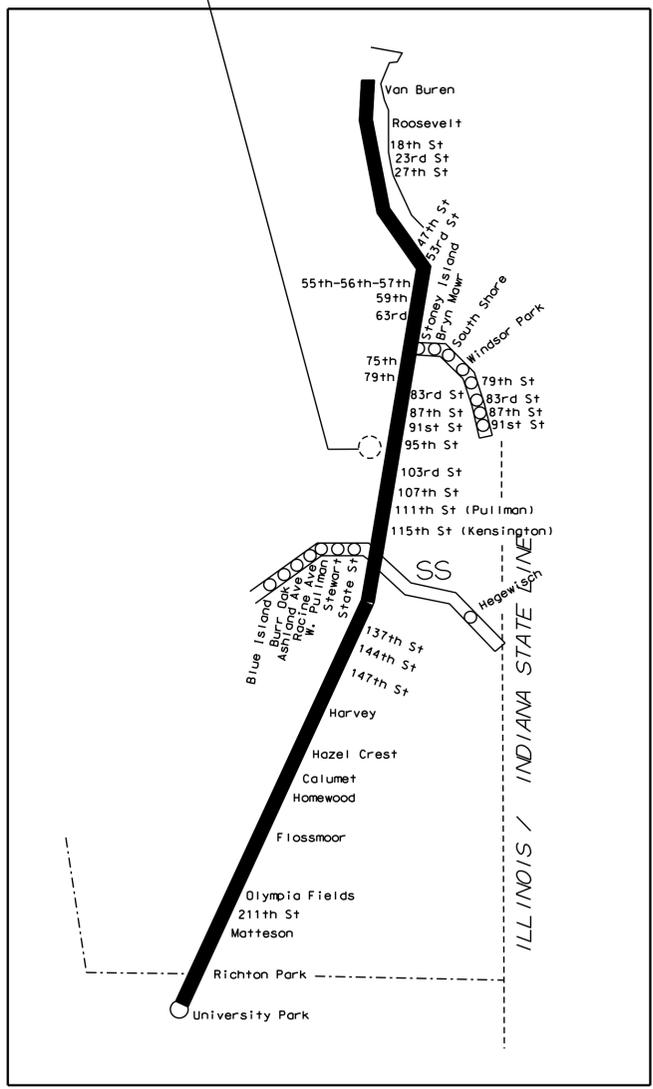
COMED REFERENCE DOCUMENTS

COMED STANDARDS

C4050	CONDUIT RUN TRENCH PREPARATION, PAGES 1 & 2
C4090	CONDUIT RUN FORMATIONS, PAGES 1 & 2
C4171	CONDUIT RUN INSTALLATION, PAGES 1 THRU 7
C5285	ESS INSTALLATION REQUIREMENTS, PAGES 1 THRU 3
C5295	VEHICULAR BARRIER, PAGE 1
C5302	PAD MOUNTED SWITCHGEAR FOUNDATIONS, PAGES 1 THRU 12
C8550	GROUNDING INSTALLATION, PAGES 1 THRU 6

SERVICE ENTRANCE LOCATION SKETCHES

SERVICE ENTRANCE LOCATION SKETCH 1 OF 5
SERVICE ENTRANCE LOCATION SKETCH 2 OF 5
SERVICE ENTRANCE LOCATION SKETCH 3 OF 5
SERVICE ENTRANCE LOCATION SKETCH 4 OF 5
SERVICE ENTRANCE LOCATION SKETCH 5 OF 5



SYSTEM MAP  
ELECTRIC DISTRICT



PRINTED ON: \$DATES

REV	DATE	BY	APP	DESCRIPTION	REV	DATE	BY	APP	DESCRIPTION
2	06-08-2018	HS	HS	ISSUED FOR BID					
1	03-30-2018	HS	HS	ISSUED FOR ADDENDUM 1					
0	12-19-2017	HS	HS	ISSUED FOR BID					

**LTK**  
LTK Engineering Services

**KMI**  
Kaltsouni Mehdi, Inc.  
ARCHITECTS • ENGINEERS  
223 W. Jackson Blvd., Suite 1010 Chicago, IL 60606  
Tel.: (312)987-9800 Fax: (312)987-9892

**IDP** A Company of **Gannett Fleming**  
Consulting Engineers  
20 N. Wacker Dr. Ste. 1500 Chicago IL, 60606

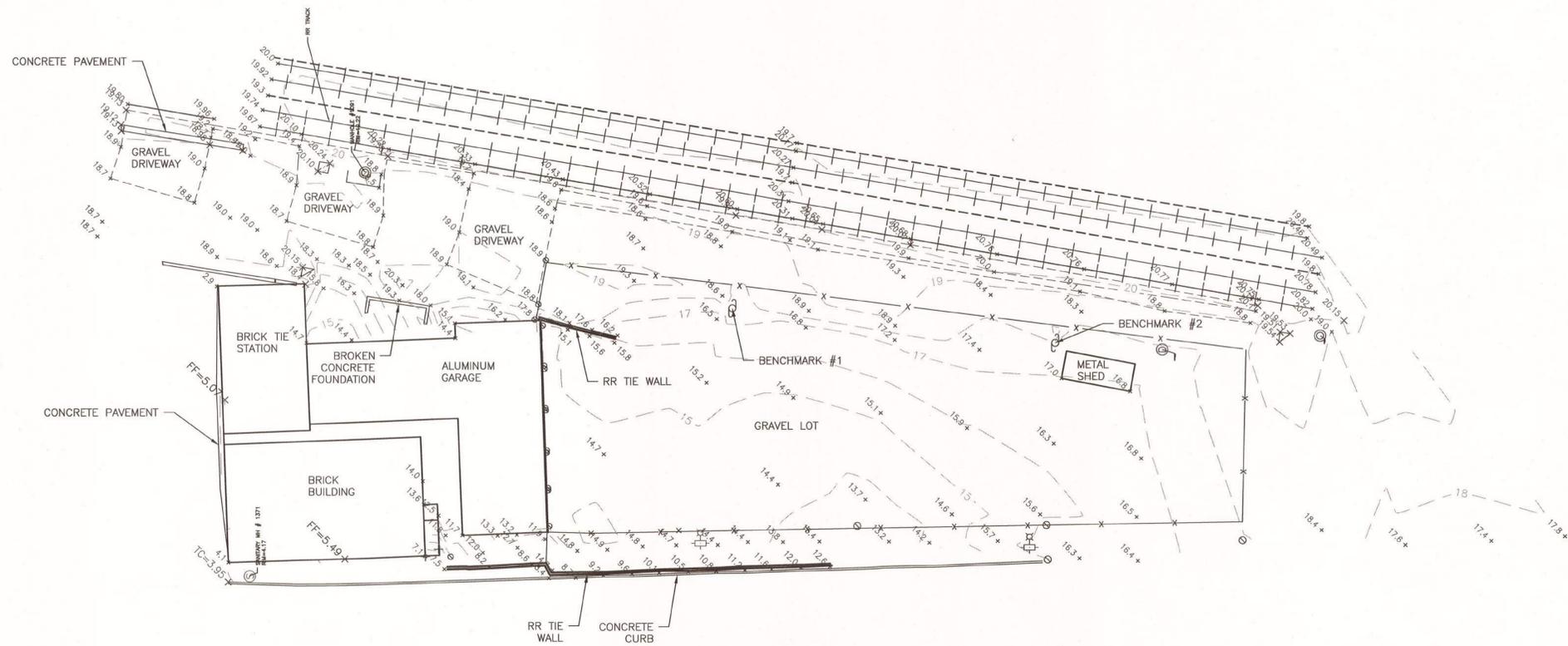
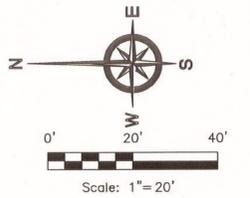
**Metra**  
ENGINEERING DEPARTMENT  
547 W. JACKSON BOULEVARD  
CHICAGO, ILLINOIS 60661

LOCATION NAME: <b>95TH. STREET SUBSTATION</b>
TITLE: <b>COVER SHEET</b>

CAD FILE NUMBER: CS-11.9-1000.DGN
SCALE: NTS
DISTRICT: MED
PROJECT NO. GW4254-57102002
SHEET NO. <b>CS-11.9-1000</b>
MILE POST NO. 11.9

**SURVEYOR'S NOTES:**

1. ALL DIMENSIONS ARE GIVEN IN FEET AND DECIMAL PARTS THEREOF.
2. BEARINGS BASED ON ILLINOIS STATE PLANE COORDINATES, EAST ZONE, NAD83(2011), GPS DERIVED.
3. VERTICAL DATUM IS CITY OF CHICAGO DATUM.
4. ONLY THOSE BUILDING LINE SETBACKS AND EASEMENTS WHICH ARE SHOWN ON THE RECORDED PLAT OF SUBDIVISION ARE SHOWN HEREON. UNLESS OTHERWISE INDICATED, REFER TO THE DEED, TITLE INSURANCE POLICY AND LOCAL ORDINANCES FOR OTHER RESTRICTIONS WHICH MAY OR MAY NOT EXIST.
5. COMPARE DEED DESCRIPTION AND SITE CONDITIONS WITH THE DATA GIVEN ON THIS PLAT AND REPORT ANY DISCREPANCIES TO THE SURVEYOR AT ONCE.
6. NO DIMENSIONS SHALL BE DERIVED FROM SCALE MEASUREMENT.
7. DISTANCES ALONG CURVES ARE ARC DISTANCES UNLESS OTHERWISE NOTED.
8. THIS SURVEY WAS PERFORMED ON THE GROUND AND COMPLETED 05/05/17.
9. ONLY THE IMPROVEMENTS THAT WERE VISIBLE FROM ABOVE GROUND AT TIME OF SURVEY AND THROUGH A NORMAL SEARCH AND WALK THROUGH OF THE SITE ARE SHOWN ON THE FACE OF THIS PLAT. LAWN SPRINKLER SYSTEMS, IF ANY, ARE NOT SHOWN ON THIS SURVEY.
10. SURFACE INDICATIONS OF UTILITIES ON THE SURVEYED PARCEL HAVE BEEN SHOWN. UNDERGROUND AND OFFSITE OBSERVATIONS HAVE NOT BEEN MADE TO DETERMINE THE EXTENT OF UTILITIES SERVING OR EXISTING ON THE PROPERTY. PUBLIC AND/OR PRIVATE RECORDS HAVE NOT BEEN SEARCHED TO PROVIDE ADDITIONAL INFORMATION. OVERHEAD WIRES, IF ANY, ARE EXISTING AND THEIR POLES HAVE BEEN SHOWN, HOWEVER THEIR FUNCTION AND DIMENSIONS HAVE NOT BEEN NOTED.
11. OTHER THAN VISIBLE OBSERVATIONS NOTED HEREON, THIS SURVEY MAKES NO STATEMENT REGARDING THE ACTUAL PRESENCE OR ABSENCE OF ANY SERVICE OR UTILITY LINE. CONTROLLED UNDERGROUND EXPLORATORY EFFORT TOGETHER WITH DIGGER IS RECOMMENDED TO DETERMINE THE FULL EXTENT OF UNDERGROUND SERVICE AND UTILITY LINES. CONTACT DIGGER AT 1-312-744-7000.



BENCHMARK #1  
BENCH TIE NAIL IN UTILITY POLE  
ELEV. = 20.02 CCD

BENCHMARK #2  
BENCH TIE NAIL IN UTILITY POLE  
ELEV. = 20.95 CCD

LEGEND	
SYMBOL	DESCRIPTION
ΔBM	BENCHMARK LOCATION
⊗	WATER VALVE
⊠E	ELECTRIC METER
⊙	GUY WIRE ANCHOR
⊕	POWER POLE
⊙	SANITARY MANHOLE
⊙	MANHOLE
⊙	STORM MANHOLE
⊙	DRAIN
⊙	BOLLARD
⊙	STREET LIGHT STANDARD
⊙	STREET LIGHT W/MAST ARM
⊙	SIGN
⊙	STEEL POST
⊙	SHRUB
⊙	DECIDUOUS TREE W/SIZE
X 100.00	SPOT GRADE
(R)	RECORD BEARING OR DISTANCE
(M)	MEASURED BEARING OR DISTANCE
TC	TOP OF CURB
FL	FLOWLINE
TW	TOP OF WALL
FF	FINISHED FLOOR
— —	COMBINATION SEWER LINE
— —	OVERHEAD WIRES
—x—	CHAINLINK FENCE LINE
— —	WOOD/IRON FENCE LINE
— —	STEEL GUARDRAIL

STATE OF ILLINOIS)  
JSS  
COUNTY OF COOK)

THIS IS TO CERTIFY THAT THE TOPOGRAPHIC IMPROVEMENTS DEPICTED HEREON WERE SURVEYED UNDER THE DIRECT SUPERVISION OF AN ILLINOIS PROFESSIONAL LAND SURVEYOR, AND THAT THIS PLAT REPRESENTS THE CONDITIONS FOUND AT THE TIME OF SAID SURVEY.

GIVEN UNDER MY HAND AND SEAL THIS 17TH OF JANUARY, 2018 IN CHICAGO, ILLINOIS.

ENVIRONMENTAL DESIGN INTERNATIONAL, INC.  
PROFESSIONAL DESIGN FIRM NO. 184-001224

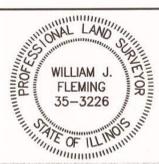
*William J. Fleming*  
WILLIAM FLEMING, IPLS NO. 035.003226  
LICENSE EXPIRES: 11/30/2018

THIS PROFESSIONAL SERVICE CONFORMS TO THE CURRENT ILLINOIS MINIMUM STANDARDS FOR TOPOGRAPHIC SURVEYS.

THIS PLAT IS VALID ONLY WITH AN ORIGINAL SIGNATURE AND EMBOSSED SEAL.

PRINTED ON: 01/17/2018

REV	DATE	BY	APP	DESCRIPTION	REV	DATE	BY	APP	DESCRIPTION
0	01-17-2018	MW	WF	ISSUED FOR BID					



**EDI**  
Environmental Design International, inc.  
Civil, Survey, Environmental and  
Construction Inspection Services  
33 W. Monroe St., Suite 1625  
Chicago, IL 60603  
Ph: (312) 345-1400 Fax: (312)345-0529  
www.edidesign.com MBE/WBE/DBE

DESIGNED: WF  
DRAWN: MW  
CHECKED: WF  
METRA P.M.: R.CERANT  
DATE: JANUARY 17, 2018

**Metra**  
ENGINEERING DEPARTMENT  
547 W. JACKSON BOULEVARD  
CHICAGO, ILLINOIS 60661

LOCATION NAME: **95TH STREET SUBSTATION**  
TITLE: **TOPOGRAPHIC SURVEY**

CAD FILE NUMBER: SS-11.9-1001.DGN  
SCALE: AS SHOWN  
PROJECT NO. GW4254-57102002  
MILE POST NO. 11.3  
DISTRICT: MED  
SHEET NO. **SS-11.9-1001**

**GENERAL NOTES:**

- ALL ITEMS OF THIS PROJECT SHALL BE GOVERNED BY THE CODES AND SPECIFICATIONS LISTED BELOW:
  - INTERNATIONAL BUILDING CODE-2012
  - CHICAGO BUILDING CODE-2017
  - "STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION" PREPARED BY THE DEPARTMENT OF TRANSPORTATION OF THE STATE OF ILLINOIS AND ADOPTED BY SAID DEPARTMENT (LATEST VERSION).
  - "SUPPLEMENTAL SPECIFICATIONS AND RECURRING SPECIAL PROVISIONS" ADOPTED BY THE ILLINOIS DEPARTMENT OF TRANSPORTATION (LATEST VERSION).
  - "STANDARDS AND SPECIFICATIONS FOR SOIL EROSION AND SEDIMENT CONTROL" (LATEST VERSION).
  - "STANDARD SPECIFICATIONS FOR WATER AND SEWER MAIN CONSTRUCTION IN ILLINOIS" (LATEST VERSION).
- CONTRACTOR SHALL BE RESPONSIBLE FOR SECURING AND PAYING FOR ALL REQUIRED PERMITS INCLUDING MUNICIPAL PERMITS.
- ALL IMPROVEMENTS WILL BE SUBJECT TO OBSERVATION BY METRA AUTHORIZED REPRESENTATIVE AND/OR QUALIFIED AGENTS ACTING ON BEHALF OF METRA BOTH DURING THE COURSE OF CONSTRUCTION AND AFTER CONSTRUCTION IS COMPLETE. THE AGENT SHALL HAVE AUTHORITY OVER MATERIALS OF CONSTRUCTION AND WORKMANSHIP TO INSURE COMPLIANCE WITH CONSTRUCTION DOCUMENTS. THE CONTRACTOR SHALL PROVIDE FOR REASONABLE TESTS AND PROOF OF QUALITY OF MATERIALS AS REQUESTED BY THE AGENT. THE AGENT SHALL HAVE FORTY-EIGHT (48) HOURS NOTICE PRIOR TO CONSTRUCTION OR INSPECTION.
- THE CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING ALL EXISTING CONDITIONS, DIMENSIONS AND ELEVATIONS AT THE SITE AND MUST ADAPT HIS WORK TO ACTUAL CONDITIONS IN A MANNER APPROVED BY THE ENGINEER AT NO ADDITIONAL COST TO THE OWNER. IF THERE ARE ANY DISCREPANCIES FROM WHAT IS SHOWN ON THE CONSTRUCTION PLANS, HE MUST IMMEDIATELY REPORT SAME TO THE ENGINEER BEFORE DOING ANY WORK, OTHERWISE THE CONTRACTOR ASSUMES FULL RESPONSIBILITY. IN THE EVENT OF DISAGREEMENT BETWEEN THE CONSTRUCTION PLANS, STANDARD SPECIFICATIONS AND/OR SPECIAL DETAILS, THE CONTRACTOR SHALL SECURE WRITTEN INSTRUCTIONS FROM THE ENGINEER PRIOR TO PROCEEDING WITH ANY PART OF THE WORK AFFECTED BY OMISSIONS OR DISCREPANCIES. FAILING TO SECURE SUCH INSTRUCTIONS, THE CONTRACTOR WILL BE CONSIDERED TO HAVE PROCEEDED AT HIS OWN RISK AND EXPENSE. IN THE EVENT OF ANY DOUBT OR QUESTION ARISING WITH RESPECT TO THE TRUE MEANING OF THE CONSTRUCTION PLANS OR SPECIFICATIONS, THE DECISION OF THE ENGINEER SHALL BE FINAL AND CONCLUSIVE.
- ALL EXISTING UTILITIES SHALL BE FIELD VERIFIED BY CONTRACTOR PRIOR TO CONSTRUCTION. CONTRACTOR SHALL COORDINATE AND COMPLY WITH ALL UTILITY COMPANIES INVOLVED IN THE PROJECT AND PAY ALL REQUIRED FEES AND COSTS.
- TRAFFIC SHALL BE MAINTAINED ON ALL STREETS AT ALL TIMES.
- IN THE EVENT, THE COUNTY/CITY STANDARD DETAILS CONFLICT WITH "TYPICAL SITE DETAILS", THE COUNTY/CITY STANDARD DETAILS SHALL GOVERN.
- DUST SHALL BE CONTROLLED BY THE UNIFORM APPLICATION OF SPRINKLED WATER AS DIRECTED BY THE ENGINEER.
- ALL ADJACENT ROADWAYS SHALL BE CLEANED OF CONSTRUCTION DEBRIS AT THE END OF EACH CONSTRUCTION DAY.
- CONTRACTOR SHALL COORDINATE WITH IDOT, METRA, AND THE CITY/VILLAGE TO LOCATE SIGNAL CABLES.
- SPOT ELEVATIONS SHOWN ARE AT EDGE OF PAVEMENT UNLESS OTHERWISE NOTED ON PLAN.
- ALL DEBRIS SHALL BE REMOVED PRIOR TO CONSTRUCTION OF NEW WORK & LEGALLY DISPOSED OF OFFSITE.
- THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE CONSTRUCTION LAYOUT STAKING. THE COST FOR ALL ASSOCIATED WORK SHALL BE INCLUDED IN THE CONTRACT SUM.

**UTILITY WARNING:**

THE UNDERGROUND UTILITIES SHOWN HAVE BEEN LOCATED FROM FIELD SURVEY INFORMATION AND EXISTING DRAWINGS. KMI MAKES NO GUARANTEE THAT THE UNDERGROUND UTILITIES SHOWN COMPRISE ALL SUCH UTILITIES IN THE AREA, EITHER IN SERVICE OR ABANDONED. KMI FURTHER DOES NOT WARRANT THAT THE UNDERGROUND UTILITIES SHOWN ARE IN THE EXACT LOCATION INDICATED ALTHOUGH HE DOES CERTIFY THAT THEY ARE LOCATED AS ACCURATELY AS POSSIBLE FROM THE INFORMATION AVAILABLE. KMI HAS NOT PHYSICALLY LOCATED THE UNDERGROUND UTILITIES. CALL J.U.L.I.E. (1-800-892-0123) AND/OR DIGGER (312-744-7000) PRIOR TO CONSTRUCTION OR EXCAVATION.

**TEMPORARY EXCAVATION SUPPORT:**

- TEMPORARY EXCAVATION SUPPORT, SHALL BE DESIGNED BY CONTRACTOR AND APPROVED BY THE RAILROAD OWNER. EXCAVATION SUPPORT IS SHOWN SYMBOLICALLY ON THE DRAWINGS, IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO DETERMINE TYPE, SIZE, AND LOCATION OF ALL REQUIRED SUPPORTS.
- REFER TO SPECIFICATION SECTION 02260-EXCAVATION SUPPORT AND PROTECTION AND APPENDIX "A"-METRA SHORING GUIDELINES FOR ADDITIONAL REQUIREMENTS.

**MINIMUM DESIGN LOADS:**

FLOOR LOADS	ROOF LOADS	WIND LOAD
DL= 75 LB/SQ.FT.	DL= 20 LB/SQ.FT.	WL= 25 LB/SQ.FT.
+ EQUIPMENT WEIGHT	LL= 30 LB/SQ.FT.	
LL= 100 LB/SQ.FT.		

**EXCAVATION AND EARTHWORK:**

- ALL FOOTING EXCAVATIONS SHALL BE INSPECTED, PRIOR TO CONCRETE PLACEMENT, BY A SOILS ENGINEER TO VERIFY SUITABLE BEARING MATERIAL OF CAPACITY AS SPECIFIED.
- NOTIFY THE OWNER'S REPRESENTATIVE WHEN ADDITIONAL EXCAVATION IS REQUIRED TO REACH SUITABLE BEARING MATERIAL.
- THE SOILS ENGINEER SHALL CERTIFY IN WRITING THAT ALL FOUNDATIONS WERE PLACED ON SOIL WITH THE BEARING VALUE AS SPECIFIED.
- WITHIN THE EXCAVATION AREA OF THE FOUNDATIONS, ALL VEGETATION, TOPSOIL, PREVIOUSLY PLACED FILL AND UNSUITABLE SOILS SHALL BE REMOVED. ALL FOOTINGS TO BEAR ON VIRGIN SOIL OR PROPERLY PLACED AND COMPACTED ENGINEERED FILL.
- FOUNDATION DESIGN DOES NOT ACCOUNT FOR WINTER CONSTRUCTION. ANY UNENCLOSED/UNHEATED SPACES SHALL BE ADEQUATELY PROTECTED AGAINST FROST DURING WINTER CONSTRUCTION BY CONTRACTOR.

**CONCRETE NOTES:**

- MATERIAL: NORMAL WEIGHT CONCRETE.  $f'_c = 4000$ psi AT 28 DAYS.
- ALL REINFORCED CONCRETE CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE ACI BUILDING CODE 318, AREMA, CHAPTER 8 AND SPECIFICATIONS FOR STRUCTURAL CONCRETE FOR BUILDINGS ACI 301.
- CONTRACTOR SHALL SUBMIT MIX DESIGN FOR APPROVAL PRIOR TO ORDERING CONCRETE.
- ALL REINFORCING BARS SHALL BE ASTM A615, GRADE 60, EPOXY COATED.
- ALL WELDED WIRE FABRIC SHALL BE ASTM A185, EPOXY COATED.
- THE ARRANGEMENT OF ACCESSORIES SHALL BE IN ACCORDANCE WITH THE ACI MANUAL OF STANDARD PRACTICE FOR DETAILING REINFORCED CONCRETE STRUCTURES. ANY PART OF AN ACCESSORY WHICH WILL BE EXPOSED ON THE CONCRETE SURFACE AFTER REMOVAL OF THE FORMS SHALL BE GALVANIZED OR PLASTIC TIPPED.
- SUPPORT BARS SHALL BE MINIMUM #4 IN SIZE AND SPACED NOT MORE THAN 3'-6" O.C. HIGH CHAIRS SHALL BE PLACED NOT MORE THAN 3'-0" O.C. THERE SHALL BE A MINIMUM OF THREE CHAIRS PER BAR.
- CONTINUOUS BARS SHALL BE LAPPED MIN. 40 BAR DIAMETERS AT ALL SPLICES.
- THE MINIMUM PROTECTIVE COVERING FOR MAIN REINFORCING STEEL SHALL BE AS FOLLOWS:
  - 3" WHERE THE CONCRETE IS PLACED AGAINST THE GROUND
  - 2" WHERE THE CONCRETE IS PLACED AGAINST FORM
  - 1 1/2" FOR STIRRUPS AND TIES
- ALL SLABS ON GRADE, EXCEPT AS SHOWN OR NOTED OTHERWISE, SHALL BE REINFORCED WITH 6x6-W2.1xW2.1 WELDED WIRE FABRIC USING 1'-0" LAPS AT SPLICES. REINFORCING SHALL BE PLACED 1 1/2" CLEAR FROM THE TOP OF THE SLAB.

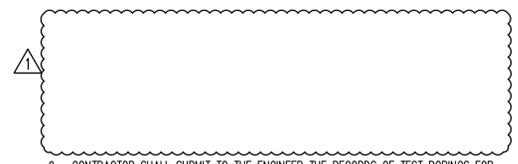
**CONCRETE NOTES CONTINUED:**

- SIZE OF THE CONCRETE POUR SHALL NOT EXCEED 2,000 S.F. FOR SLABS ON GRADE AND 90 FEET FOR WALLS, UNLESS CONSTRUCTION JOINTS ARE PROVIDED.
- EACH CONTRACTOR AND SUBCONTRACTOR SHALL PROVIDE SLEEVES IN CONCRETE FORM WORK FOR HIS OWN WORK. NO CORING OF THE CONCRETE WILL BE ALLOWED WITHOUT THE WRITTEN CONSENT OF THE STRUCTURAL ENGINEER.
- NO REINFORCEMENT SHALL BE CUT TO ACCOMMODATE ANY OPENINGS. NO OPENING LARGER THAN ONE SQUARE FOOT IS TO BE PROVIDED UNLESS SHOWN ON THE STRUCTURAL DRAWINGS OR APPROVED BY THE STRUCTURAL ENGINEER.
- PRIOR TO POURING CONCRETE, CONTRACTOR SHALL ARRANGE FOR AN INSPECTION OF REINFORCING STEEL (PLACEMENT) BY THE STRUCTURAL ENGINEER. CONTRACTOR SHALL PROVIDE THE ENGINEER WITH A MINIMUM OF 48 HOUR NOTICE AS TO WHEN STEEL IS OR WILL BE READY FOR INSPECTION. THIS REQUIREMENT DOES NOT APPLY FOR SLABS ON GRADE.
- PRIOR TO THE PLACEMENT OF ANY PIPE SLEEVES, BOX-OUTS OR OTHER SLAB PENETRATIONS, EACH MECHANICAL OR ELECTRICAL TRADE SHALL PREPARE AND SUBMIT SHOP DRAWINGS OF PROPOSED SLEEVE LAYOUT FOR STRUCTURAL ENGINEER'S REVIEW AND APPROVAL. NO CORING OF THE COMPLETED REINFORCED CONCRETE SHALL BE PERMITTED WITHOUT WRITTEN AUTHORIZATION OF THE ENGINEER.
- ALL CONCRETE SURFACES EXPOSED TO WEATHERING SHALL BE SEALED AS SPECIFIED IN SPECIFICATIONS.
- FRESHLY PLACED CONCRETE SHALL BE PROTECTED FROM PREMATURE DRYING AND EXCESSIVELY HOT OR COLD TEMPERATURES, AND SHALL BE MAINTAINED WITH MINIMUM MOISTURE LOSS AT A RELATIVELY CONSTANT TEMPERATURE FOR THE TIME REQUIRED FOR PROPER SETTING AND HARDENING OF CONCRETE, OR FOR AT LEAST 7 DAYS.
- DESIGN SOIL BEARING PRESSURE IS ASSUMED TO BE 3000 PSF. VERIFY ACTUAL BEARING PRESSURE AS RECOMMENDED BY THE GEOTECHNICAL REPORT FOR A SPECIFIC SITE.
- CONCRETE SLAB ON GRADE SHALL HAVE A MINIMUM OF 600 PSF LOADING CAPACITY.
- CONCRETE TESTS:
  - COMPRESSION TESTS: ASTM C31 AND C39. SAMPLE AT POINT OF DEPOSIT. 1 SET OF 6 CYLINDERS MADE FROM A SINGLE CONCRETE SAMPLING FOR EVERY 50 CU. YDS. OR AT LEAST FROM EACH TYPE OF CONCRETE USED EACH DAY. TEST ONE CYLINDER AT 3 DAYS, ONE AT 7 DAYS, ONE AT 14 DAYS AND TWO AT 28 DAYS.
  - SLUMP TESTS: ASTM C143. FIRST TRUCK EACH DAY, EACH SAMPLE FOR CYLINDERS, AND AS OFTEN AS NECESSARY THEREAFTER.

**EROSION CONTROL NOTES:**

- ALL EROSION AND SEDIMENT CONTROL WORK SHALL CONFORM TO THE ILLINOIS URBAN MANUAL STANDARDS AND PROCEDURES FOR EROSION CONTROL AND WITH ALL COUNTY ORDINANCES PERTAINING TO EROSION CONTROL.
- ALL EROSION AND SEDIMENT CONTROL MEASURES SHALL BE INSTALLED AND OPERATIONAL PRIOR TO ANY GROUND DISTURBANCE.
- SILT FILTER FABRIC SHALL BE PLACED BETWEEN FRAME AND GRATE OF SEWER STRUCTURES UNTIL VEGETATION IS ESTABLISHED.
- ALL DISTURBED AREAS SHALL BE TEMPORARILY STABILIZED WITHIN 7 DAYS OF ACTIVE DISTURBANCE.
- UTILIZE EXCELISOR BLANKET ON ALL SLOPES OF 4:1 OR GREATER.
- ALL EROSION AND SEDIMENT CONTROL PRACTICES SHALL BE MAINTAINED AND REPAIRED AS NEEDED TO ENSURE EFFECTIVE PERFORMANCE OF THE REQUIRED EROSION CONTROL MEASURES.
- DURING THE CONSTRUCTION OPERATION, WHEN ANY LOOSE MATERIAL IS DEPOSITED IN THE FLOW LINE OF DITCHES, GUTTERS OR DRAINAGE STRUCTURES SO THE NATURAL FLOW OF WATER IS OBSTRUCTED, THE MATERIAL SHALL BE REMOVED AT THE END OF EACH CONSTRUCTION DAY. ALL DRAINAGE STRUCTURES SHALL BE CLEANED AND BE FREE FROM ALL DIRT AND DEBRIS. THIS WORK WILL NOT BE PAID FOR SEPARATELY, BUT SHALL BE CONSIDERED INCIDENTAL TO OTHER ITEMS.
- ALL EROSION CONTROL MEASURES SHALL BE DISPOSED OF WITHIN 30 DAYS OF FINAL STABILIZATION OF THE SITE.
- GROUND COVER FOR 3:1, 4:1, & 5:1 SLOPES SHALL BE ESTABLISHED WITHIN SEVEN DAYS OF FINAL GRADING.
- ALL TOPSOIL SHALL BE STRIPPED AND STOCKPILED PRIOR TO FILLING.
- CONTRACTOR SHALL PLACE STOCKPILED TOPSOIL OR IMPORTED MATERIAL ON ALL DISTURBED AREAS WITH 6" TOPSOIL UNLESS OTHERWISE NOTED ON PLANS, RAKED SMOOTH TO BE READY FOR SEEDING (LANDSCAPING, ETC.).
- SEEDING SHALL BE PER I.D.O.T. MANUAL, SECTION 250 STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION, LATEST REVISION. PROVIDE SALT TOLERANT ROADSIDE/SLOPE MIXTURE. MULCH / HYDROSEED SHALL BE PER I.D.O.T. MANUAL, SECTION 251, STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION, LATEST REVISION DATE. MULCH / HYDROSEED METHOD 2, PROCEDURE 3.
- ALL NEW SEEDED AREA TO BE WATERED BY THE CONTRACTOR UNTIL GRASS IS A MINIMUM OF 5" HIGH OR METRA HAS RELEASED THE WATERING REQUIREMENTS.

**CAISSON NOTES:**



- CONTRACTOR SHALL SUBMIT TO THE ENGINEER THE RECORDS OF TEST BORINGS FOR REVIEW & EXAMINATION PRIOR TO CONSTRUCTION.
- IF ANY EXISTING SERVICE LINES, UTILITIES AND UTILITY STRUCTURES WHICH ARE TO REMAIN IN SERVICE ARE UNCOVERED OR ENCOUNTERED DURING CONSTRUCTION, THEY SHALL BE SAFEGUARDED, PROTECTED FROM DAMAGE AND SUPPORTED IF NECESSARY.
- THE CONTRACTOR SHALL NOTIFY THE ENGINEER IN THE EVENT ANY EXISTING UTILITIES, UTILITY STRUCTURES OR ANY OBSTRUCTION WHICH INTERFERES WITH THE PROPER INSTALLATION OF THE FOUNDATION WORK.
- THE CONTRACTOR SHALL SUBMIT TO THE ENGINEER FOR APPROVAL, THE CAISSON CONSTRUCTION METHOD (INCLUDING THE SEQUENCE OF OPERATIONS). METHOD OF EXCAVATION, DETAILS OF CASING AND LINER REQUIRED, METHOD OF POURING CONCRETE, ETC.
- ALL TEMPORARY AND PERMANENT CASINGS SHALL EXTEND ABOVE THE GROUND. TEMPORARY LINER MUST EXTEND BELOW SOFT CLAY MATERIAL. FINAL LENGTH OF TEMPORARY LINER TO BE DETERMINED BY THE GEOTECHNICAL ENGINEER.
- NO CAISSON EXCAVATION SHALL BE LEFT UNSUPPORTED OR NOT FILLED FOR MORE THAN EIGHT HOURS.
- ALL CAISSONS SHALL BEAR ON THE MATERIAL CAPABLE OF SAFELY SUPPORTING THE CAISSON LOAD LISTED ON DRAWINGS. SEE TYPICAL CAISSON DETAILS.
- ALL CAISSON CONCRETE SHALL HAVE A COMPRESSIVE STRENGTH OF 4000 P.S.I. AT 28 DAYS.
- ALL REINFORCING BARS SHALL BE A.S.T.M. A615, GRADE 60, EPOXY COATED.
- CONCRETE SHALL BE VIBRATED IN UPPER 10'-0" OF CAISSON SHAFT.
- THE CAISSON CONTRACTOR SHALL REMOVE ALL LAITANCE FROM THE TOP OF THE CAISSON SHAFT A MINIMUM OF 24 HOURS AFTER THE CONCRETE POUR FOR EACH CAISSON. ALL NECESSARY PRECAUTIONS SHALL BE TAKEN SO THAT THERE IS NO DAMAGE TO THE CONCRETE BELOW.
- SUBMIT THE ACTUAL CAISSON LOCATION PLAN PREPARED BY A REGISTERED SURVEYOR IN STATE OF ILLINOIS AND FULL DETAILS OF CORRECTIVE MEASURES FOR CAISSONS EXCEEDING THE TOLERANCE LIMIT OF PLUS OR MINUS 3".
- THE CONTRACTOR SHALL SETUP REFERENCE POINTS FOR OBSERVING OF FOUNDATION SETTLEMENT ON ALL BUILDINGS CLOSER THAN 50 FEET PRIOR TO ANY CAISSON INSTALLATION. THE CONTRACTOR SHALL CLOSELY OBSERVE ANY SETTLEMENT DURING CAISSON INSTALLATION AND SHALL REPORT ALL FINDINGS TO THE ENGINEER.
- PUMPING OF WATER FROM THE CAISSON SHAFT SHALL NOT BE PERMITTED UNLESS APPROVED BY THE GEOTECHNICAL ENGINEER.

**STRUCTURAL STEEL NOTES CONTINUED:**

- SHOP AND FIELD TESTING OF WELDS SHALL BE AS FOLLOWS:
  - VISUAL INSPECTION SHALL BE MADE ON 100% OF ALL WELDS.
  - MAGNETIC PARTICLE TEST SHALL BE MADE ON 100% OF ALL FILLET WELDS.
  - ULTRASONIC TESTS SHALL BE MADE ON 100% OF ALL FULL PENETRATION WELDS.
  - TWENTY FIVE (25) PERCENT OF BOLTS IN EACH SHEAR CONNECTION BUT NOT LESS THAN TWO (2) BOLTS PER CONNECTION SHALL BE CHECKED BY CALIBRATED TORQUE WRENCH.
- SUBMIT REQUIRED CALCULATIONS AND SHOP DRAWINGS PREPARED AND SEALED BY A STRUCTURAL ENGINEER LICENSED IN THE STATE OF ILLINOIS FOR REVIEW AND APPROVAL BY THE ENGINEER.
- SHOP DRAWINGS SHALL BE PREPARED USING ACTUAL FIELD SURVEY OF CAISSON LOCATIONS. CONTACT METRA FOR ANY DISCREPANCIES BETWEEN FIELD LOCATION OF CAISSONS AND DESIGN DRAWINGS.

**STEEL BAR GRATE NOTES**

- STEEL SHALL BE ASTM-A569 OR ASTM-A36 FOR BARS IN THICKNESS OF 3/16" OR LESS AND ASTM-A36 FOR ALL OTHERS.
- PANELS SHALL BE HOT DIPPED GALVANIZED AFTER FABRICATION.
- GRATING IS TO SAFELY SUSTAIN A UNIFORMLY DISTRIBUTED LOAD OF 150 PSF ON A 6'-0" SPAN.
- ATTACHMENT TO SUPPORTING STEEL SHALL BE WITH STAINLESS STEEL SADDLE CLIPS AND #12 SELF-TAPPING SCREWS AT 1'-6" CENTER TO CENTER (MAXIMUM).
- UNLESS NOTED OTHERWISE, STEEL BAR GRATE SHALL BE 1 1/4"x 3/16" BARS SPACED AT 1 3/16" O.C. WITH WELDED LOCK BARS AT 4" O.C. (McNICHOLS "GW-125" OR EQUAL)

**STANDARD ABBREVIATIONS**

B.C.	- BACK OF CURB
C.B.	- STORM CATCH BASIN
O.C., C-C OR C/C	- CENTER TO CENTER
CONC.	- CONCRETE
CONT.	- CONTINUOUS
DIA.	- DIAMETER
DET.	- DETAIL
ELEC.	- ELECTRIC
ELEV.	- ELEVATION
EXIST.	- EXISTING
EXT.	- EXTERIOR
FT	- FOOT/FEET
GALV.	- GALVANIZED
IDOT	- ILLINOIS DEPARTMENT OF TRANSPORTATION
LT	- LEFT
MAX.	- MAXIMUM
M.E.	- MATCH EXISTING
M.H.	- MANHOLE
M.N.	- MINIMUM
NO. OR #	- NUMBER
N.T.S.	- NOT TO SCALE
P.C.C.	- PORTLAND CEMENT CONCRETE
REINF.	- REINFORCED
R.O.W.	- RIGHT OF WAY
R.R.	- RAILROAD
RT	- RIGHT
SIM.	- SIMILAR
S.S.	- STAINLESS STEEL
STA.	- STATION
STD.	- STANDARD
STL.	- STEEL
T&B	- TOP AND BOTTOM
T.C.	- TOP OF CURB
TH.	- THICK
TYP.	- TYPICAL
V.I.F.	- VERIFY IN FIELD
W/	- WITH

**STRUCTURAL STEEL NOTES:**

- ALL STRUCTURAL STEEL SHALL BE DETAILED, FABRICATED AND ERECTED IN ACCORDANCE WITH THE LATEST A.I.S.C. SPECIFICATIONS AND AREMA, CHAPTER 15.
- ELEVATIONS SHOWN FOR STRUCTURAL STEEL ARE TO THE TOP OF STEEL MEMBERS. (U.N.O.)
- STRUCTURAL STEEL WIDE FLANGE SHAPES SHALL BE ASTM A992 (Fy=50 KSI). STRUCTURAL TUBES SHALL BE ASTM A500, GRADE B (Fy=46 KSI). STRUCTURAL PIPES SHALL BE ASTM A53, GRADE B, TYPE S (Fy=35 KSI). ALL OTHER STRUCTURAL STEEL SHALL BE ASTM A36 (Fy=36 KSI).
- ALL STEEL SHALL BE HOT DIPPED GALVANIZED AFTER FABRICATION.
- ALL BOLTS SHALL BE ASTM A325. ALL BOLTS SHALL BE 3/4" DIA. UNLESS NOTED OTHERWISE.
- WELDING SHALL BE DONE BY MANUAL SHIELDED METAL ARC PROCESS USING A.W.S. A5.1 OR A5.5, E70XX ELECTRODES OR BY SUBMERGED ARC WELDING USING A.W.S. A5.17, F7X3XXX, FLUX ELECTRODE COMBINATION.
- WELDS NOT OTHERWISE SPECIFIED SHALL BE CONTINUOUS 1/4" FILLET WELDS BUT NOT LESS THAN MINIMUM SIZE REQUIRED BY A.I.S.C. SPECIFICATIONS.
- NO CONNECTION SHALL CONSIST OF LESS THAN 2-3/4" DIA. BOLTS OR WELD DEVELOPING LESS THAN 10 KIPS.
- CUTS, HOLES, OPENINGS, ETC., REQUIRED IN STRUCTURAL STEEL MEMBERS FOR THE WORK OF OTHER TRADE SHALL BE SHOWN ON SHOP DRAWINGS FOR STRUCTURAL STEEL AND SHALL BE MADE IN THE SHOP. BURNING OF HOLES, OR CUTS IN STRUCTURAL STEEL MEMBERS IN THE FIELD WILL NOT BE PERMITTED EXCEPT BY THE WRITTEN PERMISSION FROM THE STRUCTURAL ENGINEER.

PRINTED ON: 06/05/2018

2	06-08-2018	OT	EG	ISSUED FOR BID					
1	04-03-2018	OT	EG	ADDENDUM 1					
0	01-18-2018	OT	EG	ISSUED FOR BID					
REV	DATE	BY	APP	DESCRIPTION	REV	DATE	BY	APP	DESCRIPTION

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CONSULTANT SEAL & SIGNATURE

MARIA KALTSOUNI  
081-005244

CONSULTANT

**KMI**  
Kaltsouni Mehdi, Inc.  
ARCHITECTS ■ ENGINEERS

223 W. Jackson Blvd., Suite 1010 Chicago, IL 60606  
Tel.: (312)987-9800 Fax.: (312)987-9892

DESIGNED: EG  
DRAWN: DC  
CHECKED: MK  
METRA P.M.: R. CERANT  
DATE: JUNE 12, 2017

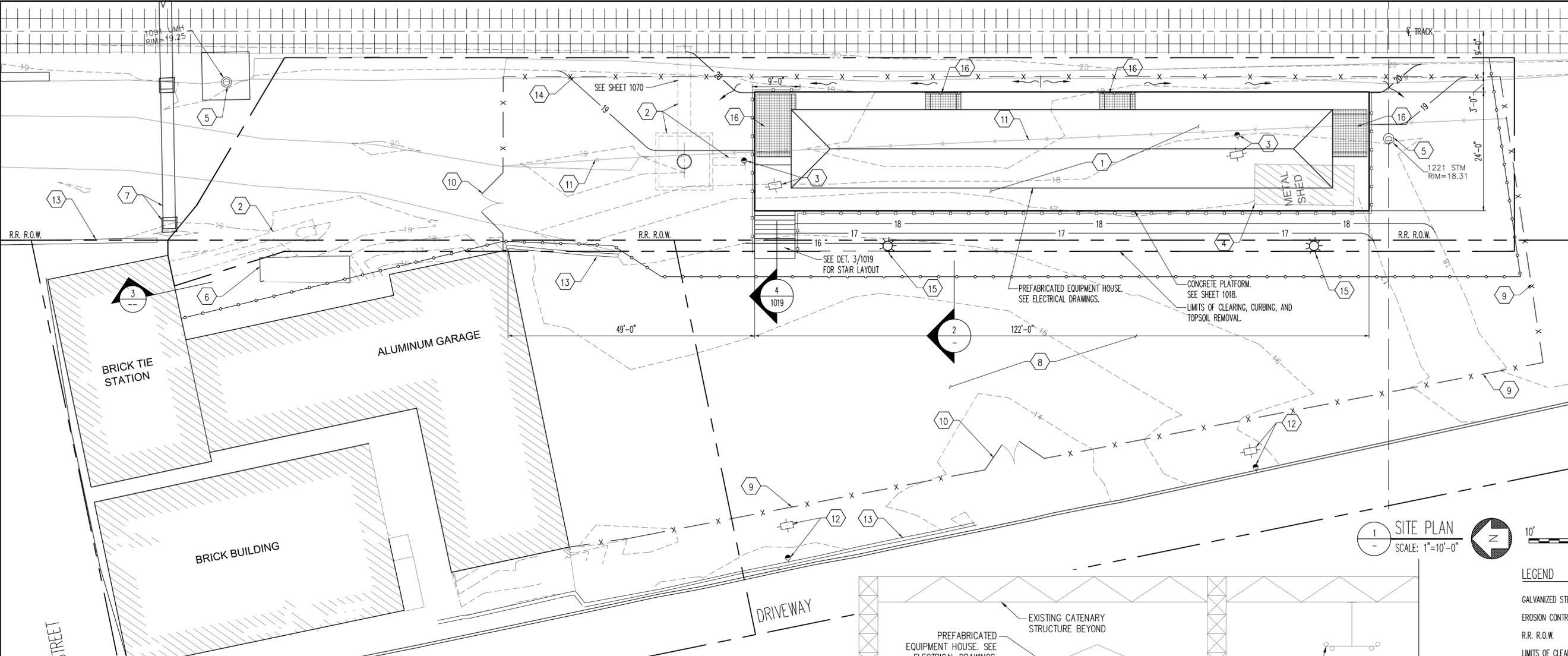
ENGINEERING DEPARTMENT  
547 W. JACKSON BOULEVARD  
CHICAGO, ILLINOIS 60661

LOCATION NAME: **95TH STREET SUBSTATION**

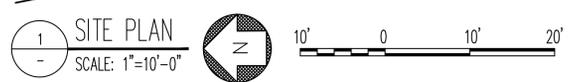
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CAD FILE NUMBER: SS-11.9-1001G.DGN

SCALE: AS SHOWN	DISTRICT: MED
PROJECT NO.	SHEET NO.
GW4254-57102002	<b>SS-11.9-1001G</b>
MILE POST NO. 11.9	



**CHAIN LINK FENCE:**  
 CHAIN LINK FENCE AND GATES SHALL BE DESIGNED AND INSTALLED AS SPECIFIED IN SPECIFICATION SECTION 02443. REFER TO SHEET SS-17.5-1020B AND SS-17.5-1020C FOR TYPICAL FENCE AND SWING GATE DETAILS. REFER TO SHEET SS-11.9-1019 FOR OPTIONAL SLIDING GATE DETAILS.



**LEGEND**

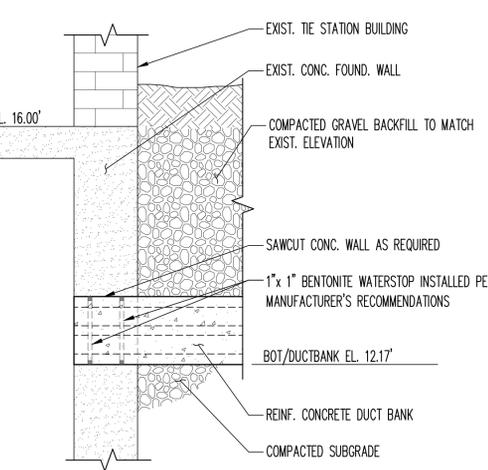
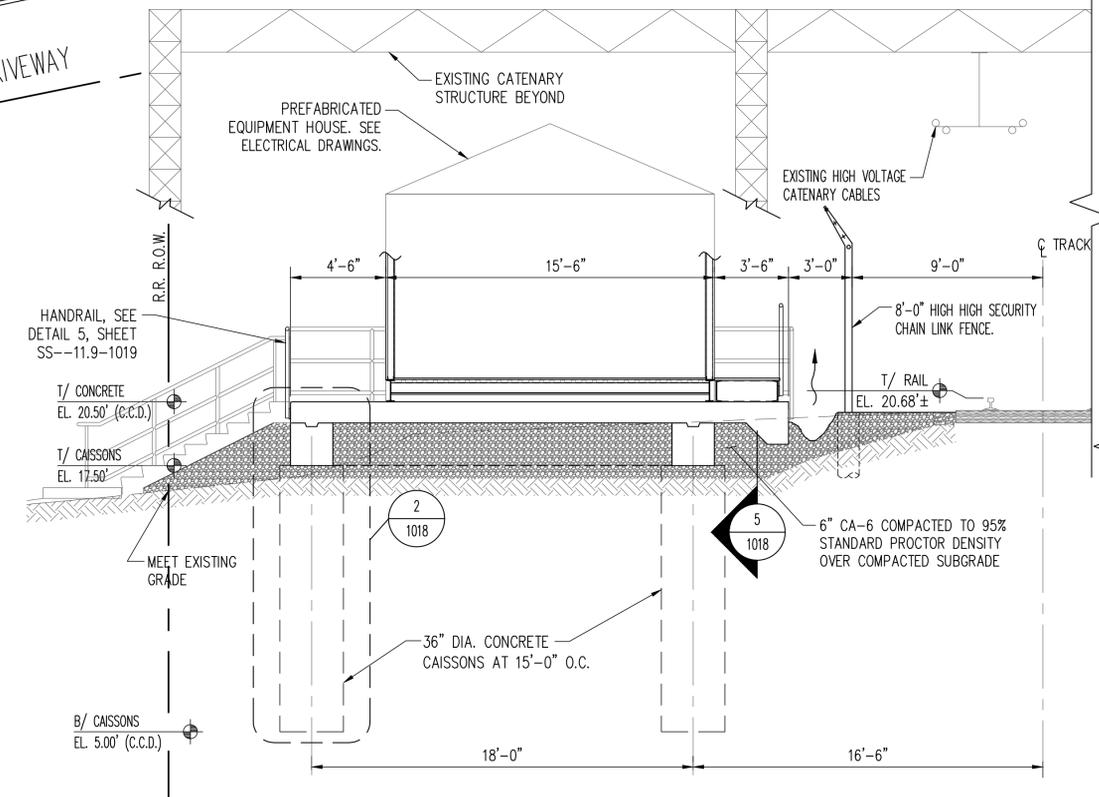
GALVANIZED STEEL HANDRAIL	
EROSION CONTROL SILT FENCE	
R.R. R.O.W.	
LIMITS OF CLEARING, CURBING AND TOPSOIL REMOVAL	
6" COMP. CA-6 AGGREGATE OVER WEED BARRIER	
EXISTING GRADE TO REMAIN	

**SYMBOLS**

	EXISTING GRADE CONTOUR
	FINISHED GRADE CONTOUR
	DIRECTION OF DRAINAGE FLOW
	FINISHED GRADE SPOT ELEVATION

- KEY NOTES**
- 1 REMOVE TREES, SHRUBS, TOPSOIL, FENCE WITHIN THE REMOVAL AREA.
  - 2 ELECTRICAL MANHOLE AND DUCTBANK. SEE SHEETS 1070, 1071.
  - 3 RELOCATE EXISTING LIGHT POLE AND REROUTE ASSOCIATED OVERHEAD POWER LINES AND GUY WIRES. RELOCATE BENCHMARKS PRIOR TO POLE RELOCATION.
  - 4 EXISTING METAL SHED (TO BE RELOCATED BY METRA FORCES)
  - 5 EXISTING STORM SEWER AND CATCH BASIN TO REMAIN. PROTECT DURING CONSTRUCTION
  - 6 CONCRETE FOOTING TO REMAIN
  - 7 EXISTING CATENARY STRUCTURE AND FOUNDATIONS TO BE PROTECTED DURING CONSTRUCTION
  - 8 EXISTING PARKING LOT. RESTORE TO ORIGINAL CONDITION.
  - 9 EXISTING CHAIN LINK FENCE TO BE REMOVED AND REPLACED WITH NEW SECURITY FENCE AT THE SAME LOCATION
  - 10 EXISTING CHAIN LINK GATE TO BE REMOVED AND REPLACED WITH NEW 12-FT WIDE BY 8-FT HIGH SECURITY GATE
  - 11 EXISTING CHAIN LINK FENCE TO BE REMOVED
  - 12 EXISTING LIGHT POLE AND GUY WIRE TO REMAIN
  - 13 EXISTING TIMBER TIE RETAINING WALL TO REMAIN
  - 14 NEW 8-FT HIGH SECURITY FENCE
  - 15 RELOCATED LIGHT POLE
  - 16 DOOR LANDING, SEE DETAIL 5/1018

- DEMOLITION/REMOVAL NOTES:**
1. REMOVE EXISTING VEGETATION, TREES, STUMPS AND TOPSOIL WITHIN THE AREA SHOWN ON PLAN. REGRADE AFTER CAISSON INSTALLATION, INSTALL VEGETATION BARRIER FABRIC AND 6" TH. CA-6 ON TOP OF FABRIC.
  2. EXACT EXTENT OF REMOVAL MAY NOT BE FULLY INDICATED BY THE DRAWINGS. THE CONTRACTOR SHALL CONFIRM WITH METRA AND DETERMINE THE NATURE AND EXTENT OF REMOVAL THAT WILL BE REQUIRED BY COMPARING THE DRAWINGS WITH THE EXISTING FIELD CONDITIONS. IT IS EXPRESSLY UNDERSTOOD THAT THIS CONTRACT INCLUDES ALL WORK OF A REMOVAL NATURE THAT MAY BE REQUIRED OR NECESSARY FOR A FULL AND COMPLETE EXECUTION OF THE WORK, WHETHER PARTICULARLY REFERRED TO HEREIN OR NOT.



**2 SECTION**  
 SCALE: 1/4"=1'-0"

**3 WALL PENETRATION DETAIL**  
 SCALE: N.T.S.

PRINTED ON: 07/28/2017

REV	DATE	BY	APP	DESCRIPTION	REV	DATE	BY	APP	DESCRIPTION
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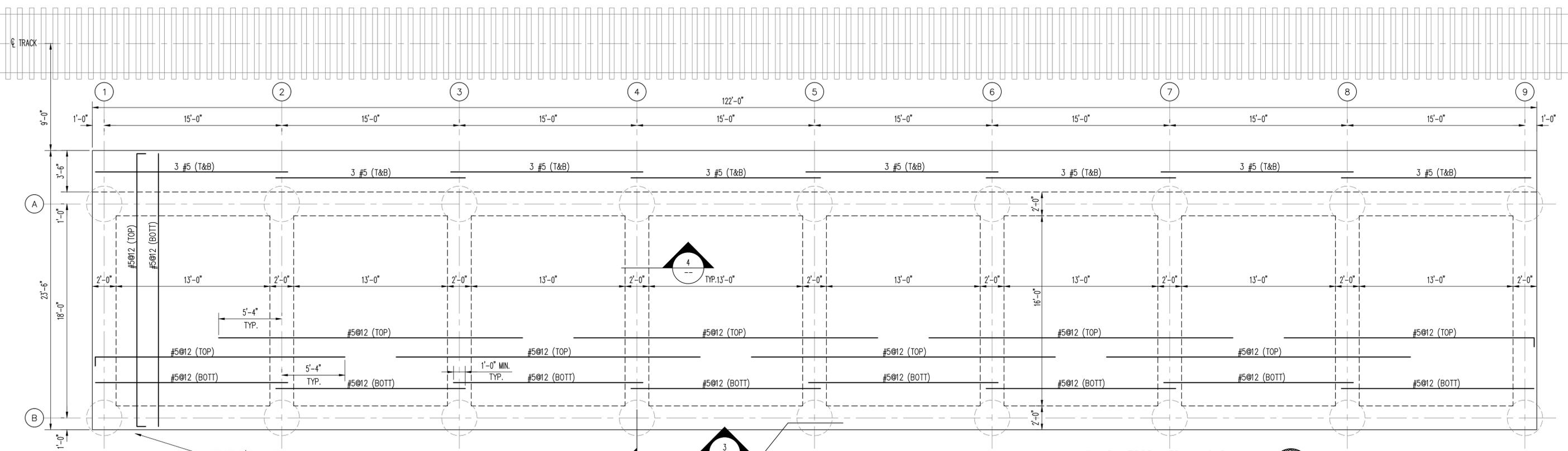
**CONSULTANT**  
**KMI**  
 Kaltsouni Mehdi, Inc.  
 ARCHITECTS ■ ENGINEERS  
 223 W. Jackson Blvd., Suite 1010 Chicago, IL 60606  
 Tel.: (312)987-9800 Fax.: (312)987-9892

DESIGNED: EG  
 DRAWN: DC  
 CHECKED: MK  
 METRA P.M.: R. CERANT  
 DATE: JUNE 12, 2017

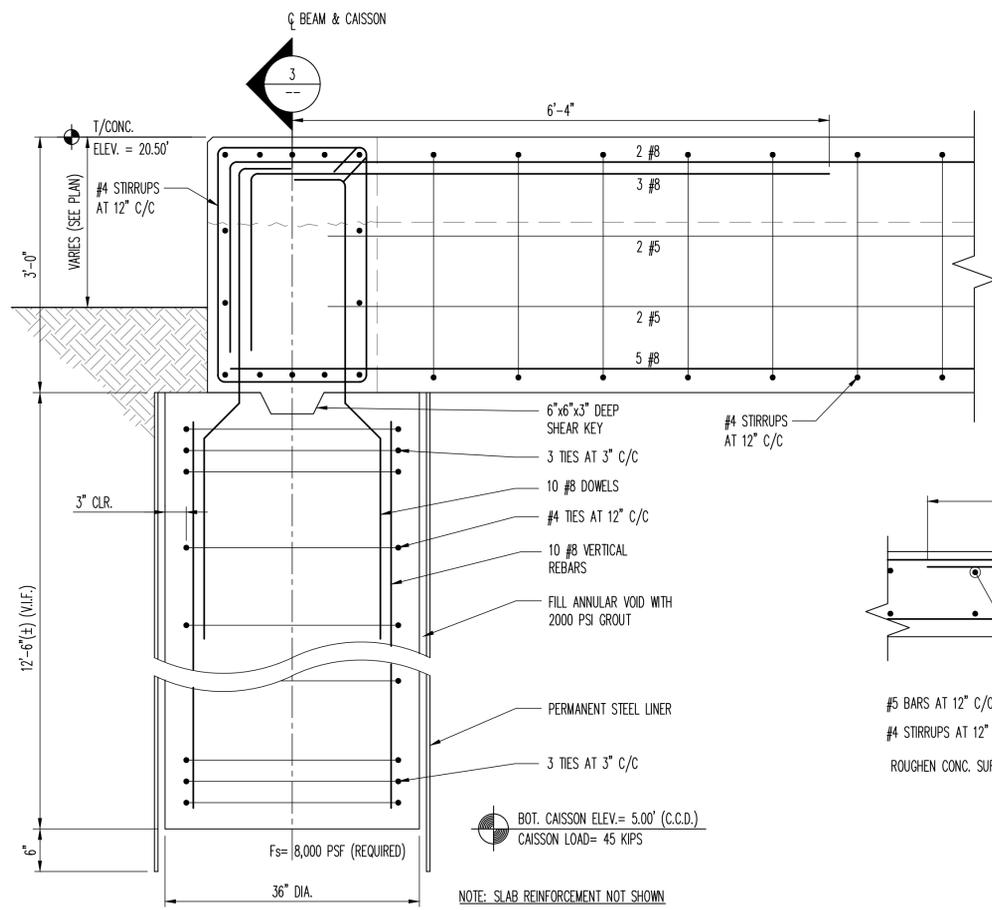


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 TITLE: **SITE PLAN**

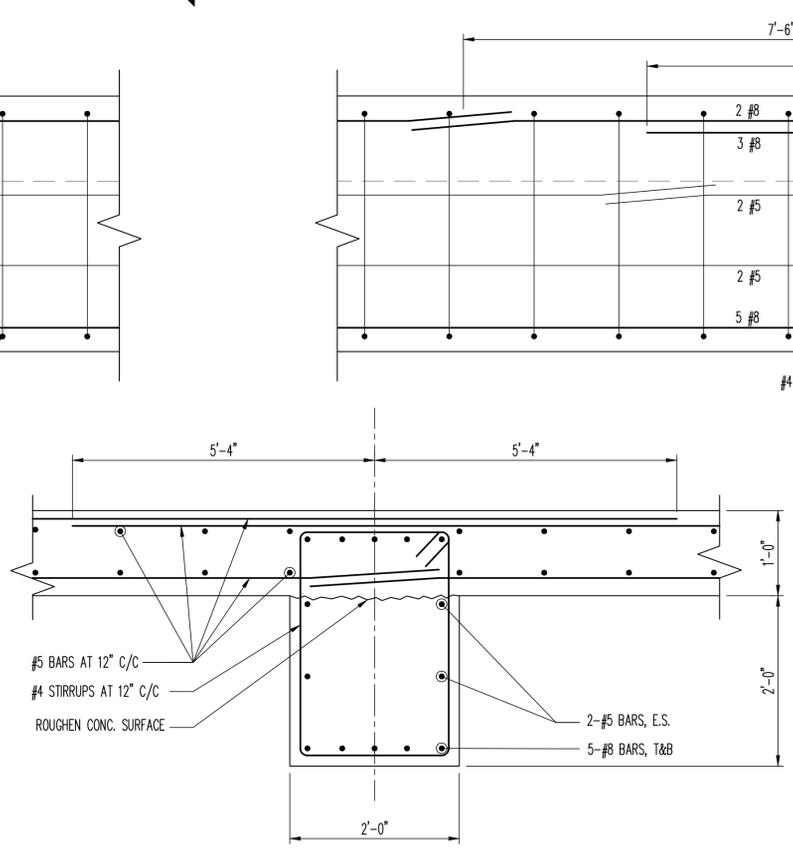
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 SCALE: AS SHOWN  
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 DISTRICT: MED  
 SHEET NO. **SS-11.9-1017**



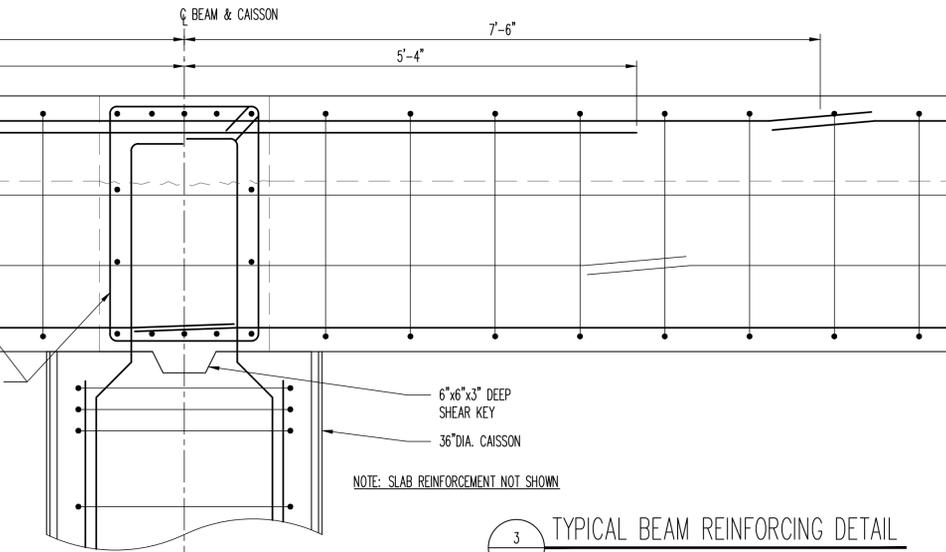
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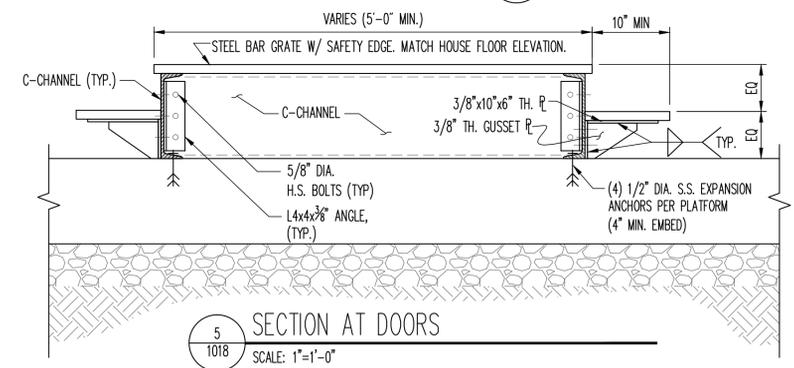
2 TYPICAL CAISSON/B EAM REINFORCING DETAIL  
SCALE: 1"=1'-0"



4 TYPICAL BEAM/SLAB REINFORCING DETAIL  
SCALE: 1"=1'-0"



3 TYPICAL BEAM REINFORCING DETAIL  
SCALE: 1"=1'-0"



5 SECTION AT DOORS  
SCALE: 1"=1'-0"

REV	DATE	BY	APP	DESCRIPTION
0	07-28-2017	OT	EG	ISSUED FOR BID

CONSULTANT SEAL & SIGNATURE  
  
 CONSULTANT  
**KMI**  
 Kaltsouni Mehdi, Inc.  
 ARCHITECTS ■ ENGINEERS  
 223 W. Jackson Blvd., Suite 1010 Chicago, IL 60606  
 Tel.: (312)987-9800 Fax.: (312)987-9892

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 METRA P.M.: R. CERANT  
 DATE: JUNE 12, 2017

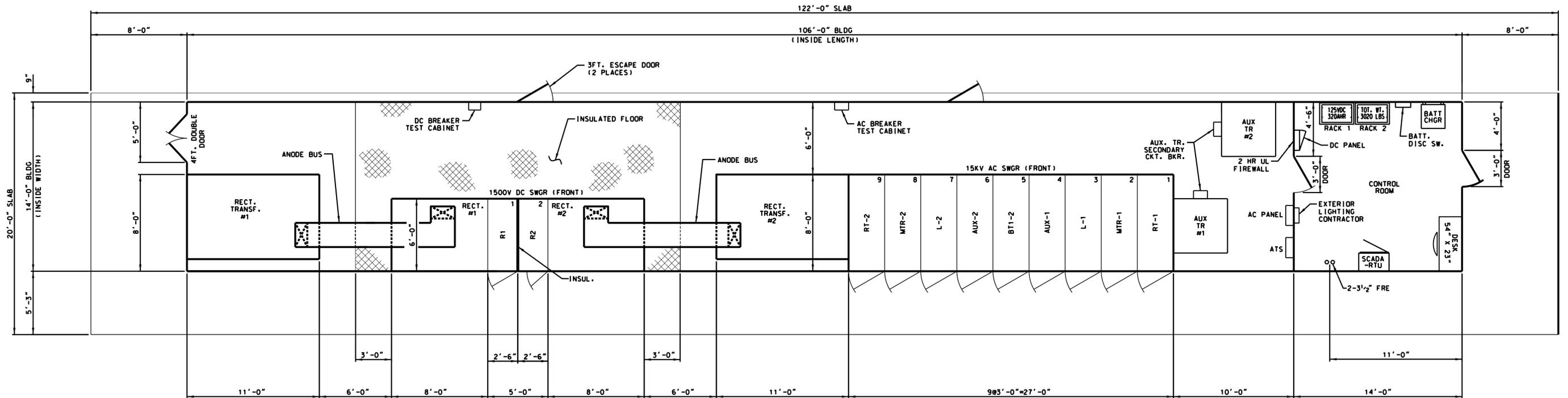


LOCATION NAME: **95TH STREET SUBSTATION**  
 TITLE: **FRAMING PLAN AND DETAILS**

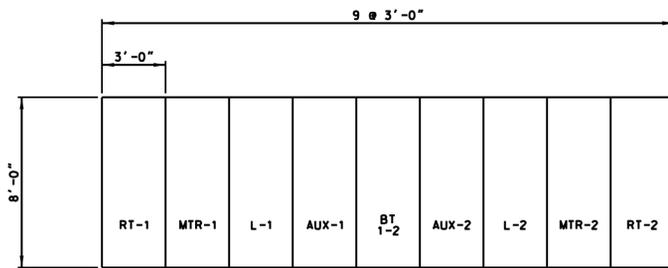
CAD FILE NUMBER: SS-11.9-1018.DGN  
 SCALE: AS SHOWN  
 PROJECT NO. GW4254-57102002  
 MILE POST NO. 11.9  
 DISTRICT: MED  
 SHEET NO. **SS-11.9-1018**

PRINTED ON: 07/28/2017





PLAN  
SCALE: 1/4" = 1'-0" N



15kV AC SWITCHGEAR ELEVATION  
SCALE: 1/4" = 1'-0"

NOTES:

1. SUBSTATION BUILDING ENCLOSURE SHALL BE MAXIMUM 14 FEET HIGH.
2. FOR UNDERGROUND DUCTBANKS SEE DWG. SS-11.9-1071.
3. THE REAR OF TRANSFORMER AND RECTIFIER SHALL BE PROVIDED WITH REMOVABLE PANELS.

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REV	DATE	BY	APP	DESCRIPTION	REV	DATE	BY	APP	DESCRIPTION
0	07-28-2017	HS	HS	ISSUED FOR BID					

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CONSULTANT



DESIGNED: HS  
DRAWN: JC  
CHECKED: FM  
METRA P.M.: R. CERANT  
DATE: JUNE 12, 2017



LOCATION NAME:  
95TH. STREET SUBSTATION

TITLE:

SUBSTATION EQUIPMENT LAYOUT PLAN

CAD FILE NUMBER: SS-11.9-1050.DGN

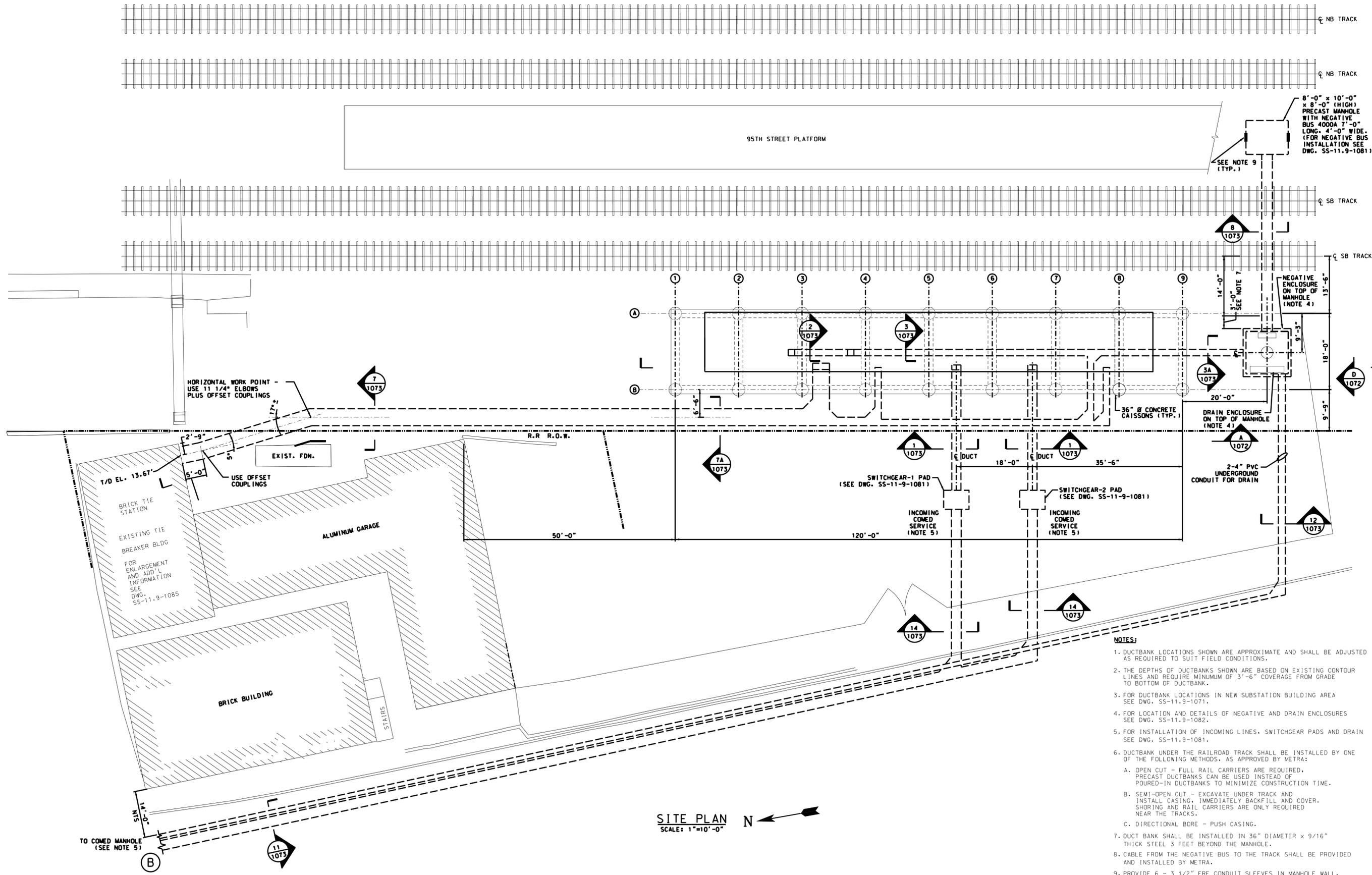
SCALE:  
1/4" = 1'-0"

DISTRICT:  
MED

PROJECT NO.  
GW4254-57102002

MILE POST NO.  
11.9

SHEET NO.  
SS-11.9-1050



- NOTES:**
1. DUCTBANK LOCATIONS SHOWN ARE APPROXIMATE AND SHALL BE ADJUSTED AS REQUIRED TO SUIT FIELD CONDITIONS.
  2. THE DEPTHS OF DUCTBANKS SHOWN ARE BASED ON EXISTING CONTOUR LINES AND REQUIRE MINIMUM OF 3'-6" COVERAGE FROM GRADE TO BOTTOM OF DUCTBANK.
  3. FOR DUCTBANK LOCATIONS IN NEW SUBSTATION BUILDING AREA SEE DWG. SS-11.9-1071.
  4. FOR LOCATION AND DETAILS OF NEGATIVE AND DRAIN ENCLOSURES SEE DWG. SS-11.9-1082.
  5. FOR INSTALLATION OF INCOMING LINES, SWITCHGEAR PADS AND DRAIN SEE DWG. SS-11.9-1081.
  6. DUCTBANK UNDER THE RAILROAD TRACK SHALL BE INSTALLED BY ONE OF THE FOLLOWING METHODS, AS APPROVED BY METRA:
    - A. OPEN CUT - FULL RAIL CARRIERS ARE REQUIRED. PRECAST DUCTBANKS CAN BE USED INSTEAD OF POURED-IN DUCTBANKS TO MINIMIZE CONSTRUCTION TIME.
    - B. SEMI-OPEN CUT - EXCAVATE UNDER TRACK AND INSTALL CASING. IMMEDIATELY BACKFILL AND COVER. SHORING AND RAIL CARRIERS ARE ONLY REQUIRED NEAR THE TRACKS.
    - C. DIRECTIONAL BORE - PUSH CASING.
  7. DUCT BANK SHALL BE INSTALLED IN 36" DIAMETER x 9/16" THICK STEEL 3 FEET BEYOND THE MANHOLE.
  8. CABLE FROM THE NEGATIVE BUS TO THE TRACK SHALL BE PROVIDED AND INSTALLED BY METRA.
  9. PROVIDE 6 - 3 1/2" FRE CONDUIT SLEEVES IN MANHOLE WALL.

**SITE PLAN**  
SCALE: 1"=10'-0"

REV	DATE	BY	APP	DESCRIPTION	REV	DATE	BY	APP	DESCRIPTION
2	06-08-2018	JMC	HS	ISSUED FOR BID					
1	03-30-2018	JMC	HS	ISSUED FOR ADDENDUM 1					
0	12-19-2017	HS	HS	ISSUED FOR BID					

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Consulting Engineers  
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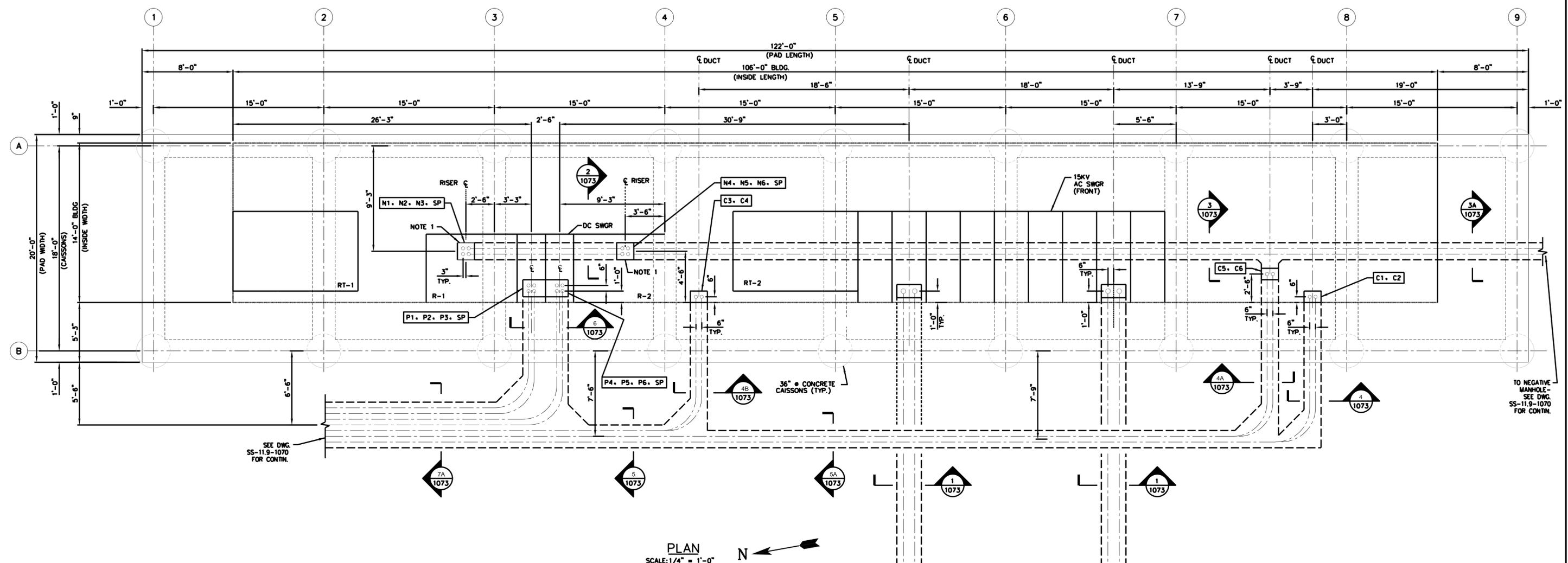
DESIGNED: HS
DRAWN: JMC
CHECKED: FM
METRA P.M.: R. CERANT
DATE: JUNE 12, 2017

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547 W. JACKSON BOULEVARD  
CHICAGO, ILLINOIS 60661

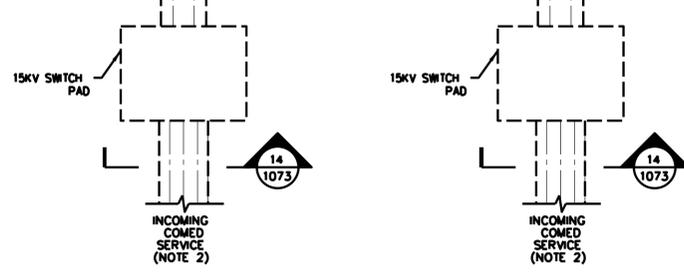
LOCATION NAME: <b>95TH STREET SUBSTATION</b>
TITLE: <b>ELECTRICAL SITE PLAN</b>

CAD FILE NUMBER: SS-11.9-1070.DGN	DISTRICT: MED
SCALE: 1" = 10'-0"	SHEET NO. SS-11.9-1070
PROJECT NO. GW4254-57102002	
MILE POST NO. 11.9	

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PLAN  
SCALE: 1/4" = 1'-0" N



- NOTES:**
1. LOCATE (4) 3 1/2" FRE CONDUITS IN AREA DESIGNATED FOR OUTGOING NEGATIVE FEEDERS - SEE RECTIFIER MFR'S. DWGS.
  2. FOR INSTALLATION OF INCOMING LINES AND SWITCHGEAR PADS SEE DWG. SS-11.9-1081
  3. THE CONTRACTOR SHALL SUBMIT FOR APPROVAL THE DUCTBANK LAYOUT AFTER THE EQUIPMENT MANUFACTURER'S DWGS ARE APPROVED. THE CONTRACTOR SHALL BE RESPONSIBLE FOR EXACT LOCATION OF CONDUIT RISER AT EACH PIECE OF EQUIPMENT.
  4. FOR UNDERGROUND CABLE TABULATION SEE DWG. SS-11.9-1073

TO NEGATIVE MANHOLE - SEE DWG. SS-11.9-1070 FOR CONTIN.

SEE DWG. SS-11.9-1070 FOR CONTIN.

REV	DATE	BY	APP	DESCRIPTION	REV	DATE	BY	APP	DESCRIPTION
2	06-08-2018	JMC	HS	ISSUED FOR BID					
1	03-30-2018	HS	HS	ISSUED FOR ADDENDUM 1					
0	12-19-2017	HS	HS	ISSUED FOR BID					

**KMI**  
Kaltsouni Mehdi, Inc.  
ARCHITECTS • ENGINEERS  
223 W. Jackson Blvd., Suite 1010 Chicago, IL 60606  
Tel.: (312)987-8800 Fax: (312)987-8892

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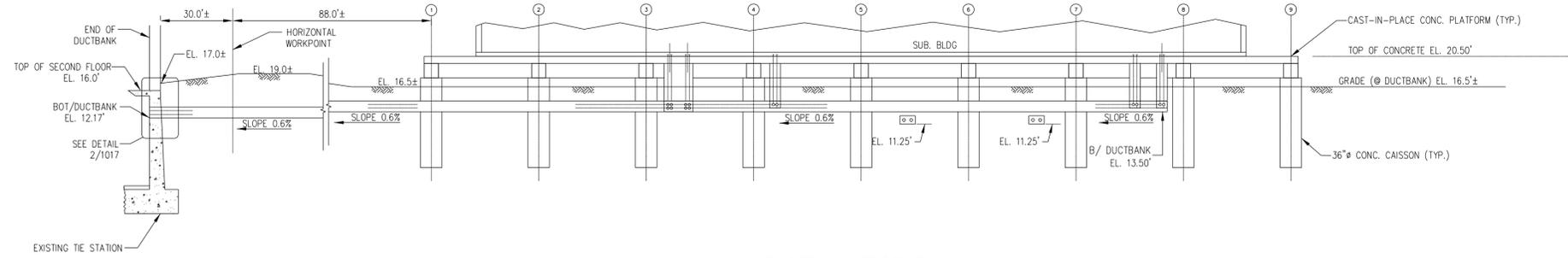
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CHECKED: FM
METRA P.M.: R. CERANT
DATE: JUNE 12, 2017

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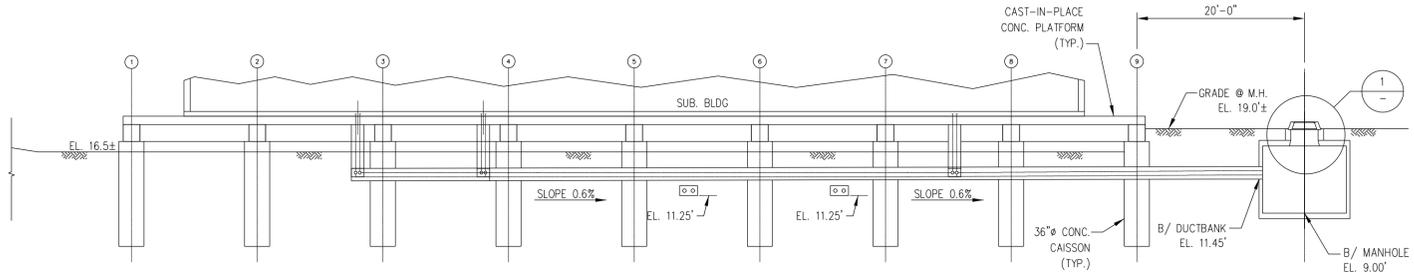
LOCATION NAME: <b>95TH STREET SUBSTATION</b>	TITLE: <b>DUCTBANK LAYOUT</b>
MILE POST NO. 11.9	

CAD FILE NUMBER: SS-11.9-1071.DGN	DISTRICT: MED
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PROJECT NO. GW4254-57102002	

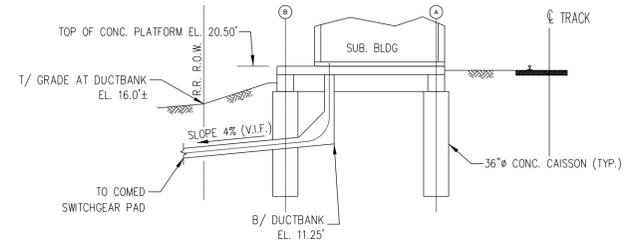
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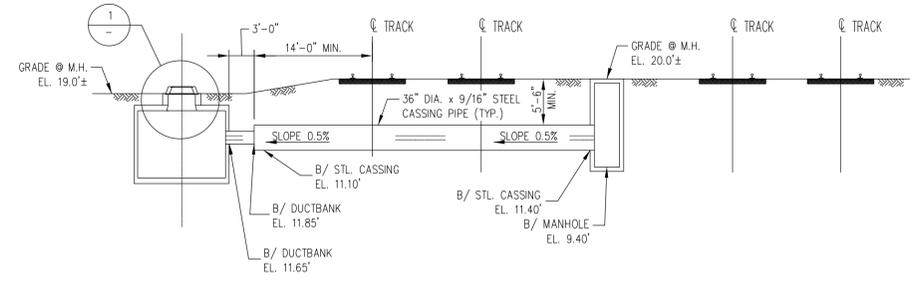
**A**  
1070  
DUCTBANK PROFILE  
SCALE: 1"=10'-0"



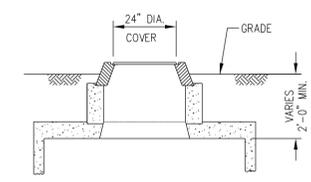
**B**  
1070  
DUCTBANK PROFILE  
SCALE: 1"=10'-0"



**C**  
1070  
AC DUCTBANK PROFILE  
SCALE: 1"=10'-0"



**D**  
1070  
DUCTBANK PROFILE  
SCALE: 1"=10'-0"



**1**  
DETAIL  
SCALE: N.T.S.

- NOTES:**
- DUCTBANK LOCATIONS SHOWN ARE APPROXIMATE AND SHALL BE ADJUSTED AS REQUIRED TO SUIT FIELD CONDITIONS.
  - THE DEPTHS OF DUCTBANKS SHOWN ARE BASED ON EXISTING CONTOUR LINES AND REQUIRE MINIMUM OF 3'-6" COVERAGE FROM GRADE TO BOTTOM OF DUCTBANK.
  - FOR DUCTBANK LOCATIONS IN NEW SUBSTATION BUILDING AREA SEE DWG. SS-11.9-1071.

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1	03-30-2018	HS	HS	ISSUED FOR ADDENDUM 1					
0	07-28-2017	HS	HS	ISSUED FOR BID					

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Kaltsouni Mehdi, Inc.  
ARCHITECTS • ENGINEERS  
223 W. Jackson Blvd., Suite 1010 Chicago, IL 60606  
Tel.: (312)987-8800 Fax: (312)987-8892

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CONSULTANT

**LDP** | A Company of **Gannett Fleming**  
Consulting Engineers  
20 N. Wacker Dr. Ste. 1500 Chicago IL 60606

DESIGNED: HS  
DRAWN: JC  
CHECKED: FM  
METRA P.M.: R. CERANT  
DATE: JUNE 12, 2017

**Metra**  
ENGINEERING DEPARTMENT  
547 W. JACKSON BOULEVARD  
CHICAGO, ILLINOIS 60661

LOCATION NAME:  
**95TH STREET SUBSTATION**

TITLE:  
**DUCTBANK PROFILES**

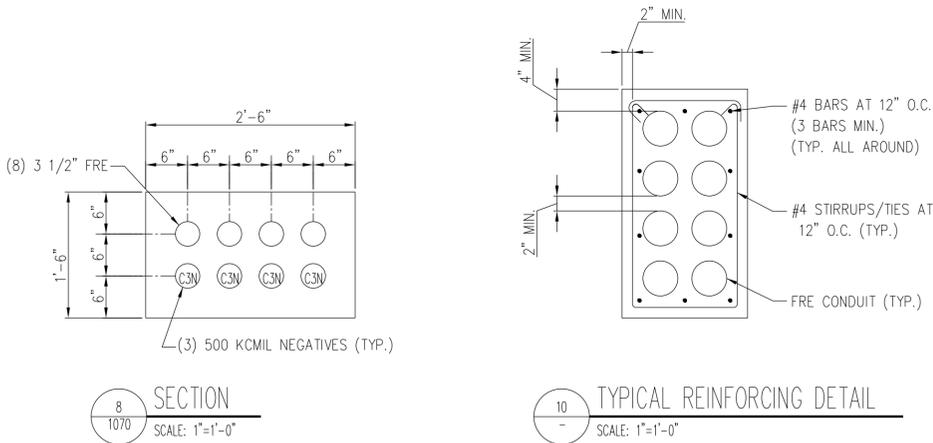
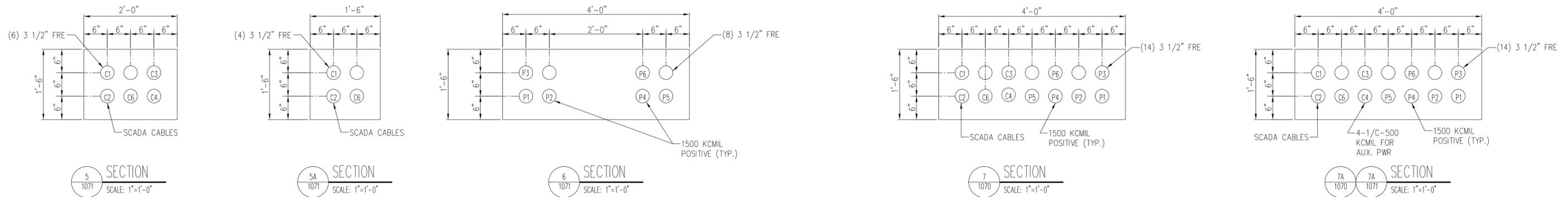
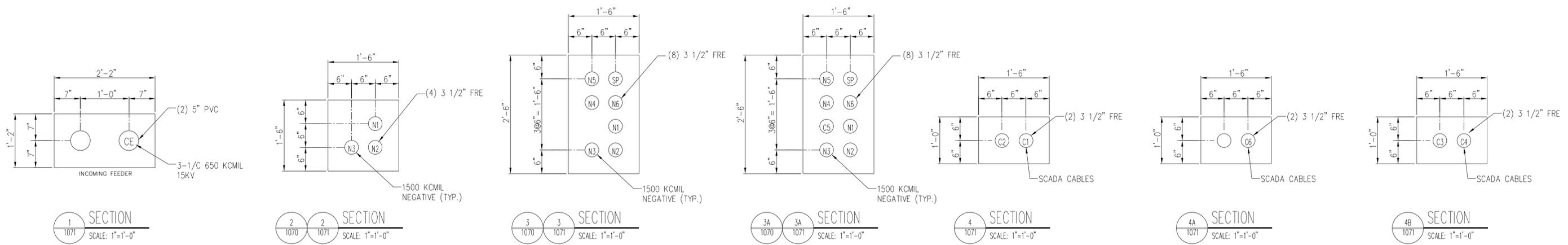
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SCALE: AS NOTED  
DISTRICT: MED

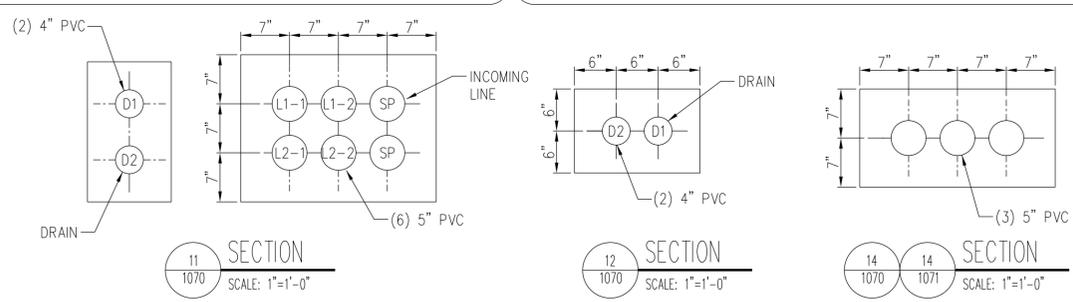
PROJECT NO. GW4254-57102002  
SHEET NO. **SS-11.9-1072**

MILE POST NO. 11.9

PRINTED ON: \$DATES



INSTALL DUCTBANKS PER COMED STANDARDS C4050, C4090 AND C4171



CABLE TABLE		
CABLE I.D.	FROM	TO
CE	COMED SWITCHGEAR	15KV AC SWITCHGEAR CUBICLE 2 OR 8
P1, P2, ETC.	CATHODE BREAKERS IN DC SWITCHGEAR	DC SWITCHGEAR IN TIE STATION
N1, N2, ETC.	RECTIFIER #1 OR #2	NEGATIVE ENCLOSURE ON TOP OF NEGATIVE MANHOLE
C3N	NEGATIVE ENCLOSURE ON TOP OF NEGATIVE MANHOLE	TRACK-RUNNING RAIL
ML	15KV AC SWITCHGEAR CUBICLE 1 OR 9 (TOP)	METRA LINE (FUTURE) 12KV
C1, C2	CONTROL ROOM	SCADA IN TIE STATION
C3, C4	CATHODE BKR IN DC SWGR	SWITCH ENCLOSURES
C5	AC PANEL	NEGATIVE/DRAINAGE PANEL
C6	AC PANEL	AUX PWR TO TIE BKR STA

**NOTES:**  
 1. ALL DUCT BANKS INCLUDING COMED INCOMING LINES AND DRAIN SHALL BE REINFORCED.

REV	DATE	BY	APP	DESCRIPTION	REV	DATE	BY	APP	DESCRIPTION
2	06-08-2018	JMC	HS	ISSUED FOR BID					
1	03-30-2018	HS	HS	ISSUED FOR ADDENDUM 1					
0	12-19-2017	HS	HS	ISSUED FOR BID					

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 Tel.: (312)987-8800 Fax: (312)987-8892

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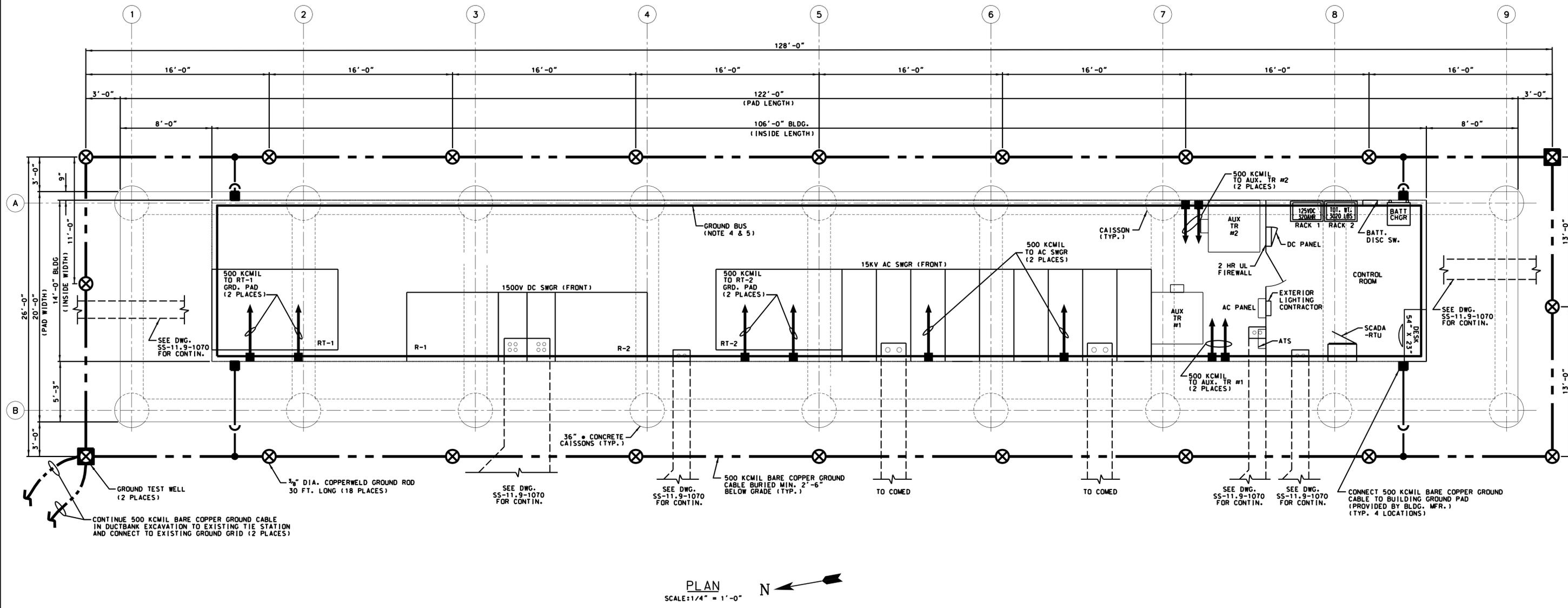
CONSULTANT

DESIGNED: HS  
 DRAWN: JC  
 CHECKED: FM  
 METRA P.M.: R. CERANT  
 DATE: JUNE 12, 2017

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 547 W. JACKSON BOULEVARD  
 CHICAGO, ILLINOIS 60661

LOCATION NAME:  
**95TH STREET SUBSTATION**  
 TITLE:  
**DUCTBANK DETAILS**

CAD FILE NUMBER: SS-11.9-1073.DGN  
 SCALE: 1"=1'-0"  
 DISTRICT: MED  
 PROJECT NO. GW4254-57102002  
 SHEET NO. **SS-11.9-1073**  
 MILE POST NO. 11.9



PLAN  
SCALE: 1/4" = 1'-0" N

- LEGEND:**
- GROUND CABLE BURIED IN EARTH OR EMBEDDED IN CONCRETE
  - GROUND CADWELD CONNECTION
  - GROUND BOLTED CONNECTION
  - GROUND CABLE CHANGE OF ELEVATION
  - GROUND ROD  
3/4" DIA. 5' LONG COPPERWELD GROUND RODS, MIN. 30 FT. TOTAL LENGTH (6 SECTIONS)
  - GROUND TEST WELL  
3/4" DIA. 5' LONG COPPERWELD GROUND RODS, MIN. 30 FT. TOTAL LENGTH (6 SECTIONS)

- NOTES:**
1. BARE COPPER GROUND CABLE SHALL BE BURIED MINIMUM 2'-6" BELOW GRADE.
  2. ALL GROUNDING CONNECTIONS BELOW GRADE SHALL BE MADE USING CADWELD PROCESS. ONLY INSIDE TEST WELL CLAMP CONNECTIONS SHALL BE USED.
  3. GROUND ROD LOCATIONS SHOWN ARE APPROXIMATE. CONTRACTOR MAY RELOCATE RODS AS REQUIRED TO CLEAR FIELD OBSTRUCTIONS.
  4. 1/2" x 2" COPPER GROUND BUS SHALL BE INSTALLED AROUND THE ENTIRE BUILDING ON THE INSIDE FACE OF BUILDING WALL, AND SHALL BE CONNECTED TO GROUND PADS OF THE BUILDING AT FOUR LOCATIONS.
  5. ALL SUBSTATION EQUIPMENT REQUIRING GROUNDING SHALL BE CONNECTED TO SUBSTATION GROUND BUS PER NATIONAL ELECTRICAL CODE.
  6. ALL GROUNDING RISERS ABOVE GRADE FOR CONNECTION TO THE BUILDING GROUND PADS SHALL BE INSTALLED IN THE RIGID STEEL CONDUIT SUPPORTED ALONG THE CAISSONS.

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0	07-28-2017	HS	HS	ISSUED FOR BID					



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**Gannett Fleming**  
 Consulting Engineers  
 20 N. Wacker Dr. Ste. 1500 Chicago IL 60606

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 DATE: JUNE 12, 2017

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 CHICAGO, ILLINOIS 60661

LOCATION NAME:  
**95TH. STREET SUBSTATION**  
 TITLE:  
**SUBSTATION GROUNDING LAYOUT**

CAD FILE NUMBER: SS-11.9-1075.DGN  
 SCALE: 1/4" = 1'-0"  
 PROJECT NO. GW4254-57102002  
 MILE POST NO. 11.9  
 DISTRICT: MED  
 SHEET NO. SS-11.9-1075

SYMBOLS			GROUNDING NOTES	GENERAL NOTES
<p><b>GENERAL</b></p>  POWER TRANSFORMER  POTENTIAL TRANSFORMER  CURRENT TRANSFORMER  AIR CIRCUIT BREAKER  DRAWOUT TYPE  FUSE  RESISTOR  SHUNT  STATION CLASS ARRESTER  DISTRIBUTION CLASS ARRESTER  CAPACITOR FIXED  BATTERY  RECTIFIER  DISCONNECT SWITCH  AUTOMATIC TRANSFER SWITCH	<p><b>GENERAL CONT'D</b></p>  MAGNETIC OVERLOAD DEVICE  THERMAL OVERLOAD DEVICE  ELECTRICAL EQUIPMENT, SUCH AS CONTROL PANELS, PULLBOXES, ETC.  JUNCTION BOX (ALSO IDENTIFIED AS J.B. OR JCT. BOX)  POWER OUTLET  CONDUIT EMBEDDED IN CONCRETE OR BURIED IN EARTH.  CONDUIT EXPOSED  CONDUIT TURNING UP OR TOWARD OBSERVER  CONDUIT TURNING DOWN OR AWAY FROM OBSERVER  FLEXIBLE ELECTRICAL CONDUIT <p><b>METERING/INDICATING DEVICES</b></p>  AMMETER  VOLTMETER  AMMETER SWITCH  VOLTMETER SWITCH  INDICATING LIGHT AIL-AMBER BIL-BLUE GIL-GREEN RIL-RED WIL-WHITE	<p><b>GROUNDING</b></p>  GROUND CABLE BURIED IN EARTH OR EMBEDDED IN CONCRETE  GROUND CADWELD CONNECTION  GROUND BOLTED CONNECTION  GROUND CABLE CHANGE OF ELEVATION  GROUND ROD $\frac{3}{4}$ " DIA. 5' LONG COPPERWELD GROUND RODS, MIN. 30 FT. TOTAL LENGTH (6 SECTIONS)  GROUND TEST WELL $\frac{3}{4}$ " DIA. 5' LONG COPPERWELD GROUND RODS, MIN. 30 FT. TOTAL LENGTH (6 SECTIONS)  EXPOSED COPEER GROUND BAR BUS UNLESS OTHERWISE NOTED	<ol style="list-style-type: none"> <li>GROUND CABLE RUNS ARE SHOWN DIAGRAMMATICALLY. EXACT RUNS SHALL BE DETERMINED IN FIELD TO SUIT CONDITIONS.</li> <li>ALL OUTDOOR UNDERGROUND CABLE SHALL BE 500KCMIL BARE COPPER, UNLESS NOTED OTHERWISE.</li> <li>UNDERGROUND GRID TO BE RUN MINIMUM 2'-6" BELOW GRADE AND SHALL BE INSTALLED WITH SUFFICIENT SLACK TO PREVENT DAMAGE DUE TO GROUND FAULTS AND/OR EARTH SETTLEMENT.</li> <li>AT POINTS OF CROSSING, UNDERGROUND CABLE SHALL BE RUN ABOVE FOUNDATION FOOTINGS, EXISTING DUCTBANKS, SEWER LINES AND OTHER BURIED UTILITIES.</li> <li>GROUND WELLS AND RODS SHALL BE INSTALLED AT APPROXIMATE LOCATIONS SHOWN BY DRIVING (NOT DRILLING OR JETTING) USING DRIVING STUD FITTINGS TO ABSORB IMPACT.</li> <li>ALL SURFACES TO BE GROUNDED SHALL BE THOROUGHLY CLEANED TO BARE METAL BEFORE MAKING CONNECTIONS.</li> <li>ALL GROUND GRID CONNECTIONS BELOW GRADE SHALL BE CADWELD TYPE &amp; SHALL BE MADE IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS. ALL CADWELD CONNECTIONS SHALL BE INSPECTED BEFORE BACKFILLING. IF PUFFY OR POROUS WELDS ARE FOUND, THEY SHALL BE CUT OUT AND THE CONNECTIONS REMADE.</li> <li>ALL GROUNDING CABLE CONNECTIONS TO EQUIPMENT ABOVE GRADE AND INSIDE THE SUBSTATION BUILDING SHALL BE THE BOLTED TYPE.</li> <li>BAR TO BAR AND LUG TO BAR BOLTED CONNECTIONS SHALL BE MADE WITH <math>\frac{1}{2}</math>" SILICON BRONZE BOLTS, NUTS AND WASHERS. ALL CONNECTIONS SHALL BE MADE ELECTRICALLY CLEAN. SILVER-PLATE ALL BAR AND LUG CONNECTIONS.</li> <li>ALL METAL CONDUITS, EQUIPMENT AND JUNCTION BOXES SHALL BE GROUNDED WITH MINIMUM #2 COPEER CABLE. COAT GROUND CABLE CONNECTIONS TO ALUMINUM TRAY WITH NO-OXIDE COMPOUND.</li> <li>AFTER THE ENTIRE GROUNDING SYSTEM HAS BEEN INSTALLED, INCLUDING RODS, THE SYSTEM SHALL BE TESTED TO MEET SPECIFICATION REQUIREMENTS.</li> </ol>	<ol style="list-style-type: none"> <li>ALL DISTANCES OF EXISTING STRUCTURES SHOWN ON THE DRAWINGS ARE APPROXIMATE. THE CONTRACTOR SHALL VERIFY DIMENSIONS BEFORE PROCEEDING WITH THE INSTALLATIONS.</li> <li>CONDUIT USED SHALL BE AS FOLLOWS:             <ol style="list-style-type: none"> <li>EXPOSED CONDUIT INSIDE SUBSTATION BUILDING SHALL BE IMC (INTERMEDIATE METAL CONDUIT), UNLESS NOTED OTHERWISE.</li> <li>OUTDOOR CONDUIT FOR GENERAL USE SHALL BE HOT-DIP GALVANIZED RIGID STEEL.</li> <li>CONDUIT FOR TRACTION POWER POSITIVE AND NEGATIVE FEEDERS, WHETHER EXPOSED OR CONCRETE ENCASED, SHALL BE FRE (FIBERGLASS REINFORCED EPOXY) AS SHOWN ON PLANS.</li> <li>CONCRETE ENCASED CONDUIT FOR INCOMING 12KV COMED FEEDERS SHALL BE FRE. (FIBERGLASS REINFORCED EPOXY)</li> <li>WHEN CONDUITS OF VARIOUS SERVICES ARE ENCASED IN COMMON CONCRETE DUCTBANK, THE CONDUIT TYPE IS SPECIFIED ON PLANS.</li> <li>DIRECT BURIED UNDERGROUND CONDUIT SHALL BE HEAVY WALL PVC, TYPE DB-120, MANUFACTURED PER NEMA-6 AND 8.</li> </ol> </li> <li>EXPOSED CONDUIT SHALL BE SUPPORTED AT APPROX. 6'-0" INTERVALS (MAXIMUM INTERVAL NOT TO EXCEED 10'-0").</li> <li>RADIUS OF CURVATURE TO THE INSIDE EDGE OF FIELD BENDS SHALL BE A MINIMUM OF EIGHT-TIMES THE TRADE SIZE OF CONDUIT, UNLESS NOTED OTHERWISE.</li> <li>EXPOSED CONDUIT SHALL, IN GENERAL, BE RUN PARALLEL TO OR AT RIGHT ANGLES TO WALLS AND STRUCTURAL MEMBERS.</li> <li>CONDUITS INSTALLED PARALLEL TO HOT SURFACES SHALL BE RUN A MINIMUM OF 12 INCHES AWAY FROM SUCH SURFACES.</li> <li>AT EQUIPMENT ENCLOSURES, CONDUIT SHALL BE TERMINATED WITH 2-LOCKNUTS AND BUSHINGS OR INSULATED GROUNDING BUSHING INDOORS AND GASKETED CONDUIT HUB PLATES OUTDOORS, EXCEPT WHERE ENCLOSURES ARE FURNISHED WITH INTEGRAL THREADED HUBS.</li> <li>CONDUIT TERMINATIONS AT MOTORS, ELECTRICAL INSTRUMENTS AND WHERE SPECIFIED SHALL BE LIQUIDTITE (SEALTITE TYPE "UA" OR EQUAL) AND SHALL BE INSTALLED WITH LIQUIDTITE CONNECTORS, WITH A MAXIMUM LENGTH OF TWO FEET.</li> <li>ALL INDOOR JCT. &amp; TERM. BOXES SHALL BE NEMA 12 TYPE, ALL OUTDOOR BOXES NEMA 4R TYPE, UNLESS OTHERWISE NOTED, AND SHALL BE LOCATED CLEAR OF INTERFERENCES FOR READY ACCESS.</li> <li>UNLESS SPECIFIED, JUNCTION BOXES SHALL BE SIZED BY THE CONTRACTOR WHEN TOTAL DEGREES OF CONDUIT BENDS EXCEED 270°, CONTRACTOR SHALL ADD AND LOCATE PULL BOX AS NEEDED.</li> <li>WHEREVER THE TERMS "DRAWING" OR "SHEET" ARE USED FOR REFERENCE ON A DRAWING, THE TWO TERMS SHOULD BE CONSIDERED SYNONYMOUS.</li> </ol>

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0	07-28-2017	HS	HS	ISSUED FOR BID
REV	DATE	BY	APP	DESCRIPTION

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CONSULTANT



DESIGNED: HS
DRAWN: JC
CHECKED: FM
METRA P.M.: R. CERANT
DATE: JUNE 12, 2017



ENGINEERING DEPARTMENT  
547 W. JACKSON BOULEVARD  
CHICAGO, ILLINOIS 60661

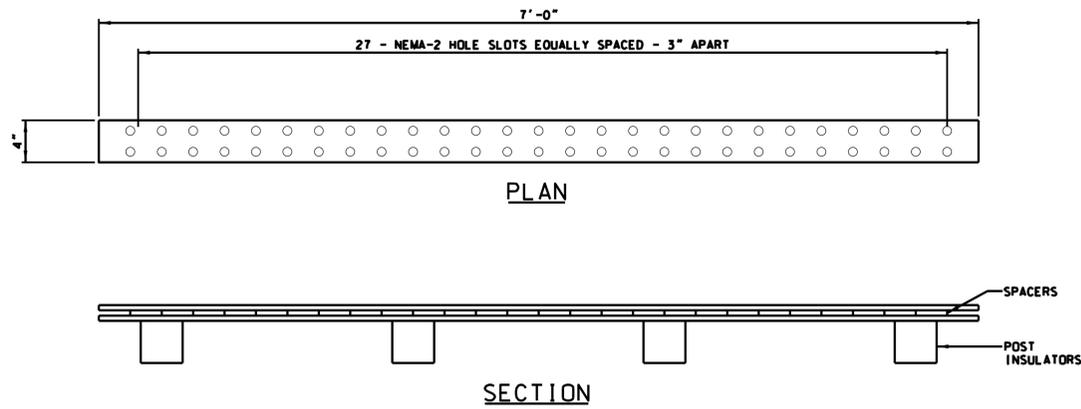
LOCATION NAME:  
**95TH. STREET SUBSTATION**

TITLE: <b>ELECTRICAL NOTES &amp; SYMBOLS</b>
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CAD FILE NUMBER: SS-11.9-1080.DGN

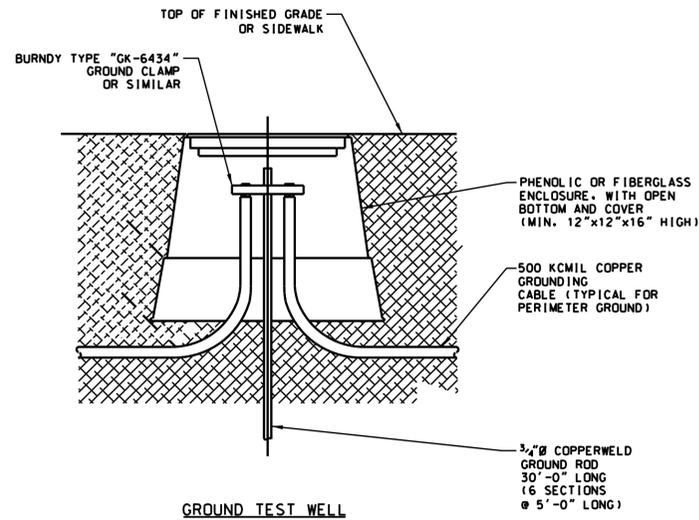
SCALE: NTS	DISTRICT: MED
PROJECT NO. GW4254-57102002	SHEET NO. <b>SS-11.9-1080</b>
MILE POST NO. 11.9	

INSTALLATION DETAIL OF NEGATIVE BUS INSIDE WAYSIDE MANHOLE.



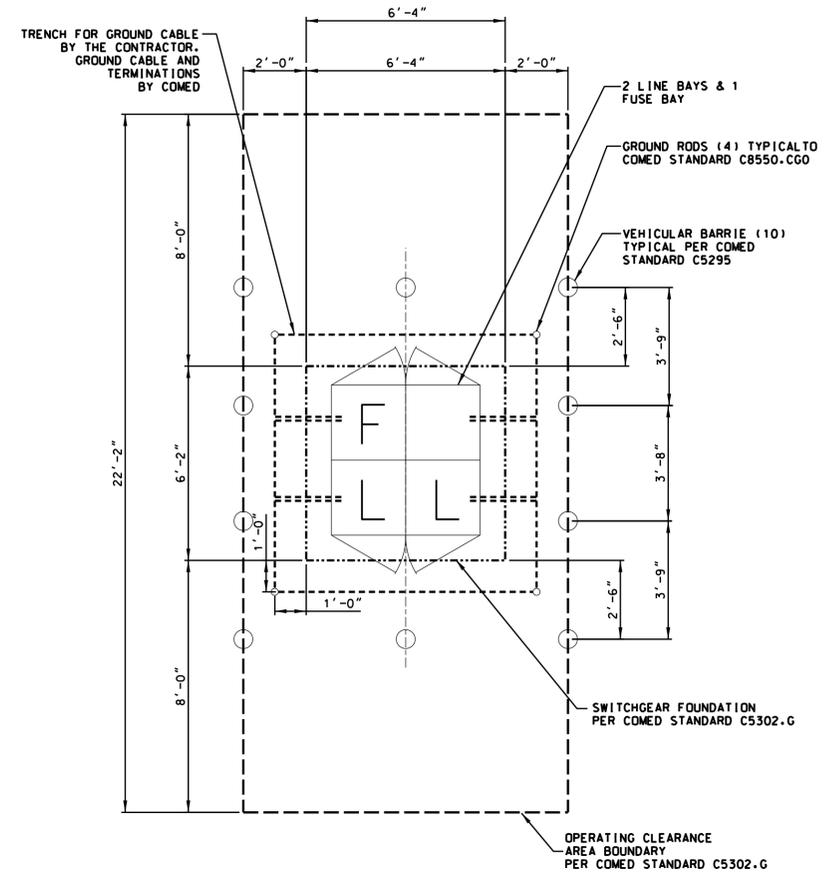
NOTES FOR INSTALLATION OF NEGATIVE BUS

1. INSTALL NEGATIVE BUS 12" BELOW MANHOLE CEILING
2. SILVER PLATED NEGATIVE COPPER BUS SHALL BE 7 FEET LONG\* WITH (2)-1/2" X 4" BUS BARS WITH 1/2" SPACER RATED FOR MINIMUM 4000 AMPS.
3. BUS BARS SHALL BE MOUNTED ON 5KV POST INSULATORS INSTALLED ON UNISTRUT MOUNTED ON MANHOLE WALL.
4. PROVIDE NEMA-2 NOLE PATTERN SLOT EQUALLY SPACED 3" APART.
5. INSTALL VIEW WINDOWS IN MANHOLE COVER.



GROUND TEST WELL

DETAIL 1  
SCALE: NONE



PADMOUNT SWITCHGEAR FOUNDATION  
SCALE: NONE

NOTES FOR INSTALLATION OF INCOMING LINE AND DRAIN

1. VERIFY EXACT LOCATION OF COMED INCOMING LINES AND DRAIN DUCTS.
2. INTERCEPT COMED DRAIN DUCT AT LOCATION MARK (B) INSTALL (2) 4" PVC SCHD. 40 CONCRETE ENCASED CONDUITS BETWEEN MARK (B) AND NEGATIVE MANHOLE - APPROXIMATELY 210 LINEAR FEET.
3. MAKE TERMINATIONS COMED PROVIDED 1/C- 750 KCMIL CU EX DRAIN WIRE AND 1/C- #6 CU EX DRAIN SIGNAL WIRE IN THE DRAIN ENCLOSURE MOUNTED ON THE NEGATIVE MANHOLE.
4. INTERCEPT COMED INCOMING LINE-1 DUCT AT LOCATION MARK - (B) INSTALL (3) 5" PVC SCHD. 40 CONCRETE ENCASED CONDUIT BETWEEN MARK - (B) AND COMED SWITCHGEAR-1. APPROXIMATELY 225 LINEAR FEET.
5. INTERCEPT COMED INCOMING LINE-2 DUCT AT LOCATION MARK - (B) INSTALL (3) 5" PVC SCHD. 40 CONCRETE ENCASED CONDUIT BETWEEN MARK - (B) AND COMED SWITCHGEAR-2. APPROXIMATELY 245 LINEAR FEET.
6. INSTALL (2) 5" PVC SCHD CONCRETE ENCASED CONDUIT AND (1) 3/C- 650 KCMIL CU CABLE BETWEEN EACH OF THE COMED SWITCHGEAR 1 AND 2 TO INDOOR AC SWITCHGEAR CUBICLES AND MAKE TERMINATIONS IN THE INDOOR SWITCHGEAR CUBICLES.
7. INCOMING LINE CABLES FROM COMED MANHOLES TO COMED SWITCHGEAR 1 AND 2 WILL BE INSTALLED BY COMED.
8. ALL TERMINATIONS AT COMED EQUIPMENT WILL BE BY COMED.

PRINTED ON: \$DATES

REV	DATE	BY	APP	DESCRIPTION	REV	DATE	BY	APP	DESCRIPTION
2	06-08-2018	JMC	HS	ISSUED FOR BID					
1	03-30-2018	JMC	HS	ISSUED FOR ADDENDUM 1					
0	12-19-2017	HS	HS	ISSUED FOR BID					

CONSULTANT SEAL & SIGNATURE



CONSULTANT



DESIGNED: HS  
DRAWN: JC  
CHECKED: FM  
METRA P-M: R. CERANT  
DATE: JUNE 12, 2017

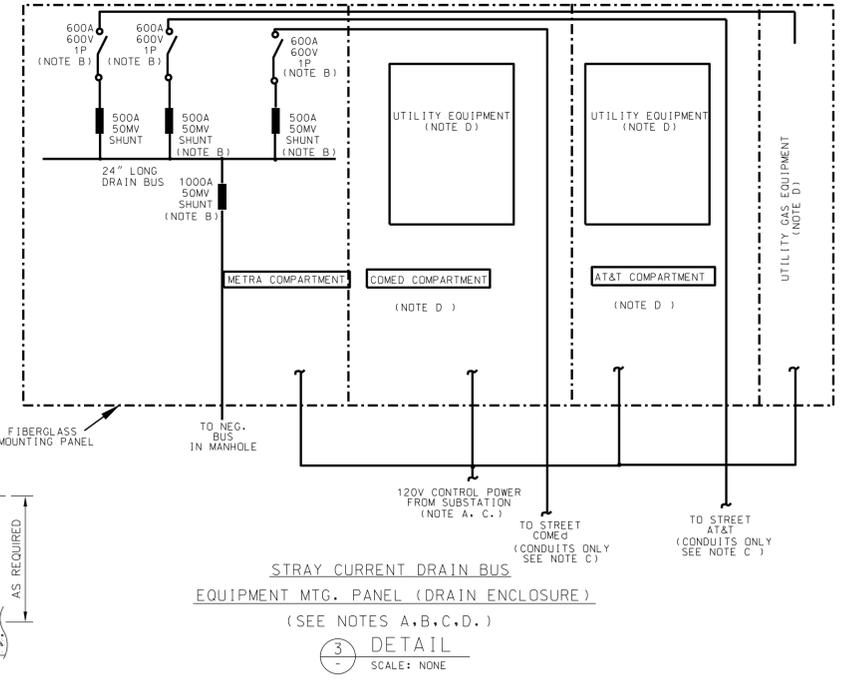
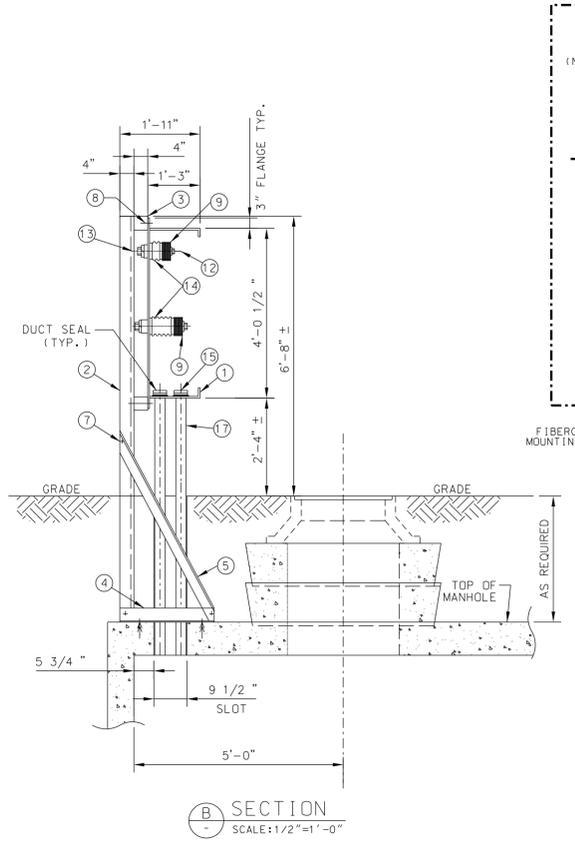
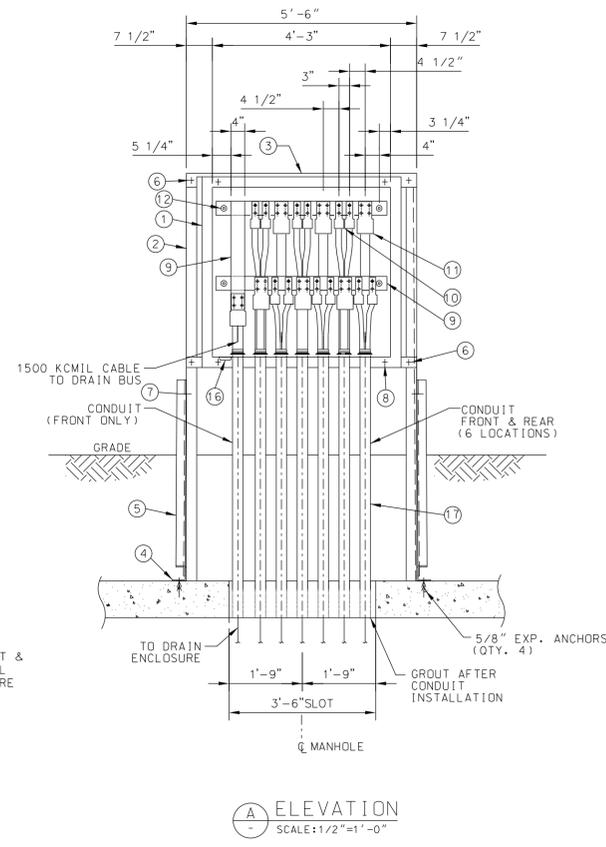
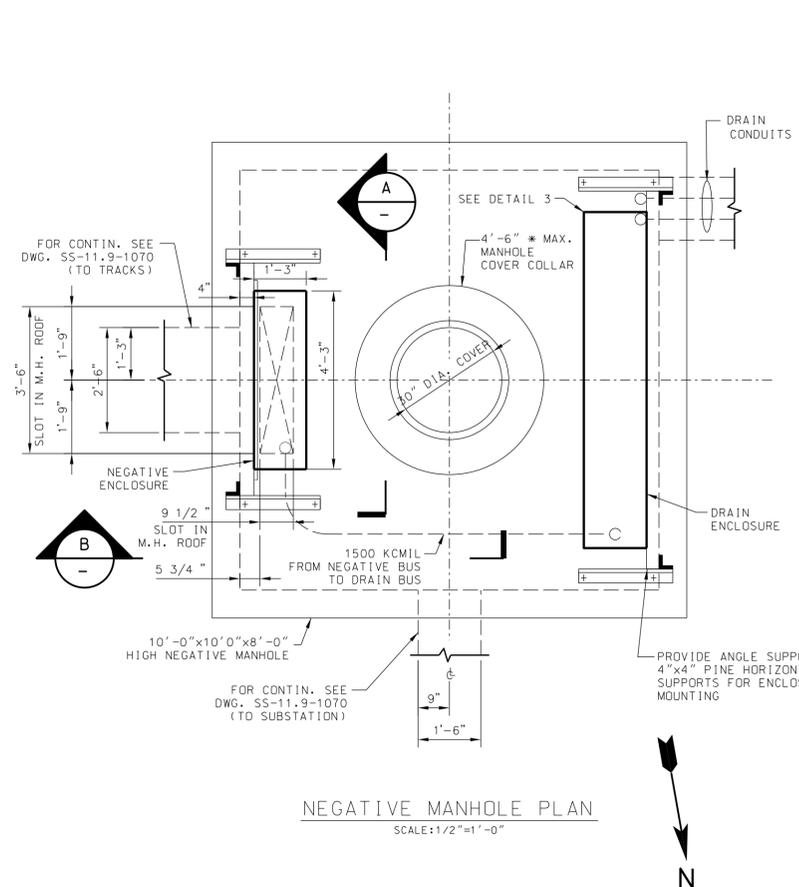


LOCATION NAME:  
95TH. STREET SUBSTATION

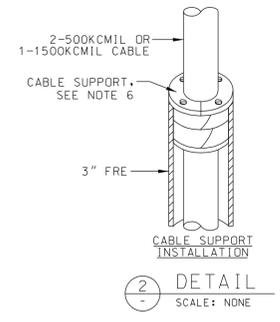
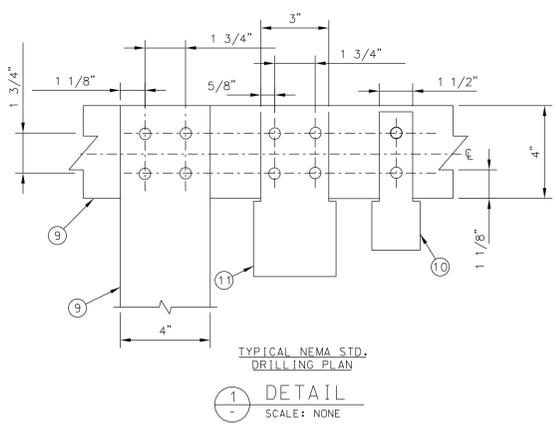
ELECTRICAL DETAILS

CAD FILE NUMBER: SS-11.9-1081.DGN

SCALE: NTS	DISTRICT: MED
PROJECT NO. GW4254-57102002	SHEET NO. SS-11.9-1081
MILE POST NO. 11.9	



- NOTES:
- A. THE CONTRACTOR SHALL PROVIDE A FIBERGLASS MOUNTING PANEL FOR THE UTILITIES DRAIN EQUIPMENT. THE NEW PANEL SHALL HAVE FOUR (4) COMPARTMENTS ONE EACH FOR METRA, AT&T, GAS, AND COMED. EACH COMPARTMENT SHALL BE 42"X24" WITH 120V, 15A DUPLEX OUTLET IN EACH COMPARTMENT.
  - B. THE CONTRACTOR SHALL PROVIDE THE FOUR (4) SHUNTS AND THREE (3) DISCONNECT SWITCHES AS PER THIS SKETCH. THE DISCONNECT SWITCHES SHALL BE FILINOR TYPE A, CAT A-6716, THE SHUNTS SHALL BE CANADIAN SHUNT IND. E SERIES, MANIGAN SHUNTS. BOTH SHUNTS AND SWITCHES MANUFACTURERS ARE "OR APPROVED EQUAL".
  - C. THE STRAY CURRENT CONDUITS SHALL BE FURNISHED AND INSTALLED BY THE CONTRACTOR AND CABLES BY THE UTILITIES. THE 120V CONTROL POWER CIRCUITS SHALL BE PROVIDED AND INSTALLED BY THE CONTRACTOR.
  - D. THE UTILITIES WILL PROVIDE AND INSTALL THEIR DRAINAGE CABLES AND EQUIPMENT ON THIS PANEL.



BILL OF MATERIAL-NEGATIVE BUS ENCLOSURE

- 1 (1) FIBERGLASS ENCLOSURE WITH FLANGE LIP 51" WIDE x 48 1/2" HIGH x 15" MIN. DEEP
- 2 (2) 4" x 4" x 3/8" ANGLE, LENGTH AS REQUIRED (ASTM A36 STRUCTURAL STEEL) GALVANIZED
- 3 (2) 4" x 4" PINE 5'-6" LG. TREATED WITH AWP TYPE P1(95) FOR CREO-PINE
- 4 (2) 4" x 4" x 3/8" ANGLE, 2'-3" LG (ASTM A36 STRUCTURAL STEEL) GALVANIZED
- 5 (2) 3" x 3" x 1/4" (BRACE ANGLE), LENGTH AS REQUIRED (ASTM A36 STRUCTURAL STEEL) GALVANIZED
- 6 (4) 3/4" Ø THROBOLT, NUT & 2 WASHERS (IN 13/16" Ø HOLES) A307 GALVANIZED
- 7 (4) 1/2" Ø BOLT & WASHERS A307 GALVANIZED
- 8 (4) 1/2" Ø STAINLESS STEEL BOLT, NUT, SQUARE WASHER & LOCKWASHER
- 9 (4) 1/4" x 4" COPPER BUS BARS (44 FT. TOTAL NEEDED)
- 10 (12) COPPER ALLOY BOLTED POWER CONNECTOR FOR 500 KCMIL CABLE
- 11 (7) COPPER ALLOY BOLTED POWER CONNECTOR FOR 1500 KCMIL CABLE
- 12 (4) 5/8" HEX HEAD SILICON BRONZE BOLT WITH STAINLESS STEEL BELLEVILLE WASHER
- 13 (4) 3/4" HEX HEAD STAINLESS STEEL BOLT WITH FLAT & SPLIT WASHERS
- 14 (2) 7 1/2" & (2) 14" FIBERGLASS REINFORCED STANDOFF INSULATOR CLASS A-40
- 15 (13) CABLE SUPPORT, SEE DETAIL 2
- 16 (3) DRAIN PLUG
- 17 (13) 3" FRC CONDUIT LENGTH AS REQUIRED

- NOTES:
1. CONTRACTOR SHALL FIELD VERIFY ALL DIMENSIONS.
  2. PROVIDE KNOCKOUTS IN BOTTOM OF ENCLOSURE FOR 3" FRC CONDUIT AS DIMENSIONED.
  3. SEAL ALL MOUNTING BOLTS AND ANY PENETRATION THROUGH THE ENCLOSURE WITH RTV SILICON SEALER PER ENCLOSURE MANUFACTURER'S INSTRUCTIONS.
  4. BUS SHALL BE ADEQUATELY BRACED. SPACING BETWEEN BUS BARS SHALL BE 1/4" AND MAINTAINED ENTIRE LENGTH.
  5. ENCLOSURES DOORS ARE NOT SHOWN FOR CLARITY.
  6. FOR CABLE SUPPORT USE CONDUIT SEALING BUSHING TYPE CSBE-300P-SEG (500KCMIL) AND CSBE-300P (1500KCMIL) MANUFACTURED BY O-Z/GEDNEY OR APPROVED EQUAL.
  7. ALL MILD STEEL STRUCTURAL SHAPES, BOLTS, NUTS, AND WASHERS ARE TO BE GALVANIZED.
  8. ALL EQUIPMENT SHALL BE FURNISHED AND INSTALLED BY THE CONTRACTOR UNLESS NOTED OTHERWISE.

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REV	DATE	BY	APP	DESCRIPTION	REV	DATE	BY	APP	DESCRIPTION
2	06-08-2018	JMC	HS	ISSUED FOR BID					
1	03-30-2018	JMC	HS	ISSUED FOR ADDENDUM 1					
0	07-28-2017	HS	HS	ISSUED FOR BID					

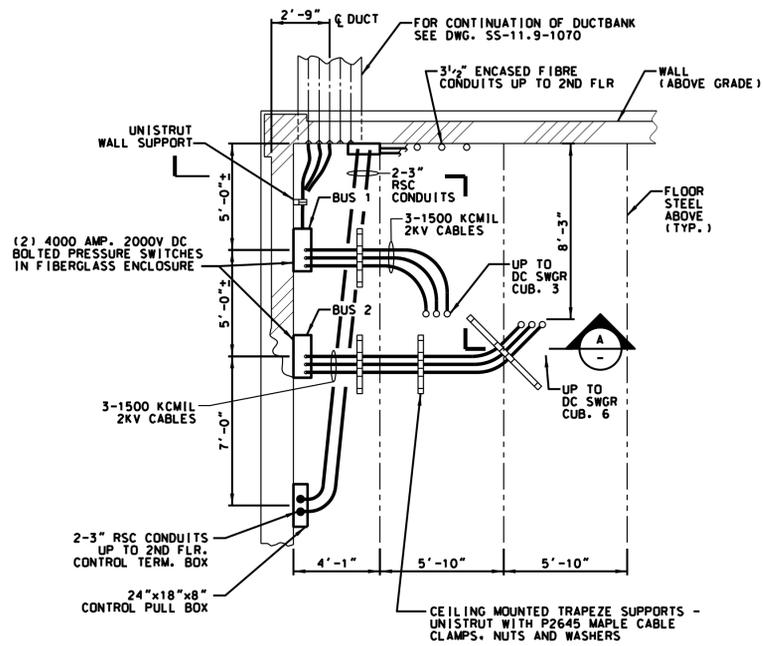


DESIGNED: HS
DRAWN: JC
CHECKED: FM
METRA P.M.: R. CERANT
DATE: JUNE 12, 2017

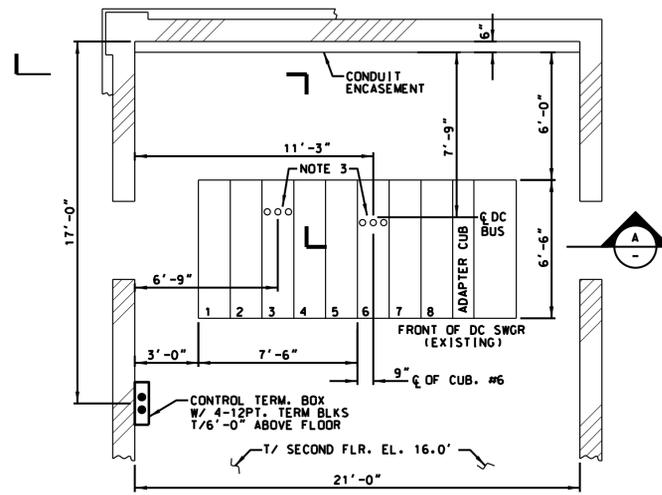


LOCATION NAME: <b>95TH. STREET SUBSTATION</b>
TITLE: <b>NEGATIVE AND DRAIN ENCLOSURES</b>

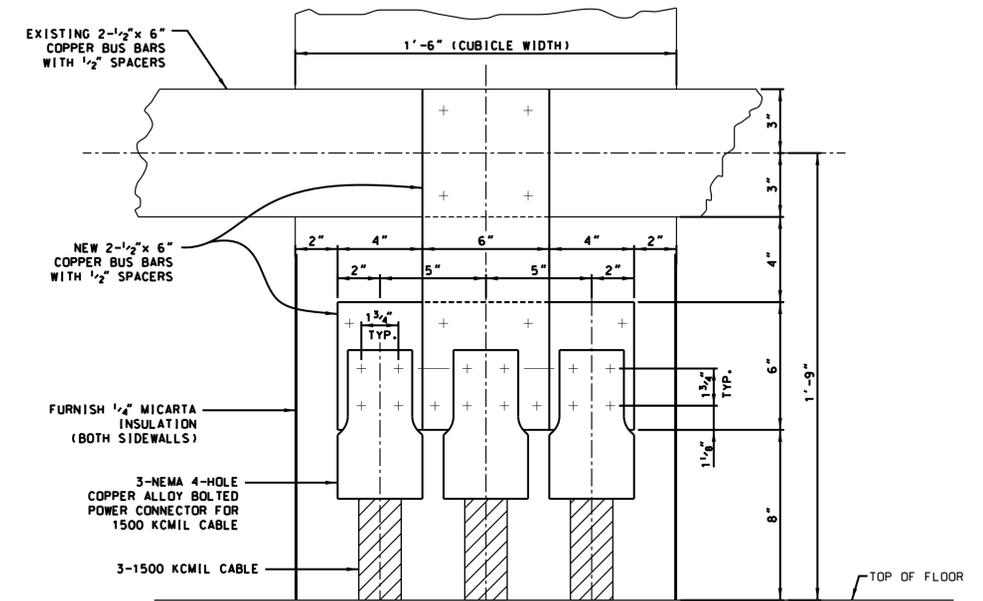
CAD FILE NUMBER: SS-11.9-1082	DISTRICT: MED
SCALE: AS NOTED	SHEET NO. SS-11.9-1082
PROJECT NO. GW4254-57102002	
MILE POST NO. 11.9	



FIRST FLOOR PLAN  
SCALE: 1/4" = 1'-0"

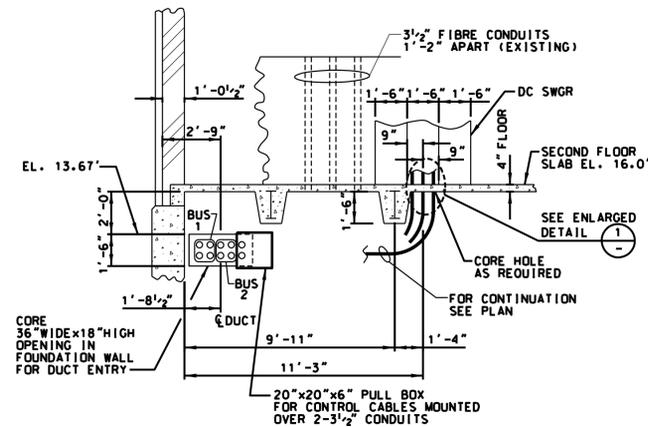


SECOND FLOOR PLAN  
SCALE: 1/4" = 1'-0"



DC SWITCHGEAR HIGH VOLTAGE  
LOWER COMPARTMENT  
ELEVATION (CUB. 3 & 6)

1 DETAIL  
SCALE: 1/4" = 1'



A SECTION  
SCALE: 1/4" = 1'-0"

NOTES:

- CONTRACTOR SHALL FIELD VERIFY ALL EXISTING INSTALLATIONS AND MAKE NECESSARY ADJUSTMENTS.
- ALL EQUIPMENT SHOWN IS NEW, UNLESS IDENTIFIED AS EXISTING.
- EXTEND SWITCHGEAR DC BUS PER DETAIL 1 ON THIS DRAWING, TERMINATE 3-1500KCMIL TO THE BUS EXTENSION.
- REFERENCES TO BUS 1 AND BUS 2 (AT SWITCHES AND WITHIN DUCTBANK) ARE FOR FUTURE CONFIGURATION.

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0	07-28-2017	HS	HS	ISSUED FOR BID	REV	DATE	BY	APP	DESCRIPTION
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DESIGNED: HS  
DRAWN: JC  
CHECKED: FM  
METRA P.M.: R. CERANT  
DATE: JUNE 12, 2017

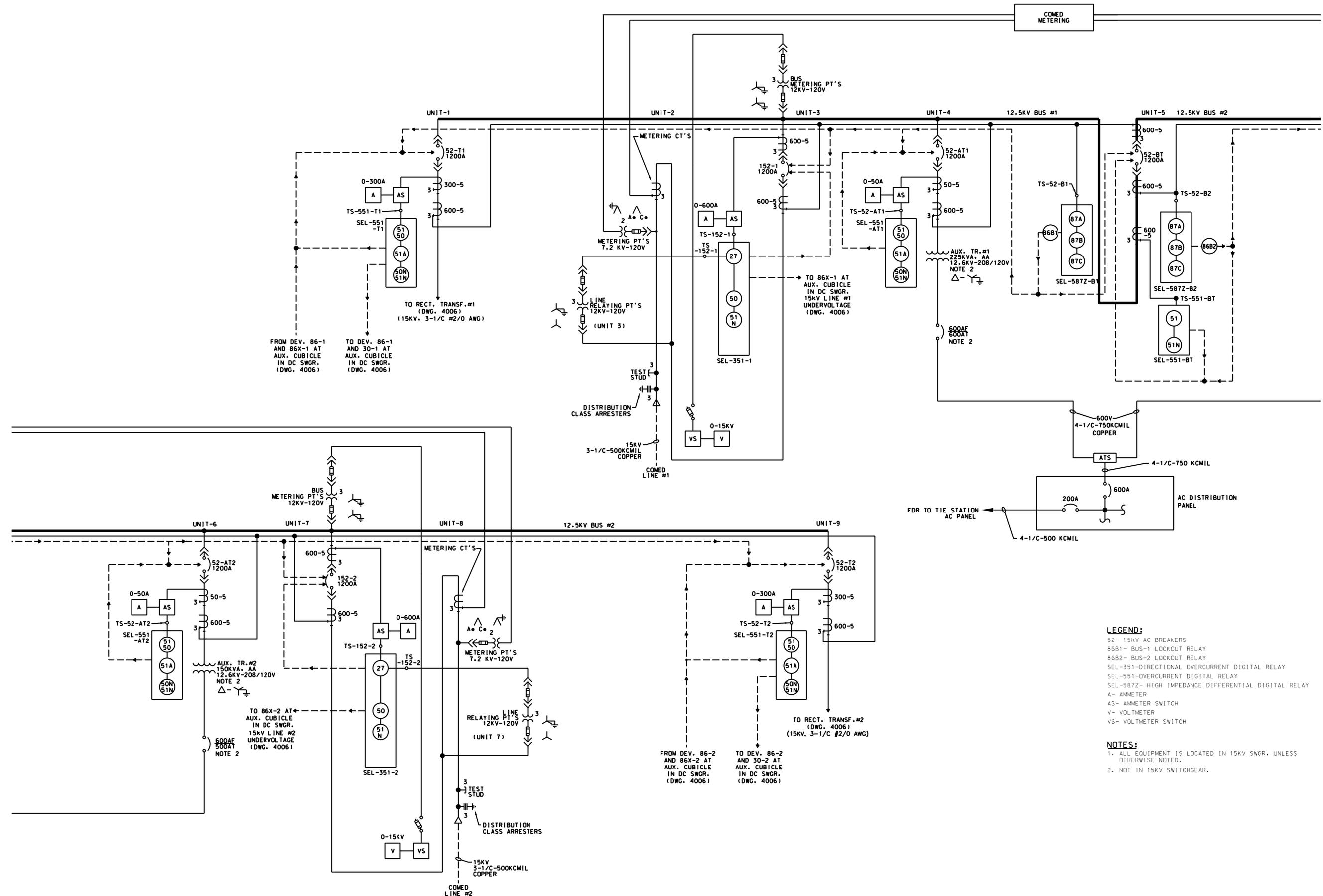


LOCATION NAME:  
95TH. STREET SUBSTATION

TITLE:  
TIE STATION INCOMING FEEDER & CONTROL CABLES PLAN & SECTIONS

CAD FILE NUMBER: SS-11.9-1085.DGN

SCALE: AS NOTED  
PROJECT NO. GW4254-57102002  
MILE POST NO. 11.9  
DISTRICT: MED  
SHEET NO. SS-11.9-1085



CONTINUED BELOW

CONTINUED FROM ABOVE

- LEGEND:**
- 52- 15KV AC BREAKERS
  - 86B1- BUS-1 LOCKOUT RELAY
  - 86B2- BUS-2 LOCKOUT RELAY
  - SEL-351-DIRECTIONAL OVERCURRENT DIGITAL RELAY
  - SEL-551-OVERCURRENT DIGITAL RELAY
  - SEL-587Z- HIGH IMPEDANCE DIFFERENTIAL DIGITAL RELAY
  - A- AMMETER
  - AS- AMMETER SWITCH
  - V- VOLTMETER
  - VS- VOLTMETER SWITCH

- NOTES:**
1. ALL EQUIPMENT IS LOCATED IN 15KV SWGR, UNLESS OTHERWISE NOTED.
  2. NOT IN 15KV SWITCHGEAR.

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REV	DATE	BY	APP	DESCRIPTION	REV	DATE	BY	APP	DESCRIPTION
0	07-28-2017	HS	HS	ISSUED FOR BID					



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Consulting Engineers  
20 N. Wacker Dr. Ste. 1500 Chicago IL 60606

DESIGNED: HS
DRAWN: JC
CHECKED: FM
METRA P.M.: R. CERANT
DATE: JUNE 12, 2017

**Metra**

ENGINEERING DEPARTMENT  
547 W. JACKSON BOULEVARD  
CHICAGO, ILLINOIS 60661

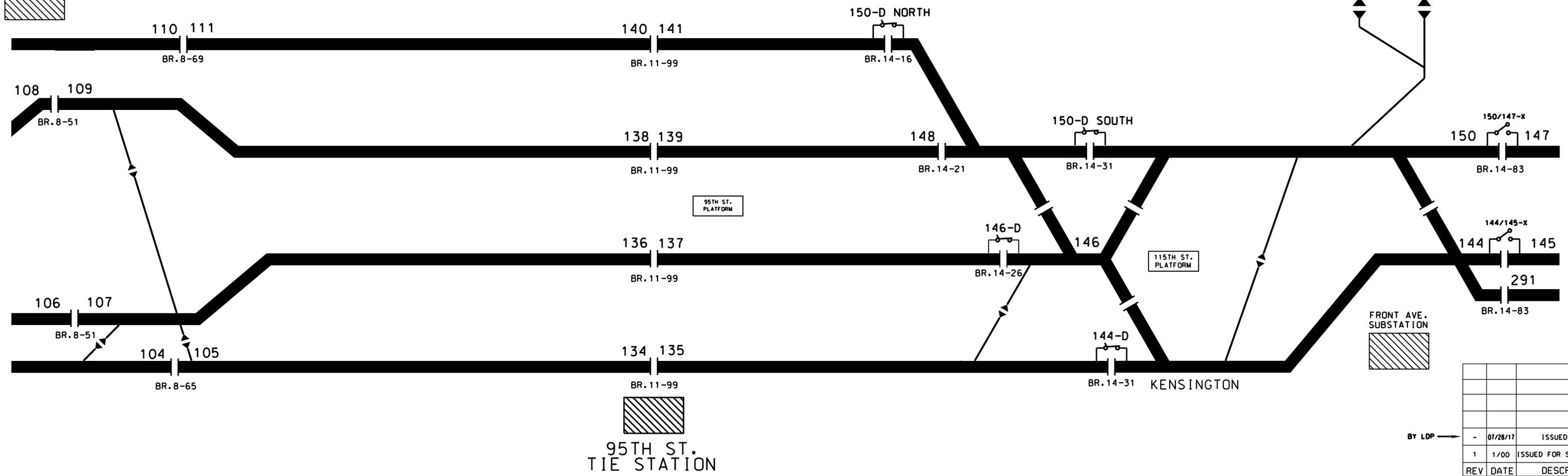
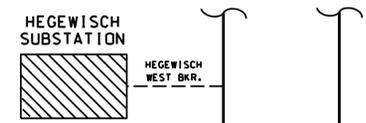
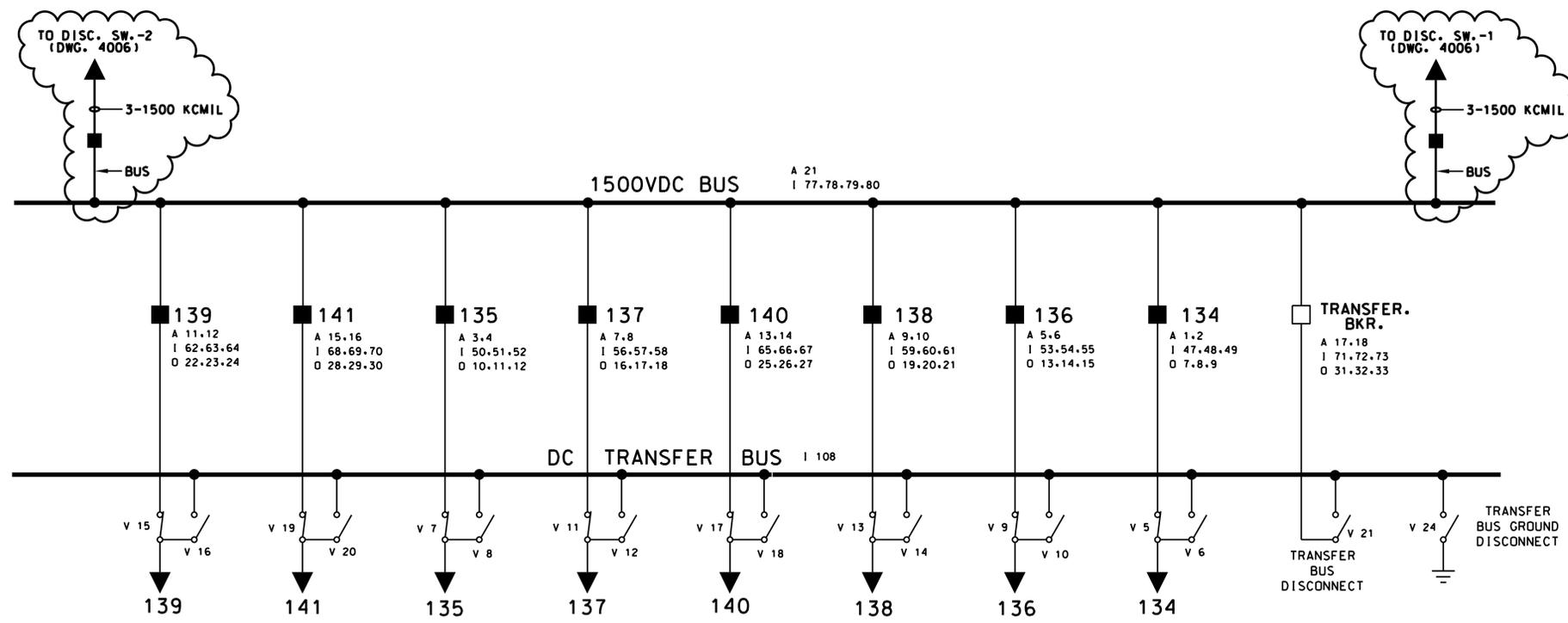
LOCATION NAME: <b>95TH. STREET SUBSTATION</b>
TITLE: <b>12.5KV AC SINGLE LINE DIAGRAM</b>

CAD FILE NUMBER: SS-11.9-4001.DGN	DISTRICT: MED
SCALE: NTS	PROJECT NO. GW4254-57102002
MILE POST NO. 11.9	<b>SS-11.9-4001</b>

# 95th STREET TIE STATION

## FEEDER STRUCTURE 11-99

CIRCUIT WITHIN THE CLOUD INDICATES NEW WORK UNDER THIS CONTRACT



BY LDP

REV	DATE	DESCRIPTION	BY
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1	1/00	ISSUED FOR SCADA AS-BUILT	WPS

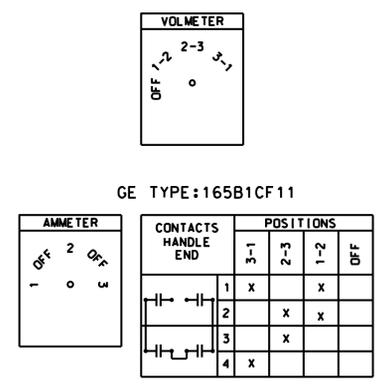
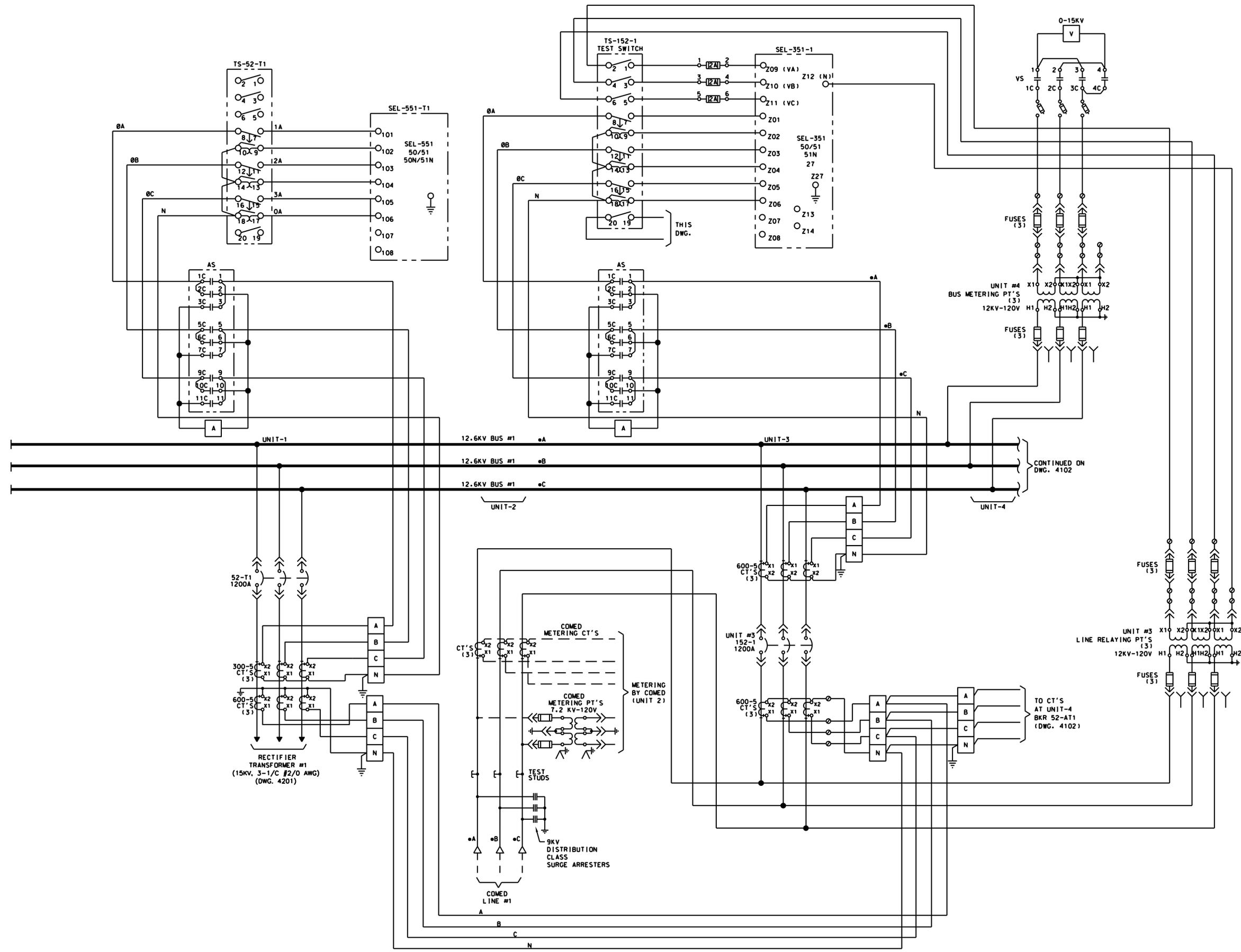
ENGINEERING DEPARTMENT  
CHICAGO, ILLINOIS

**Metra**

TRACTION POWER  
ONE LINE DIAGRAM  
95th STREET TIE STATION

SCALE: NONE  
DATE: 10/95  
DRAWN: FZ/ELEC/EML/95th/4003.dgn  
CHECKED: WDS  
DESIGNED: WDS  
APPROVED: RAS  
DISTRICT: WPS  
PRINT NUMBER: SS-11.9-4003





GE TYPE:165B1CF11

CONTACTS HANDLE END	POSITIONS			
	3-1	2-3	1-2	Df
1	X		X	
2		X		X
3			X	
4	X			

GE TYPE:165B1CF15

CONTACTS HANDLE END	POSITIONS							
	3	•	Df	•	2	•	Df	•
1	X	X	X	X	X	X	X	X
2								X
3								X
5	X	X	X	X		X	X	X
6				X	X	X		
7				X	X	X		
9		X	X	X	X	X	X	X
10	X	X						
11	X	X						

**LEGEND:**  
 52 OR 152- 15KV AC BREAKER  
 SEL-351- DIRECTIONAL OVERCURRENT DIGITAL RELAY  
 SEL-551- OVERCURRENT DIGITAL RELAY  
 TS/52 OR 152- TEST SWITCH  
 AS- AMMETER SWITCH  
 A- AMMETER  
 VS-VOLTMETER SWITCH  
 V- VOLTMETER

**NOTES:**  
 1. ALL EQUIPMENT IS LOCATED IN 15KV SWGR. UNLESS OTHERWISE NOTED.  
 2. ALL CTS SHALL BE WIRED TO A SHORTING TERMINAL BLOCK PRIOR TO CONNECTING TO A DEVICE.

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REV	DATE	BY	APP	DESCRIPTION
0	07-28-2017	HS	HS	ISSUED FOR BID

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**Gannett Fleming**  
 Consulting Engineers  
 20 N. Wacker Dr. Ste. 1500 Chicago IL 60606

DESIGNED: HS  
 DRAWN: JC  
 CHECKED: FM  
 METRA P.M.: R. CERANT  
 DATE: JUNE 12, 2017

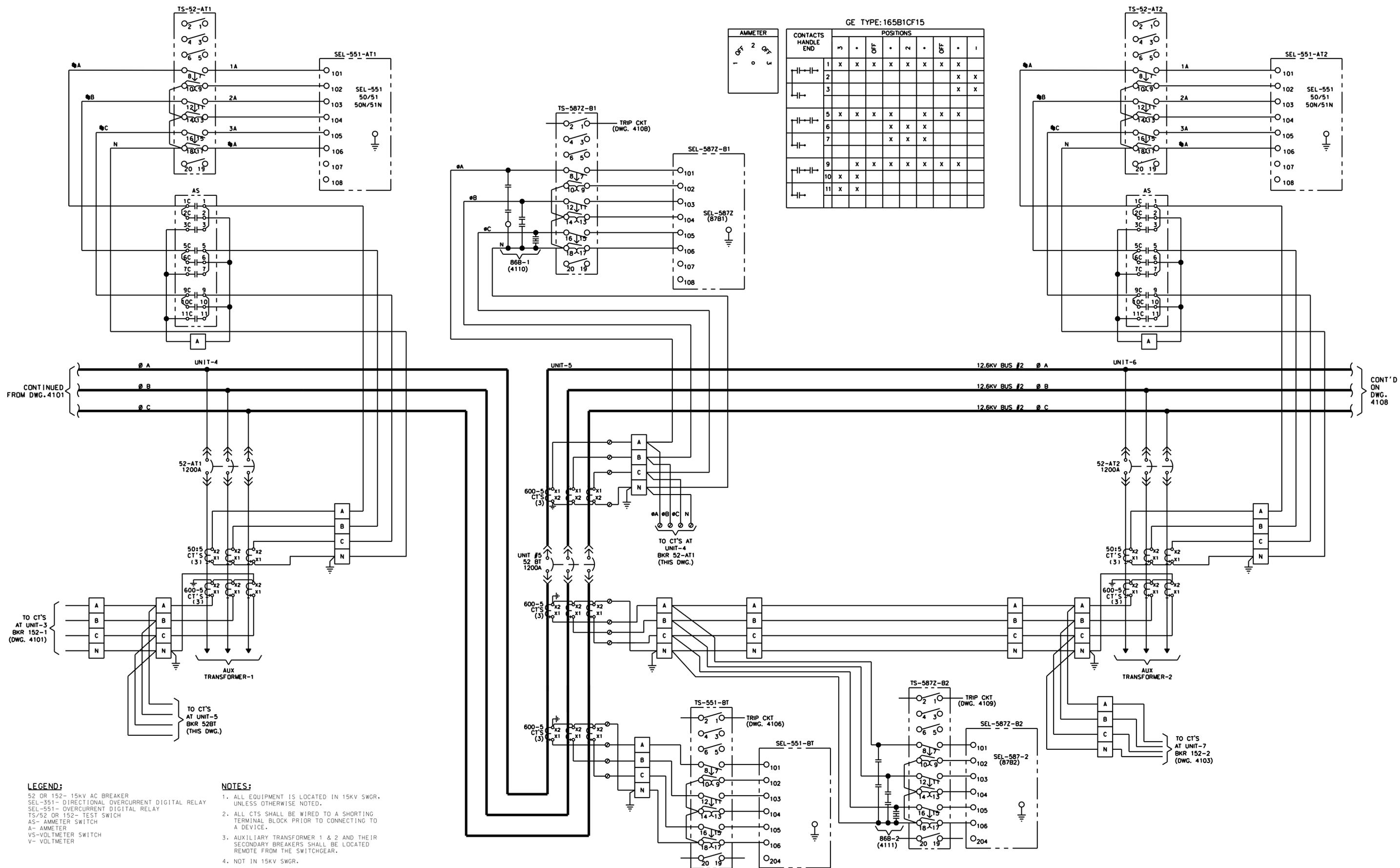
ENGINEERING DEPARTMENT  
 547 W. JACKSON BOULEVARD  
 CHICAGO, ILLINOIS 60661

LOCATION NAME:  
**95TH. STREET SUBSTATION**

TITLE:  
**12.5KV AC THREE LINE DIAGRAM  
 SHEET 1 OF 3**

CAD FILE NUMBER: SS-11.9-4101

SCALE: NTS	DISTRICT: MED
PROJECT NO. GW4254-57102002	SHEET NO. SS-11.9-4101
MILE POST NO. 11.9	



AMMETER

OFF	2	OFF
1	0	3

GE TYPE: 165B1CF15

CONTACTS HANDLE END	POSITIONS										
	5	•	OFF	•	2	•	OFF	•	1		
1	X	X	X	X	X	X	X	X	X	X	X
2										X	X
3											
5	X	X	X	X	X	X	X	X	X	X	X
6					X	X	X	X			
7					X	X	X	X			
9	X	X	X	X	X	X	X	X	X	X	X
10	X	X									
11	X	X									

**LEGEND:**  
 52 OR 152- 15KV AC BREAKER  
 SEL-351- DIRECTIONAL OVERCURRENT DIGITAL RELAY  
 SEL-551- OVERCURRENT DIGITAL RELAY  
 TS/52 OR 152- TEST SWITCH  
 AS- AMMETER SWITCH  
 A- AMMETER  
 VS-VOLTMETER SWITCH  
 V- VOLTMETER

**NOTES:**  
 1. ALL EQUIPMENT IS LOCATED IN 15KV SWGR, UNLESS OTHERWISE NOTED.  
 2. ALL CTS SHALL BE WIRED TO A SHORTING TERMINAL BLOCK PRIOR TO CONNECTING TO A DEVICE.  
 3. AUXILIARY TRANSFORMER 1 & 2 AND THEIR SECONDARY BREAKERS SHALL BE LOCATED REMOTE FROM THE SWITCHGEAR.  
 4. NOT IN 15KV SWGR.

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0	07-28-2017	HS	HS	ISSUED FOR BID
REV	DATE	BY	APP	DESCRIPTION



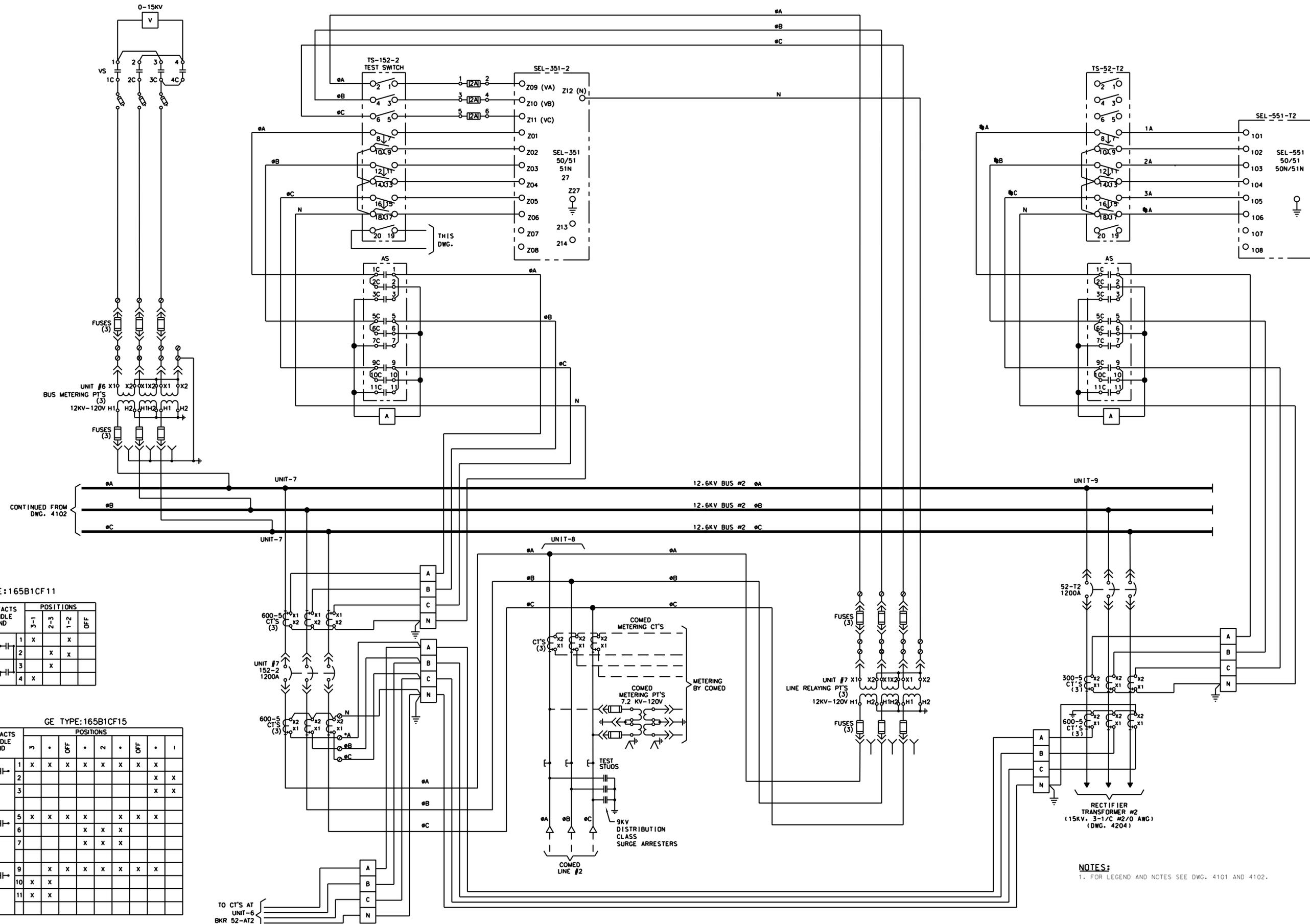
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 Consulting Engineers  
 20 N. Wacker Dr. Ste. 1500 Chicago IL 60606

DESIGNED: HS  
 DRAWN: JC  
 CHECKED: FM  
 METRA P.M.: R. CERANT  
 DATE: JUNE 12, 2017

**Metra**  
 ENGINEERING DEPARTMENT  
 547 W. JACKSON BOULEVARD  
 CHICAGO, ILLINOIS 60661

LOCATION NAME:  
**95TH. STREET SUBSTATION**  
 TITLE:  
**12.5KV AC THREE LINE DIAGRAM  
 SHEET 2 OF 3**

CAD FILE NUMBER: SS-11.9-4102.DGN  
 SCALE: NTS  
 DISTRICT: MED  
 PROJECT NO. GW4254-57102002  
 SHEET NO. SS-11.9-4102  
 MILE POST NO. 11.9



GE TYPE: 165B1CF11

CONTACTS HANDLE END	POSITIONS			
	3-1	2-3	1-2	DF
1	X		X	
2		X		X
3			X	
4	X			

GE TYPE: 165B1CF15

CONTACTS HANDLE END	POSITIONS								
	3	•	OFF	•	2	•	OFF	•	1
1	X	X	X	X	X	X	X	X	X
2								X	X
3								X	X
5	X	X	X	X	X	X	X	X	X
6				X	X	X			
7				X	X	X			
9		X	X	X	X	X	X	X	X
10	X	X							
11	X	X							

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REV	DATE	BY	APP	DESCRIPTION
0	07-28-2017	HS	HS	ISSUED FOR BID

REV	DATE	BY	APP	DESCRIPTION



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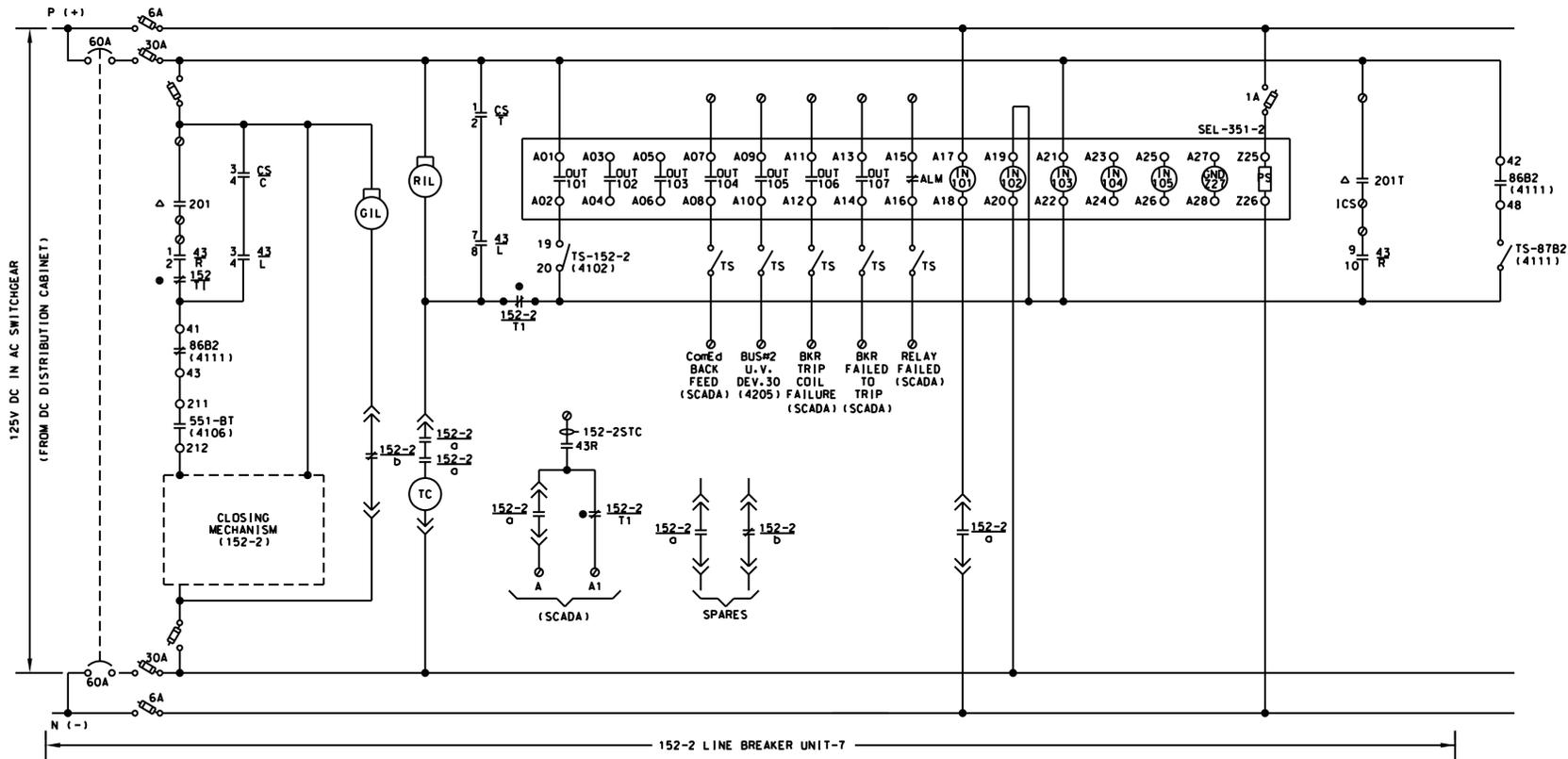
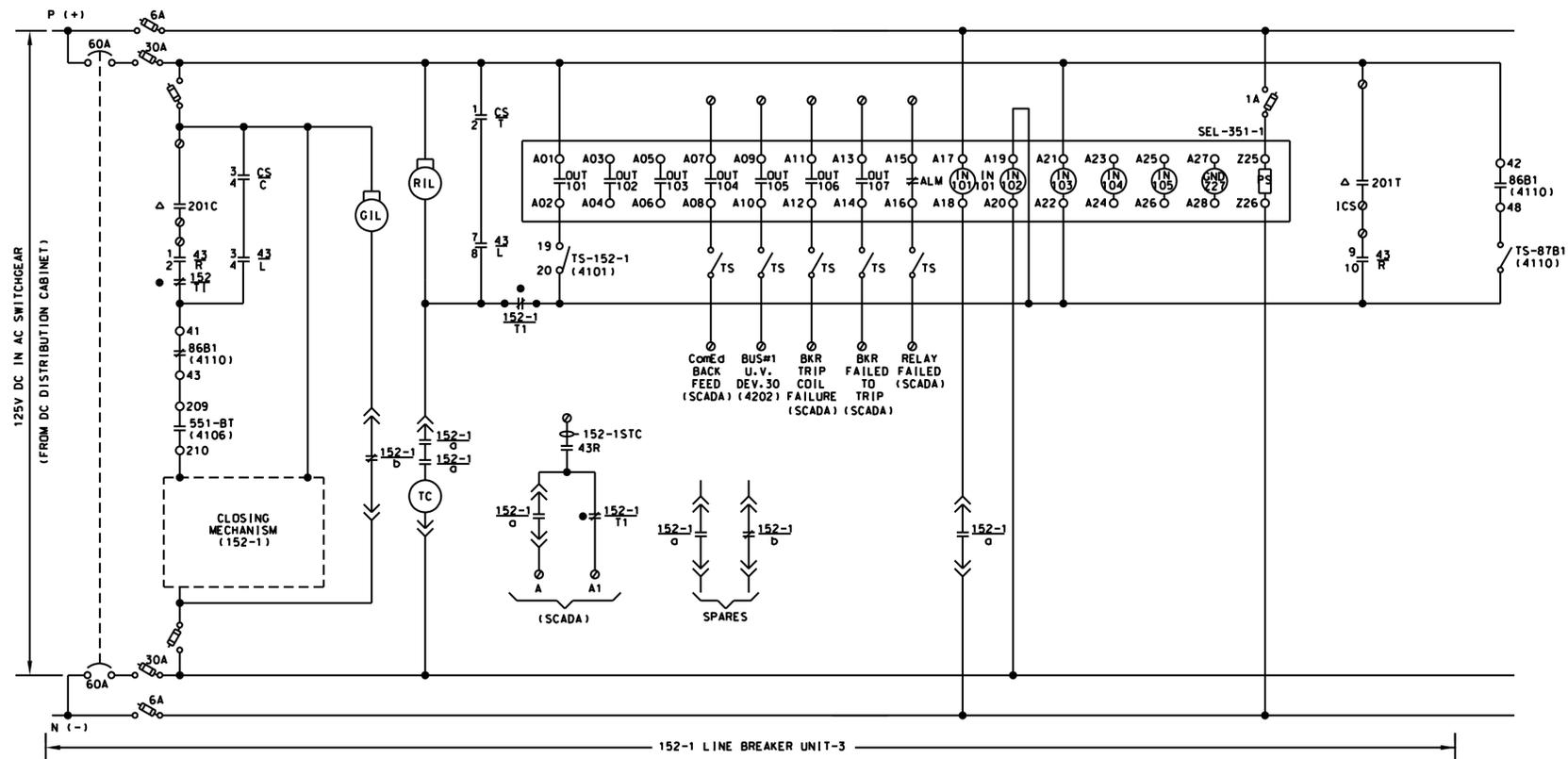
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 DRAWN: JC  
 CHECKED: FM  
 METRA P.M.: R. CERANT  
 DATE: JUNE 12, 2017



LOCATION NAME:  
**95TH. STREET SUBSTATION**  
 TITLE:  
**12.5KV AC THREE LINE DIAGRAM SHEET 3 OF 3**

CAD FILE NUMBER: SS-11.9-4103.DGN  
 SCALE: NTS  
 PROJECT NO. GW4254-57102002  
 MILE POST NO. 11.9  
 DISTRICT: MED  
 SHEET NO. **SS-11.9-4103**

NOTES:  
 1. FOR LEGEND AND NOTES SEE DWG. 4101 AND 4102.



CONTROL-SWITCH DEVICE-CS

CONTACTS	POSITION		
	TRIP	OFF AFTER TRIP	CLOSE
1-2	T	X	
3-4	C		X

SPRING RETURN TO "OFF"

SELECTOR SWITCH DEVICE-43

CONTACTS	POSITION	
	REMOTE	LOCAL
1-2	R	X
3-4	L	X
5-6	R	X
7-8	L	X
9-10	R	X
11-12	L	X

NON-SPRING RETURN.  
REMOTE POSITION AT 12 O' CLOCK.  
LOCAL POSITION CLOCKWISE WHEN FACING FRONT OF SWITCH

LEGEND:  
 ▲-LOCATED IN SCADA RTU CABINET  
 ●-CLOSED ONLY WITH BREAKER IN CONNECTED POSITION  
 ▲-OPEN ONLY WITH BREAKER IN CONNECTED POSITION  
 ○-TERMINAL BLOCK

NOTES:  
 1. ALL EQUIPMENT IS LOCATED IN 15KV SWGR. UNLESS OTHERWISE NOTED.  
 2. NUMBER IN PARENTHESIS REFERS TO A DRAWING NUMBER.

PRINTED ON: SDATES

REV	DATE	BY	APP	DESCRIPTION
0	07-28-2017	HS	HS	ISSUED FOR BID



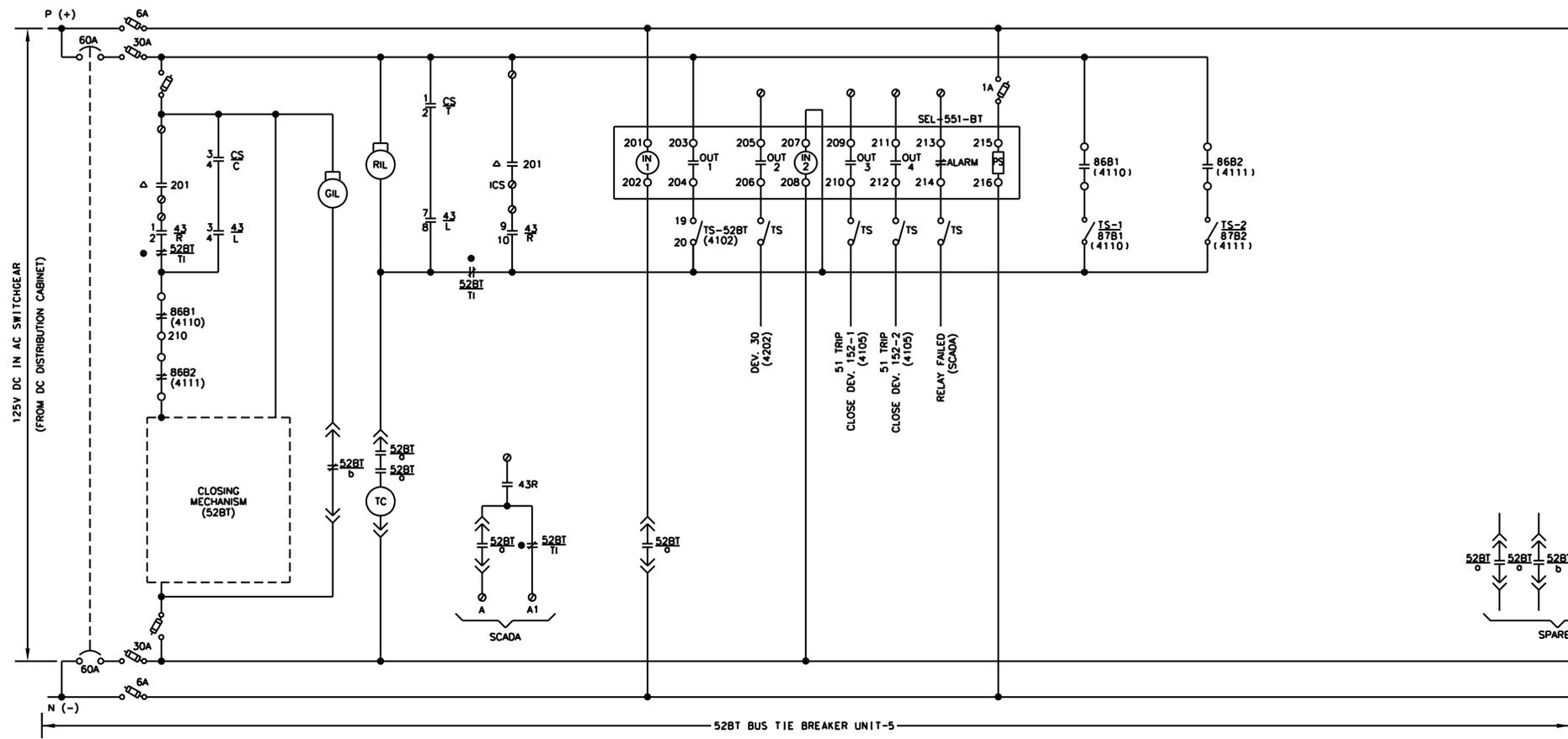
CONSULTANT SEAL & SIGNATURE  
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**Gannett Fleming**  
 Consulting Engineers  
 20 N. Wacker Dr. Ste. 1500 Chicago IL 60606

DESIGNED: HS  
 DRAWN: JC  
 CHECKED: FM  
 METRA P.M.: R. CERANT  
 DATE: JUNE 12, 2017



LOCATION NAME:  
**95TH. STREET SUBSTATION**  
 TITLE:  
**12.5KV AC SCHEMATIC DIAGRAM  
 INC. LINE BKRS. 152-1 & 152-2**

CAD FILE NUMBER: SS-11.9-4105.DGN	
SCALE: NTS	DISTRICT: MED
PROJECT NO. GW4254-57102002	SHEET NO. <b>SS-11.9-4105</b>
MILE POST NO. 11.9	



CONTROL-SWITCH DEVICE-CS

CONTACTS	POSITION		
	TRIP	OFF AFTER TRIP	CLOSE
1-2	T	X	
3-4	C		X

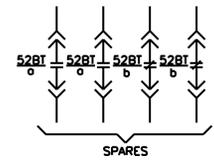
SPRING RETURN TO "OFF"

SELECTOR SWITCH DEVICE-43

CONTACTS	POSITION	
	REMOTE	LOCAL
1-2	R	X
3-4	L	X
5-6	R	X
7-8	L	X
9-10	R	X
11-12	L	X

NON-SPRING RETURN.  
REMOTE POSITION AT 12 O' CLOCK.  
LOCAL POSITION CLOCKWISE WHEN FACING FRONT OF SWITCH

**LEGEND:**  
 ▲-LOCATED IN SCADA RTU CABINET  
 ●-CLOSED ONLY WITH BREAKER IN CONNECTED POSITION  
 ▲-OPEN ONLY WITH BREAKER IN CONNECTED POSITION  
 ○-TERMINAL BLOCK



**NOTES:**  
 1. ALL EQUIPMENT IS LOCATED IN 15KV SWGR. UNLESS OTHERWISE NOTED.  
 2. NUMBER IN PARENTHESIS REFERS TO A DRAWING NUMBER.

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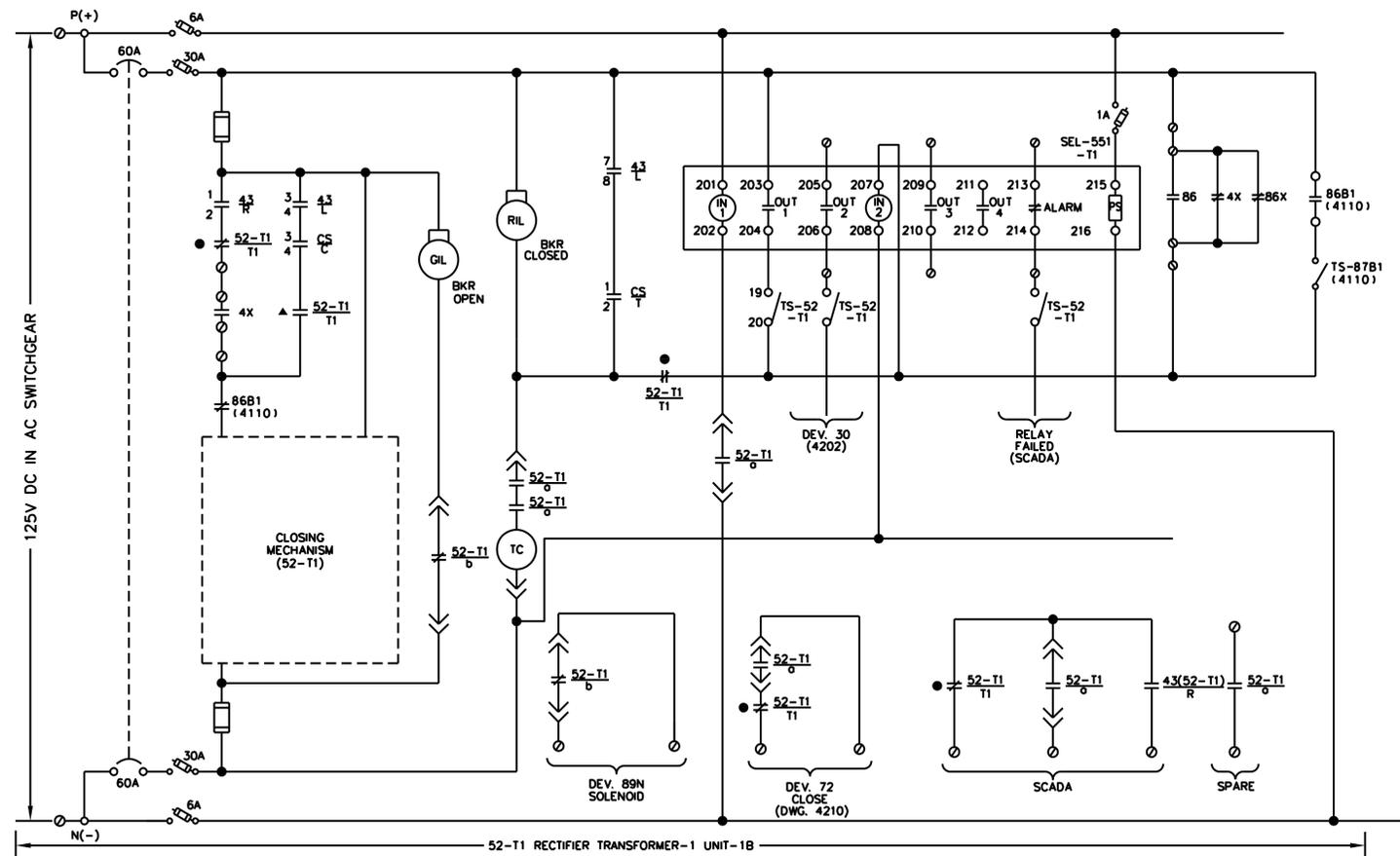
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 DRAWN: JC  
 CHECKED: FM  
 METRA P.M.: R. CERANT  
 DATE: JUNE 12, 2017



LOCATION NAME:  
**95TH. STREET SUBSTATION**

TITLE:  
**12.5KV AC SCHEMATIC DIAGRAM  
 BUS TIE BKR. 52BT**

CAD FILE NUMBER: SS-11.9-4106.DGN	
SCALE: NTS	DISTRICT: MED
PROJECT NO. GW4254-57102002	SHEET NO. <b>SS-11.9-4106</b>
MILE POST NO. 11.9	



CONTROL-SWITCH DEVICE-CS

CONTACTS	POSITION		
	TRIP	OFF AFTER TRIP	CLOSE
1-2	T	X	
3-4	C		X

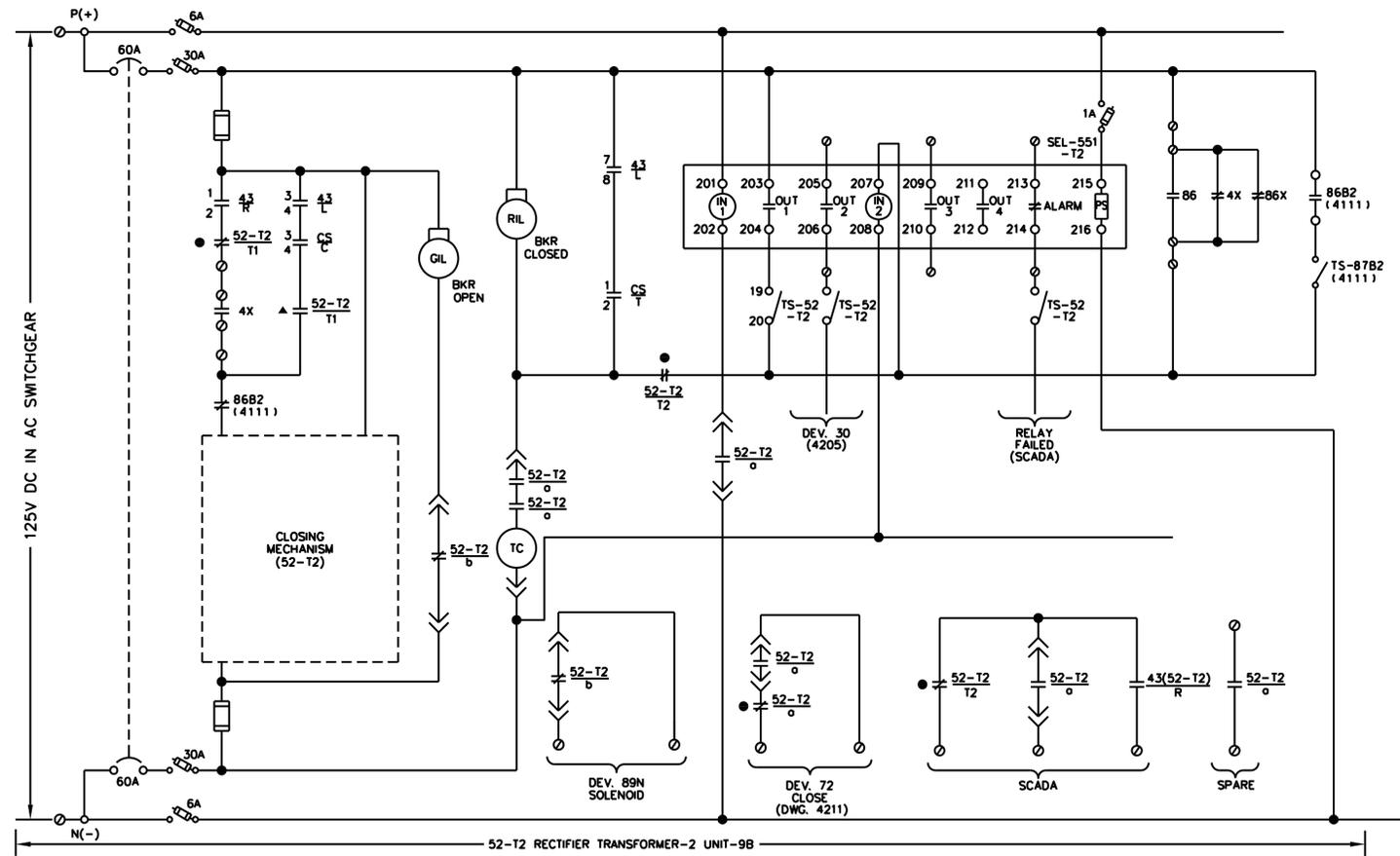
SPRING RETURN TO "OFF"

SELECTOR SWITCH DEVICE-43

CONTACTS	POSITION	
	REMOTE	LOCAL
1-2	R	X
3-4	L	X
5-6	R	X
7-8	L	X
9-10	R	X
11-12	L	X

NON-SPRING RETURN.  
REMOTE POSITION AT 12 O' CLOCK.  
LOCAL POSITION CLOCKWISE WHEN FACING FRONT OF SWITCH

LEGEND:  
▲-LOCATED IN SCADA RTU CABINET  
●-CLOSED ONLY WITH BREAKER IN CONNECTED POSITION  
▲-OPEN ONLY WITH BREAKER IN CONNECTED POSITION  
○-TERMINAL BLOCK



NOTES:  
1. ALL EQUIPMENT IS LOCATED IN 15KV SWGR. UNLESS OTHERWISE NOTED.  
2. NUMBER IN PARENTHESIS REFERS TO A DRAWING NUMBER.

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DESIGNED: HS  
DRAWN: JC  
CHECKED: FM  
METRA P.M.: R. CERANT  
DATE: JUNE 12, 2017

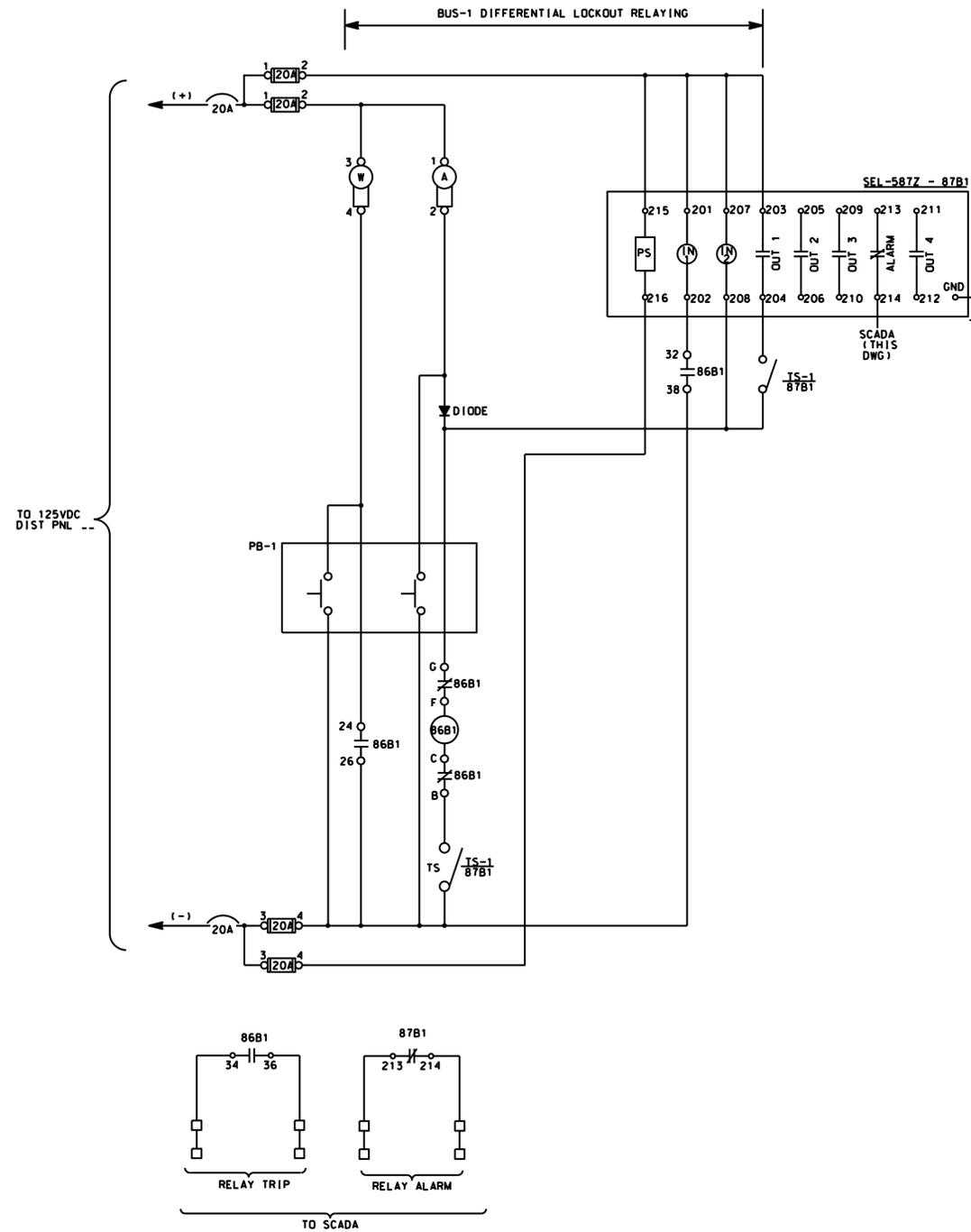


LOCATION NAME:  
95TH. STREET SUBSTATION

12.5KV AC SCHEMATIC DIAGRAM  
RECT. TRANSF. BKR. 52-T1 & 52-T2

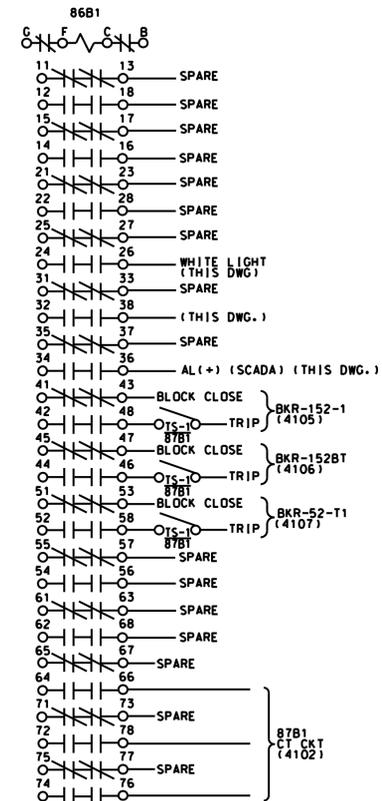
CAD FILE NUMBER: SS-11.9-4107.DGN

SCALE:	DISTRICT:
NTS	MED
PROJECT NO. GW4254-57102002	SHEET NO. SS-11.9-4107
MILE POST NO. 11.9	



LOCKOUT RELAY 86B1  
X - DENOTES CLOSED IN POSITION

DECK	CONTACTS	POSITION
		TRIP
1	110-111-013	X
1	120-111-018	X
1	150-111-017	X
1	140-111-016	X
2	210-111-023	X
2	220-111-028	X
2	250-111-027	X
2	240-111-026	X
3	310-111-033	X
3	320-111-038	X
3	350-111-037	X
3	340-111-036	X
4	410-111-043	X
4	420-111-048	X
4	450-111-047	X
4	440-111-046	X
5	510-111-053	X
5	520-111-058	X
5	550-111-057	X
5	540-111-056	X
6	610-111-063	X
6	620-111-068	X
6	650-111-067	X
6	640-111-066	X
7	710-111-073	X
7	720-111-078	X
7	750-111-077	X
7	740-111-076	X



**LEGEND:**

- 87B1 BUS-1 DIFFERENTIAL RELAY
- 86B1 BUS-1 LOCKOUT RELAY
- TS-1 TEST SWITCH FOR BUS DIFFERENTIAL AND LOCKOUT RELAY FOR BUS-1
- PB MOMENTARY TEST PUSHBUTTON

**NOTES:**

1. NUMBER IN PARENTHESIS REFERS TO A DRAWING NUMBER

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DESIGNED: HS  
DRAWN: JC  
CHECKED: FM  
METRA P.M.: R. CERANT  
DATE: JUNE 12, 2017

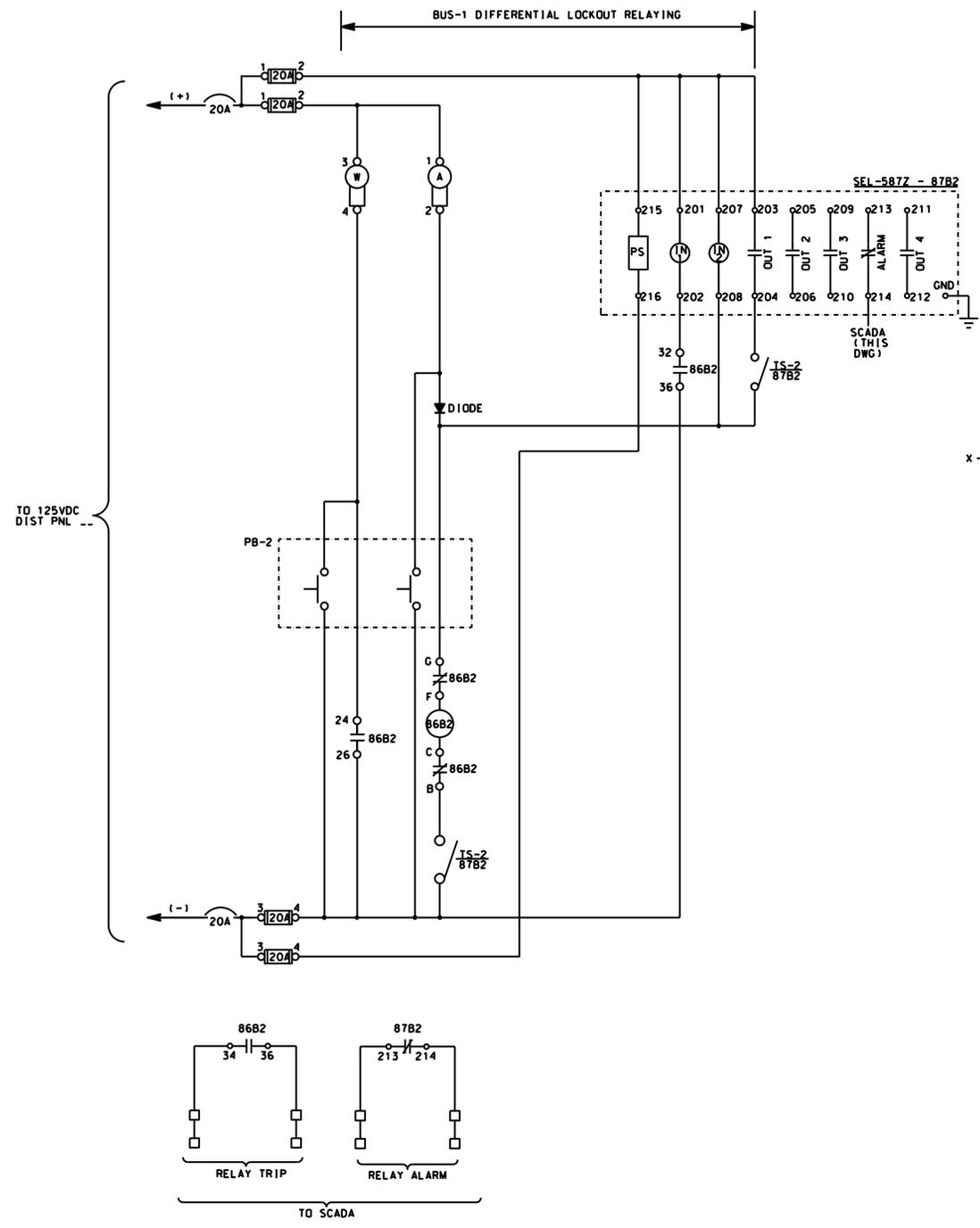


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CHICAGO, ILLINOIS 60661

LOCATION NAME:  
**95TH. STREET SUBSTATION**

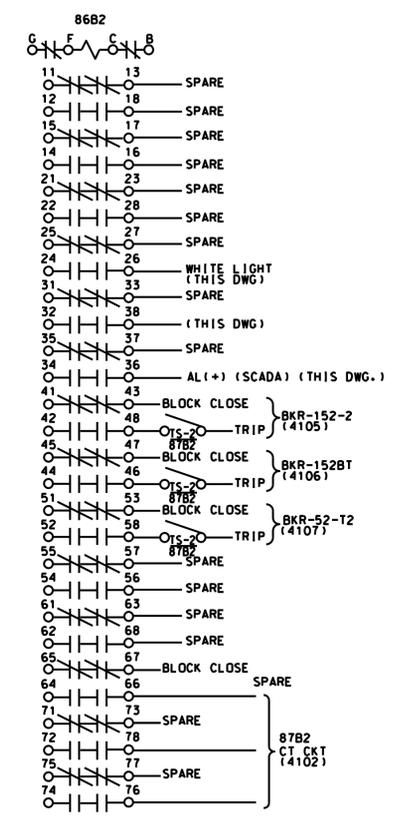
TITLE:  
**12.5KV AC SCHEMATIC DIAGRAM  
BUS-1 DIFFERENTIAL LOCKOUT**

CAD FILE NUMBER: SS-11.9-4110.DGN	
SCALE: NTS	DISTRICT: MED
PROJECT NO. GW4254-57102002	SHEET NO. <b>SS-11.9-4110</b>
MILE POST NO. 11.9	



**LOCKOUT RELAY 86B2**  
X - DENOTES CLOSED IN POSITION

DECK	CONTACTS	POSITION
1	11 0-1-1-013	X
1	12 0-1-1-018	X
1	15 0-1-1-017	X
1	14 0-1-1-016	X
2	21 0-1-1-023	X
2	22 0-1-1-028	X
2	25 0-1-1-027	X
2	24 0-1-1-026	X
3	31 0-1-1-033	X
3	32 0-1-1-038	X
3	35 0-1-1-037	X
3	34 0-1-1-036	X
4	41 0-1-1-043	X
4	42 0-1-1-048	X
4	45 0-1-1-047	X
4	44 0-1-1-046	X
5	51 0-1-1-053	X
5	52 0-1-1-058	X
5	55 0-1-1-057	X
5	54 0-1-1-056	X
6	61 0-1-1-063	X
6	62 0-1-1-068	X
6	65 0-1-1-067	X
6	64 0-1-1-066	X
7	71 0-1-1-073	X
7	72 0-1-1-078	X
7	75 0-1-1-077	X
7	74 0-1-1-076	X



**LEGEND:**  
 87B2 BUS-2-DIFFERENTIAL RELAY  
 86B2 BUS-2-LOCKOUT RELAY  
 TS-2 TEST SWITCH FOR BUS DIFFERENTIAL AND LOCKOUT RELAY FOR BUS-2  
 PB MOMENTARY TEST PUSHBUTTON

**NOTES:**  
 1. NUMBER IN PARENTHESIS REFERS TO A DRAWING NUMBER

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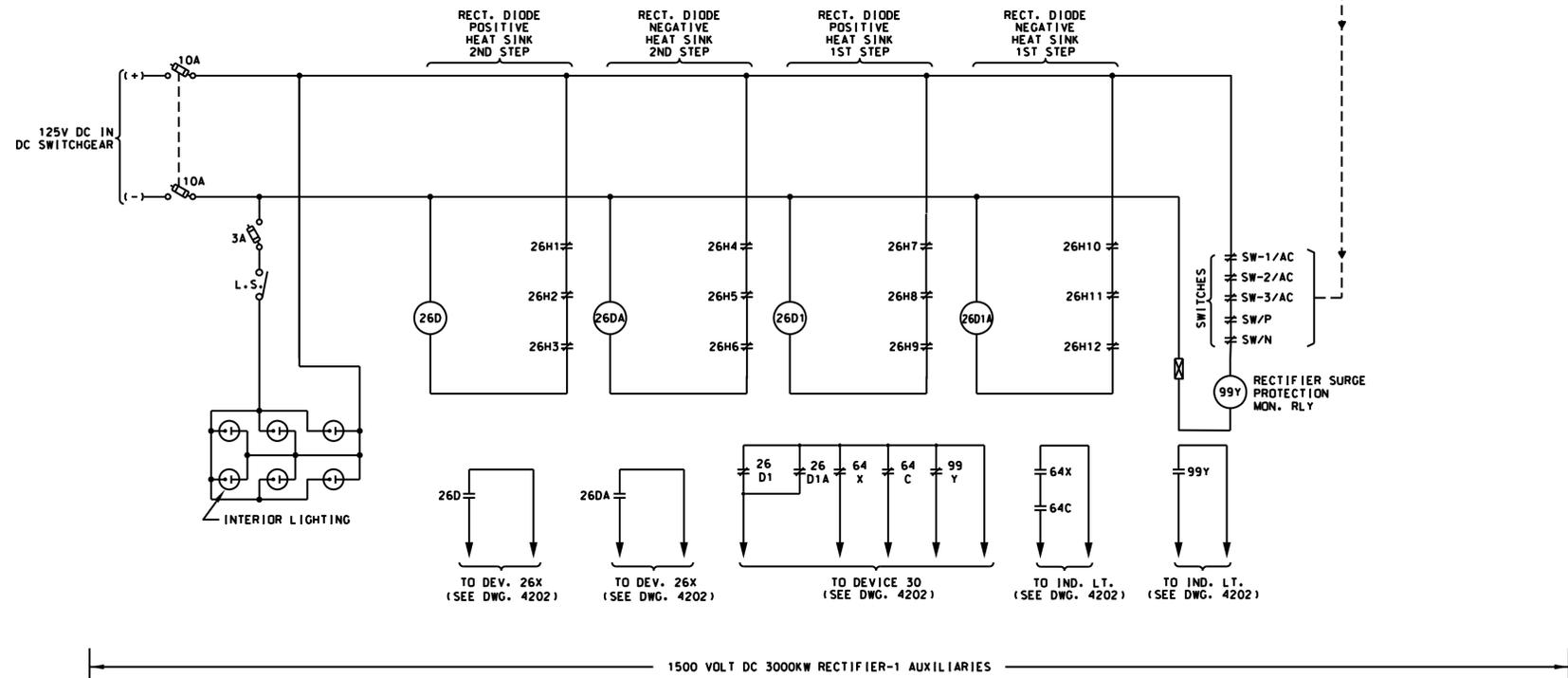
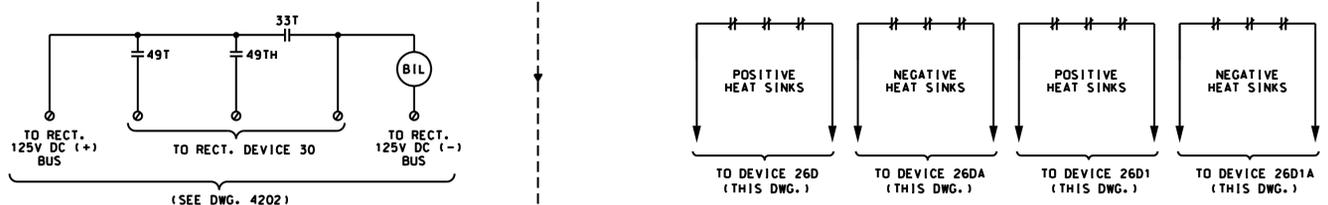
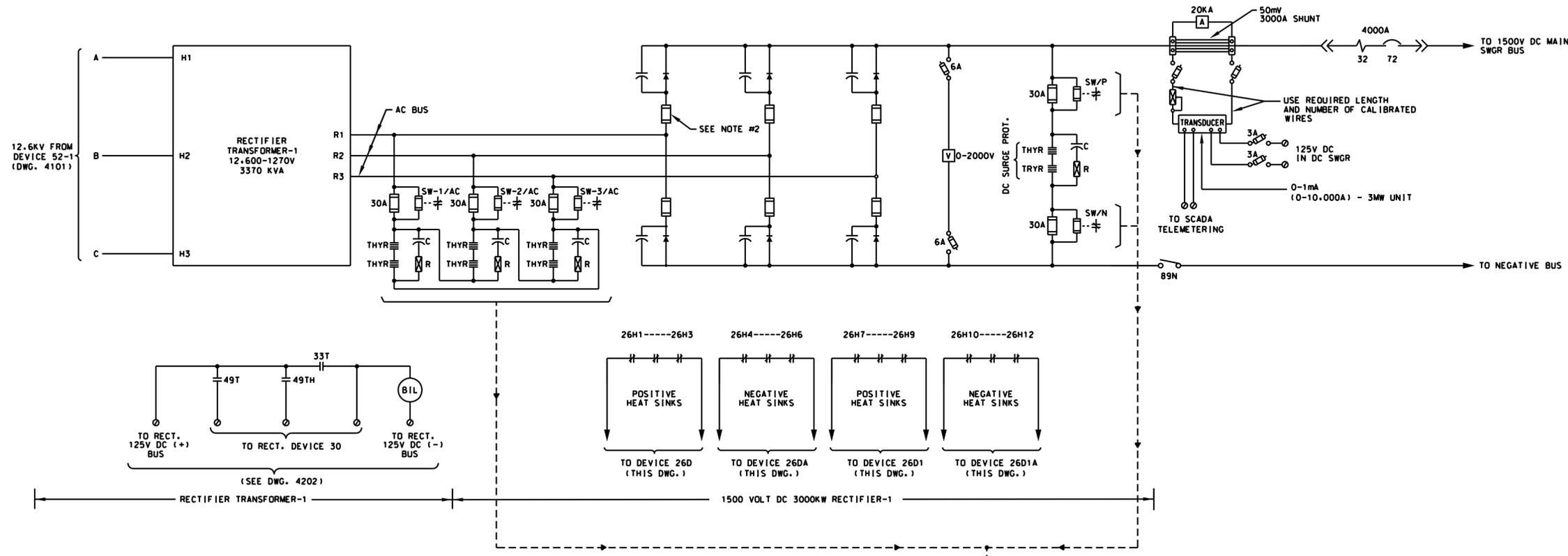
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 CONSULTANT  
**IDP**  
 A Company of  
**Gannett Fleming**  
 Consulting Engineers  
 20 N. Wacker Dr. Ste. 1500 Chicago IL 60606

DESIGNED: HS  
 DRAWN: JC  
 CHECKED: FM  
 METRA P.M.: R. CERANT  
 DATE: JUNE 12, 2017

**Metra**  
 ENGINEERING DEPARTMENT  
 547 W. JACKSON BOULEVARD  
 CHICAGO, ILLINOIS 60661

LOCATION NAME:  
**95TH. STREET SUBSTATION**  
 TITLE:  
**12.5KV AC SCHEMATIC DIAGRAM  
 BUS-2 DIFFERENTIAL LOCKOUT**

CAD FILE NUMBER: SS-11.9-4111.DGN  
 SCALE: NTS  
 PROJECT NO. GW4254-57102002  
 MILE POST NO. 11.9  
 DISTRICT: MED  
 SHEET NO. **SS-11.9-4111**



**NOTES:**

1. DIODE THERMAL DEVICES CONNECTED TOGETHER MUST BE ON HEAT SINKS OF THE SAME POLARITY UNDER ALL CONDITIONS.
2. PROVIDE TRIGGER TARGET TYPE DIODE FUSES.
3. CONTACT WILL CLOSE IN NORMAL CONDITION & WILL OPEN IN FAULT CONDITION.

**SYMBOLS:**

- TERMINAL BLOCK

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Consulting Engineers  
20 N. Wacker Dr. Ste. 1500 Chicago IL 60606

DESIGNED: HS  
DRAWN: JC  
CHECKED: FM  
METRA P.M.: R. CERANT  
DATE: JUNE 12, 2017

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547 W. JACKSON BOULEVARD  
CHICAGO, ILLINOIS 60661

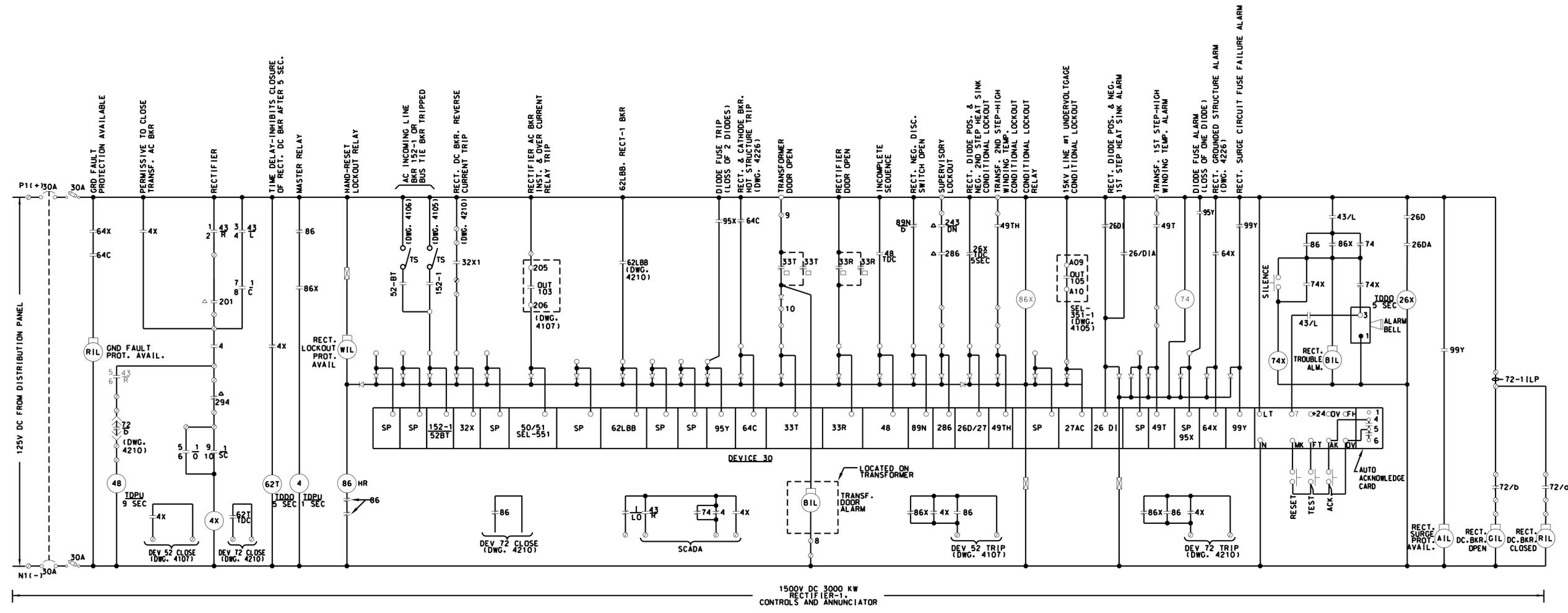
LOCATION NAME:  
**95TH. STREET SUBSTATION**

TITLE:  
**1500V DC SCHEMATIC DIAGRAM  
RECTIFIER-1 POWER & AUXILIARIES**

CAD FILE NUMBER: SS-11.9-4201.DGN

SCALE: NTS  
PROJECT NO. GW4254-57102002  
MILE POST NO. 11.9

DISTRICT: MED  
SHEET NO. SS-11.9-4201



**SYMBOLS:**

- △ LOCATED IN SCADA RTU CABINET
- CLOSED ONLY WITH BREAKER IN CONNECTED POS.
- ▲ OPEN ONLY WITH BREAKER IN CONNECTED POS.
- ⬢ TERMINAL BLOCK
- RTU-INDICATES SCADA REMOTE TERMINAL UNIT.

**MASTER CONTROL SWITCH  
DEVICE-1**

CONTACTS	POSITION			
	PULL OUT	TRIP	OFF AFTER TRIP	CLOSE
1-2	LO	X	X	X
3-4	T	X		
5-6	O		X	X
7-8	C			X
9-10	SC			X

SPRING RETURN TO "OFF"

**SELECTOR SWITCH  
DEVICE-43**

CONTACTS	POSITION	
	REMOTE	LOCAL
1-2	R	X
3-4	L	X
5-6	R	X
7-8	L	X
9-10	R	X
11-12	L	X

NON-SPRING RETURN.  
REMOTE POSITION AT 12 O' CLOCK.  
LOCAL POSITION CLOCKWISE WHEN FACING FRONT OF SWITCH.

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20 N. Wacker Dr. Ste. 1500 Chicago IL 60606

DESIGNED: HS  
DRAWN: JC  
CHECKED: FM  
METRA P.M.: R. CERANT  
DATE: JUNE 12, 2017

**Metra**

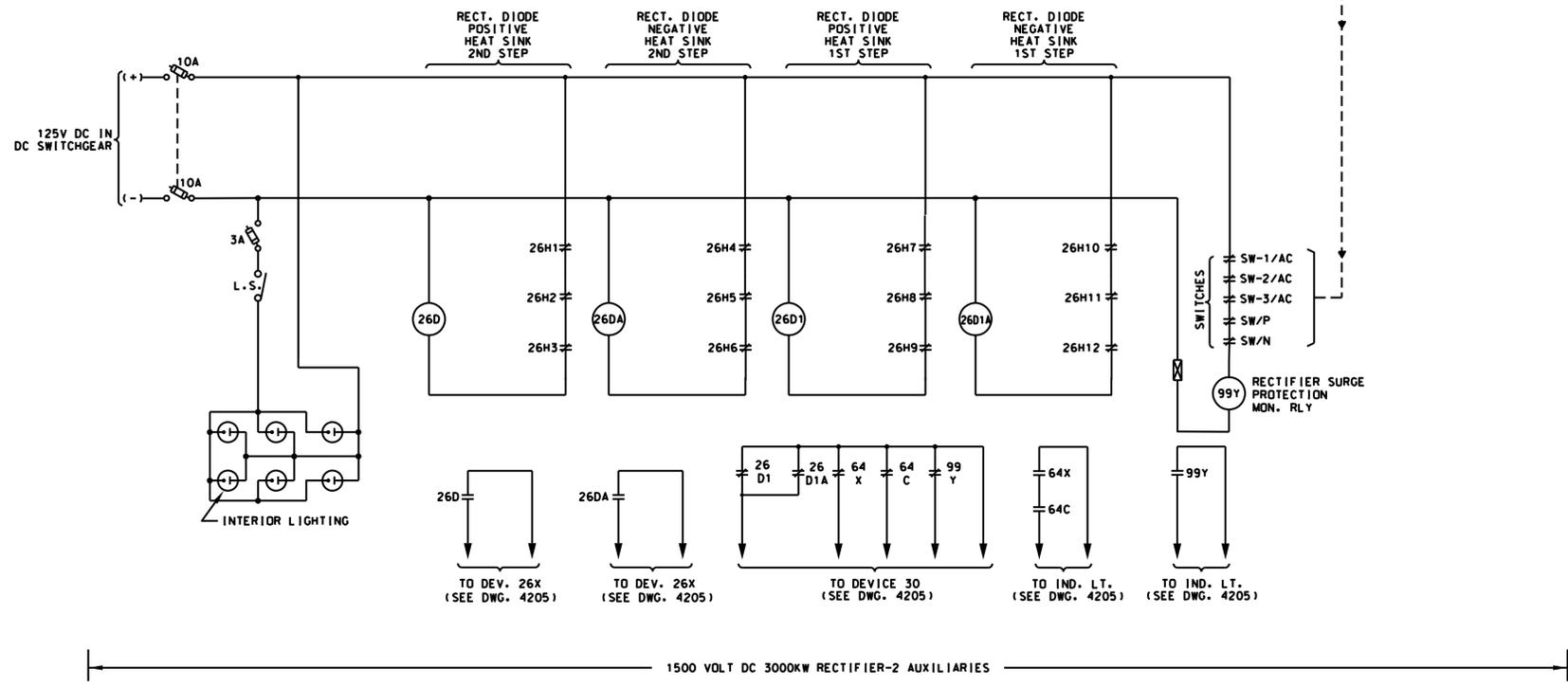
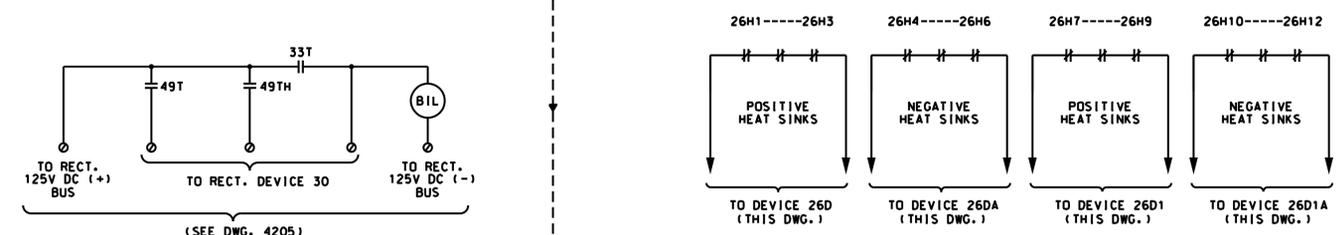
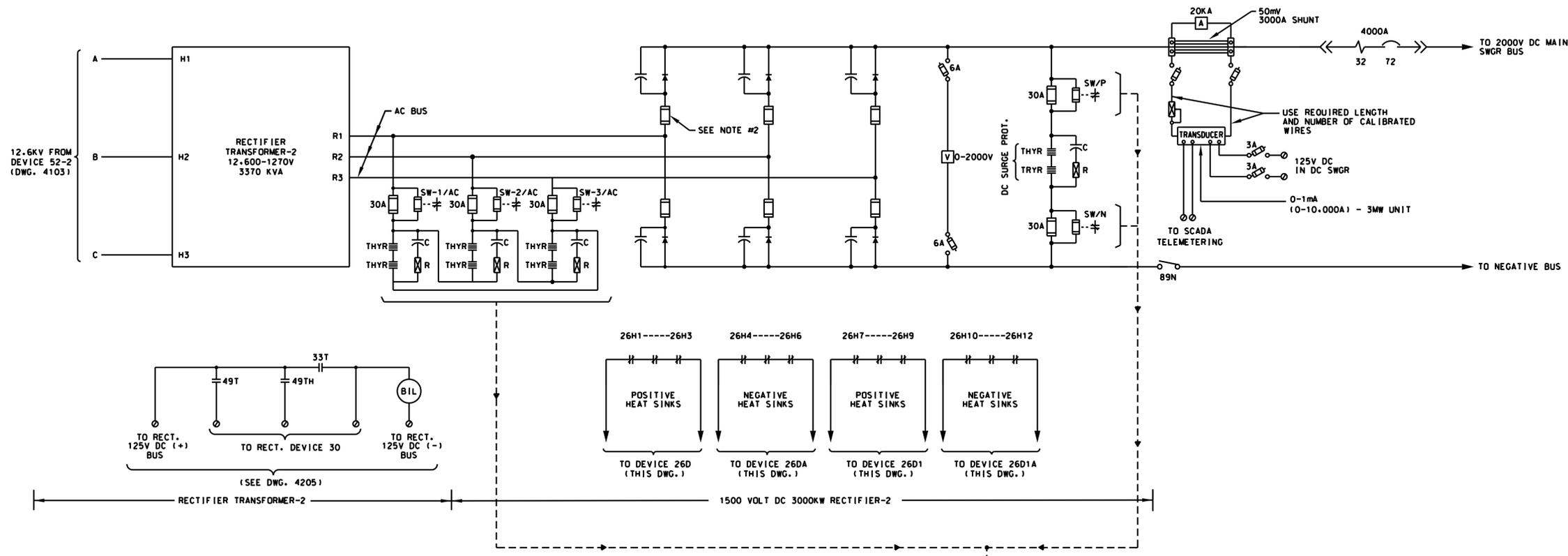
ENGINEERING DEPARTMENT  
547 W. JACKSON BOULEVARD  
CHICAGO, ILLINOIS 60661

LOCATION NAME:  
**95TH. STREET SUBSTATION**

TITLE:  
**1500V DC SCHEMATIC DIAGRAM  
RECTIFIER-1 CONTROLS & ANNUNCIATOR**

CAD FILE NUMBER: SS-11.9-4202.DGN

SCALE: NTS	DISTRICT: MED
PROJECT NO. GW4254-57102002	SHEET NO. <b>SS-11.9-4202</b>
MILE POST NO. 11.9	



- NOTES:**
1. DIODE THERMAL DEVICES CONNECTED TOGETHER MUST BE ON HEAT SINKS OF THE SAME POLARITY UNDER ALL CONDITIONS.
  2. PROVIDE TRIGGER TARGET TYPE DIODE FUSES.
  3. CONTACT WILL CLOSE IN NORMAL CONDITION & WILL OPEN IN FAULT CONDITION.
- SYMBOLS:**
- ⊙ TERMINAL BLOCK

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DESIGNED: HS  
DRAWN: JC  
CHECKED: FM  
METRA P.M.: R. CERANT  
DATE: JUNE 12, 2017

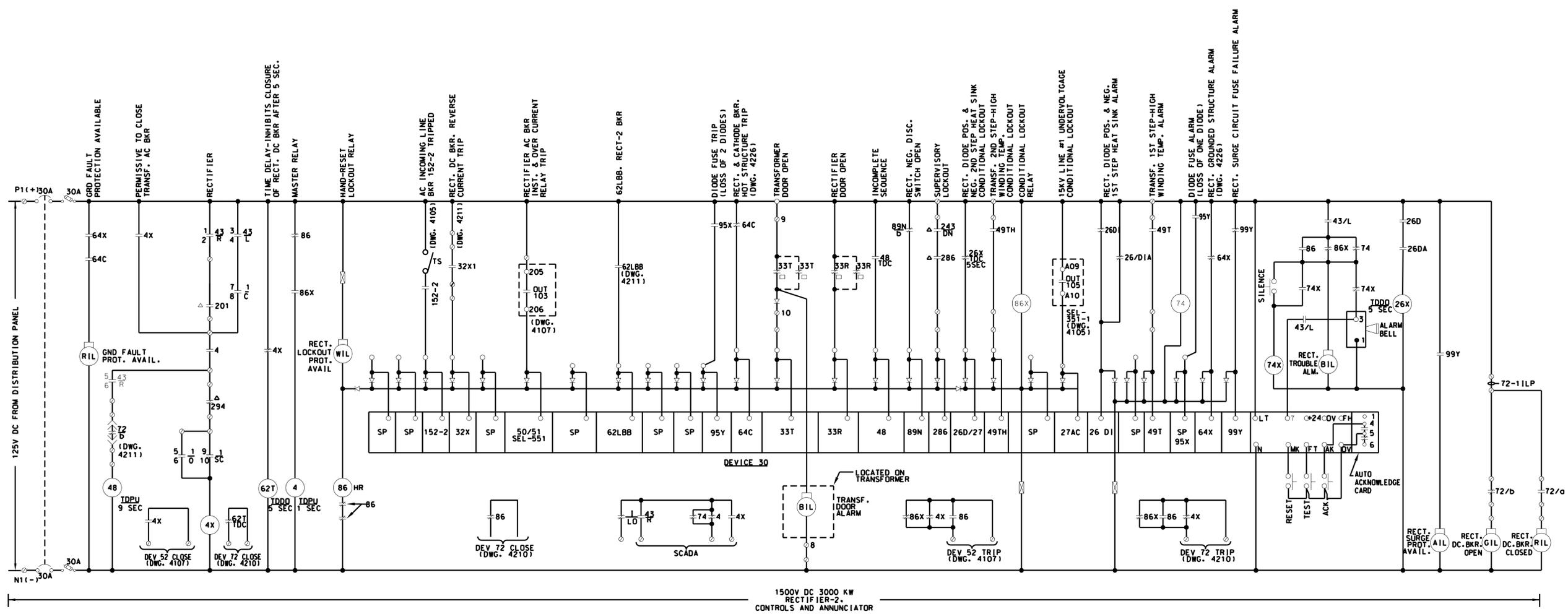
**Metra**

ENGINEERING DEPARTMENT  
547 W. JACKSON BOULEVARD  
CHICAGO, ILLINOIS 60661

LOCATION NAME:  
**95TH. STREET SUBSTATION**

TITLE:  
**1500V DC SCHEMATIC DIAGRAM  
RECTIFIER-2 POWER & AUXILIARIES**

CAD FILE NUMBER: SS-11.9-4204.DGN	
SCALE: NTS	DISTRICT: MED
PROJECT NO. GW4254-57102002	SHEET NO. <b>SS-11.9-4204</b>
MILE POST NO. 11.9	



**SYMBOLS:**

- △ LOCATED IN SCADA RTU CABINET
- CLOSED ONLY WITH BREAKER IN CONNECTED POS.
- ▲ OPEN ONLY WITH BREAKER IN CONNECTED POS.
- ⊙ TERMINAL BLOCK
- RTU-INDICATES SCADA REMOTE TERMINAL UNIT.

**MASTER CONTROL SWITCH  
DEVICE-1**

CONTACTS	POSITION			
	PULL OUT	TRIP	OFF AFTER TRIP	CLOSE
1-2	LO	X	X	X
3-4	T	X		X
5-6	D		X	X
7-8	C			X
9-10	SC			X

SPRING RETURN TO "OFF"

**SELECTOR SWITCH  
DEVICE-43**

CONTACTS	POSITION	
	REMOTE	LOCAL
1-2	R	X
3-4	L	X
5-6	R	X
7-8	L	X
9-10	R	X
11-12	L	X

NON-SPRING RETURN:  
REMOTE POSITION AT 12 O' CLOCK.  
LOCAL POSITION CLOCKWISE WHEN FACING FRONT OF SWITCH.

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Consulting Engineers  
20 N. Wacker Dr. Ste. 1500 Chicago IL 60606

DESIGNED: HS  
DRAWN: JC  
CHECKED: FM  
METRA P.M.: R. CERANT  
DATE: JUNE 12, 2017



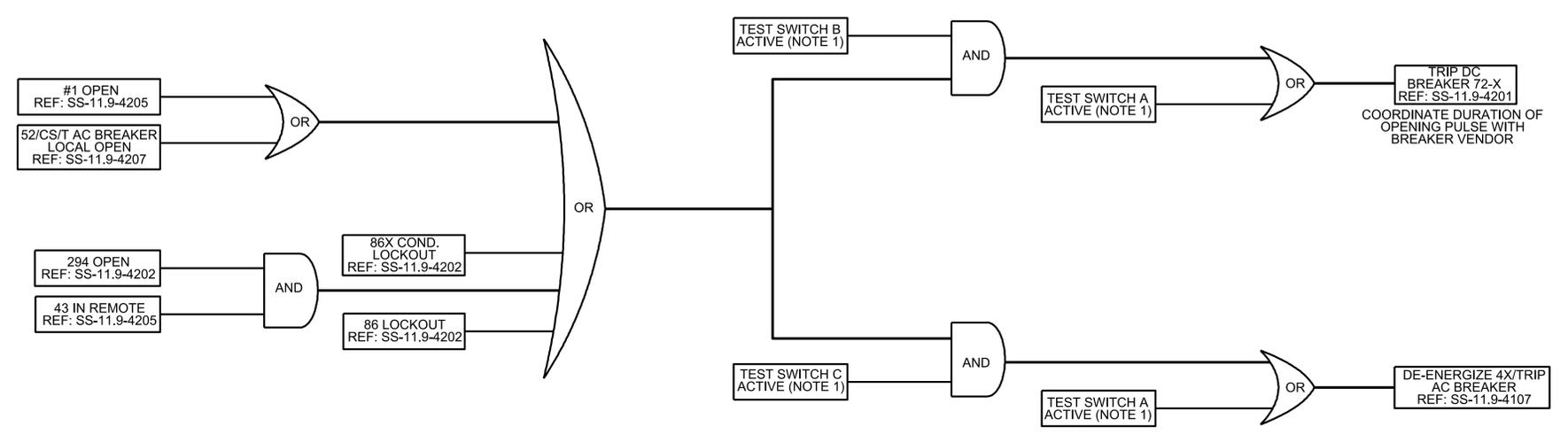
LOCATION NAME:  
**95TH. STREET SUBSTATION**

TITLE:  
**1500V DC SCHEMATIC DIAGRAM  
RECTIFIER-2 CONTROLS & ANNUNCIATOR**

CAD FILE NUMBER: SS-11.9-4205.DGN

SCALE: NTS	DISTRICT: MED
PROJECT NO. GW4254-57102002	SHEET NO. <b>SS-11.9-4205</b>
MILE POST NO. 11.9	

AC BREAKER/CATHODE TRIP



NOTES:

- TEST SWITCHES SHOWN IN THE LOGIC DIAGRAM SHALL BE SOFT KEYS PROGRAMMED ON THE HMI USED FOR THE ANNUNCIATOR. THE FOLLOWING KEYS SHALL BE AVAILABLE:
  - A TRIP AND BLOCK 52R AND 172R
  - B ENABLE TRIP TO 172R
  - C ENABLE TRIP TO 52R
  - D RESET 48 INCOMPLETE SEQUENCE
  - E ENABLE 48 INCOMPLETE SEQUENCE
  - F ENABLE 86 LOCKOUT
- ALL LOGIC DIAGRAMS ARE FOR INFORMATION ONLY. THE SUPPLIER SHALL ENSURE THAT THE PLC CODE MATCHES ALL CONTRACTUAL REQUIREMENTS BASED ON THE EQUIPMENT PROVIDED

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SUB CONSULTANT

PRIMARY CONSULTANT  
SEAL/ SIGNATURE



PRIMARY CONSULTANT



DESIGNED: A. ACHHAMMER  
DRAWN: N. DIAZ  
CHECKED: E. ROWE  
METRA P.M. R. CERANT  
DATE: JUNE 12, 2017



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547 W. JACKSON BOULEVARD  
CHICAGO, ILLINOIS 60661

LOCATION NAME:  
**95TH STREET SUBSTATION**

TITLE:  
**RECTIFIER PLC LOGIC DIAGRAM  
AC BREAKER/CATHODE TRIP  
SHEET 1 OF 4**

CAD FILE NUMBER:  
\$FILES\$

SCALE:  
NTS

PROJECT NO.  
GW4254-57102002

MILE POST NO.  
11.9

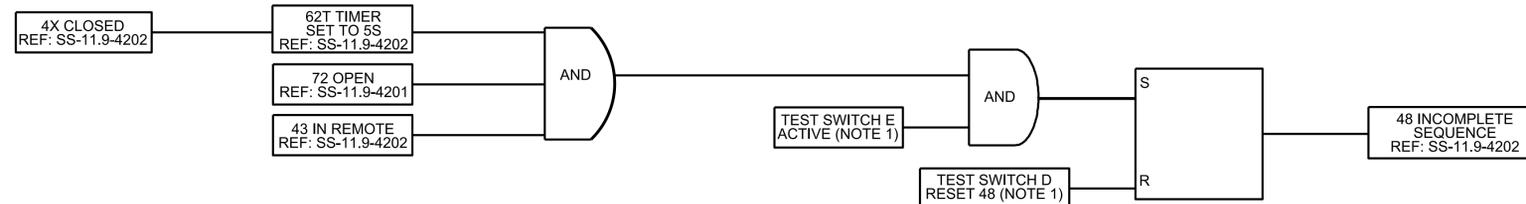
DISTRICT:  
MED

SHEET NO.  
**SS-11.9-4206**

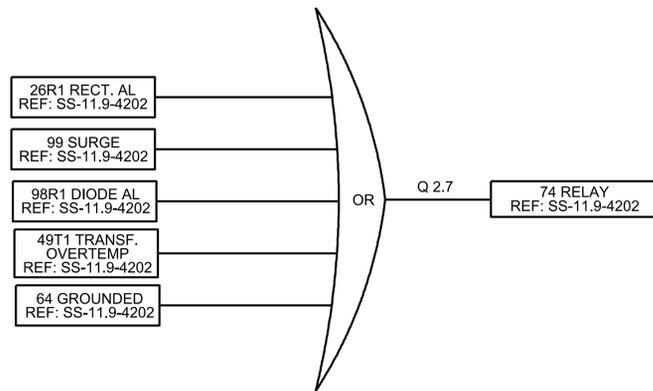




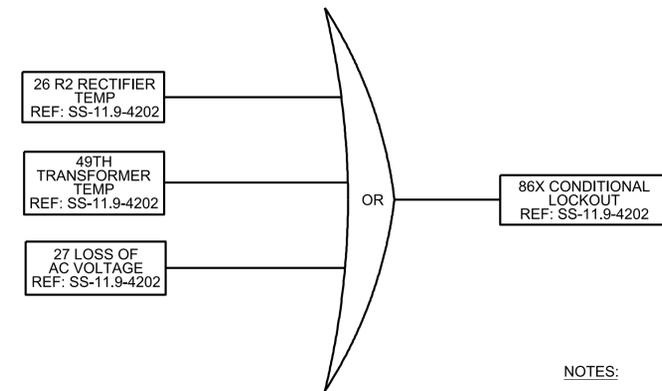
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74 RELAY TROUBLE



CONDITIONAL LOCKOUT

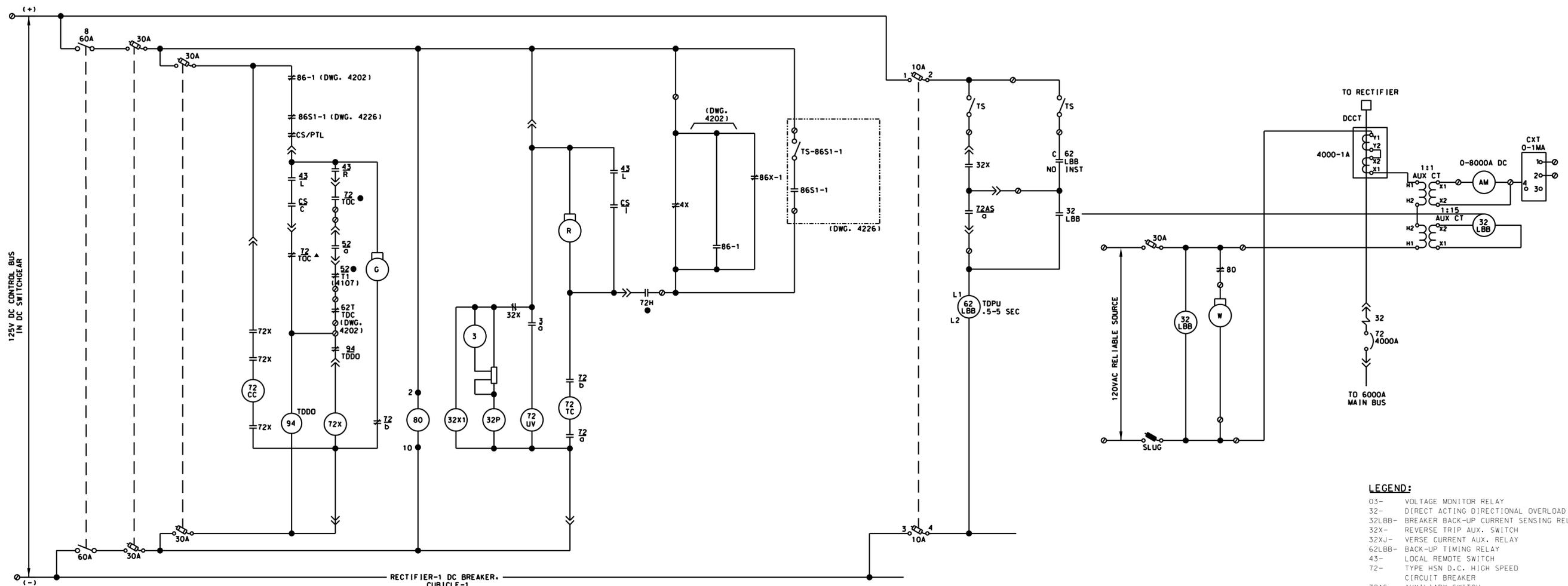


NOTES:

- TEST SWITCHES SHOWN IN THE LOGIC DIAGRAM SHALL BE SOFT KEYS PROGRAMMED ON THE HMI USED FOR THE ANNUNCIATOR. THE FOLLOWING KEYS SHALL BE AVAILABLE:
  - A TRIP AND BLOCK 52R AND 172R
  - B ENABLE TRIP TO 172R
  - C ENABLE TRIP TO 52R
  - D RESET 48 INCOMPLETE SEQUENCE
  - E ENABLE 48 INCOMPLETE SEQUENCE
  - F ENABLE 86 LOCKOUT
- ALL LOGIC DIAGRAMS ARE FOR INFORMATION ONLY. THE SUPPLIER SHALL ENSURE THAT PLC CODE MATCHES ALL CONTRACTUAL REQUIREMENTS BASED ON THE EQUIPMENT PROVIDED.

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																				ENGINEERING DEPARTMENT 547 W. JACKSON BOULEVARD CHICAGO, ILLINOIS 60661				TITLE:  <b>RECTIFIER PLC LOGIC DIAGRAM                  LOCKOUT AND ALARM LOGIC                  SHEET 4 OF 4</b>				SCALE: NTS				DISTRICT: MED			
0 7/28/2017 AA ER ISSUED FOR BID				REV DATE BY APP DESCRIPTION																MILE POST NO. 11.9															



- LEGEND:**
- 03- VOLTAGE MONITOR RELAY
  - 32- DIRECT ACTING DIRECTIONAL OVERLOAD
  - 32LBB- BREAKER BACK-UP CURRENT SENSING RELAY
  - 32X- REVERSE TRIP AUX. SWITCH
  - 32J- VERSE CURRENT AUX. RELAY
  - 62LBB- BACK-UP TIMING RELAY
  - 43- LOCAL REMOTE SWITCH
  - 72- TYPE HSN D.C. HIGH SPEED CIRCUIT BREAKER
  - 72AS- AUXILIARY SWITCH
  - 72CC- CLOSING SOLENOID
  - CS- CONTROL SWITCH
  - 72TC- SHUNT TRIP
  - 72UV- UNDER VOLTAGE COIL
  - 72X- CLOSING CONTACTOR
  - 76- DIRECT ACTING OVERLOAD
  - INST- INSTANTANEOUS
  - T00- TIME DELAY OPEN
  - A- AMBER INDICATING LIGHT
  - G- GREEN INDICATING LIGHT
  - R- RED INDICATING LIGHT

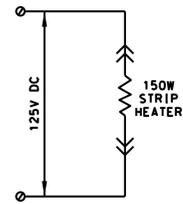
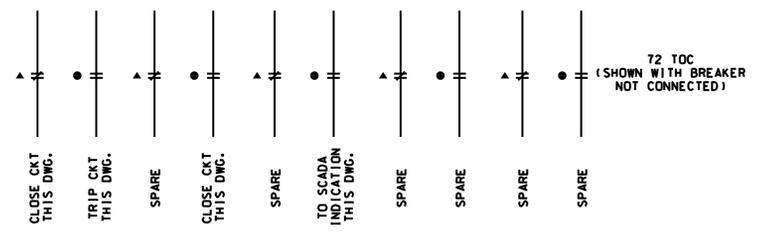
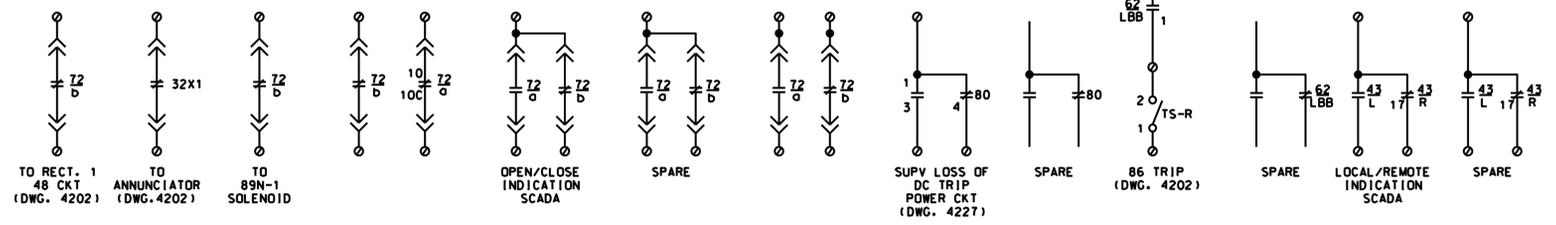
**CONTROL SWITCH DEVICE-CS**

CONTACTS	POSITION				
	PULL OUT	TRIP	OFF TRIP	AFTER CLOSE	CLOSE
1-2	L0	X	X	X	X
3-4	T	X			X
5-6	O		X	X	
7-8	C				X
9-10	SC			X	X

**SELECTOR SWITCH DEVICE-43**

CONTACTS	POSITION	
	REMOTE	LOCAL
1-2	R	X
3-4	L	X
5-6	R	X
7-8	L	X
9-10	R	X
11-12	L	X

NON-SPRING RETURN.  
REMOTE POSITION AT 12 O' CLOCK.  
LOCAL POSITION CLOCKWISE WHEN FACING FRONT OF SWITCH.



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CONSULTANT SEAL & SIGNATURE

CONSULTANT

**IDP** A Company of **Gannett Fleming**

Consulting Engineers  
20 N. Wacker Dr. Ste. 1500 Chicago IL 60606

DESIGNED: HS  
DRAWN: JC  
CHECKED: FM  
METRA P.M.: R. CERANT  
DATE: JUNE 12, 2017

**Metra**

ENGINEERING DEPARTMENT  
547 W. JACKSON BOULEVARD  
CHICAGO, ILLINOIS 60661

LOCATION NAME:  
**95TH. STREET SUBSTATION**

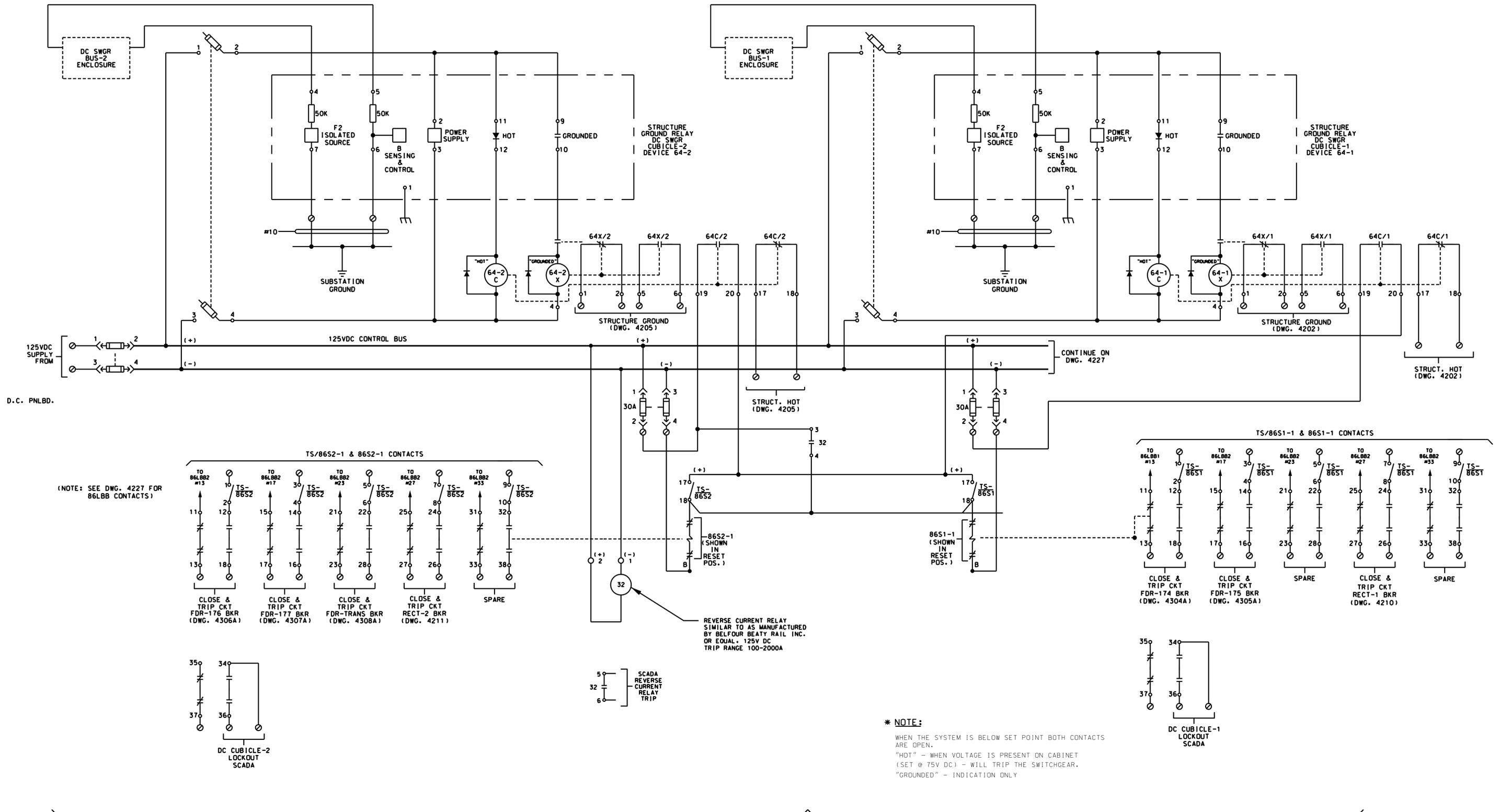
TITLE:  
**1500V DC SCHEMATIC DIAGRAM  
RECTIFIER-1 BREAKER 72-1**

CAD FILE NUMBER: SS-11.9-4210.DGN

SCALE: NTS  
PROJECT NO. GW4254-57102002  
MILE POST NO. 11.9

DISTRICT: MED  
SHEET NO. **SS-11.9-4210**





DC SWGR-STRUCTURE GRD RELAY, CUBICLE-2

DC SWGR-STRUCTURE GRD RELAY, CUBICLE-1

PRINTED ON: SDATES

REV	DATE	BY	APP	DESCRIPTION
0	07-28-2017	HS	HS	ISSUED FOR BID

CONSULTANT SEAL & SIGNATURE

CONSULTANT



**IDP** A Company of **Gannett Fleming**

Consulting Engineers  
20 N. Wacker Dr. Ste. 1500 Chicago IL 60606

DESIGNED: HS  
DRAWN: JC  
CHECKED: FM  
METRA P.M.: R. CERANT  
DATE: JUNE 12, 2017



LOCATION NAME:  
**95TH. STREET SUBSTATION**

TITLE:  
**1500V DC SCHEMATIC DIAGRAM  
DC SWITCHGEAR  
GROUND RELAY**

CAD FILE NUMBER: SS-11.9-4226.DGN

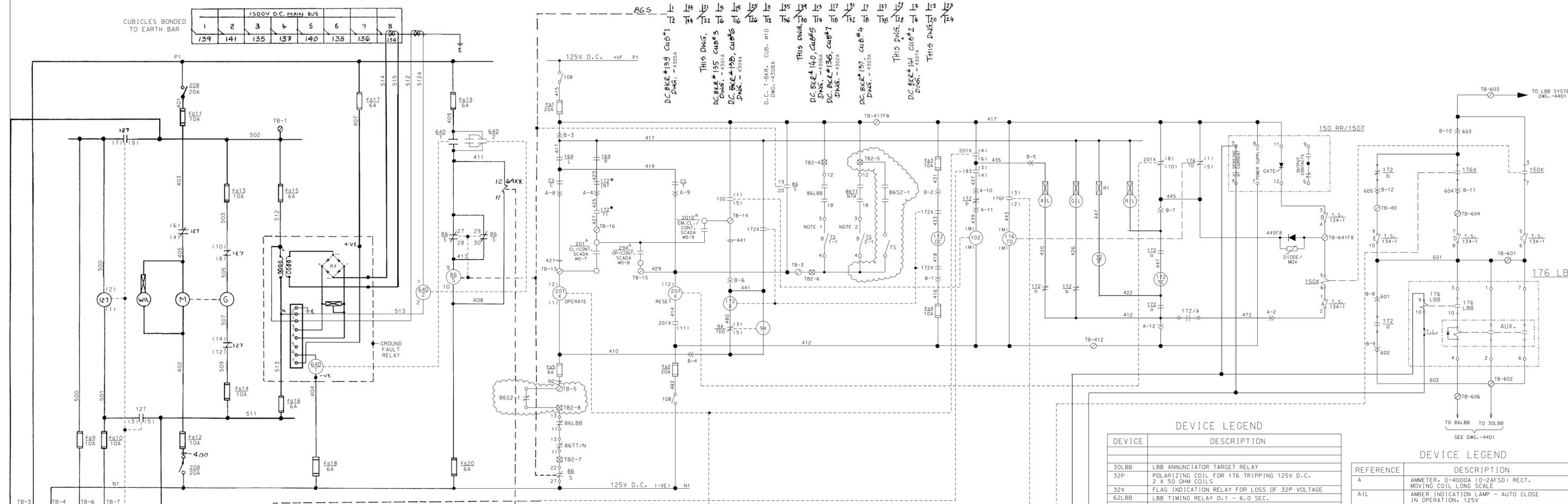
SCALE: NTS

DISTRICT: MED

PROJECT NO. GW4254-57102002

SHEET NO. **SS-11.9-4226**

MPLE POST NO. 11.9



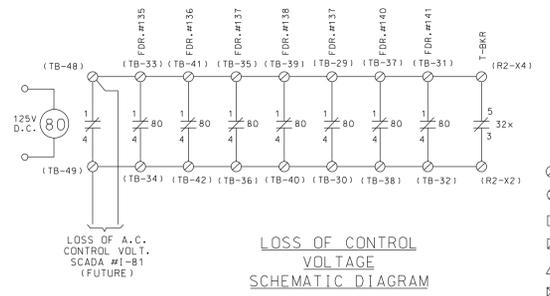
**DEVICE LEGEND**

DEVICE	DESCRIPTION
30LBB	LBB ANNUNCIATOR TARGET RELAY
32P	POLARIZING COIL FOR 176 TRIPPING 125V D.C. 2 X 50 OHM COILS
32X	FLAS INDICATION RELAY FOR LOSS OF 32P VOLTAGE
62LBB	LBB TIMING RELAY 0.1 - 6.0 SEC.
64D1	GROUND FAULT SENSING RELAY (BUS 1)
64D2	GROUND FAULT SENSING RELAY (BUS 2)
64XX	AUX. RELAY FOR GROUND FAULT TRANSFER TRIP
86/S	LOCKOUT RELAY
86LBB	BREAKER BACKUP LOCKOUT RELAY (MANUAL RESET)
86TT	TRANSFER TRIP LOCKOUT RELAY (ELECT. RESET)
94	CLOSING COIL CUT OFF (ANTI-PUMP) RELAY, 125V D.C., 7000 OHMS
94TT	TRANSFER TRIP OUTPUT RELAY
102	RE-CLOSING TIMER
108	DISCONNECT SWITCH
12T	A.C. SUPPLY CHANGE OVER RELAY
150RR	RATE OF RISE OVERCURRENT RELAY
150T	TIME OVERCURRENT RELAY
150X	AUXILIARY RELAY FOR LBB ON 150RR/150T
169	LOCAL - REMOTE SWITCH
172	D.C. FEEDER BREAKER
172D	BREAKER OPEN-CLOSE STATUS SWITCH
172C	BREAKER CLOSING COIL, 125V D.C., 1.0 OHM
172/TI	BREAKER CARRIAGE POSITION SWITCH, TRUCK INTERLOCK TRIP
172TC	SHUNT TRIP COIL, 125V D.C., 20 OHMS
172X	AUXILIARY CLOSING CONTACTOR, 125V D.C., 650 OHMS
176	MAGNETIC SERIES TRIP D/C DEVICE CAL. 3.5-4-5-6-7-8
176F	D/C RELAY (0-6000A. SCALE) 120V, 60HZ. HIGH SET POINT
176LBB	LBB D.C. CURRENT SENSING RELAY
176TD	D/C RL. TIMER, 125V D.C. (SET AT 20 SEC.) IN CASE WITH 176F
176X	AUXILIARY RELAY FOR MAGNETIC SERIES TRIP
183	VOLTAGE MEASURING TRANSFER RELAY
201	SUPERVISORY CLOSE RELAY (REMOTE CONTACT)
201D	EMERGENCY CLOSE RELAY (REMOTE CONTACT)
201X	BREAKER MASTER CONTROL RELAY (LATCHING TYPE)
294	SUPERVISORY TRIP RELAY (REMOTE CONTACT)
301TT	CONTROL SWITCH (OR TRANSFER TRIP BY-PASS)

**DEVICE LEGEND**

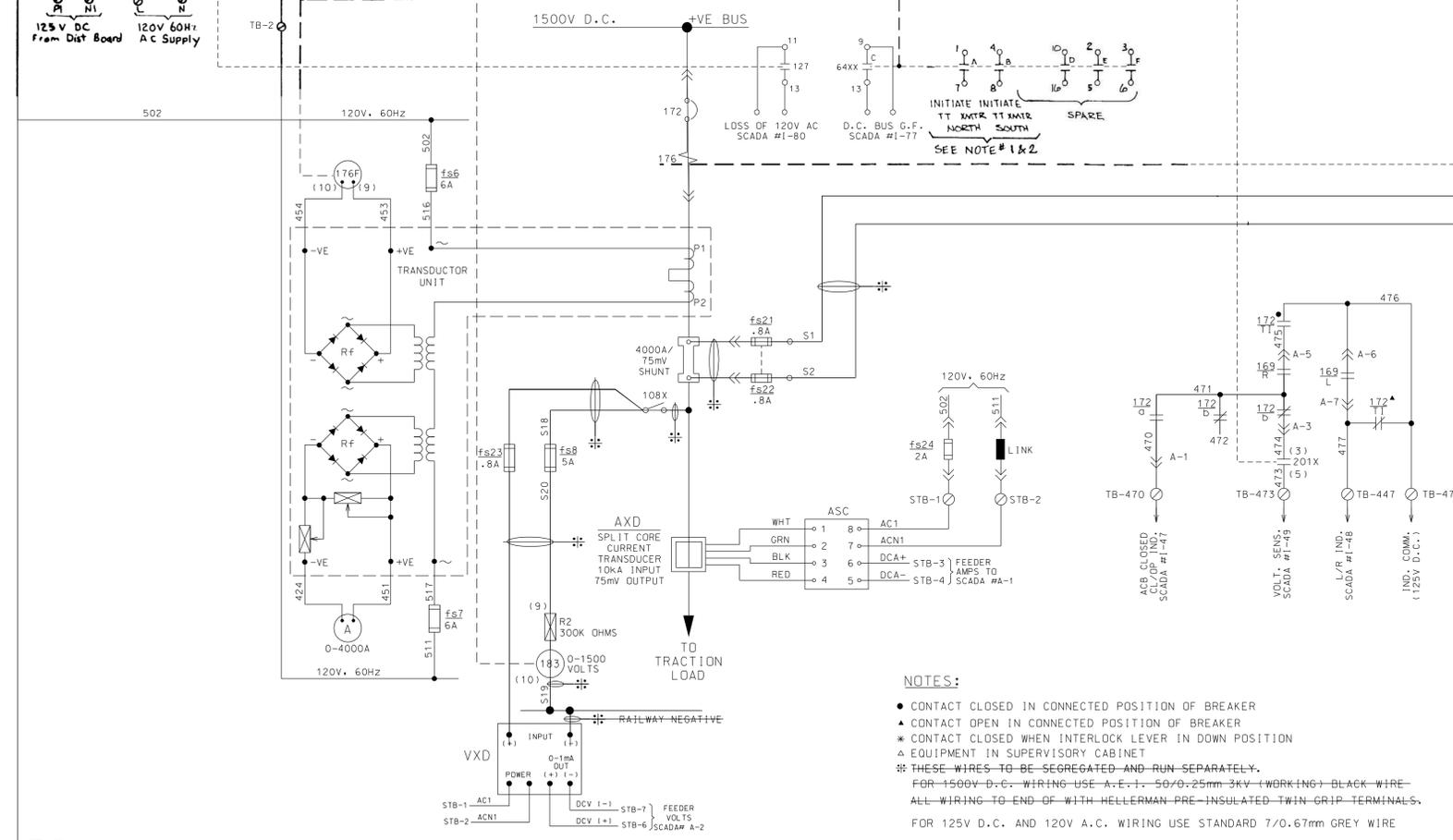
REFERENCE	DESCRIPTION
A	AMMETER, 0-4000A (0-2AFSD) RECT. MOVING COIL LONG SCALE
ATL	AMBER INDICATION LAMP - AUTO CLOSE IN OPERATION, 125V
ASC	D.C. CURRENT SIGNAL CONDITIONER
AXD	SPLIT CORE D.C. CURRENT TRANSDUCER
C	CLOSE
CC	CLOSING COIL
CS	CONTROL SWITCH, TRIP-NEUTRAL-CLOSE
DCSC	D.C. CURRENT SIGNAL CONDITIONER
DCVC	D.C. VOLTS CALIBRATOR
DCVT	D.C. VOLTS TRANSDUCER
DIODE/MOV	DIRECTIONAL BLOCKING DIODE/METAL OXIDE VARISTOR
GIL	GREEN INDICATION LAMP - C.B. OPEN, 125V
I.C.T.	IMPULSE TYPE CURRENT TRANSFORMER
L	LOCAL CONTROL MODE
LBB	LOCAL BREAKER BACKUP
OP	OPERATE
R	REMOTE CONTROL MODE OR RESISTOR
RE	RESET
RE	RED INDICATION LAMP - C.B. CLOSED, 125V
SHUNT	SWITCHBOARD D.C. SHUNT
TRIP	TRIP
TL	TEST LINK
T.S.	TEST SWITCH
TT	TRANSFER TRIP
V	VOLTMETER, 0-2000V MOVING COIL LONG SCALE DIRECT READING
VR1	ATTENUATOR, 20W, 0.2 OHM VARIABLE
VXD	FEEDER VOLTAGE TRANSDUCER
WIL	WHITE INDICATING LIGHT-CLOSING SEQUENCE IN PROGRESS

CIRCUIT WITHIN THE CLOUD INDICATES NEW WORK UNDER THIS CONTRACT



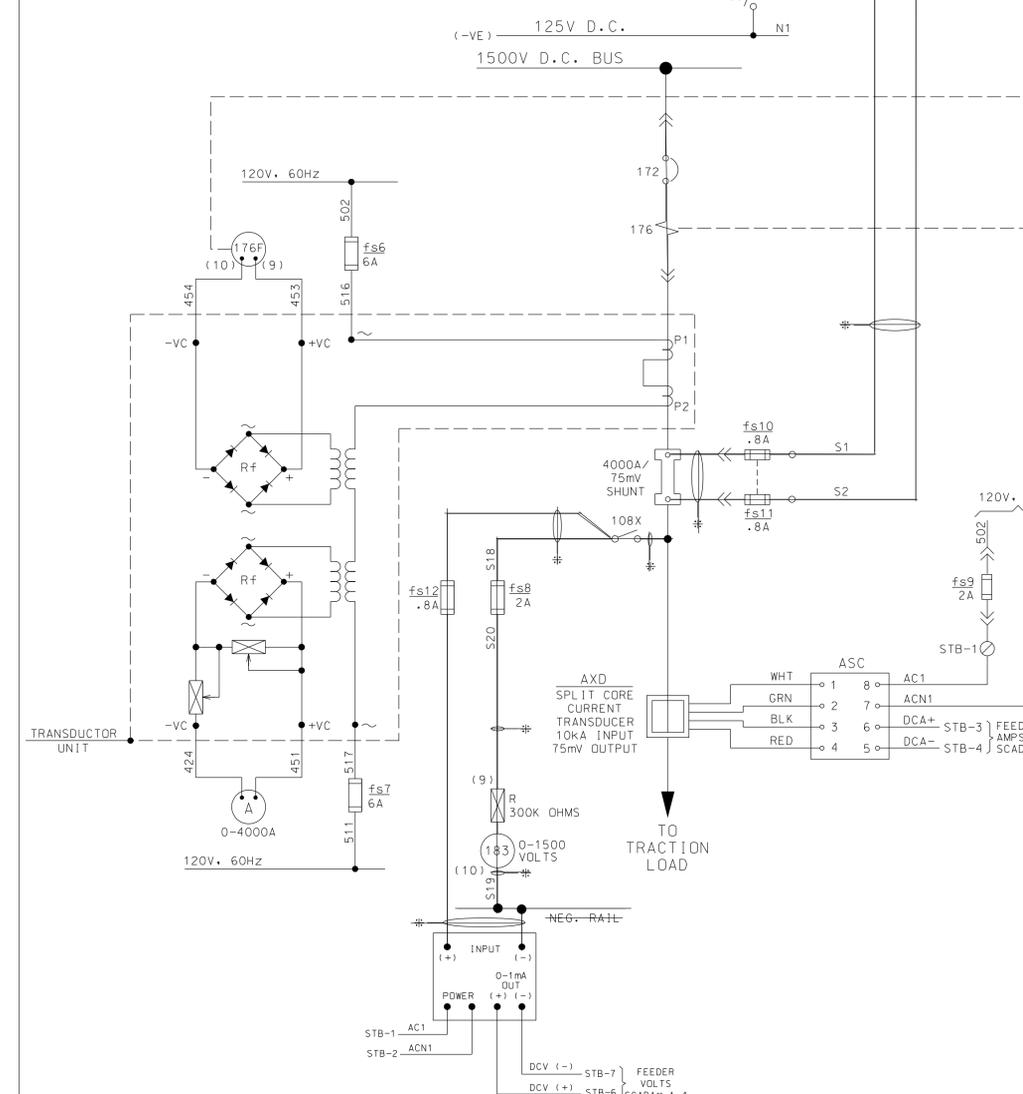
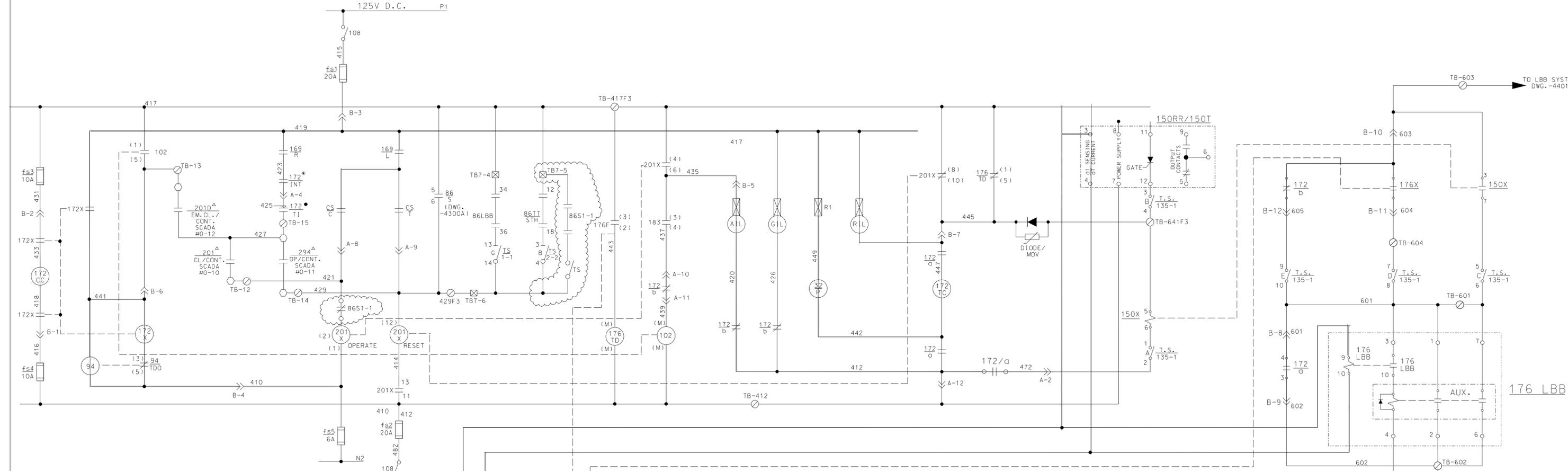
- NOTES:**
- LBB SYSTEM SCHEMATIC DIAGRAM, DWG. SS-11.9-4401.
  - TRANSFER TRIP SYSTEM SCHEMATIC DIAGRAM, DWG. SS-11.9-4402.

- LEGEND**
- ⊙ TERMINAL POINT AT 1500 V D.C. SWITCHGEAR
  - ⊗ TERMINAL POINT AT 12.4 KV A.C. SWITCHGEAR
  - ⊠ TERMINAL POINT AT 4 KV A.C. SWITCHGEAR
  - ⊡ TERMINAL POINT AT RECTIFIER CONTROL PANEL
  - ⊔ TERMINAL POINT AT TRANSFORMER CONTROL PANEL
  - ⊞ TERMINAL POINT AT TRANSFER TRIP & LBB SWITCHBOARD
  - TERMINAL POINT AT SUPERVISORY CONTROL CABINET
  - ⊞ TERMINAL POINT AT BUS FAULT RELAY PANEL OR CONTROL SWITCHBOARD OR OTHER MISC. PANELS.



- NOTES:**
- CONTACT CLOSED IN CONNECTED POSITION OF BREAKER
  - ▲ CONTACT OPEN IN CONNECTED POSITION OF BREAKER
  - \* CONTACT CLOSED WHEN INTERLOCK LEVER IN DOWN POSITION
  - ▲ EQUIPMENT IN SUPERVISORY CABINET
  - \*\* THESE WIRES TO BE SEGREGATED AND RUN SEPARATELY.
- FOR 1500V D.C. WIRING USE A.E.-1, 50/0.25mm 3KV (WORKING) BLACK WIRE - ALL WIRING TO END OF WITH HELLERMAN PRE-INSULATED TWIN GRIP TERMINALS.
- FOR 125V D.C. AND 120V A.C. WIRING USE STANDARD 7/0.67mm GREY WIRE

REV.	DATE	BY	DESCRIPTION
1	2-10-74	R.V.	Drawn
2	3-7-75	R.V.	Resistor R2 was prev. shown external to relay 193.
3	3-2-75	R.V.	Wire N-429 was prev. common to lamps ATL and GIL.
4	1-2-75	R.V.	Transducer Unit: terminal markings -1 to +VE, -2, -3, -4, -5, -6, -7, -8, -9, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -20, -21, -22, -23, -24, -25, -26, -27, -28, -29, -30, -31, -32, -33, -34, -35, -36, -37, -38, -39, -40, -41, -42, -43, -44, -45, -46, -47, -48, -49, -50, -51, -52, -53, -54, -55, -56, -57, -58, -59, -60, -61, -62, -63, -64, -65, -66, -67, -68, -69, -70, -71, -72, -73, -74, -75, -76, -77, -78, -79, -80, -81, -82, -83, -84, -85, -86, -87, -88, -89, -90, -91, -92, -93, -94, -95, -96, -97, -98, -99, -100, -101, -102, -103, -104, -105, -106, -107, -108, -109, -110, -111, -112, -113, -114, -115, -116, -117, -118, -119, -120, -121, -122, -123, -124, -125, -126, -127, -128, -129, -130, -131, -132, -133, -134, -135, -136, -137, -138, -139, -140, -141, -142, -143, -144, -145, -146, -147, -148, -149, -150, -151, -152, -153, -154, -155, -156, -157, -158, -159, -160, -161, -162, -163, -164, -165, -166, -167, -168, -169, -170, -171, -172, -173, -174, -175, -176, -177, 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-1579, -1580, -1581, -1582, -1583, -1584, -15



CIRCUIT WITHIN THE CLOUD INDICATES NEW WORK UNDER THIS CONTRACT

- LEGEND**
- TERMINAL POINT AT 1500 V D.C. SWITCHGEAR
  - ⊗ TERMINAL POINT AT 12.4 KV A.C. SWITCHGEAR
  - ◻ TERMINAL POINT AT 4 KV A.C. SWITCHGEAR
  - ◻ TERMINAL POINT AT RECTIFIER CONTROL PANEL
  - △ TERMINAL POINT AT TRANSFORMER CONTROL PANEL
  - ⊗ TERMINAL POINT AT TRANSFER TRIP & LBB SWITCHBOARD
  - TERMINAL POINT AT SUPERVISORY CONTROL CABINET
  - ◻ TERMINAL POINT AT BUS FAULT RELAY PANEL OR CONTROL SWITCHBOARD OR OTHER MISC. PANELS.

- NOTES:**
- CONTACT CLOSED IN CONNECTED POSITION OF BREAKER
  - ▲ CONTACT OPEN IN CONNECTED POSITION OF BREAKER
  - \* CONTACT CLOSED WHEN INTERLOCK LEVER IN DOWN POSITION
  - ▲ EQUIPMENT IN SUPERVISORY CABINET
  - \* THESE WIRES TO BE SEGREGATED AND RUN SEPARATELY.
  - FOR 1500V D.C. WIRING USE A.T.T. 50/0.25mm 3KV (WORKING) BLACK WIRE
  - ALL WIRING TO END OF WITH HELFERMAN PRE-INSULATED TWIN GRIP TERMINALS
  - FOR 125V D.C. AND 120V A.C. WIRING USE STANDARD 7/0.67mm GREY WIRE

**DEVICE LEGEND**

REFERENCE	DESCRIPTION
A	AMMETER, 0-4000A (0-2AFSD) RECT. MOVING COIL LONG SCALE
A1L	AMBER INDICATION LAMP - AUTO CLOSE IN OPERATION, 125V
ASC	D.C. CURRENT SIGNAL CONDITIONER
AXD	SPLIT CORE D.C. CURRENT TRANSDUCER
C	CLOSE
CC	CLOSING COIL
CS	CONTROL SWITCH, TRIP-NEUTRAL-CLOSE
DCCT	D.C. CURRENT TRANSDUCER, 3000/1A, 120V, 60HZ
DCSC	D.C. CURRENT SIGNAL CONDITIONER
DCVC	D.C. VOLTS CALIBRATOR
DCVT	D.C. VOLTS TRANSDUCER
D	DIRECTIONAL BLOCKING DIODE/METAL OXIDE VARISTOR
GIL	GREEN INDICATION LAMP - C.B. OPEN, 125V
I.C.T.	IMPULSE TYPE CURRENT TRANSFORMER
L	LOCAL CONTROL MODE
LBB	LOCAL BREAKER BACKUP
OP	REMOTE CONTROL MODE
RE	RESET
RIL	RED INDICATION LAMP - C.B. CLOSED, 125V
SHUNT	SWITCHBOARD D.C. SHUNT
T	TRIP
TL	TEST LINK
T.S.	TEST SWITCH
TT	TRANSFER TRIP
V	VOLTMETER, 0-2000V MOVING COIL LONG SCALE DIRECT READING
VR1	ATTENUATOR, 20W, 0.2 OHM VARIABLE
VXD	FEEDER VOLTAGE TRANSDUCER

**DEVICE LEGEND**

DEVICE	DESCRIPTION
30LBB	LBB ANNUNCIATOR TARGET RELAY
32P	POLARIZING COIL FOR 176 TRIPPING 125V D.C. 2 X 50 OHM COILS
32X	FLAG INDICATION RELAY FOR LOSS OF 32P VOLTAGE
62LBB	LBB TIMING RELAY 0.1 - 6.0 SEC.
64D2	GROUND FAULT SENSING RELAY (BUS 2)
64XX	AUX. RELAY FOR GROUND FAULT TRANSFER TRIP
86/S	LOCKOUT RELAY
86LBB	BREAKER BACKUP LOCKOUT RELAY (MANUAL RESET)
86TT	TRANSFER TRIP LOCKOUT RELAY (ELECT. RESET)
94	CLOSING COIL CUT OFF (ANTI-PUMP) RELAY, 125V D.C., 7000 OHMS
94TT	TRANSFER TRIP OUTPUT RELAY
102	RECLOSEING TIMER
108	125V D.C. CONTROL ISOLATOR
108X	1500V D.C. VOLTAGE MEASURING ISOLATOR
127	A.C. SUPPLY CHANGE OVER RELAY
150RR	RATE OF RISE OVERCURRENT RELAY "SWARTZ"
150T	TIME OVERCURRENT RELAY
150X	AUXILIARY RELAY FOR LBB ON 150RR/150T
169	LOCAL - REMOTE SWITCH
172	D.C. FEEDER BREAKER
1720-b	BREAKER OPEN-CLOSE STATUS SWITCH
172CC	BREAKER CLOSING COIL, 125V D.C., 1.0 OHM
172TI	BREAKER CARRIAGE POSITION SWITCH
172TC	SHUNT TRIP COIL, 125V D.C., 20 OHMS
172X	AUXILIARY CLOSING CONTACTOR, 125V D.C., 650 OHMS
176	MAGNETIC SERIES TRIP O/C DEVICE CAL. 3.5-4.5-6-7-8
176F	O/C RELAY (0-6000A. SCALE) 120V, 60HZ, HIGH SET POINT
176LBB	LBB D.C. CURRENT SENSING RELAY
176TD	O/C RL.T. TIMER, 125V D.C. (SET AT 20 SEC.) IN CASE WITH 176F
176X	AUXILIARY RELAY FOR MAGNETIC SERIES TRIP
183	VOLTAGE MEASURING TRANSFER RELAY
201	SUPERVISORY CLOSE RELAY (REMOTE CONTACT)
201D	EMERGENCY CLOSE RELAY (REMOTE CONTACT)
201X	BREAKER MASTER CONTROL RELAY (LATCHING TYPE)
294	SUPERVISORY TRIP RELAY (REMOTE CONTACT)
301TT	CONTROL SWITCH (OR TRANSFER TRIP BY-PASS)

BY LDP

REV	DATE	DESCRIPTION	BY
-	07/28/17	ISSUED FOR BID	HS
-	7/11	MINOR CORRECTIONS	LB WPS
-	2/06	MINOR CORRECTIONS	WPS
-	9/04	GENERAL REVISION	WPS
-	5/03	FIELD CORRECTIONS, AS-BUILT	WPS
-	1/00	ISSUED FOR SCADA AS-BUILT	WPS

**Metra** ENGINEERING DEPARTMENT  
CHICAGO, ILLINOIS

1500V D.C. SWITCHGEAR  
D.C. FDR. BKR. SEC. NO.135. CUB. NO.3  
SCHEMATIC DIAGRAM

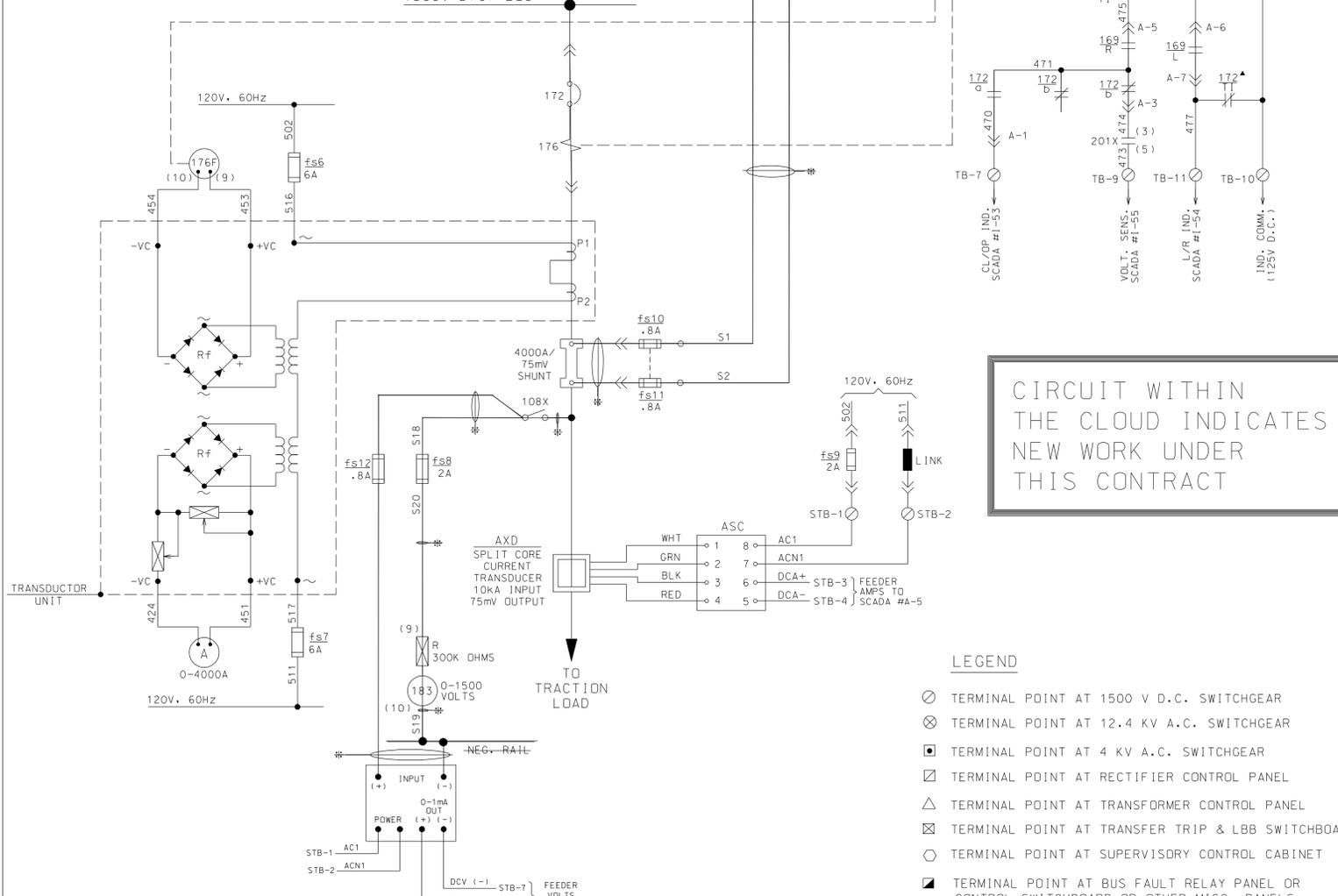
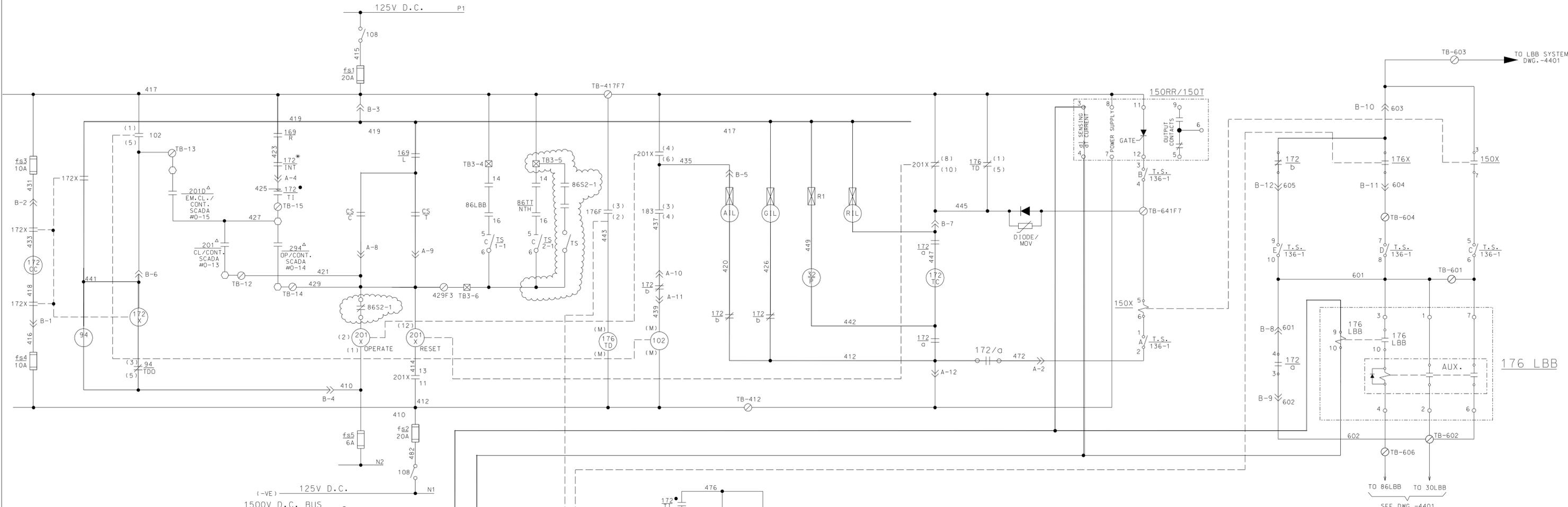
95th STREET TIE STATION

SCALE: NONE DATE: \_\_\_\_\_

CAO FILE NUMBER: \_\_\_\_\_

DESIGNED	DRAWN	CHECKED	APPROVED
RC		WPS	WPS

DISTRICT: M.E.D. PRINT NUMBER: SS-11.9-4301A



CIRCUIT WITHIN THE CLOUD INDICATES NEW WORK UNDER THIS CONTRACT

**NOTES:**

- CONTACT CLOSED IN CONNECTED POSITION OF BREAKER
- ▲ CONTACT OPEN IN CONNECTED POSITION OF BREAKER
- \* CONTACT CLOSED WHEN INTERLOCK LEVER IN DOWN POSITION
- ▲ EQUIPMENT IN SUPERVISORY CABINET

**\*\*\* THESE WIRES TO BE SEGREGATED AND RUN SEPARATELY. \*\*\***

FOR 1500V D.C. WIRING USE A.E.T. 50/0.25mm 3KV (WORKING) BLACK WIRE  
 ALL WIRING TO END OF WITH HELLERMAN PRE-INSULATED TWIN GRIP TERMINALS.

FOR 125V D.C. AND 120V A.C. WIRING USE STANDARD 7/0.67mm GREY WIRE

**DEVICE LEGEND**

REFERENCE	DESCRIPTION
A	AMMETER, 0-4000A (0-2AF5D) RECT. MOVING COIL LONG SCALE
AIL	AMBER INDICATION LAMP - AUTO CLOSE IN OPERATION, 125V
ASC	D.C. CURRENT SIGNAL CONDITIONER
AXD	SPLIT CORE D.C. CURRENT TRANSDUCER
C	CLOSE
CC	CLOSING COIL
DCCT	D.C. CURRENT TRANSDUCER, 3000/1A, 120V, 60Hz
DCSC	D.C. CURRENT SIGNAL CONDITIONER
DCVC	D.C. VOLTS CALIBRATOR
DCVT	D.C. VOLTS TRANSDUCER
DIODE/MOV	DIRECTIONAL BLOCKING DIODE/METAL OXIDE VARISTOR
GIL	GREEN INDICATION LAMP - C.B. OPEN, 125V
I.C.T.	IMPULSE TYPE CURRENT TRANSFORMER
L	LOCAL CONTROL MODE
LBB	LOCAL BREAKER BACKUP
OP	OPERATE
R	REMOTE CONTROL MODE
RE	RESET
RIL	RED INDICATION LAMP - C.B. CLOSED, 125V
SHUNT	SWITCHBOARD D.C. SHUNT
T	TRIP
TL	TEST LINK
T.S.	TEST SWITCH
TT	TRANSFER TRIP
V	VOLTMETER, 0-2000V MOVING COIL LONG SCALE DIRECT READING
VR1	ATTENUATOR, 20W, 0.2 OHM VARIABLE
VXD	FEEDER VOLTAGE TRANSDUCER

- LEGEND**
- TERMINAL POINT AT 1500 V D.C. SWITCHGEAR
  - ⊗ TERMINAL POINT AT 12.4 KV A.C. SWITCHGEAR
  - ◻ TERMINAL POINT AT 4 KV A.C. SWITCHGEAR
  - ◻ TERMINAL POINT AT RECTIFIER CONTROL PANEL
  - △ TERMINAL POINT AT TRANSFORMER CONTROL PANEL
  - ⊗ TERMINAL POINT AT TRANSFER TRIP & LBB SWITCHBOARD
  - TERMINAL POINT AT SUPERVISORY CONTROL CABINET
  - ◼ TERMINAL POINT AT BUS FAULT RELAY PANEL OR CONTROL SWITCHBOARD OR OTHER MISC. PANELS.

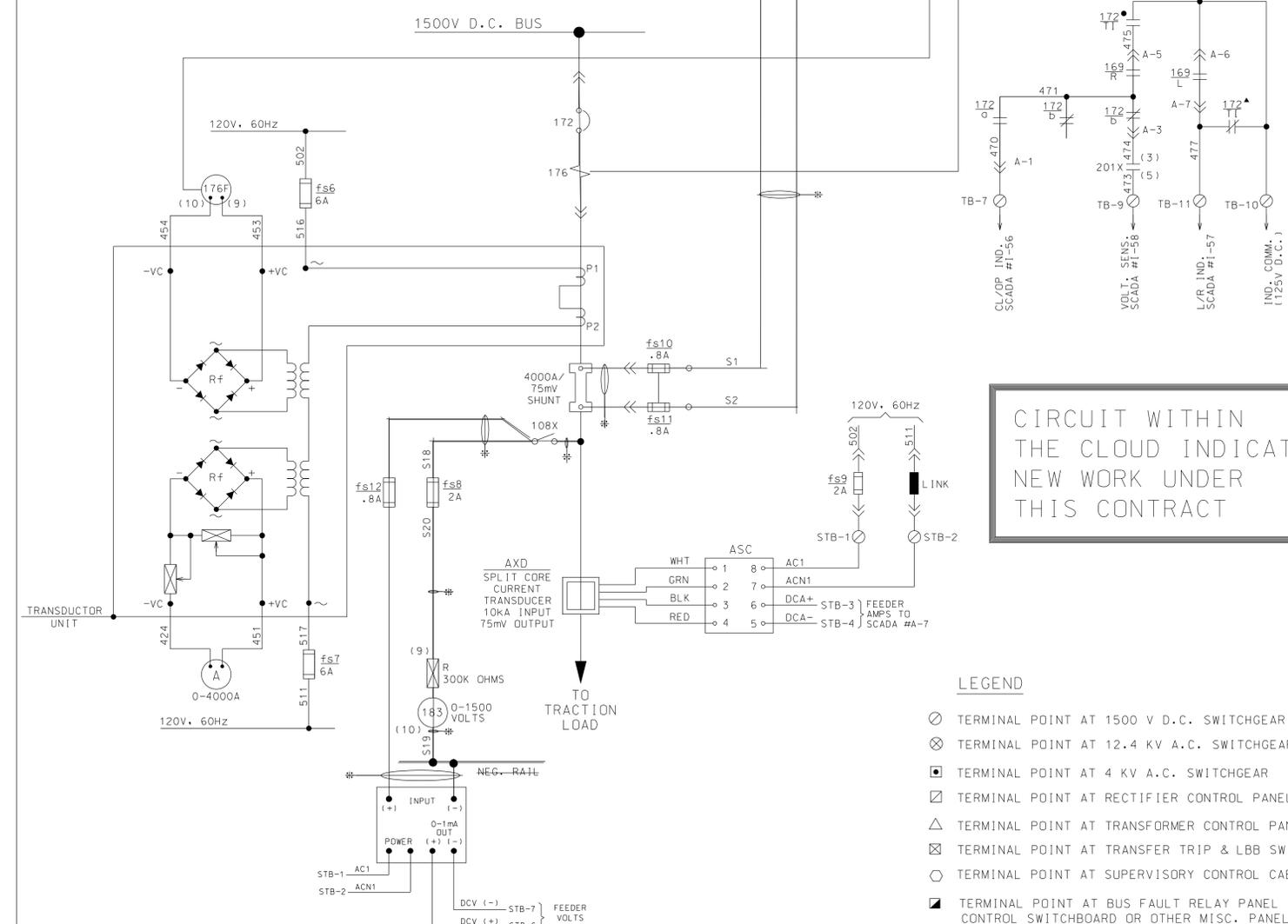
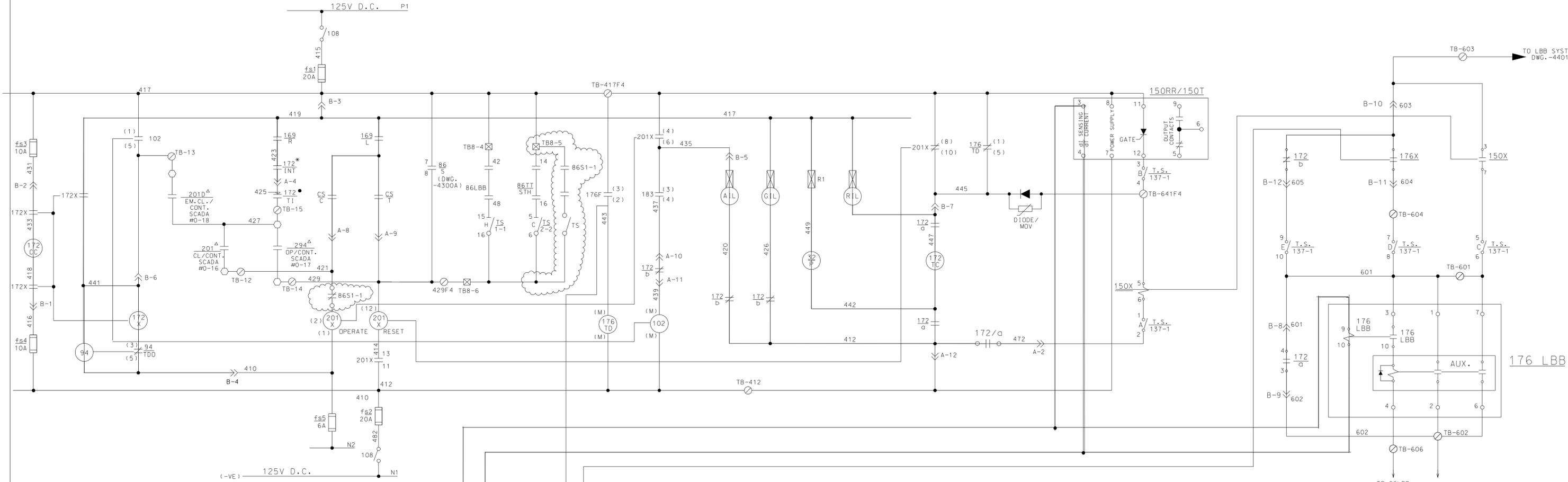
**DEVICE LEGEND**

DEVICE	DESCRIPTION
30LBB	LBB ANNUNCIATOR TARGET RELAY
32P	POLARIZING COIL FOR 176 TRIPPING 125V D.C. 2 X 50 OHM COILS
32X	FLAG INDICATION RELAY FOR LOSS OF 32P VOLTAGE
62LBB	LBB TIMING RELAY 0.1 - 6.0 SEC.
64DZ	GROUND FAULT SENSING RELAY (BUS 2)
64XX	AUX. RELAY FOR GROUND FAULT TRANSFER TRIP
86/S	LOCKOUT RELAY
86LBB	BREAKER BACKUP LOCKOUT RELAY (MANUAL RESET)
86TT	TRANSFER TRIP LOCKOUT RELAY (ELECT. RESET)
94	CLOSING COIL CUT OFF (ANTI-PUMP) RELAY, 125V D.C., 7000 OHMS
94TT	TRANSFER TRIP OUTPUT RELAY
102	RE-CLOSING TIMER
108	125V D.C. CONTROL ISOLATOR
108X	1500V D.C. VOLTAGE MEASURING ISOLATOR
127	A.C. SUPPLY CHANGE OVER RELAY
150RR	RATE OF RISE OVERCURRENT RELAY "SWARTZ"
150T	TIME OVERCURRENT RELAY
150X	AUXILIARY RELAY FOR LBB ON 150RR/150T
169	LOCAL - REMOTE SWITCH
172	D.C. FEEDER BREAKER
172a-b	BREAKER OPEN-CLOSE STATUS SWITCH
172CC	BREAKER CLOSING COIL, 125V D.C., 1.0 OHM
172T	BREAKER CARRIAGE POSITION SWITCH
172TI	BREAKER INDICATION LAMP - C.B. OPEN, 125V
172TC	SHUNT TRIP COIL, 125V D.C., 20 OHMS
172X	AUXILIARY CLOSING CONTACTOR, 125V D.C., 650 OHMS
176	MAGNETIC SERIES TRIP O/C DEVICE CAL. 3.5-4-5-6-7-8
176F	O/C RELAY (0-6000A. SCALE) 120V, 60Hz, HIGH SET POINT
176LBB	LBB D.C. CURRENT SENSING RELAY
176TD	O/C RL. TIMER, 125V D.C. (SET AT 20 SEC.) IN CASE WITH 176F
176X	AUXILIARY RELAY FOR MAGNETIC SERIES TRIP
183	VOLTAGE MEASURING TRANSFER RELAY
201	SUPERVISORY CLOSE RELAY (REMOTE CONTACT)
201D	EMERGENCY CLOSE RELAY (REMOTE CONTACT)
201X	BREAKER MASTER CONTROL RELAY (LATCHING TYPE)
294	SUPERVISORY TRIP RELAY (REMOTE CONTACT)
301TT	CONTROL SWITCH (OR TRANSFER TRIP BY-PASS)

BY LOP

REV	DATE	DESCRIPTION	BY
-	07/28/17	ISSUED FOR BID	HS
-	7/11	MINOR CORRECTIONS	LB WPS
-	2/06	MINOR CORRECTIONS	WPS
-	9/04	GENERAL REVISION	WPS
-	5/03	FIELD CORRECTIONS, AS-BUILT	WPS
-	1/00	ISSUED FOR SCADA AS-BUILT	WPS

1500V D.C. SWITCHGEAR D.C. FDR. BKR. SEC. NO.136. CUB. NO.7 SCHEMATIC DIAGRAM	
95th STREET TIE STATION	
SCALE: NONE	DATE:
DESIGNED	CHECKED
DRAWN	APPROVED
RC	WPS
DISTRICT PRINT NUMBER	
M.E.D.	SS-11.9-4302A



CIRCUIT WITHIN THE CLOUD INDICATES NEW WORK UNDER THIS CONTRACT

**NOTES:**

- CONTACT CLOSED IN CONNECTED POSITION OF BREAKER
- ▲ CONTACT OPEN IN CONNECTED POSITION OF BREAKER
- \* CONTACT CLOSED WHEN INTERLOCK LEVER IN DOWN POSITION
- △ EQUIPMENT IN SUPERVISORY CABINET
- ⊠ THESE WIRES TO BE SEGREGATED AND RUN SEPARATELY.
- FOR 1500V D.C. WIRING USE A.E.L. 50/0.25mm 3KV (WORKING) BLACK WIRE
- ALL WIRING TO END OF WITH HELLERMAN PRE-INSULATED TWIN GRIP TERMINALS.
- FOR 125V D.C. AND 120V A.C. WIRING USE STANDARD 7/0.67mm GREY WIRE

**DEVICE LEGEND**

REFERENCE	DESCRIPTION
A	AMMETER, 0-4000A (0-2AFSD) RECT. MOVING COIL LONG SCALE
A1L	AMBER INDICATION LAMP - AUTO CLOSE IN OPERATION, 125V
ASC	D.C. CURRENT SIGNAL CONDITIONER
AXD	SPLIT CORE D.C. CURRENT TRANSDUCER
C	CLOSE
CC	CLOSING COIL
CS	CONTROL SWITCH, TRIP-NEUTRAL-CLOSE
DCCT	D.C. CURRENT TRANSDUCER, 3000/1A, 120V, 60HZ
DCSC	D.C. CURRENT SIGNAL CONDITIONER
DCVC	D.C. VOLTS CALIBRATOR
DCVT	D.C. VOLTS TRANSDUCER
DIODE/MOV	DIRECTIONAL BLOCKING DIODE/METAL OXIDE VARISTOR
GIL	GREEN INDICATION LAMP - C.B. OPEN, 125V
I.C.T.	IMPULSE TYPE CURRENT TRANSFORMER
L	LOCAL CONTROL MODE
LBB	LOCAL BREAKER BACKUP
OP	OPERATE
R	REMOTE CONTROL MODE
RE	RESET
RIL	RED INDICATION LAMP - C.B. CLOSED, 125V
SHUNT	SWITCHBOARD D.C. SHUNT
T	TRIP
TL	TEST LINK
T.S.	TEST SWITCH
TT	TRANSFER TRIP
V	VOLTMETER, 0-2000V MOVING COIL LONG SCALE DIRECT READING
VR1	ATTENUATOR, 20W, 0.2 OHM VARIABLE
VXD	FEEDER VOLTAGE TRANSDUCER

- LEGEND**
- TERMINAL POINT AT 1500 V D.C. SWITCHGEAR
  - ⊗ TERMINAL POINT AT 12.4 KV A.C. SWITCHGEAR
  - ⊠ TERMINAL POINT AT 4 KV A.C. SWITCHGEAR
  - ⊡ TERMINAL POINT AT RECTIFIER CONTROL PANEL
  - △ TERMINAL POINT AT TRANSFORMER CONTROL PANEL
  - ⊞ TERMINAL POINT AT TRANSFER TRIP & LBB SWITCHBOARD
  - TERMINAL POINT AT SUPERVISORY CONTROL CABINET
  - ⊠ TERMINAL POINT AT BUS FAULT RELAY PANEL OR CONTROL SWITCHBOARD OR OTHER MISC. PANELS.

**DEVICE LEGEND**

DEVICE	DESCRIPTION
30LBB	LBB ANNUNCIATOR TARGET RELAY
32P	POLARIZING COIL FOR 176 TRIPPING 125V D.C. 2 X 50 OHM COILS
32X	FLAG INDICATION RELAY FOR LOSS OF 32P VOLTAGE
62LBB	LBB TIMING RELAY 0.1 - 6.0 SEC.
64D2	GROUND FAULT SENSING RELAY (BUS 2)
64XX	AUX. RELAY FOR GROUND FAULT TRANSFER TRIP
86/S	LOCKOUT RELAY
86LBB	BREAKER BACKUP LOCKOUT RELAY (MANUAL RESET)
86TT	TRANSFER TRIP LOCKOUT RELAY (ELECT. RESET)
94	CLOSING COIL CUT OFF (ANTI-PUMP) RELAY, 125V D.C., 7000 OHMS
94TT	TRANSFER TRIP OUTPUT RELAY
102	RE-CLOSING TIMER
108	125V D.C. CONTROL ISOLATOR
108X	1500V D.C. VOLTAGE MEASURING ISOLATOR
127	A.C. SUPPLY CHANGE OVER RELAY
150RR	RATE OF RISE OVERCURRENT RELAY "SWARTZ"
150T	TIME OVERCURRENT RELAY
150X	AUXILIARY RELAY FOR LBB ON 150RR/150T
169	LOCAL - REMOTE SWITCH
172	D.C. FEEDER BREAKER
172a-b	BREAKER OPEN-CLOSE STATUS SWITCH
172CC	BREAKER CLOSING COIL, 125V D.C., 1.0 OHM
172T	BREAKER CARRIAGE POSITION SWITCH
172TC	SHUNT TRIP COIL, 125V D.C., 20 OHMS
172X	AUXILIARY CLOSING CONTACTOR, 125V D.C., 650 OHMS
176	MAGNETIC SERIES TRIP O/C DEVICE CAL. 3,5-4-5-6-7-8
176F	O/C RELAY (0-6000A, SCALE) 120V, 60HZ, HIGH SET POINT
176LBB	LBB D.C. CURRENT SENSING RELAY
176TD	O/C RL.T. TIMER, 125V D.C. (SET AT 20 SEC.) IN CASE WITH 176F
176X	AUXILIARY RELAY FOR MAGNETIC SERIES TRIP
183	VOLTAGE MEASURING TRANSFER RELAY
201	SUPERVISORY CLOSE RELAY (REMOTE CONTACT)
201D	EMERGENCY CLOSE RELAY (REMOTE CONTACT)
201X	BREAKER MASTER CONTROL RELAY (LATCHING TYPE)
294	SUPERVISORY TRIP RELAY (REMOTE CONTACT)
301TT	CONTROL SWITCH (OR TRANSFER TRIP BY-PASS)

BY LDP

REV	DATE	DESCRIPTION	BY
-	07/28/17	ISSUED FOR BID	HS
-	7/11	MINOR CORRECTIONS	LB WPS
-	2/06	MINOR CORRECTIONS	WPS
-	9/04	GENERAL REVISION	WPS
-	5/03	FIELD CORRECTIONS, AS-BUILT	WPS
-	1/00	ISSUED FOR SCADA AS-BUILT	WPS

DESIGNED	DRAWN	CHECKED	APPROVED
-	Rc	WPS	WPS

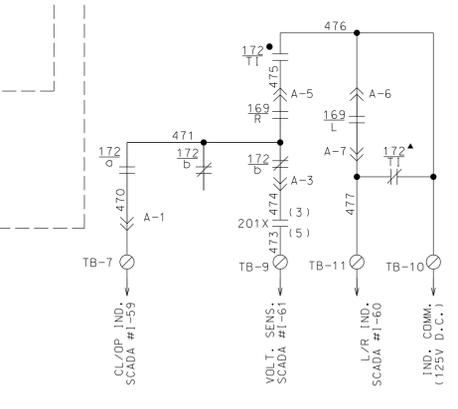
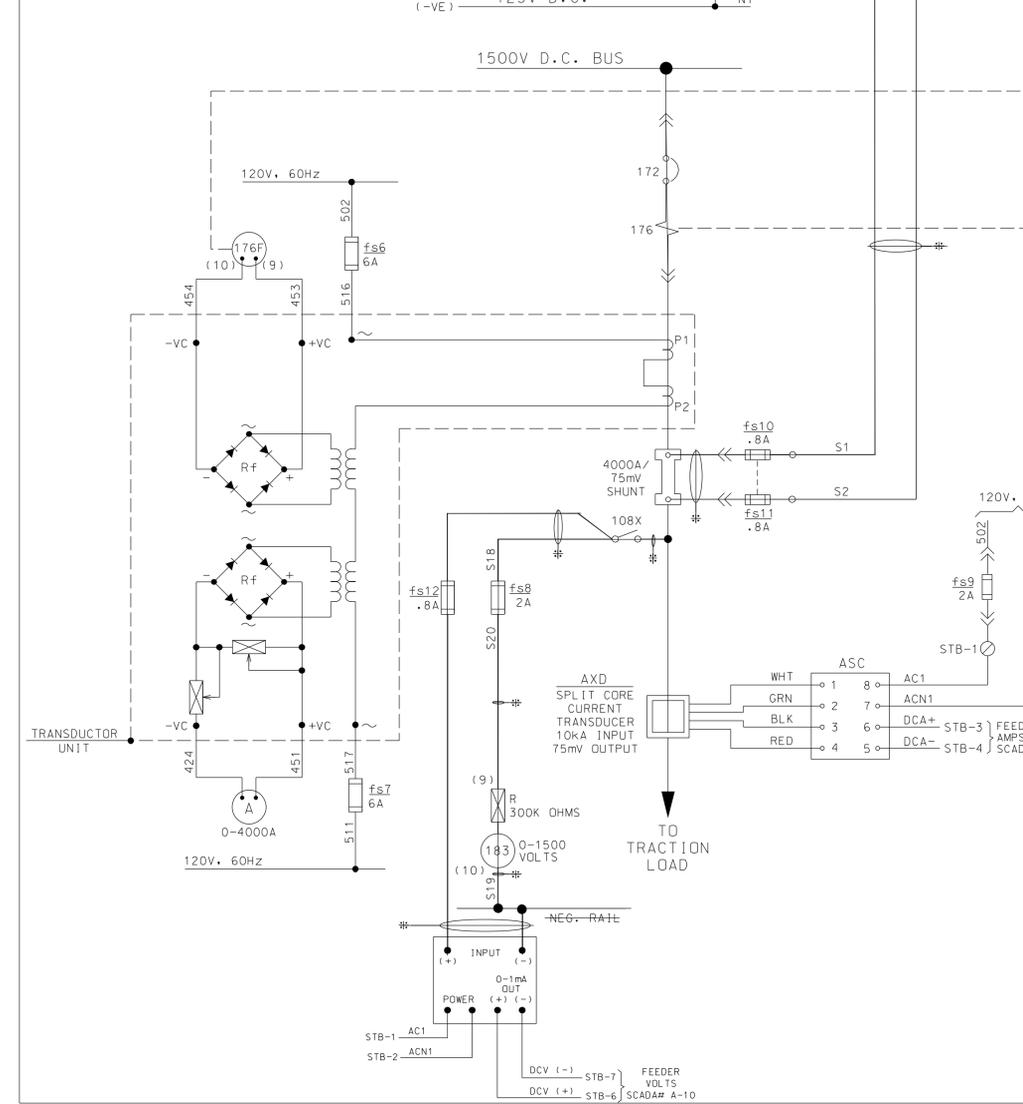
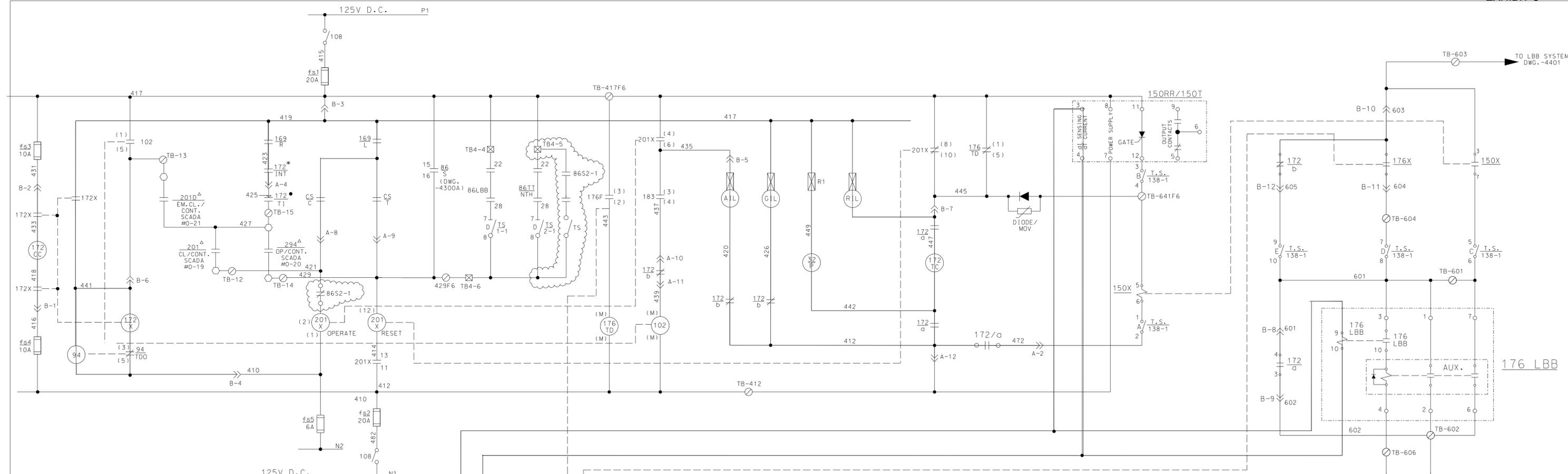
**95th STREET TIE STATION**

1500V D.C. SWITCHGEAR  
D.C. FDR. BKR. SEC. NO.137. CUB. NO.4  
SCHEMATIC DIAGRAM

SCALE: NONE DATE: \_\_\_\_\_

CAD FILE NUMBER: P:\e\scdr\1\cal\eml\95thst\hyb\4303a.hyb -

DISTRICT: M.E.D. PRINT NUMBER: SS-11.9-4303A



CIRCUIT WITHIN THE CLOUD INDICATES NEW WORK UNDER THIS CONTRACT

**NOTES:**

- CONTACT CLOSED IN CONNECTED POSITION OF BREAKER
- ▲ CONTACT OPEN IN CONNECTED POSITION OF BREAKER
- \* CONTACT CLOSED WHEN INTERLOCK LEVER IN DOWN POSITION
- ▲ EQUIPMENT IN SUPERVISORY CABINET
- ~~W THESE WIRES TO BE SEGREGATED AND RUN SEPARATELY.~~
- FOR 1500V D.C. WIRING USE A.E.L. 50/0.25mm 3KV (WORKING) BLACK WIRE
- ALL WIRING TO END OF WITH HEILERMANN PRE-INSULATED TWIN GRIP TERMINALS.

FOR 125V D.C. AND 120V A.C. WIRING USE STANDARD 7/0.67mm GREY WIRE

- LEGEND**
- TERMINAL POINT AT 1500 V D.C. SWITCHGEAR
  - ⊗ TERMINAL POINT AT 12.4 KV A.C. SWITCHGEAR
  - TERMINAL POINT AT 4 KV A.C. SWITCHGEAR
  - ☒ TERMINAL POINT AT RECTIFIER CONTROL PANEL
  - △ TERMINAL POINT AT TRANSFORMER CONTROL PANEL
  - ⊠ TERMINAL POINT AT TRANSFER TRIP & LBB SWITCHBOARD
  - TERMINAL POINT AT SUPERVISORY CONTROL CABINET
  - TERMINAL POINT AT BUS FAULT RELAY PANEL OR CONTROL SWITCHBOARD OR OTHER MISC. PANELS.

**DEVICE LEGEND**

REFERENCE	DESCRIPTION
A	AMMETER, 0-4000A (0-2AFSD) RECT. MOVING COIL LONG SCALE
A1L	AMBER INDICATION LAMP - AUTO CLOSE IN OPERATION, 125V
ASC	D.C. CURRENT SIGNAL CONDITIONER
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CC	CLOSING COIL
CS	CONTROL SWITCH, TRIP-NEUTRAL-CLOSE
DCCT	D.C. CURRENT TRANSDUCER, 3000/1A, 120V, 60Hz
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DCVC	D.C. VOLTS CALIBRATOR
DCVT	D.C. VOLTS TRANSDUCER
DIODE/MOV	DIRECTIONAL BLOCKING DIODE/METAL OXIDE VARISTOR
GIL	GREEN INDICATION LAMP - C.B. OPEN, 125V
I.C.T.	IMPULSE TYPE CURRENT TRANSFORMER
L	LOCAL CONTROL MODE
LBB	LOCAL BREAKER BACKUP
OP	OPERATE
R	REMOTE CONTROL MODE
RE	RESET
RIL	RED INDICATION LAMP - C.B. CLOSED, 125V
SHUNT	SWITCHBOARD D.C. SHUNT
T	TRIP
TL	TEST LINK
T.S.	TEST SWITCH
TT	TRANSFER TRIP
V	VOLTMETER, 0-2000V MOVING COIL LONG SCALE DIRECT READING
VR1	ATTENUATOR, 20W, 0.2 OHM VARIABLE
VXD	FEEDER VOLTAGE TRANSDUCER

**DEVICE LEGEND**

DEVICE	DESCRIPTION
30LBB	LBB ANNUNCIATOR TARGET RELAY
32P	POLARIZING COIL FOR 176 TRIPPING 125V D.C. 2 X 50 OHM COILS
32X	FLAG INDICATION RELAY FOR LOSS OF 32P VOLTAGE
62LBB	LBB TIMING RELAY 0.1 - 6.0 SEC.
64D2	GROUND FAULT SENSING RELAY (BUS 2)
64XX	AUX. RELAY FOR GROUND FAULT TRANSFER TRIP
86/S	LOCKOUT RELAY
86LBB	BREAKER BACKUP LOCKOUT RELAY (MANUAL RESET)
86TT	TRANSFER TRIP LOCKOUT RELAY (ELECT. RESET)
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102	RE-CLOSING TIMER
108	125V D.C. CONTROL ISOLATOR
108X	1500V D.C. VOLTAGE MEASURING ISOLATOR
127	A.C. SUPPLY CHANGE OVER RELAY
150RR	RATE OF RISE OVERCURRENT RELAY "SWARTZ"
150T	TIME OVERCURRENT RELAY
150X	AUXILIARY RELAY FOR LBB ON 150RR/150T
169	LOCAL - REMOTE SWITCH
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172TI	BREAKER CARRIAGE POSITION SWITCH
172TC	SHUNT TRIP COIL, 125V D.C., 20 OHMS
172X	AUXILIARY CLOSING CONTACTOR, 125V D.C., 650 OHMS
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176F	O/C RELAY (0-6000A. SCALE) 120V, 60Hz, HIGH SET POINT
176LBB	LBB D.C. CURRENT SENSING RELAY
176TD	O/C RL. TIMER, 125V D.C. (SET AT 20 SEC.) IN CASE WITH 176F
176X	AUXILIARY RELAY FOR MAGNETIC SERIES TRIP
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201	SUPERVISORY CLOSE RELAY (REMOTE CONTACT)
201D	EMERGENCY CLOSE RELAY (REMOTE CONTACT)
201X	BREAKER MASTER CONTROL RELAY (LATCHING TYPE)
294	SUPERVISORY TRIP RELAY (REMOTE CONTACT)
301TT	CONTROL SWITCH (OR TRANSFER TRIP BY-PASS)

BY LDP

REV	DATE	DESCRIPTION	BY
-	07/28/17	ISSUED FOR BID	HS
-	7/11	MINOR CORRECTIONS	LB WPS
-	2/06	MINOR CORRECTIONS	WPS
-	9/04	GENERAL REVISION	WPS
-	5/03	FIELD CORRECTIONS, AS-BUILT	WPS
-	1/00	ISSUED FOR SCADA AS-BUILT	WPS

**Metra** ENGINEERING DEPARTMENT  
CHICAGO, ILLINOIS

1500V D.C. SWITCHGEAR  
D.C. FDR. BKR. SEC. NO.138. CUB. NO.6  
SCHEMATIC DIAGRAM

95th STREET TIE STATION

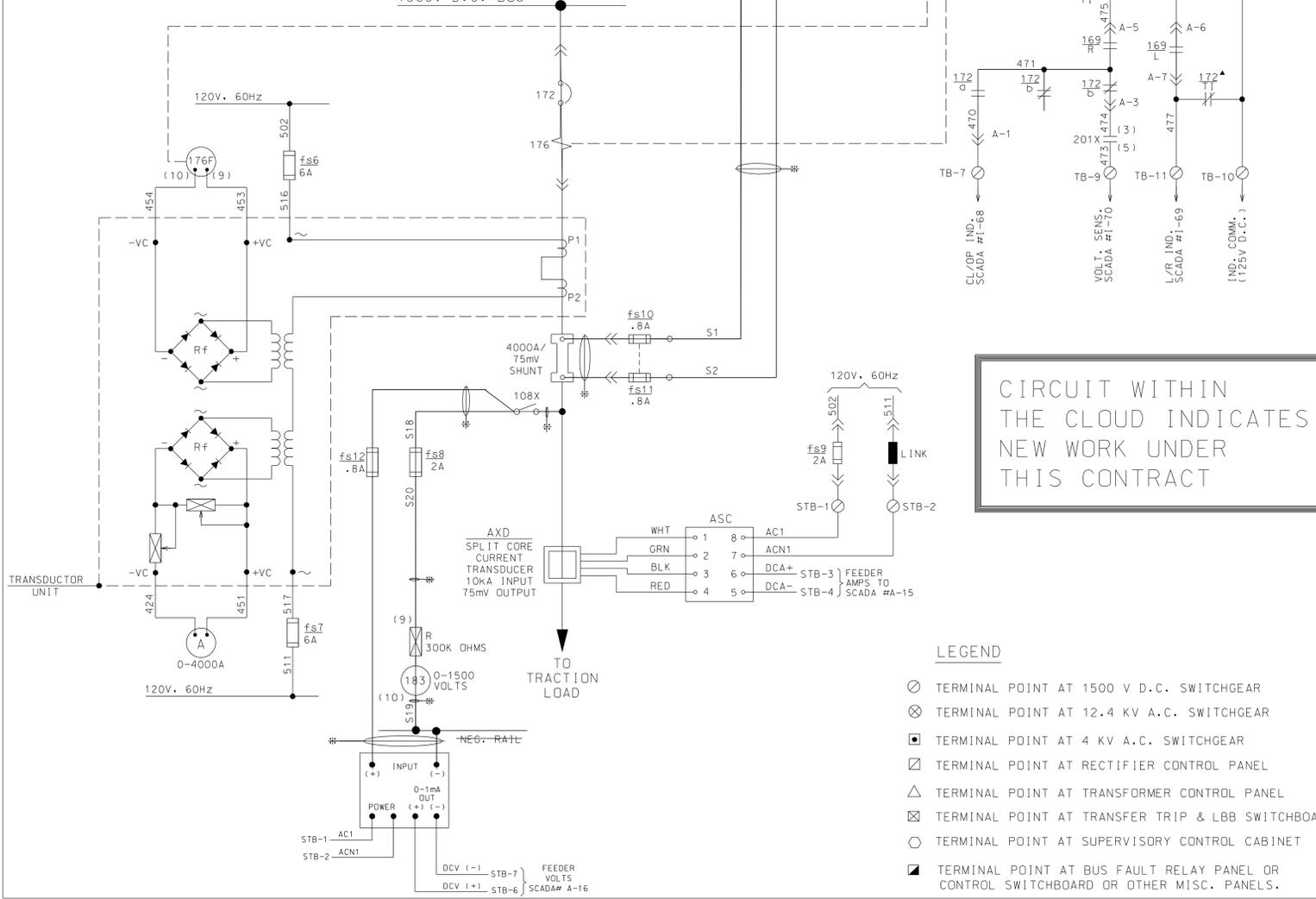
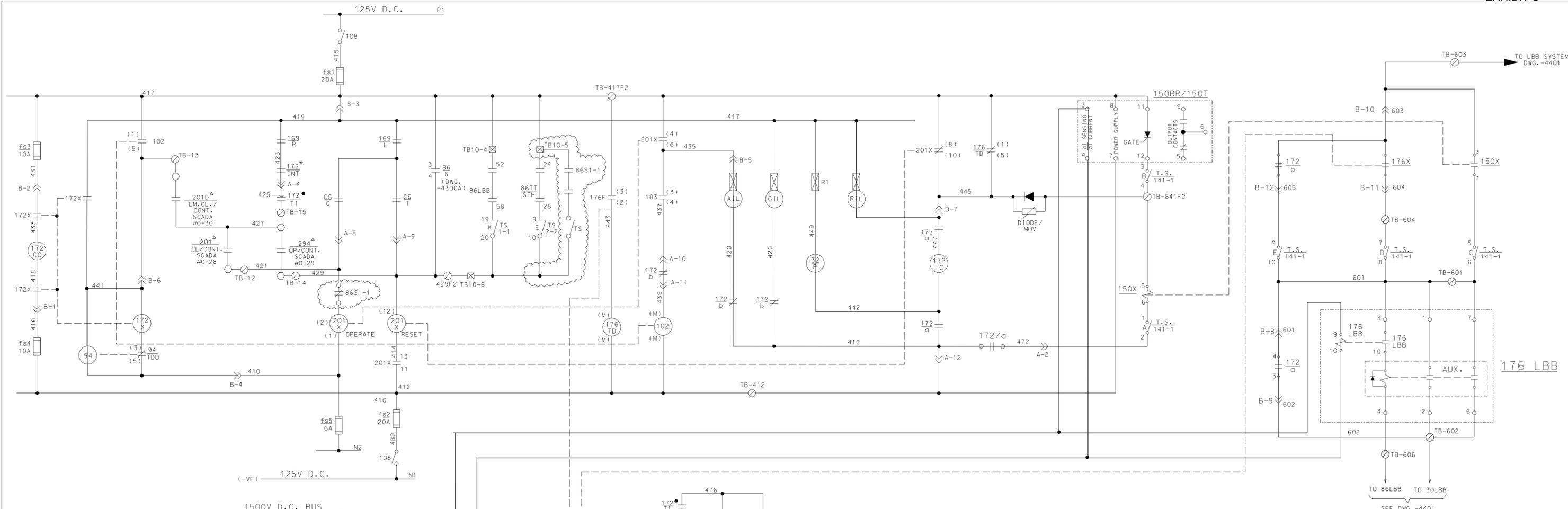
SCALE: NONE DATE: \_\_\_\_\_

DESIGNED: RC DRAWN: WPS CHECKED: WPS APPROVED: WPS

DISTRICT: M.E.D. PRINT NUMBER: SS-11.9-4304A







CIRCUIT WITHIN THE CLOUD INDICATES NEW WORK UNDER THIS CONTRACT

- NOTES:**
- CONTACT CLOSED IN CONNECTED POSITION OF BREAKER
  - ▲ CONTACT OPEN IN CONNECTED POSITION OF BREAKER
  - \* CONTACT CLOSED WHEN INTERLOCK LEVER IN DOWN POSITION
  - △ EQUIPMENT IN SUPERVISORY CABINET
  - ≡ THESE WIRES TO BE SEGREGATED AND RUN SEPARATELY -
  - FOR 1500V D.C. WIRING USE A.E.I. 50/0.25mm 3KV (WORKING) BLACK WIRE
  - ALL WIRING TO END OF WITH HELLERMAN PRE-INSULATED TWIN GRIP TERMINALS.
- FOR 125V D.C. AND 120V A.C. WIRING USE STANDARD 7/0.67mm GREY WIRE

**DEVICE LEGEND**

REFERENCE	DESCRIPTION
A	AMMETER, 0-4000A (0-2AFSD) RECT. MOVING COIL LONG SCALE
A1L	AMBER INDICATION LAMP - AUTO CLOSE IN OPERATION, 125V
ASC	D.C. CURRENT SIGNAL CONDITIONER
AXD	SPLIT CORE D.C. CURRENT TRANSDUCER
C	CLOSE
CC	CLOSING COIL
CS	CONTROL SWITCH, TRIP-NEUTRAL-CLOSE
DCCT	D.C. CURRENT TRANSDUCER, 3000/1A, 120V, 60Hz
DCSC	D.C. CURRENT SIGNAL CONDITIONER
DCVC	D.C. VOLTS CALIBRATOR
DCVT	D.C. VOLTS TRANSDUCER
DIODE/MOV	DIRECTIONAL BLOCKING DIODE/METAL OXIDE VARISTOR
GIL	GREEN INDICATION LAMP - C.B. OPEN, 125V
I.C.T.	IMPULSE TYPE CURRENT TRANSFORMER
L	LOCAL CONTROL MODE
LBB	LOCAL BREAKER BACKUP
OP	OPERATE
R	REMOTE CONTROL MODE
RE	RESET
RIL	RED INDICATION LAMP - C.B. CLOSED, 125V
SHUNT	SWITCHBOARD D.C. SHUNT
T	TRIP
TL	TEST LINK
T.S.	TEST SWITCH
TT	TRANSFER TRIP
V	VOLTMETER, 0-2000V MOVING COIL LONG SCALE DIRECT READING
VR1	ATTENUATOR, 20W, 0.2 OHM VARIABLE
VXD	FEEDER VOLTAGE TRANSDUCER

- LEGEND**
- TERMINAL POINT AT 1500 V D.C. SWITCHGEAR
  - ⊗ TERMINAL POINT AT 12.4 KV A.C. SWITCHGEAR
  - TERMINAL POINT AT 4 KV A.C. SWITCHGEAR
  - ☒ TERMINAL POINT AT RECTIFIER CONTROL PANEL
  - △ TERMINAL POINT AT TRANSFORMER CONTROL PANEL
  - ⊠ TERMINAL POINT AT TRANSFER TRIP & LBB SWITCHBOARD
  - TERMINAL POINT AT SUPERVISORY CONTROL CABINET
  - TERMINAL POINT AT BUS FAULT RELAY PANEL OR CONTROL SWITCHBOARD OR OTHER MISC. PANELS.

**DEVICE LEGEND**

DEVICE	DESCRIPTION
30LBB	LBB ANNUNCIATOR TARGET RELAY
32P	POLARIZING COIL FOR 176 TRIPPING 125V D.C. 2 X 50 OHM COILS
32X	FLAG INDICATION RELAY FOR LOSS OF 32P VOLTAGE
62LBB	LBB TIMING RELAY 0.1 - 6.0 SEC.
64D2	GROUND FAULT SENSING RELAY (BUS 2)
64XX	AUX. RELAY FOR GROUND FAULT TRANSFER TRIP
86/S	LOCKOUT RELAY
86LBB	BREAKER BACKUP LOCKOUT RELAY (MANUAL RESET)
86TT	TRANSFER TRIP LOCKOUT RELAY (ELECT. RESET)
94	CLOSING COIL CUT OFF (ANTI-PUMP) RELAY, 125V D.C., 7000 OHMS
94TT	TRANSFER TRIP OUTPUT RELAY
102	RE-CLOSING TIMER
108	125V D.C. CONTROL ISOLATOR
108X	1500V D.C. VOLTAGE MEASURING ISOLATOR
127	A.C. SUPPLY CHANGE OVER RELAY
150RR	RATE OF RISE OVERCURRENT RELAY "SWARTZ"
150T	TIME OVERCURRENT RELAY
150X	AUXILIARY RELAY FOR LBB ON 150RR/150T
169	LOCAL - REMOTE SWITCH
172	D.C. FEEDER BREAKER
1720-b	BREAKER OPEN-CLOSE STATUS SWITCH
172CC	BREAKER CLOSING COIL, 125V D.C., 1.0 OHM
172T	BREAKER CARRIAGE POSITION SWITCH
172TT	SHUNT TRIP COIL, 125V D.C., 20 OHMS
172X	AUXILIARY CLOSING CONTACTOR, 125V D.C., 650 OHMS
176	MAGNETIC SERIES TRIP O/C DEVICE CAL. 3,5-4-5-6-7-8
176F	O/C RELAY (0-6000A. SCALE) 120V, 60Hz, HIGH SET POINT
176LBB	LBB D.C. CURRENT SENSING RELAY
176TD	O/C RL.T. TIMER, 125V D.C. (SET AT 20 SEC.) IN CASE WITH 176F
176X	AUXILIARY RELAY FOR MAGNETIC SERIES TRIP
183	VOLTAGE MEASURING TRANSFER RELAY
201	SUPERVISORY CLOSE RELAY (REMOTE CONTACT)
201D	EMERGENCY CLOSE RELAY (REMOTE CONTACT)
201X	BREAKER MASTER CONTROL RELAY (LATCHING TYPE)
294	SUPERVISORY TRIP RELAY (REMOTE CONTACT)
301TT	CONTROL SWITCH (OR TRANSFER TRIP BY-PASS)

BY LDP

REV	DATE	DESCRIPTION	BY
-	07/28/17	ISSUED FOR BID	HS
-	7/11	MINOR CORRECTIONS	LB WPS
-	2/06	MINOR CORRECTIONS	WPS
-	9/04	GENERAL REVISION	WPS
-	5/03	FIELD CORRECTIONS, AS-BUILT	WPS
-	1/00	ISSUED FOR SCADA AS-BUILT	WPS

**Metra** ENGINEERING DEPARTMENT  
CHICAGO, ILLINOIS

1500V D.C. SWITCHGEAR  
D.C. FDR. BKR. SEC. NO.141. CUB. NO.2  
SCHEMATIC DIAGRAM

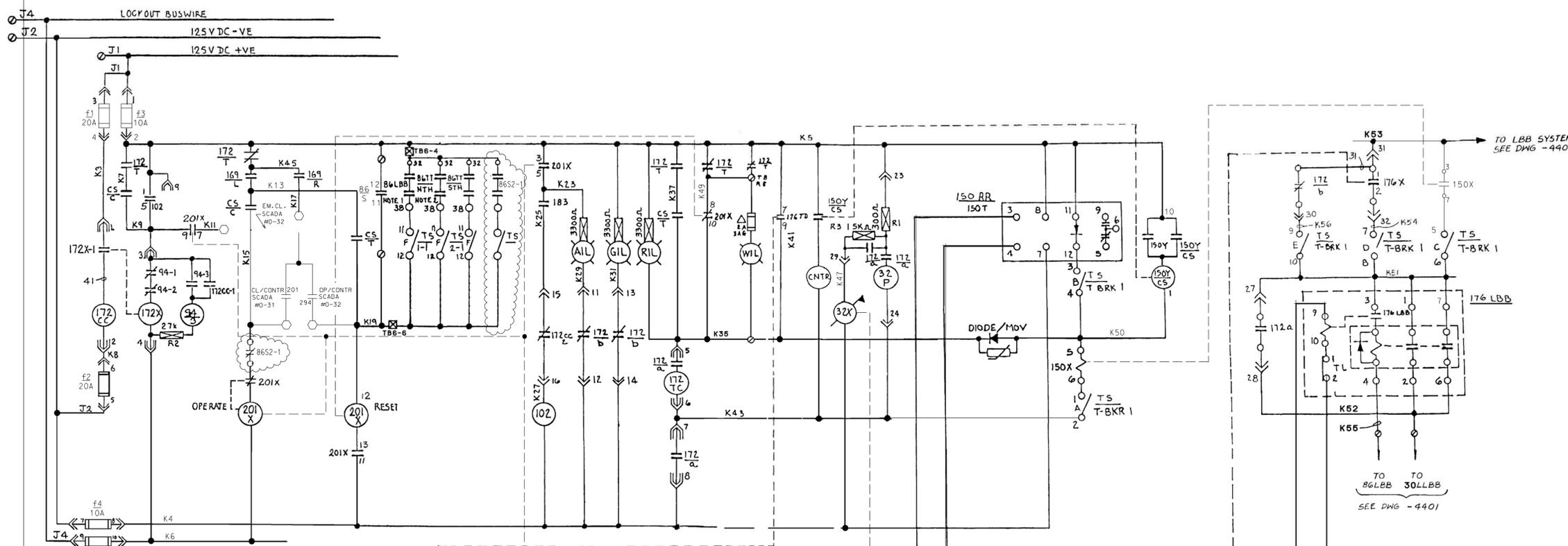
95th STREET TIE STATION

SCALE: NONE DATE: \_\_\_\_\_

CAO FILE NUMBER: #1500VDC141/eml/95thst/hyb/4307a-hyb

DESIGNED	DRAWN	CHECKED	APPROVED
-	Rc	WPS	WPS

DISTRICT: M.E.D. PRINT NUMBER: SS-11.9-4307A

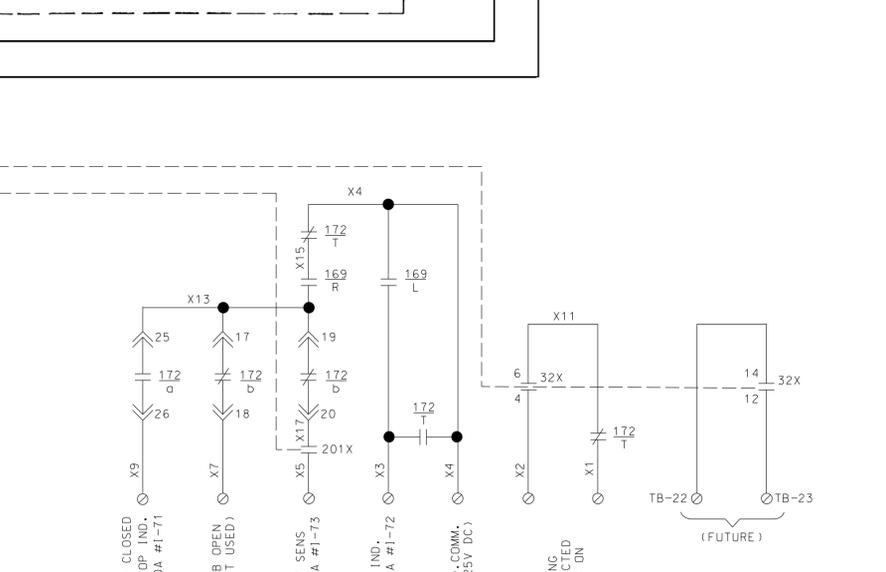
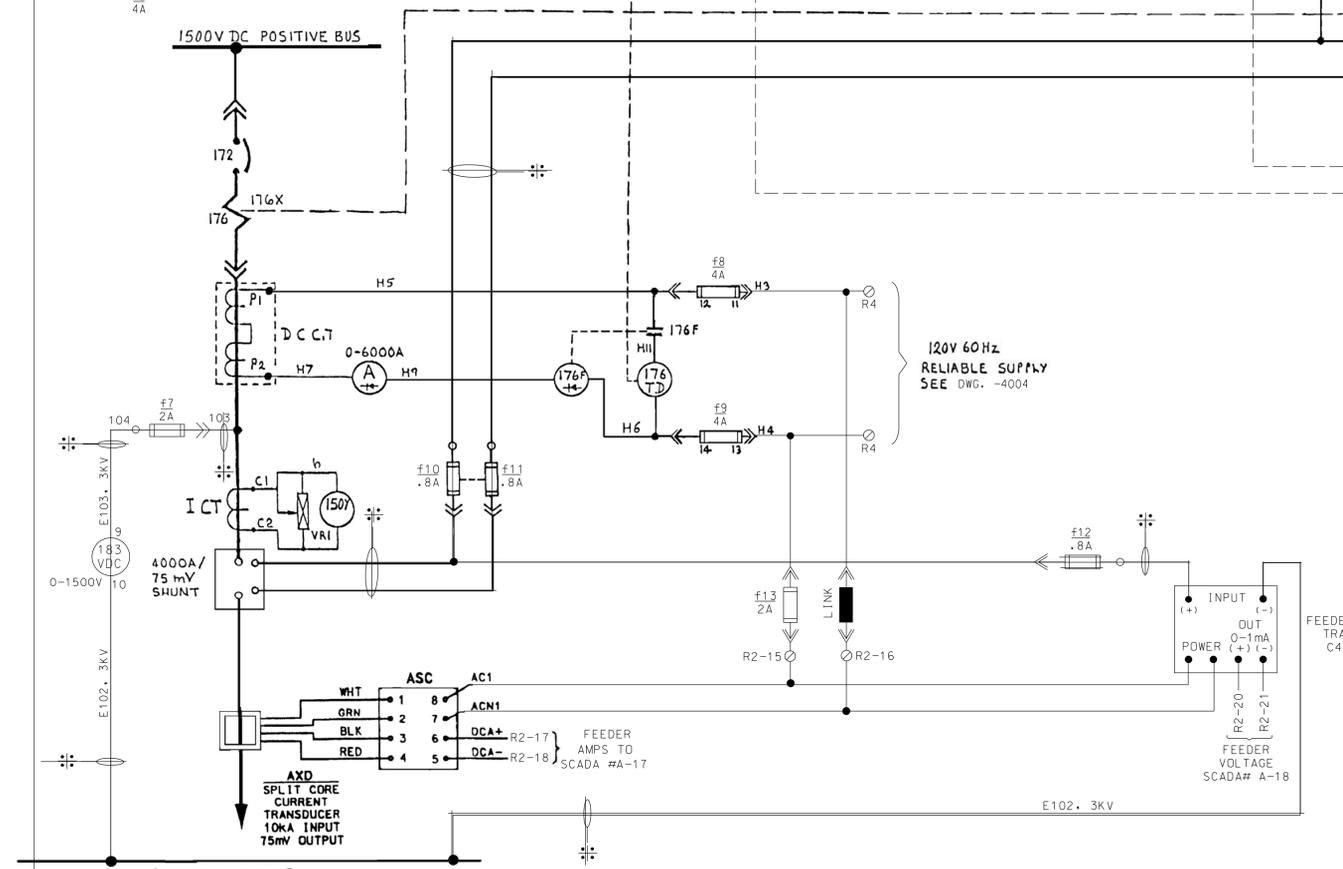


**DEVICE LEGEND**

DEVICE	DESCRIPTION
30LBB	LBB Annunciator Target Relay
32P	Polarizing Coil for 176 Tripping 125VDC 2x30 ohm coils
32X	Flag Indication Relay for Loss of 32P Voltage
62LBB	LBB Timing Relay 0.1 6.0 Sec.
62TT	TT Timing Relay 0.1 6.0 Sec.
64D	Ground Fault Sensing Relay
64XX	Aux. Relay for Ground Fault Transfer Trip
86L	Lockout Relay
86LBB	Breaker Backup Lockout Relay (Manual Reset)
86TT	Transfer Trip Lockout Relay (Elect. Reset)
94	Closing Coil Cut Off (Anti Pump) Riv. 125V.DC 7000 ohm
94TT	Transfer Trip Output Relay
102	Reclosing Timer
127	AG Supply Change Over Relay
130BR	Rate of Rise Overcurrent Relay
130T	Time Overcurrent Relay
150X	Auxiliary Relay for LBB on 130BR/130T
150Y	Impulse Tripping Relay (Rate of Rise)
150YCS	Auxiliary Relay on 150Y (in same case as 150Y)
169	Local Remote Switch
172	D. C. Feeder Breaker
172a	Breaker Open Close Status Switch
172CC	Breaker Closing Coil 125VDC 1.8 ohm
172T	Breaker Position Switch
172TC	Shunt Trip Coil 125VDC 20 ohm
172X	Auxiliary Closing Contactor 125VDC 630 ohm
176	Magnetic Series Trip O/C Device Cal. 3.5 4.5 6.7 8
176F	O/C Relay (0.6000A, Scale) 120V 60HZ, High Set Point
176LBB	LBB D. C. Current Sensing Relay
176TD	O/C Relay, Timer 125VDC (Set at 20s.) in case with 176F
176X	Auxiliary Relay for Magnetic Series Trip
183	Voltage Measuring Transfer Relay
201	Supervisory Close Relay (Remote Contact)
201D	Emergency Close Relay (Remote Contact)
201X	Breaker Master Control Relay (Latching Type)
296	Supervisory Trip Relay (Remote Contact)
301TT	Control Switch for Transfer Trip By Pass

**DEVICE LEGEND**

REF	DESCRIPTION
A	Ammeter 0 6000A (0.2AFSD) Rest. Moving Coil Long Scale
AIL	Amber Indication Lamp Auto Close in Operation 125V
C	Close
CC	Closing Coil
GNTR	Operation Counter 150V
GS	Control Switch TRIP Neutral Close
DCGT	D. C. Current Transducer 3000/1A 120V 60HZ
DCSC	D. C. Current Signal Conditioner
DCVC	D. C. Volts Calibrator
DCVT	D. C. Volts Transducer
DIODE/MOV	Directional Blocking Diode/Metal Oxide Varistor
GIL	Green Indication Lamp C.B. Open 125V
I.C.T.	Impulse Type Current Transformer
L	Local Control Mode
LBB	Local Breaker Backup
OP	Operate
R	Remote Control Mode
RE	Reset
RIL	Red Indication Lamp C.B. Closed 125 V.
Shunt	Switchboard D. C. Shunt
Trip	Trip
T.S.	Test Switch
TT	Transfer Trip
V	Voltmeter 0 2000V Moving Coil Longscale Direct Reading
VR1	Attenuator 20W 0.2 ohm variable
TL	T&T LINK
ASC	CURRENT SIGNAL CONDITIONER
AXD	SPLIT CORE CURRENT TRANSDUCER
VXD	FEEDER VOLTAGE TRANSDUCER



CIRCUIT WITHIN THE CLOUD INDICATES NEW WORK UNDER THIS CONTRACT

**BREAKER CONTACTS LEGEND:**

- ⊙ MULTICORE TERMINATION
- BUS WIRING TB
- △ LOCATED IN SEPARATE ENCLOSURE
- 172 ⊕ CARRIAGE SWITCH OPEN IN SERVICE
- 172 ⊖ CARRIAGE SWITCH CLOSED IN SERVICE POSITION
- 172 ⊕ ⊖ AUX. SWITCH OPEN IN CB OPEN POSITION  
AUX. SWITCH CLOSED IN CB CLOSED POSITION
- 172 ⊖ ⊕ AUX. SWITCH CLOSED IN CB OPEN POSITION  
AUX. SWITCH OPEN IN CB CLOSED POSITION
- ⊖ ⊕ MINOR DISCONNECT CONTACT CLOSED ONLY WHEN CIRCUIT BREAKER IS IN 'SERVICE' POSITION
- ⊖ ⊕ ⊖ MINOR DISCONNECT CONTACT CLOSED WHEN CIRCUIT BREAKER IS IN 'TEST' POSITION AND 'SERVICE' POSITION

**LEGEND**

- ⊙ TERMINAL POINT AT 1500 V D.C. SWITCHGEAR
- ⊗ TERMINAL POINT AT 12.4 KV A.C. SWITCHGEAR
- ⊠ TERMINAL POINT AT 4 KV A.C. SWITCHGEAR
- ⊡ TERMINAL POINT AT RECTIFIER CONTROL PANEL
- ⊢ TERMINAL POINT AT TRANSFORMER CONTROL PANEL
- ⊣ TERMINAL POINT AT TRANSFER TRIP & LBB SWITCHBOARD
- TERMINAL POINT AT SUPERVISORY CONTROL CABINET
- ⊤ TERMINAL POINT AT BUS FAULT RELAY PANEL OR CONTROL SWITCHBOARD OR OTHER MISC. PANELS.

**NOTES:**  
 \* THESE WIRES TO BE SEGREGATED AND RUN SEPARATELY FOR 1500V D.C. WIRING USE A.E.T. 50/0.25mm 3KV (WORKING) BLACK WIRE - ALL WIRING TO END OF WITH HELLERMAN PRE-INSULATED TWIN GRIP TERMINALS - FOR 125V D.C. AND 120V A.C. WIRING USE STANDARD 7/0.67mm GREY WIRE

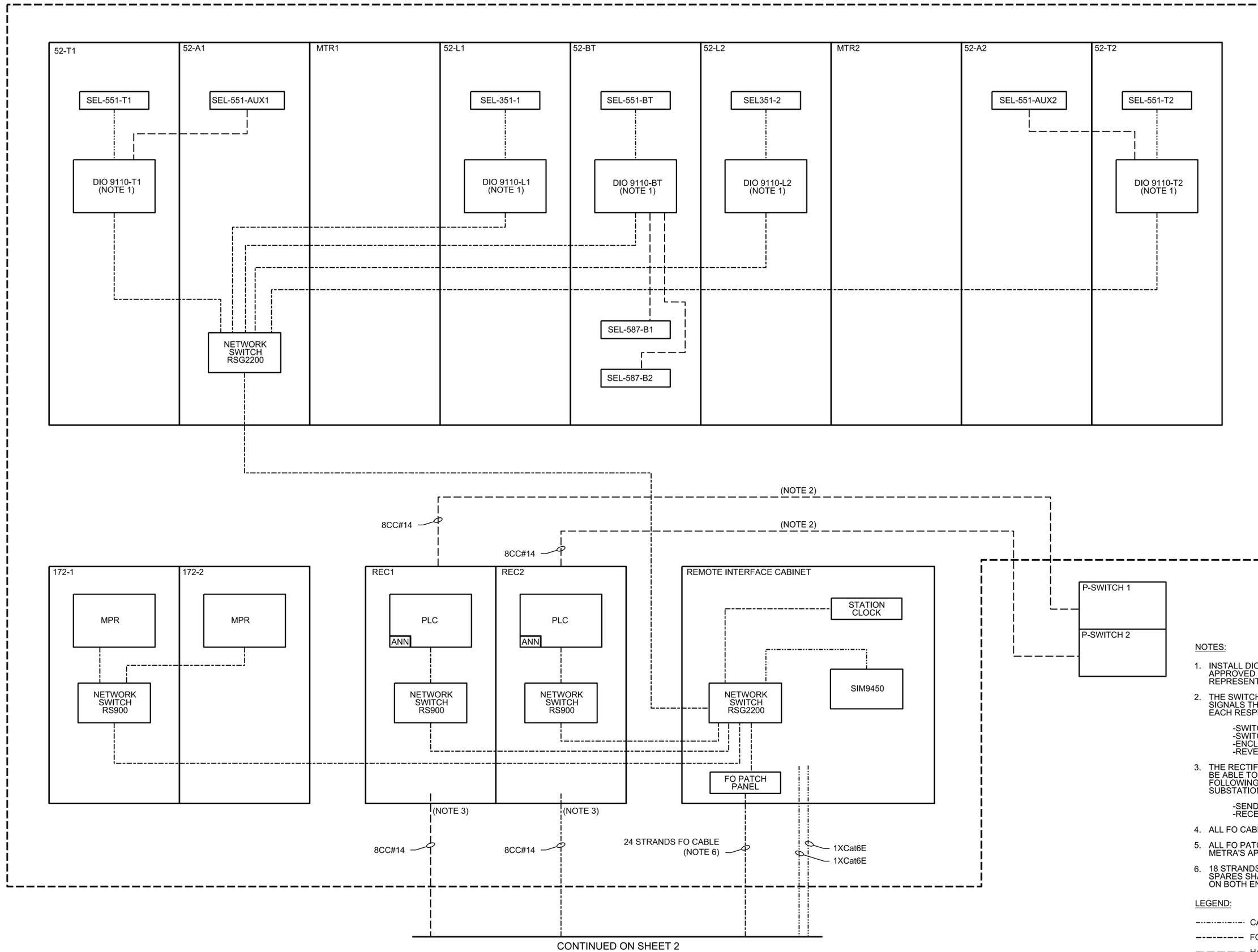
NO	REVISION	DATE	BY
1	C. JACKSON		
2	172X AUX CONTACT REMOVED FROM SCHEMATIC		
3	2 NO BKR AUX SWS AND R3 ADDED TO POLARISING CIRCUIT		
4	CB AUX SWITCH ON WFS 15216 IS NEW A LATE BREAK SW TYPE STA		
5	443 ON 32X IS NOW 44 N/C CARAVING CLS CONTACT ADDED IN SERIES WITH 20K FAULT CONTACT NOTE X ADDED		
6	WIRE AW 139 REMOVED CORRECT INTERNAL WIRING OF 150Y NOW SHOWN		
7	3-9-83 AS BUILT		
8	3-14-84 LAMP ADDED		
9	ADD LBB AND TRANSFER TRIP		
10	JAN 97 MFS GENERAL REVISION		

REV	DATE	DESCRIPTION	BY
-	07/28/17	ISSUED FOR BID	HS
-	2/06	MINOR CORRECTIONS	WPS
-	9/04	GENERAL REVISION	WPS
-	5/03	FIELD CORRECTIONS, AS-BUILT	WPS
-	1/00	ISSUED FOR SCADA AS-BUILT	WPS

**Metra** ENGINEERING DEPARTMENT  
 CHICAGO, ILLINOIS  
 1500V D.C. SWITCHGEAR  
 D.C. FDR. BKR. SEC.  
 T-BKR CUB. #10  
 SCHEMATIC DIAGRAM  
 95th ST. TIE STATION  
 SCALE: NONE DATE:  
 CAD FILE NUMBER: 5-27-74  
 DESIGNED: DRAWN: CHECKED: APPROVED:  
 DISTRICT: PRIORITY NUMBER:  
 M.F.G. BY WHIPP & BOURNE LTD. W & B DWG. NO. 418766  
 M.E.D. SS-11.9-4308A

LAST NO USED K56

NEW PREFABRICATED SUBSTATION



- NOTES:**
- INSTALL DIO MODULES AS NEEDED AND AS APPROVED BY METRA'S AUTHORIZED REPRESENTATIVE.
  - THE SWITCH SHALL SEND THE FOLLOWING SIGNALS THROUGH DRY CONTACTS TO EACH RESPECTIVE CONTROL CABINET:
    - SWITCH OPENED
    - SWITCH CLOSED
    - ENCLOSURE DOOR OPEN
    - REVERSE CURRENT
  - THE RECTIFIER CONTROL CABINET SHALL BE ABLE TO SEND/RECEIVE THE FOLLOWING SIGNALS TO THE EXISTING SUBSTATION:
    - SEND TRIP DC LOCKOUT
    - RECEIVE TRIP FROM 64HS
  - ALL FO CABLES USED SHALL BE MULTIMODE.
  - ALL FO PATCH PANELS SHALL BE SUBJECT TO METRA'S APPROVAL.
  - 18 STRANDS SHALL BE KEPT AS SPARES. ALL SPARES SHALL BE PROPERLY TERMINATED ON BOTH ENDS FOR FUTURE USE.
- LEGEND:**
- CAT 6E
  - FO CABLE
  - HARDWIRED

CONTINUED ON SHEET 2

PRINTED ON: SDATES

0	7/28/2017	AA	ER	ISSUED FOR BID
REV	DATE	BY	APP	DESCRIPTION

SUB CONSULTANT

PRIMARY CONSULTANT  
SEAL/ SIGNATURE

PRIMARY CONSULTANT

DESIGNED: A. ACHHAMMER  
DRAWN: N. DIAZ  
CHECKED: E. ROWE  
METRA P.M. R. CERANT  
DATE: JUNE 12, 2017

ENGINEERING DEPARTMENT  
547 W. JACKSON BOULEVARD  
CHICAGO, ILLINOIS 60661

LOCATION NAME:  
**95TH STREET SUBSTATION**

TITLE:  
**STATION CONTROL ARCHITECTURE  
NEW BUILDING AND INTERFACES  
SHEET 1 OF 2**

CAD FILE NUMBER:  
SFILES5

SCALE:  
NTS

PROJECT NO.  
GW4254-57102002

MILE POST NO.  
11.9

DISTRICT:  
MED

SHEET NO.  
SS-11.9-5000



# CONDUIT RUN TRENCH PREPARATION

THESE INSTRUCTIONS COVER DESIGN AND CONSTRUCTION INFORMATION NECESSARY FOR THE LAY-OUT AND INSTALLATION OF CONDUIT RUNS.

## SAFEGUARDING UNDERGROUND FACILITIES

IN ORDER TO SAFEGUARD THE UNDERGROUND FACILITIES OF BOTH THE COMPANY AND OTHERS, APPLICABLE COMPANY INSTRUCTIONS AND PROCEDURES COVERING THE PROVISIONS OF ANY AGREEMENT BETWEEN THE COMPANY AND ANOTHER UTILITY CONCERNING INTERCHANGE OF INFORMATION AND CONSTRUCTION WORK PRACTICES SHALL BE FOLLOWED.

▶ RADIAL SEPARATION OF CONDUIT SYSTEMS FROM GAS AND OTHER LINES THAT TRANSPORT FLAMMABLE MATERIAL SHALL BE NOT LESS THAN 12" AND SHOULD HAVE SUFFICIENT SEPARATION FROM GAS AND OTHER LINES THAT TRANSPORT FLAMMABLE MATERIAL TO PERMIT THE USE OF PIPE MAINTENANCE EQUIPMENT (NESC 320.B.5)

## CONDUIT RUN LAYOUT

CONDUIT RUNS AND MANHOLES SHOULD BE LOCATED SO THAT THE RUN WILL FOLLOW AS NEARLY AS POSSIBLE A STRAIGHT LINE BETWEEN MANHOLES. IF OBSTRUCTIONS MAKE THIS IMPRACTICAL, THE RUN MAY BE CURVED AS NECESSARY.

A CONDUIT RUN MAY ENTER A STANDARD MANHOLE AT A MAXIMUM ANGLE OF 15° TO THE RESPECTIVE AXIS OF THE MANHOLE. IN CASES WHERE A LARGER ANGLE IS REQUIRED, THE MANHOLE SHALL BE REDESIGNED TO OBTAIN SATISFACTORY CABLE PULLING AND TRAINING CONDITIONS. IN LOCATIONS WHERE STREET LINES ARE NOT DETERMINED BY CURBS, SIDEWALKS OR BUILDINGS, THE EXACT POSITION OF THE CONDUIT RUN SHALL BE DETERMINED BY A SURVEY.

THE PROPOSED TRENCH MAY BE MARKED OFF BY MEANS OF A CHALK LINE IN UNPAVED TERRITORY AND BY A ROUTE IDENTIFICATION SPRAY PAINT IN PAVED TERRITORY. BOTH SIDES OF THE TRENCH SHALL BE MARKED IF THE TRENCH IS TO BE DUG BY HAND. IF A MACHINE IS TO BE USED, ONLY ONE SIDE OF THE TRENCH NEED BE MARKED.

## EXCAVATION

THE STANDARD WIDTH OF THE TRENCH SHALL BE EQUAL TO THE OVERALL WIDTH OF THE CONDUIT RUN AS SHOWN ON C4090 FOR REGULAR FORMATIONS, AND ON C4130-35 WHERE TRANSPOSITIONS ARE PLANNED TO PASS OBSTRUCTIONS. THE SIDES OF THE TRENCH SHALL BE TRIMMED SMOOTHLY TO GIVE A UNIFORM THICKNESS OF CONCRETE AROUND THE CONDUIT. THE SIDES OF THE EXCAVATION SHALL BE SHORED IN ACCORDANCE WITH SAFETY REGULATING COMMISSION PRACTICES TO PREVENT CAVE-INS.

## DEPTH OF TRENCH

THE DEPTH OF THE TRENCH IN THE RUN IS GOVERNED BY THE MINIMUM DEPTH OF THE CONDUIT RUN BELOW THE STREET SURFACE OR ESTABLISHED GRADE, THE HEIGHT OF THE DUCT SECTION, AND THE PRESENCE OF OBSTRUCTIONS. AT THE APPROACH TO THE MANHOLE, THE MINIMUM DISTANCE FROM THE MANHOLE ROOF TO THE TOP DUCTS AND THE FANNING OF THE DUCTS AT THE DUCT ENTRANCE OF THE MANHOLE ALSO GOVERN THE DEPTH OF THE TRENCH.

IF CINDERS, SLAG, RUBBISH FILL OR OTHER MATERIAL HAVING POOR HEAT CONDUCTING PROPERTIES ARE UNCOVERED IN THE EXCAVATION, THE WIDTH AND DEPTH OF THE TRENCH SHALL BE INCREASED. CONSULT CONSTRUCTION STANDARD GROUP. THIS EXTRA SPACE IS TO PROVIDE FOR THE PLACING OF SPECIAL BACKFILL GRAVEL AROUND THE CONDUIT

THE MINIMUM DISTANCE FROM THE TOP OF A CONDUIT RUN TO THE SURFACE OF A ROADWAY OR ESTABLISHED GRADE SHALL BE 2 FEET 6 INCHES EXCEPT WHERE THE CONDUIT PASSES UNDER A VIADUCT AND CAUSES A SUMP IN THE LINE. IN THIS CASE THE MINIMUM DISTANCE SHALL BE 3 FEET 0 INCHES. CONDUIT RUNS WHICH PASS UNDER RAILROAD SWITCH TRACKS, OR MAIN LINE TRACKS SHALL HAVE THE CLEARANCE SHOWN ON C4110.

THE HEIGHT OF THE DUCT SECTION FOR VARIOUS STANDARD FORMATIONS OF DUCTS IS SHOWN ON STANDARD C4090, AND FOR TRANSPOSITION SECTIONS ON C4130-35.

THE MINIMUM DISTANCE FROM THE TOP OF THE DUCTS TO THE MANHOLE ROOF IS SPECIFIED ON THE MANHOLE DRAWINGS AND THE SEPARATION OF THE DUCTS AT THE MANHOLE DUCT ENTRANCE IS SHOWN ON STANDARD C4231. THIS WILL DETERMINE THE MINIMUM WIDTH AND DEPTH OF THE TRENCH AT THE MANHOLE.

OBSTRUCTIONS AFFECT THE DEPTH OF THE TRENCH IN THAT THE GRADE OF THE CONDUIT RUN MUST BE ADJUSTED TO AVOID THEM. THE ENTIRE TRENCH SHOULD BE OPENED BETWEEN MANHOLES BEFORE ANY CONDUIT IS LAID TO ASCERTAIN THE EXISTENCE AND POSITION OF ANY OBSTRUCTIONS.

WHEN THE REQUIRED DEPTH OF THE TRENCH IS KNOWN FOR ALL POINTS, THE GRADE MAY BE ESTABLISHED.

GRADE

IN GENERAL, ALL CONDUIT RUNS SHALL BE UNIFORMLY GRADED SO THAT WATER WILL DRAIN INTO THE MANHOLES FROM ANY POINT IN THE RUN. THE EXCEPTIONS TO THIS RULE ARE CONDUIT RUNS WHICH PASS UNDER RIVERS, VIADUCTS, AND ABNORMAL OBSTRUCTIONS IN THE RUN. IT IS ESSENTIAL THAT THE CONDUIT RUN SHALL BE UNIFORMLY GRADED SO THAT THERE WILL BE NO RIPPLES IN THE RUN.

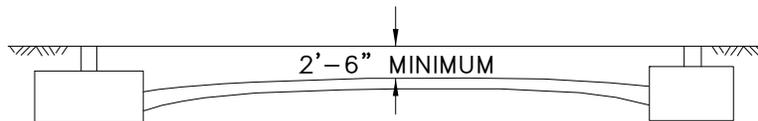
THE MINIMUM GRADE FOR A CONDUIT RUN SHALL BE 1 INCH PER 100 FT. ALL GRADES SHALL BE ESTABLISHED WITH A LEVEL BY THE COMPANY'S ENGINEER AND MARKED BY WOODEN GRADE STAKES ON THE CENTER LINE OF THE BOTTOM OF THE TRENCH. THE STAKES SHALL BE SET 5 FT., APART WHEN CONCRETE CONDUIT IS TO BE INSTALLED AND 10 FT., APART FOR PLASTIC CONDUIT.

THE TOP OF THE GRADE STAKES SHALL INDICATE THE TOP SURFACE OF THE BOTTOM CONDUIT CONCRETE ENCASEMENT.

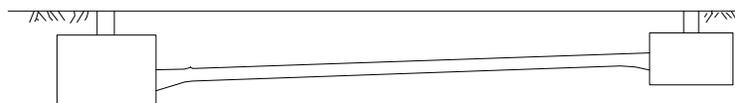
AFTER THE GRADE OF THE CONDUIT RUN HAS BEEN ESTABLISHED BY MEANS OF THE GRADE STAKES, THE BOTTOM OF THE TRENCH SHALL BE TRIMMED 3 INCHES BELOW THE TOP OF THE STAKES EXCEPT WHERE THE TRENCH CROSSES A RAILROAD TRACK. IN SUCH CASES THE BOTTOM SHALL BE TRIMMED 6 INCHES BELOW THE TOP OF THE STAKES. TRENCHES WHICH HAVE BEEN DUG TOO DEEP AND THEN PARTIALLY REFILLED SHALL BE TAMPED SOLID AFTER REFILLING BEFORE POURING THE CONCRETE ENCASEMENT.

DOUBLE SLOPE GRADING

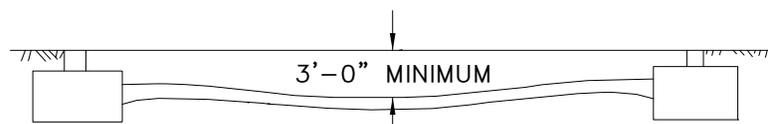
THE MOST DESIRABLE METHOD OF GRADING A CONDUIT RUN BETWEEN MANHOLES IS ILLUSTRATED IN THE SKETCH SHOWN BELOW. THE MINIMUM DISTANCE FROM THE TOP OF THE CONDUIT RUN TO THE STREET SURFACE IS 2 FT. 6 INCHES, AT THE CENTER OF THE RUN. FROM THERE THE RUN FALLS IN A DOUBLE SLOPE AND DRAINS TOWARD BOTH MANHOLES.

SINGLE SLOPE GRADING

WHERE THE STREET LEVEL SLOPES FROM ONE MANHOLE TO THE OTHER, OR WHERE OBSTRUCTIONS WILL NOT PERMIT DOUBLE SLOPE GRADING, THE CONDUIT RUN SHALL BE GRADED IN ONLY ONE DIRECTION AS SHOWN.

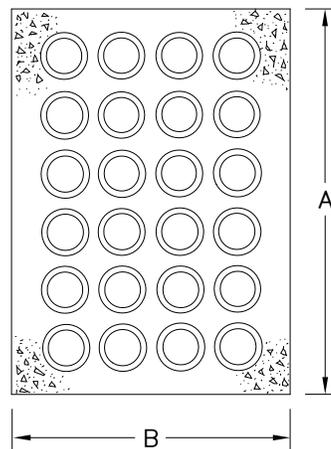
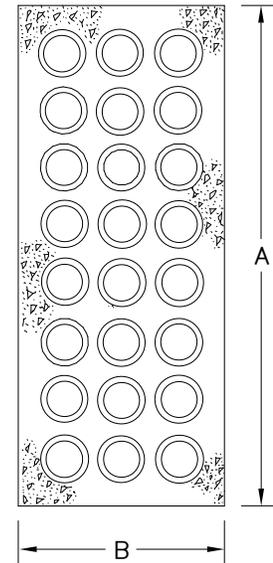
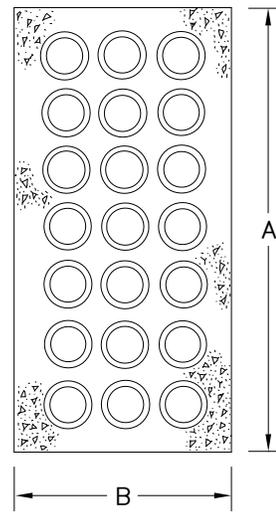
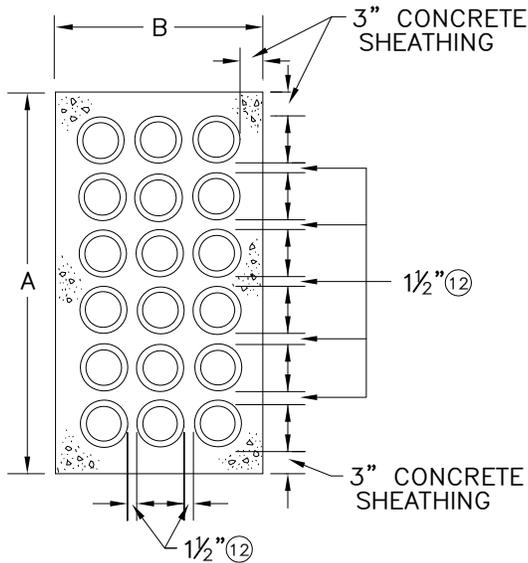
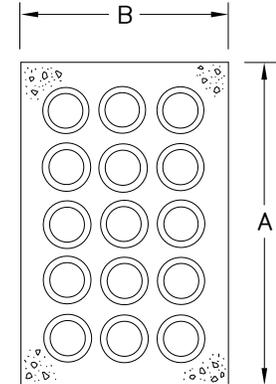
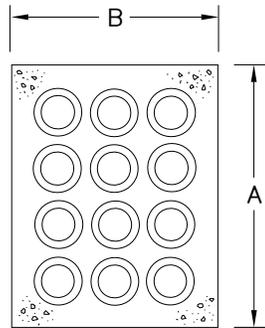
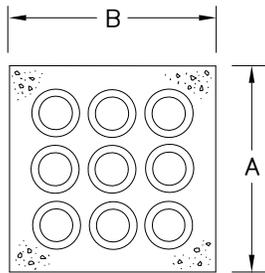
GRADING UNDER VIADUCT OR LARGE OBSTRUCTIONS

A CONDUIT RUN, WHICH IS TO BE INSTALLED UNDER A VIADUCT WHERE THE STREET GRADE IS DEPRESSED, OR UNDER A LARGE OBSTRUCTION MAY BE GRADED WITH A SUMP IN THE LINE AS SHOWN, PROVIDED THAT THE SINGLE SLOPE GRADING METHOD IS NOT PRACTICABLE OR ECONOMICAL. THE TOP OF THE RUN SHALL BE AT LEAST 3 FT., BELOW STREET GRADE TO PREVENT FREEZING. IF THE STREET GRADE IS LEVEL UNDER THE VIADUCT THIS RULE DOES NOT APPLY.



# CONDUIT RUN FORMATIONS

## BETWEEN MANHOLES



**NOTES:**

**APPLICATION**

- THIS STANDARD SHALL BE USED FOR THE ARRANGEMENT OF CONDUIT FORMATIONS BETWEEN MANHOLES AND SUBURBAN SUBSTATION EXITS.
- THE TWO (2) WIDE CONDUIT FORMATION ON PAGE 2 IS THE REQUIRED INSTALLATION FOR SUBURBAN SUBSTATION EXITS.

**INFORMATION**

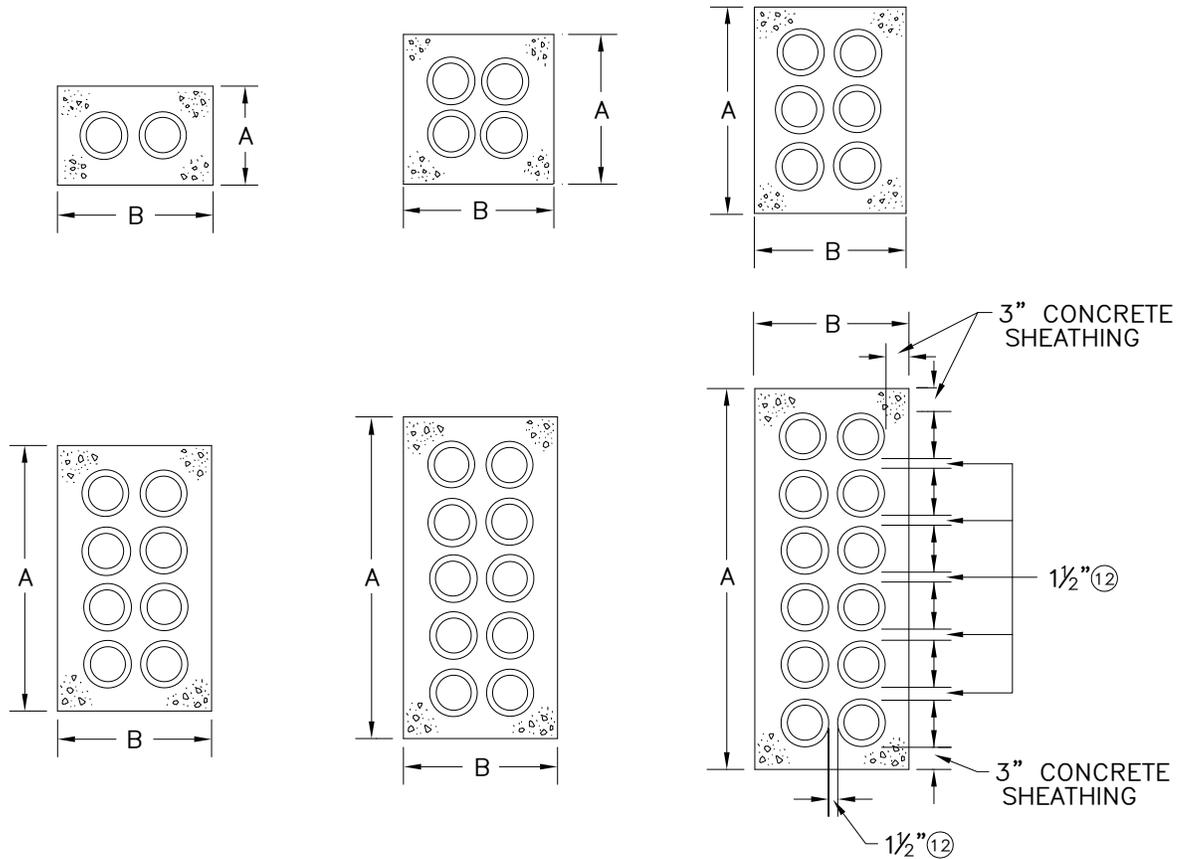
- 11 THIS STANDARD COVERS THE ARRANGEMENT OF CONDUIT IN CONDUIT RUNS AND LATERALS.
- 12 SEPARATION BETWEEN CONDUITS SHALL BE 1/2 INCH. CONCRETE SHEATHING SHALL BE 3 INCHES THICK, EXCEPT WHERE A CONDUIT RUN IS UNDER RAILROAD SWITCH TRACKS OR MAINLINE RAILROAD TRACKS. THEN SHEATHING BE AS SHOWN ON **C4110**.

- 13 THESE DIMENSIONS REFLECT THE USE OF PLASTIC SPACERS WHICH PROVIDES HORIZONTAL SEPARATION AT OR GREATER THAN MINIMUM REQUIREMENTS.

NO. OF DUCTS	DIMENSIONS (12) (13)			
	PLASTIC CONDUIT			
	4" CONDUIT		5" CONDUIT	
	A *	B *	A *	B *
9	22 3/4"	23"	26 1/2"	26 1/2"
12	29"	23"	33 3/4"	26 1/2"
15	35"	23"	41"	26 1/2"
18	41 1/4"	23"	48 1/4"	26 1/2"
21	47 1/4"	23"	55 1/2"	26 1/2"
24 (3X8)	53 1/2"	23"	63"	26 1/2"
24 (4X6)	41 1/4"	29 1/4"	48 1/4"	34"

\* DIMENSIONS ARE TO NEXT LARGER 1/4"

SUBURBAN SUBSTATION EXIT FORMATIONS



NO. OF DUCTS	DIMENSIONS (12)(13)			
	PLASTIC CONDUIT			
	4" CONDUIT		5" CONDUIT	
	A *	B *	A *	B *
2	10½"	16¾"	11¾"	19"
4	16¾"	16¾"	19"	19"
6	23"	16¾"	26½"	19"
8	29"	16¾"	33¾"	19"
10	35"	16¾"	41"	19"
12	41¼"	16¾"	48¼"	19"

\* DIMENSIONS ARE TO NEXT LARGER ¼"

# CONDUIT RUN INSTALLATION

## MONOLITHIC METHOD

### 1. APPLICATION

- THIS STANDARD COVERS THE PROCEDURE FOR INSTALLING CONCRETE ENCASED CONDUIT BY THE MONOLITHIC METHOD. THIS METHOD CONSISTS OF BUILDING UP LAYERS OF CONDUIT ON SPACERS AND THEN POURING THE CONCRETE ENCASEMENT IN A MONOLITHIC MASS.

### 2. GENERAL

- 2.1 THE TYPE AND SIZE OF CONDUIT IS GIVEN IN ESP 5.3.3.2, BUT SHALL BE SPECIFIED FOR EACH JOB ON THE INSTALLATION DRAWINGS.

- 2.2 RADIAL SEPARATION OF CONDUIT SYSTEMS FROM GAS AND OTHER LINES THAT TRANSPORT FLAMMABLE MATERIAL SHALL NOT BE LESS THAN 12" AND SHOULD HAVE SUFFICIENT SEPARATION FROM GAS AND OTHER LINES THAT TRANSPORT FLAMMABLE MATERIAL TO PERMIT THE USE OF PIPE MAINTENANCE EQUIPMENT (NESC 320.B.5)

- 2.3 SPLIT CONDUIT SHALL BE USED TO REBUILD OR CHANGE THE LOCATION OF EXISTING DUCTS THAT CONTAIN CABLES, AS SHOWN IN STANDARD C4175.

- 2.4 CONNECTIONS FOR CONDUIT OF DIFFERENT SIZES AND MATERIALS ARE SHOWN IN STANDARDS C4162 AND C4163.

- 2.5 ALL CONDUIT BROKEN ENDS SHALL BE CUT AND USED WHENEVER POSSIBLE.

### 3. TRENCH PREPARATION

- 3.1 THE PREPARATION OF THE TRENCH FOR CONDUIT RUNS SHALL BE AS PRESCRIBED IN CONSTRUCTION STANDARD C4050. WHERE SWAMPY OR UNSTABLE SOIL IS ENCOUNTERED, CONDUIT SHALL BE PLACED ON A CONCRETE BASE, LAYING THE CONDUIT AFTER THE CONCRETE IS LEVELED AND STARTS TO SET. AT THIS POINT THE BASE OF THE CONCRETE WILL SUPPORT THE CONDUIT AND PERMIT THE BASE SPACERS TO BE DEPRESSED AND TO FIND AN EVEN BEARING WHILE THE BASE CONCRETE IS STILL YIELDING. THE BASE CONCRETE IS BY VOLUME:

1 PART PORTLAND CEMENT EM48000  
3 PARTS #2 TORPEDO SAND EM48002  
5 PARTS 3/4" TO #4 GRAVEL EM48005

- 3.2 IF THE CONDUIT DOES NOT REST ON UNDISTURBED EARTH WITHIN 3' OF THE MANHOLE OR VAULT, BRIDGE THE GAP TO THE UNDISTURBED EARTH WITH 6" BASE OF REINFORCED CONCRETE. THIS CONCRETE SHALL BE A DENSE SHEATHING (PAGE 4) WITH #4 REINFORCING BARS ON 6" CENTERS, 3" FROM THE BOTTOM.

4. CONCRETE MIX FOR SHEATHING4.1 (A) READY-MIXED

READY MIXED CONCRETE DELIVERED TO THE JOB SHALL BE SPECIFIED AS 3000 POUNDS PER SQUARE INCH MINIMUM (AT 28 DAYS) CONCRETE. THE COARSE AGGREGATE SHALL BE PEA GRAVEL. THE FINE AGGREGATE SHALL BE #2 TORPEDO SAND (EM48002). SLUMP AT POINT OF DELIVERY SHALL NOT BE MORE THAN 4" NOR LESS THAN 2".

MINIMUM CEMENT CONTENT SHALL BE 3 1/2 BAGS OF TYPE 1 PORTLAND CEMENT PER CUBIC YARD. FLY ASH SHALL BE INCORPORATED IN THE MIX ON THE BASIS OF 20 POUNDS PER SACK OF CEMENT. INCLUDE AIR ENTRAINMENT AGENT TO ENTRAIN BETWEEN 4 AND 6 PERCENT OF AIR IN CONCRETE.

EXCEPT AS OTHERWISE DESIGNATED IN THIS STANDARD, READY-MIXED CONCRETE SHALL CONFORM TO THE REQUIREMENTS OF SPECIFICATIONS OF READY-MIXED CONCRETE (ASTM C94 LATEST ADDITION).

READY-MIXED CONCRETE SHALL BE PLACED WITHIN 1 HOUR AFTER WATER HAS BEEN ADDED TO THE MIX.

4.2 (B) BATCH-MIXED

WHEN THE CONCRETE IS MIXED ON THE JOB, A PREBAGGED CEMENT MIX CONSISTING BY WEIGHT OF 70 PERCENT PORTLAND CEMENT AND 30 PERCENT FLY ASH SHALL NORMALLY BE USED. THE CONCRETE MIX PROPORTIONS BY VOLUME (RODDED SATURATED SURFACE DRY BASIS) SHALL BE:

1 PART OF PREBAGGED MIX (1 BAG IS 1 CUBIC FOOT)  
3 1/2 PARTS #2 TORPEDO SAND EM48002  
2 1/2 PARTS PEA GRAVEL

MAXIMUM WATER CONTENT, INCLUDING FREE SURFACE MOISTURE IN AGGREGATES, SHALL NOT EXCEED 7 GALLONS PER BAG OF CEMENT MIX. SLUMP SHALL BE AS SPECIFIED ABOVE IN PARAGRAPH 4.1 READY-MIXED CONCRETE.

IN THE EVENT THAT THE PREBAGGED CEMENT MIX IS NOT AVAILABLE, 1 BAG OF TYPE 1 PORTLAND CEMENT (EM48000) SHALL BE SUBSTITUTED FOR 1 BAG OF CEMENT MIX. WATER CONTENT, SLUMP, AND CEMENT MIX PROPORTIONS SHALL REMAIN AS STATED IN THE PROCEEDING PARAGRAPH.

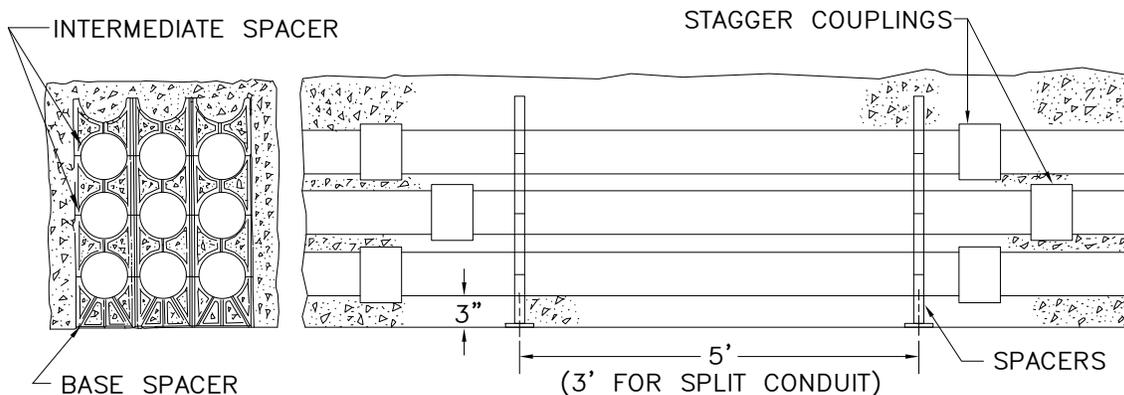
THE AGGREGATES SHALL BE MEASURED BEFORE BEING PUT IN THE MIXER, AND SHALL BE IN SUCH PROPORTIONS THAT ONE FULL BAG OF CEMENT WILL BE USED IN EACH BATCH. ALL CONCRETE SHALL BE MIXED FOR A MINIMUM OF TWO MINUTES IN A MACHINE MIXER.

HAND MIXING SHALL NOT BE DONE EXCEPT BY SPECIAL PERMISSION OF THE ENGINEER. MORTAR OR CONCRETE SHALL NOT BE "RETEMPERED" EITHER BY REMIXING OR BY THE ADDITION OF ANY MATERIALS OR ADMIXTURES. THE DRUM OF THE MIXER SHALL BE COMPLETELY EMPTIED BEFORE RECEIVING MATERIALS FOR THE SUCCEEDING BATCH. CONCRETE THAT HAS OBTAINED ITS INITIAL SET BEFORE BEING PLACED SHALL BE DISCARDED AND NOT USED ON THE JOB.

5. COLD WEATHER CONCRETING (BELOW 40° F)

INGREDIENTS OF CONCRETE POURED WHEN THE SURROUNDING AIR IS BELOW 40°F SHALL BE HEATED SO THAT THE TEMPERATURE OF THE CONCRETE AFTER PLACEMENT IS NEITHER LOWER THAN 55°F NOR GREATER THAN 65°F. PLUG ENDS OF CONDUIT RUN TO PREVENT AIR CIRCULATION. PROTECT CONCRETE FROM FREEZING FOR A MINIMUM OF 48 HOURS.

WHEREVER POSSIBLE, ALL CONCRETE MATERIALS AND ALL REINFORCEMENT, FORMS, FILLERS AND GROUND WITH WHICH CONCRETE IS TO COME IN CONTACT SHOULD BE FREE FROM FROST.

ELEVATION OF MONOLITHIC METHOD6. CONDUIT INSTALLATION

THE STANDARD ARRANGEMENT AND SEPARATION OF DUCTS AND THE THICKNESS OF CONCRETE SHEATHING SHALL BE AS SHOWN ON STANDARD C4110 FOR CONDUIT RUNS UNDER MAIN LINE RAILROAD TRACK, OR ON STANDARD C4090 FOR ALL OTHER LOCATIONS. IF SPECIAL ARRANGEMENTS ARE REQUIRED, THE SECTIONAL OUTLINE OF DUCTS SHALL BE SHOWN ON THE INSTALLATION DRAWINGS. TRANSPOSITION OF DUCTS FOR VARIOUS STANDARD FORMATIONS SHALL BE MADE PER STANDARDS C4130-36, BUT SHALL BE DONE ONLY WHEN SPECIFIED ON THE DRAWINGS OR SPECIALLY AUTHORIZED BY THE ENGINEER AFTER UNFORSEEN OBSTRUCTIONS ARE UNCOVERED.

THE FIRST LAYER OF CONDUIT SHALL BE LAID ON PLASTIC BASE SPACERS (4" CATID 0000402327 FOR MAINTENANCE ONLY, 5" CATID 0000402328) HORIZONTALLY LOCKED, WHICH WILL PROVIDE A 3" LAYER OF CONCRETE BELOW THE CONDUIT. THEY SHALL BE PLACED AT INTERVALS OF APPROXIMATELY 5'. SUCCEEDING LAYERS ARE PLACED ON PLASTIC INTERMEDIATE SPACERS (4" CATID 0000402325 FOR MAINTENANCE ONLY, 5" CATID 0000402326) VERTICALLY LOCKED TO PREVIOUSLY PLACED SPACERS. THE CONDUIT COUPLINGS SHALL BE STAGGERED SO THAT NO COUPLING IS IN LINE WITH THE COUPLING ON AN ADJACENT CONDUIT.

ACAD

CONDUIT INSTALLATION (CONT'D)

THE CONCRETE SHALL BE CONSOLIDATED THOROUGHLY BY MECHANICAL VIBRATING EQUIPMENT SUPPLEMENTED BY HAND-SPADING, PUDDLING, RODDING, OR TAMPING IN AND AROUND THE CONDUIT PACKAGE. DO NOT USE VIBRATORS TO TRANSPORT CONCRETE INSIDE FORMS. INSERT AND WITHDRAW VIBRATORS VERTICALLY AT UNIFORMLY SPACED LOCATIONS NOT FARTHER THAN VISIBLE EFFECTIVENESS OF MACHINE. PLACE VIBRATORS TO RAPIDLY PENETRATE PLACED LAYER AND AT LEAST 6" INTO PRECEDING LAYER. DO NOT INSERT VIBRATORS INTO LOWER LAYERS OF CONCRETE THAT HAS BEGUN TO SET. AT EACH INSERTION, LIMIT DURATION OF VIBRATION TO TIME NECESSARY TO CONSOLIDATE CONCRETE. WHEN THE REQUIRED LAYERS OF CONDUIT ARE BUILT UP, THE ENTIRE ASSEMBLY SHALL BE BRACED TO PREVENT LATERAL AND VERTICAL MOVEMENT. WHEN THE INSTALLATION OF SPLIT DUCT IS SPECIFIED, PLACE SPACERS AT 3' INTERVALS.

BRACING SHALL BE REMOVED WHEN CONCRETE HAS STARTED TO SET AND THERE IS NO FURTHER DANGER THAT DUCTS WILL FLOAT OR MOVE OUT OF ALIGNMENT. HOLES LEFT BY BRACING SHOULD THEN BE FILLED WITH GROUT.

IN FORMATIONS GREATER THAN 4 DUCTS HIGH, THE PREFERRED PRACTICE IS TO INSTALL THE FORMATION IN TWO LAYERS WITH THE CONCRETE BEING POURED IN TWO STEPS. THIS WILL PREVENT THE SPACERS FROM SPREADING OUT UNEVENLY AND CREATING UNEVEN VARIANCES IN CLEARANCES BETWEEN CONDUITS. THIS PROCEDURE WILL ALSO ENSURE THAT THERE IS A CONCRETE ENVELOPE AROUND EVERY DUCT AND DECREASE VERTICAL DROP TO THE LOWEST POSSIBLE DISTANCE WHEN POURING THE CONCRETE.

7. UNFINISHED CONSTRUCTION

IF THE CONDUIT RUN MUST BE TEMPORARILY LEFT UNFINISHED DURING CONSTRUCTION, CONDUIT SHALL BE CLOSED WITH PLASTIC CONDUIT PLUGS (5" CATID 000402249). IF THE CONDUIT RUN IS TO BE DEAD-ENDED FOR COMPLETION AT SOME FUTURE TIME, THE END OF EACH CONDUIT SHALL BE PLUGGED AND STAGGERED APPROXIMATELY 3" FROM THE ADJACENT CONDUIT. THE END OF THE CONCRETE SHEATHING SHALL BE STEPPED BACK APPROXIMATELY 6" FOR EACH HORIZONTAL ROW OF CONDUIT. THE ENDS OF THE CONDUIT SHALL EXTEND BEYOND THE SHEATHING TO PERMIT CONNECTION TO FUTURE CONDUIT.

IN INSTANCES WHERE THE CONDUIT ENDS MAY NOT BE EASILY LOCATED, INSTALL AN ELECTRONIC MARKER (CATID 0000649202) TO ASSIST IN LOCATING. AFTER CONDUIT IS INSTALLED, BACKFILL THE HOLE COVERING THE CONDUIT ENDS APPROXIMATELY 6" TO 12" AND INSERT A MARKER IN THE HOLE ABOVE THE CONDUIT END. LAY MARKER ON FLAT GROUND AND CONTINUE BACKFILLING, INSURING THAT THE MARKER STAYS IN A HORIZONTAL POSITION SO THAT THE LOCATOR TOOL MAY LOCATE IT.

#### 8. TRANSPOSING AROUND OBSTRUCTIONS

WHEN SMALL OBSTRUCTIONS ARE ENCOUNTERED, AND IT IS NOT ECONOMICAL OR DESIREABLE TO INSTALL THE CONDUIT RUN BELOW THE OBSTRUCTION, THE CONDUIT PACKAGE MAY BE TRANSPOSED. IN SUCH AN OPERATION, A 1" SPACE SHALL BE LEFT ABOVE AND BELOW, BETWEEN THE CONCRETE SHEATH AND THE OBSTRUCTION. A 6" GAP SHALL BE LEFT AROUND UTILITIES THAT ARE OBSTRUCTIONS. EACH PORTION OF THE TRANSPOSED CONDUIT SECTION SHALL BE INSTALLED AS A DOUBLE REVERSE CURVE USING A MINIMUM RADIUS OF 300'.

THE SPACE BETWEEN THE TWO PORTIONS OF THE TRANSPOSED SECTION SHALL BE COMPLETELY FILLED WITH CONCRETE TO WITHIN 3" OF EACH SIDE OF THE OBSTRUCTION. THIS SPACE SHALL BE FILLED WITH #2 TORPEDO SAND (EM48002).

#### 9. CONDUIT BELLS

ALL CONDUIT SHALL TERMINATE AT A MANHOLE IN PLASTIC CONDUIT ENTRANCE BELLS AS SHOWN ON STANDARD C4231. ALL CONDUIT SHALL TERMINATE AT A NETWORK CENTER OR VAULT PER C4250. IF CONDUIT PLUGS ARE USED, THEY SHOULD BE REMOVED AFTER CONSTRUCTION IS COMPLETED UNLESS OTHERWISE SPECIFIED.

#### 10. BACKFILLING

AFTER THE CONCRETE SHEATHING HAS ATTAINED ITS INITIAL SET, THE TRENCH SHALL BE BACKFILLED. SAND OR OTHER STATE OR MUNICIPAL APPROVED MATERIAL SHALL BE USED UNDER PAVEMENTS EXCEPT WHEN THE EXCAVATED MATERIAL IS FINE, DRY, CAN BE WELL COMPACTED, AND WILL NOT SETTLE AFTER PAVEMENT IS RESTORED. IF THE EXCAVATION IS MADE IN SANDY SOIL, THE REMOVED MATERIAL MAY BE USED FOR BACKFILL IF SATISFACTORY TO THE ENGINEER. LAKE SAND SHALL NEVER BE USED FOR BACKFILL IN CONDUIT TRENCHES BECAUSE OF ITS POOR HEAT CONDUCTING PROPERTIES. ALL BACKFILL IN PAVED AREAS SHALL BE THOROUGHLY COMPACTED AND FLOODED.

CONDUIT RUNS IN PARKWAYS MAY BE BACKFILLED WITH THE EXCAVATED MATERIAL IF IT IS CLAY, LOAM, COARSE SAND, OR GRAVEL.

WHEN LAKE SAND, PEAT, CINDERS, SLAG, OR OTHER MATERIAL WITH POOR HEAT CONDUCTING PROPERTIES ARE ENCOUNTERED IN THE CONDUIT EXCAVATION, THERMAL BACKFILL SHALL BE ADDED AROUND AND ABOVE THE CONDUIT, AS SPECIFIED ON THE INSTALLATION PLANS OR BY THE OWNER'S ENGINEER. THIS THERMAL BACKFILL WILL BE PER EM48008 OR BANK RUN GRAVEL FROM A LOCATION APPROVED BY A TEMPERATURE CONTROL ENGINEER.

#### 11. PAVING, CURBS, SIDEWALKS

REPLACEMENT OF PAVING, CURBS AND SIDEWALKS SHALL BE DONE IN ACCORDANCE WITH THE MUNICIPAL OR STATE REQUIREMENTS.

12. CONDUIT PREPARATION

AFTER THE CONCRETE SHEATHING HAS ATTAINED ITS INITIAL SET, EACH DUCT SHALL BE RODDED AND A MANDREL FURNISHED BY THE OWNER SHALL BE PULLED THROUGH THE DUCT. WHEN A PREVIOUSLY DEAD-ENDED CONDUIT RUN IS EXTENDED, THE ENTIRE RUN SHALL BE RODDED AND MANDRELED. CONDUIT RUNS CONTAINING OR TERMINATING IN SMALL RADIUS BENDS (LESS THAN 4' RADIUS) THAT WILL NOT PERMIT THE PASSAGE OF A STANDARD SIZE MANDREL SHALL BE MANDRELED THROUGH THEIR STRAIGHT PORTION TO THE CONSTRUCTION OR INSTALLATION OF THE BENDS. THE MANDRELING OF ALL RADIUS BENDS SHALL BE DONE WITH A FLEXIBLE MANDREL NO SMALLER IN DIAMETER THAN 1/2" LESS THAN THE NOMINAL DIAMETER OF THE BEND.

WHEN DESIGNATED, THE CONTRACTOR SHALL AS A PART OF THE MANDRELING OPERATION, PULL IN AND LEAVE IN CERTAIN DESIGNATED DUCTS A #8 GALVANIZED STEEL PULLING WIRE (EM31110) OR A 9/16" DOUBLE BRAIDED PULLING ROPE (9/16" X 300' CATID 0001122282 OR 9/16" X 600' CATID 0001122283). THE PULLING WIRE OR ROPE WILL BE FURNISHED BY THE OWNER.

13. LATERALS

CONDUIT LATERALS THAT ARE TO BE CONCRETE ENCASED SHALL BE INSTALLED IN THE SAME MANNER AS MAIN CONDUIT RUNS. LATERALS THAT TERMINATE AT BUILDING WALLS SHALL BE CONSTRUCTED AS SHOWN ON STANDARD C4250. THOSE THAT TERMINATE AT A POLE SHALL BE CONSTRUCTED PER C4270 OR C4273. THOSE THAT TERMINATE AT AN EQUIPMENT FOUNDATION SHALL BE CONSTRUCTED PER THE SPECIFIC EQUIPMENT FOUNDATION STANDARD.

14. DENSE CONDUIT SHEATHING FOR SPECIAL CONDITIONS

WHEN SPECIFIED ON THE INSTALLATION DRAWINGS, CONDUIT RUNS TO BE INSTALLED IN KNOWN CORROSIVE LOCATIONS, SUCH AS IN CINDER FILL, ADJACENT TO COAL STORAGE PILES, IN GAS PURIFIER SLAG, ETC., SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE FOLLOWING INSTRUCTIONS. ALL OTHER PROCEDURES GIVEN IN PRECEEDING PAGES OF THIS STANDARD SHALL BE FOLLOWED.

THE OUTER SHEATHING ALL AROUND SHALL BE 4" THICK. CONCRETE SHALL CONSIST OF THE FOLLOWING MIX:

1 PART TYPE 1 PORTLAND CEMENT EM48000  
2 PARTS #2 TORPEDO SAND EM48002  
2 PARTS PEA GRAVEL (NOT CRUSHED STONE)  
1/2 BAG OF FLY ASH SHALL BE ADDED TO THE MIX FOR EACH  
BAG OF PORTLAND CEMENT USED

DENSE CONDUIT SHEATHING FOR SPECIAL CONDITIONS (CONT'D)

FOR AN ALTERNATIVE TO PORTLAND CEMENT AND FLY ASH, LUMINITE CEMENT SHALL BE SPECIFIED. INCLUDE AIR ENTRAINMENT AGENT TO ENTRAIN 7 1/2 PERCENT OF AIR IN CONCRETE

INCLUDING FREE SURFACE MOISTURE IN THE AGGREGATES, NOT MORE THAN 6 GALLONS OF WATER PER BAG OF CEMENT SHALL BE USED.

MINIMUM SLUMP SHALL BE 2" AND A MAXIMUM SLUMP 4".

# ESS INSTALLATION REQUIREMENTS

## USING COMPARTMENTAL TRANSFORMERS

### 1. APPLICATION

- 1.1 THE INFORMATION IN THIS STANDARD COVERS GENERAL CONDITIONS AND REQUIREMENTS FOR THE INSTALLATION OF 1-PHASE AND 3-PHASE COMPARTMENTAL TRANSFORMERS FOR AN ELECTRIC SERVICE STATION.

### 2. GENERAL

- 2.1 THE SERVICE FACILITIES FURNISHED AND INSTALLED BY THE CUSTOMER AND ComEd SHALL BE IN ACCORDANCE WITH ComEd's REQUIREMENTS AND STANDARDS CONTAINED HEREIN, IN OTHER APPROPRIATE STANDARDS, AND IN "ComEd's GENERAL TERMS AND CONDITIONS", IN ADDITION TO A SERVICE ENTRANCE LOCATION SKETCH.
- 2.2 THIS INFORMATION IS RELEVANT TO A TRANSFORMER LOCATION THAT IS ACCEPTABLE TO ComEd. THE SIZE AND LOCATION OF THE UNDERGROUND PRIMARY SERVICE CONNECTION ON THE CUSTOMER'S PROPERTY IS FURNISHED ON A SEPARATE SERVICE ENTRANCE LOCATION SKETCH.

### 3. ComEd WILL FURNISH, INSTALL, OWN AND MAINTAIN

- 3.1 IN ACCORDANCE WITH THE PROVISIONS FOR FURNISHING "NONSTANDARD SERVICES AND FACILITIES":
- (A) COMPARTMENTAL TRANSFORMER, APPROPRIATE PROTECTIVE EQUIPMENT, GROUND CONNECTION INCLUDING GROUNDING CONDUCTOR, GROUND RODS, AND LUGS FOR TERMINATING SECONDARY CABLE AT TRANSFORMER (IF REQUIRED).
  - (B) THAT PORTION OF THE PRIMARY SERVICE CONNECTION IN EXCESS OF A STANDARD PRIMARY SERVICE CONNECTION.
  - (C) PRIMARY SERVICE CONNECTION CABLES FOR THE ENTIRE SERVICE CONNECTION, EITHER DIRECT-BURIED (INCLUDING TRENCH) OR IN CONDUIT. IF THE CUSTOMER PREFERS DIRECT-BURIAL OF THE CABLES, ComEd SHALL HAVE CONTINUED ACCESS TO THE INSTALLATION, WITHOUT IMPEDIMENTS FROM OVER-BUILDING OR OBSTRUCTIONS, FOR OPERATION AND MAINTENANCE OF CABLE.
  - (D) CONNECTORS TO CONNECT THE PRIMARY CABLES TO THE TRANSFORMER.
  - (E) SECONDARY CABLE AND CONNECTORS TO CONNECT BETWEEN TRANSFORMER TERMINALS AND JUNCTION CABINET, IF USED.
  - (F) LOCKING PROVISION FOR JUNCTION CABINET, IF USED.

### 4. ComEd WILL CONNECT

- 4.1 THE PRIMARY AND SECONDARY SERVICE CONNECTION CABLES TO THE COMPARTMENTAL TRANSFORMER TERMINALS.

### 5. CUSTOMER SHALL FURNISH, INSTALL, OWN AND MAINTAIN

- 5.1 FOUNDATION FOR COMPARTMENTAL TRANSFORMER, CONDUIT AND TRENCH FOR GROUND WIRE PER ComEd's STANDARDS (C5288 FOR 1-PHASE TRANSFORMER, C5289 FOR OPEN DELTA TRANSFORMER BANK, AND C5286 OR C5293 FOR 3-PHASE TRANSFORMER).
- 5.1.1 THE FOUNDATION SHALL BE LOCATED AS FAR AS PRACTICAL FROM WINDOWS, DOORS, FIRE ESCAPES, ENTRANCES, AND VENTILATING DUCTS SO AS NOT TO PRESENT A PHYSICAL OBSTRUCTION.
- 5.1.2 THE FOUNDATION SHALL BE LOCATED AT LEAST 3 FEET (HORIZONTALLY) FROM ANY NATURAL GAS METER, REGULATOR, OR OTHER INSTALLATION; AT LEAST 10 FEET (HORIZONTALLY) FROM ANY L.P. OR PROPANE TANK, REGULATOR, OR OTHER INSTALLATION; AND OUTSIDE OF ANY OTHER N.E.C. HAZARDOUS (CLASSIFIED) LOCATION.
- 5.1.3 IT SHALL BE THE CUSTOMER'S RESPONSIBILITY TO COMPLY WITH ANY INSURANCE REGULATIONS AFFECTING THE INSTALLATION. FIGURES 1, 2 AND 3 SHOW THE MINIMUM CLEARANCES PERMITTED BY ComEd BETWEEN THE TRANSFORMER FOUNDATION AND WINDOWS, DOORS, FIRE ESCAPES, ENTRANCES, AND VENTILATING DUCTS.
- 5.2 A VEHICULAR BARRIER SHALL BE INSTALLED PER C5295, WHERE DAMAGE TO THE TRANSFORMER BY VEHICLES IS POSSIBLE. BARRIERS SHALL BE INSTALLED BEFORE TRANSFORMER IS SET.
- 5.3 THE CONDUIT RUN FOR PRIMARY SERVICE CONNECTION CABLE ON PRIVATE PROPERTY - SEE 3.1(C).

#### 1-PHASE TRANSFORMER:

CONDUIT RUN SHALL CONSIST OF 3" MINIMUM IRON PIPE SIZE CONDUIT, (SINGLE CONDUIT RECOMMENDED) FROM A POINT ON CUSTOMER'S PROPERTY LINE, DESIGNATED BY ComEd, TO THE TRANSFORMER FOUNDATION, TERMINATING WITH 3" 90 DEGREE 36" MINIMUM RADIUS, PLASTIC SCHEDULE 40 BENDS OR HOT GALVANIZED RIGID STEEL BENDS PROVIDED WITH GROUND BUSHINGS FOR I/O WIRE, O.Z. GEDNEY TYPE "BLG" OR EQUIVALENT. TOP OF BENDS, INCLUDING GROUND BUSHINGS IF STEEL CONDUIT, SHALL TERMINATE FLUSH WITH TOP OF FOUNDATION. FOUNDATION SHALL BE BOXED OUT AROUND CONDUIT BENDS.

#### 3-PHASE TRANSFORMER:

THE CONDUIT RUN SHALL CONSIST OF 4" MINIMUM IRON PIPE SIZE CONDUIT, (SINGLE CONDUIT RECOMMENDED) FROM A POINT ON CUSTOMER'S PROPERTY LINE DESIGNATED BY ComEd, TO THE TRANSFORMER FOUNDATION, TERMINATING WITH 4" 90 DEGREE 36" MINIMUM RADIUS PLASTIC SCHEDULE 40 BENDS OR HOT GALVANIZED RIGID STEEL BENDS PROVIDED WITH GROUND BUSHINGS FOR I/O WIRE, O.Z. GEDNEY TYPE "BLG" OR EQUIVALENT. TOP OF BENDS, INCLUDING GROUND BUSHINGS IF STEEL CONDUIT, SHALL TERMINATE FLUSH WITH TOP OF FOUNDATION, UNLESS OTHERWISE NOTED. FOUNDATION SHALL BE BOXED OUT AROUND CONDUIT BENDS.

## 5. CUSTOMER SHALL FURNISH, INSTALL, OWN AND MAINTAIN (CONT'D)

TYPES OF APPROVED CONDUIT RUNS			
CONDUIT	SEPARATION BETWEEN CONDUITS	MINIMUM DEPTH TO 3" CONCRETE ENVELOPE*	MINIMUM DEPTH TO CONDUIT WITHOUT CONCRETE ENVELOPE*
HOT GALVANIZED RIGID STEEL	1 1/2"	--	30"
MULTIPLE CONCRETE CONDUIT	--	--	30"
PLASTIC	1 1/2"	30"	(SEE 5.8)

\* FROM FINAL GRADE.

CONDUIT PASSING THROUGH BUILDINGS SHALL BE HOT GALVANIZED RIGID STEEL ENCASED IN 3" CONCRETE ENVELOPE AND PROVIDED WITH A WATERTIGHT SEAL BETWEEN CONDUIT AND BUILDING WALL.

CURVES AND BENDS IN THE CONDUIT RUN SHOULD BE AVOIDED WHEREVER POSSIBLE. WHERE A RUN CONTAINS CURVES IN ANY PLANE OR IF A STRAIGHT RUN EXCEEDS 560 FEET IN LENGTH, THE COMPANY SHALL BE CONSULTED AS TO PERMISSIBLE MAXIMUM LENGTH AND RADII OF CURVATURE. MANHOLES, BUILT TO ComEd's STANDARDS, WILL BE REQUIRED WHERE TOTAL DISTANCE EXCEEDS PERMISSIBLE CONDUIT RUN LENGTHS.

THE ENTIRE CONDUIT RUN SHALL BE INSTALLED PER C4171 ON UNDISTURBED OR WELL TAMPED EARTH. CONDUIT SHALL SLOPE A MINIMUM OF 1" PER 100 FEET AND MAY DRAIN EITHER WAY OR IN BOTH DIRECTIONS TO MANHOLE. AFTER INSTALLATION, CONDUIT SHALL BE CHECKED WITH A WIRE BRUSH TYPE MANDREL (DESIGNED FOR THE CONDUIT), AND A #8 GALVANIZED STEEL PULLING WIRE OR 1/4" POLYETHYLENE ROPE SHALL BE LEFT IN DESIGNATED DUCT. ComEd INSPECTOR TO CHECK INSTALLATION OF CONDUIT BEFORE TRENCH IS BACKFILLED. ENDS OF CONDUIT SHALL BE TEMPORARILY SEALED.

- 5.4 THE CONDUIT BEND AT TRANSFORMER FOUNDATION FOR PRIMARY SERVICE CONNECTION CABLE WHEN CONDUIT RUN IS NOT INSTALLED. THE CONDUIT BEND SHALL BE OF PLASTIC SCHEDULE 40 OR HOT GALVANIZED RIGID STEEL CONDUIT – SEE 3.1 (c). METAL CONDUIT BENDS SHALL HAVE ACCEPTABLE GROUND BUSHINGS FOR 1/0 WIRE, O.Z. GEDNEY TYPE "BLG" OR EQUIVALENT.

1-PHASE TRANSFORMER:

CONDUIT BEND SHALL BE 3" IRON PIPE SIZE, 90 DEGREE, 36" MINIMUM RADIUS. TOP OF BENDS, INCLUDING GROUND BUSHING IF STEEL CONDUIT, SHALL TERMINATE FLUSH WITH THE TOP OF THE FOUNDATION AND 1 FOOT BEYOND THE FOUNDATION 2 1/2 FEET BELOW FINAL GRADE.

3-PHASE TRANSFORMER:

CONDUIT BEND SHALL BE 3" IRON PIPE SIZE, 90 DEGREE, 36" MINIMUM RADIUS. TOP OF BENDS, INCLUDING GROUND BUSHING IF STEEL CONDUIT, SHALL TERMINATE FLUSH WITH TOP OF FOUNDATION, UNLESS OTHERWISE NOTED, AND 1 FOOT BEYOND THE FOUNDATION 2 1/2 FEET BELOW FINAL GRADE.

- 5.5 UNDERGROUND SECONDARY SERVICE CONNECTION

THE UNDERGROUND SECONDARY SERVICE CONNECTION SHALL CONSIST OF CABLE AND CONDUIT BENDS. THE BENDS SHALL BE OF PLASTIC OR HOT GALVANIZED RIGID STEEL CONDUIT. TOP OF BENDS, INCLUDING GROUND BUSHINGS IF STEEL CONDUIT, SHALL TERMINATE FLUSH WITH TOP OF FOUNDATION (SEE 3.1A AND 4.1). METAL CONDUIT BENDS SHALL HAVE GROUND BUSHINGS FOR 1/0 WIRE, O.Z. GEDNEY TYPE "BLG" OR EQUIVALENT. WITHOUT EXCEPTION, CUSTOMER'S SERVICE NEUTRAL SHALL BE CONNECTED TO THE SECONDARY NEUTRAL OF THE COMPARTMENTAL TRANSFORMER. FOUNDATION SHALL BE BOXED OUT AROUND BENDS.

- 5.6 AN APPROVED JUNCTION CABINET WITH BUS BARS, FOUNDATION FOR JUNCTION CABINET AND TRANSFORMER, CONDUIT TO CABINET, CONDUIT BETWEEN TRANSFORMER AND CABINET, AND A TRENCH FOR GROUND WIRE PER ComEd's STANDARDS (SEE C5286, PAGE 3 FOR DETAILS) SHALL ALL BE PROVIDED WHEN CUSTOMER'S SECONDARY CONDUIT SPACE REQUIREMENTS EXCEED DIMENSIONS SPECIFIED ON C5286, PAGE 1.

- 5.7 TRANSPORTATION OF TRANSFORMERS

WHERE AN ELECTRIC SERVICE STATION IS TRUCK ACCESSIBLE TO ComEd, TRANSFORMERS SHALL BE TRANSPORTED TO THE STATION LOCATION. WHERE SUCH STATION IS NOT ACCESSIBLE, ANY ADDITIONAL MOVING EXPENSE, WHICH MAY BE NECESSARY TO PLACE TRANSFORMERS IN POSITION FOR INSTALLATION, WILL BE THE CUSTOMER'S RESPONSIBILITY.

- 5.8 PLASTIC CONDUIT FOR NON-ENCASED INSTALLATIONS.

IF LARGE STRESS-PRODUCING LOADS, SUCH AS VEHICULAR TRAFFIC, WILL NOT BE PRESENT, THEN THE CUSTOMER MAY, AT THE CUSTOMER'S EXPENSE AND UNDER ComEd DIRECTION, INSTALL NON-ENCASED SCHEDULE 40 PLASTIC CONDUIT FOR ComEd PRIMARY CABLE INSTALLATION.

ACAD

5. CUSTOMER SHALL FURNISH, INSTALL, OWN AND MAINTAIN (CONT'D)

5.8 PLASTIC CONDUIT FOR NON-ENCASED INSTALLATIONS.

NON-ENCASED PLASTIC CONDUIT MAY BE INSTALLED IN NON-CONTINUOUS RUNS THAT DO NOT CONTAIN BENDS, SUCH AS WHERE THE PRIMARY CABLE IS DIRECT BURIED AND THEN PUT INTO CONDUIT FOR A SHORT SEGMENT UNDER A SIDEWALK OR PATIO TO MINIMIZE SUBSEQUENT EXCAVATION FOR MAINTENANCE. NON-ENCASED PLASTIC CONDUIT MAY ALSO BE USED FOR CONTINUOUS RUNS, PROVIDED THAT ANY BENDS IN THE RUN SHALL BE RIGID GALVANIZED STEEL, MINIMUM 48" RADIUS. NON-ENCASED PLASTIC CONDUIT SHALL NOT BE USED IN AREAS WITH A HIGH RISK OF LATER DAMAGE BY EXCAVATION OR WHERE MULTIPLE PRIMARY SERVICE CONNECTIONS ARE INSTALLED IN A COMMON TRENCH.

THE BOTTOM OF THE TRENCH SHALL BE UNDISTURBED, TAMPED, OR RELATIVELY SMOOTH EARTH. WHERE THE EXCAVATION IS IN ROCK, THE DUCT SHALL BE LAID ON A PROTECTIVE LAYER OF CLEAN TAMPED BACKFILL. ALL BACKFILL SHALL BE FREE OF MATERIALS THAT MAY DAMAGE THE DUCT.

THE CONDUIT SHALL BE SUITABLY RESTRAINED BY BACKFILL TO MAINTAIN ITS DESIGN POSITION UNDER THE STRESS OF INSTALLATION PROCEDURES, CABLE PULLING OPERATIONS, AND OTHER CONDITIONS SUCH AS SETTLING AND HYDRAULIC OR FROST UPLIFT. THE LOCATION OF BURIED CONDUIT ENDS SHALL BE PERMANENTLY MARKED BY THE CUSTOMER. AFTER INSTALLATION, CONDUIT LENGTHS GREATER THAN 20 FEET SHALL BE CHECKED WITH A WIRE BRUSH TYPE MANDREL (DESIGNED FOR THE CONDUIT) AND A #8 GALVANIZED STEEL PULLING WIRE OR 1/4" POLYETHYLENE ROPE SHALL BE LEFT IN THE CONDUIT. CONDUIT SHALL BE ADEQUATELY SIZED TO ACCOMMODATE THE LARGEST ANTICIPATED CABLE. CONDUIT SHALL BE SCHEDULE 40 PLASTIC AND SHALL BE BURIED A MINIMUM OF 30" BELOW GRADE. A MINIMUM OF 12" OF WELL-TAMPED EARTH SHALL BE MAINTAINED BETWEEN ComEd AND COMMUNICATIONS CONDUITS OR OTHER UTILITY LINES.

CLEARANCES TO BUILDINGS (SEE 5.1)

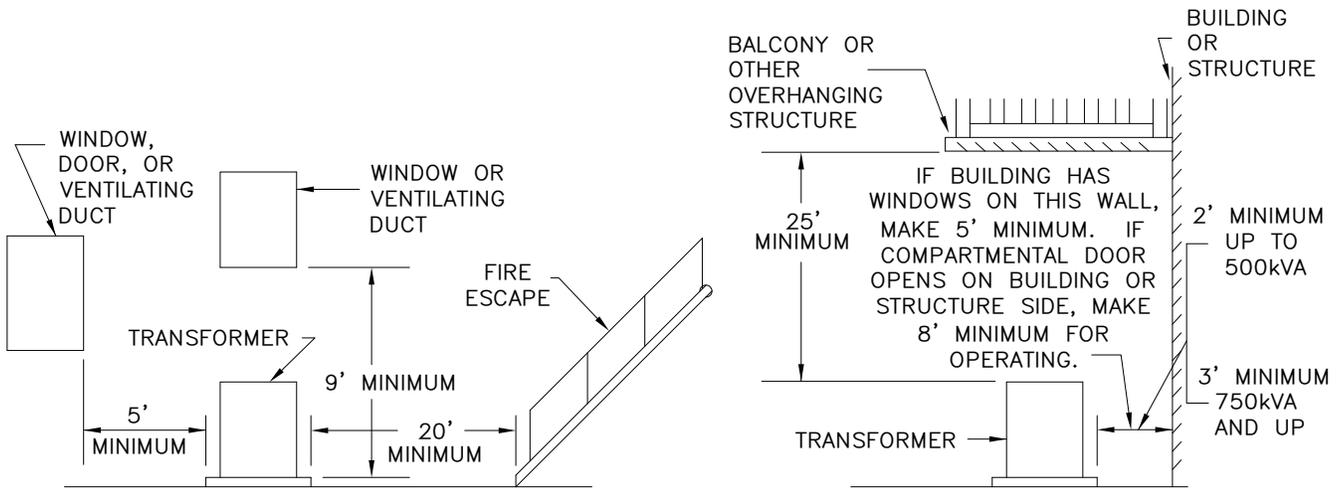


FIGURE 1

FIGURE 2

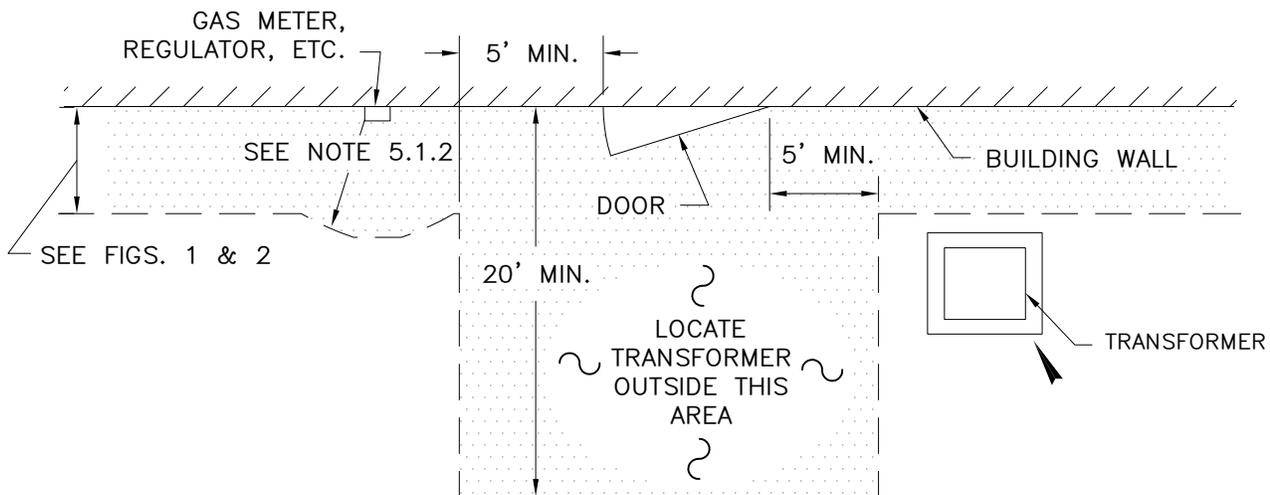


FIGURE 3

CLEARANCE TO DOOR OR GAS FIXTURE

ACAD

# VEHICULAR BARRIER

- └ BARRIER TYPE  
 ↓  
 C5295.A RIGID STEEL CONDUIT  
 .B POWER-INSTALLED BUMPER POST

ITEM	CAT ID DESCRIPTION	TABLE-1	*	CAT ID	UNIT	QUANTITY	
						.A	.B
A	CONDUIT, RIGID, 4 IN. X 10 FT. LONG, HOT DIPPED GALVANIZED, TH			0000376224	FT	10	
B	CONCRETE, BAG, 60 LB. BAG, DRY, 1 PART CEMENT, 2-1/4 PARTS #2		①	0000539471	BG	8	
C	POST, BUMPER, POWER INSTALLED, 8 IN. HELIX, 3-1/2 IN. O.D. X 8			0000701127	EA		1

**NOTES:**

\* MATERIAL SHOWN FOR ONE BARRIER

**APPLICATION**

- THIS STANDARD SHALL BE USED TO INSTALL VEHICULAR BARRIERS.

- 12 OTHER TYPES OF BARRIERS MAY BE USED UPON APPROVAL OF REGIONAL ENGINEERING OR DISTRIBUTION STANDARDS DEPARTMENT.

**SUPPLEMENTARY MATERIAL**

- ① EACH BAG OF CONCRETE WILL REQUIRE APPROXIMATELY 3 QTS CLEAN WATER.

- ⑬ INSTALL BARRIERS BEFORE TRANSFORMER OR SWITCHGEAR IS IN PLACE.

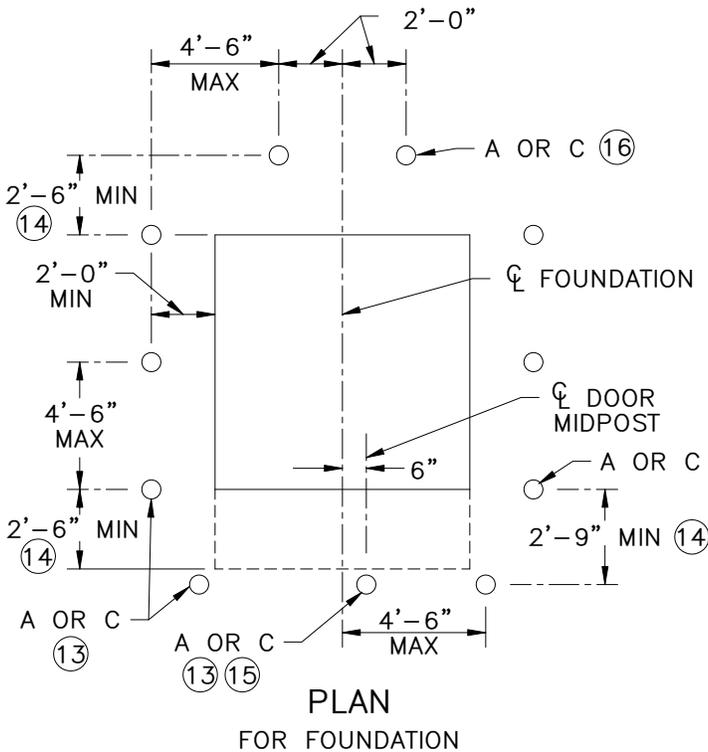
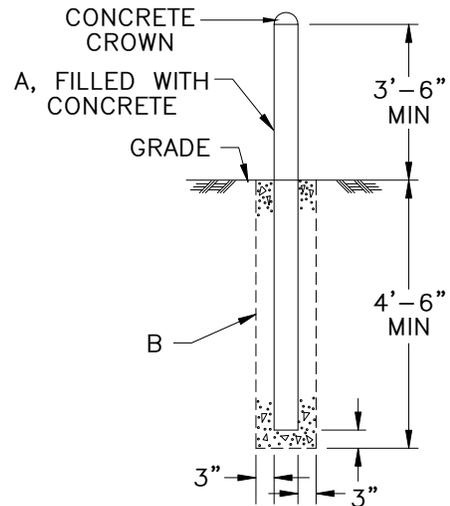
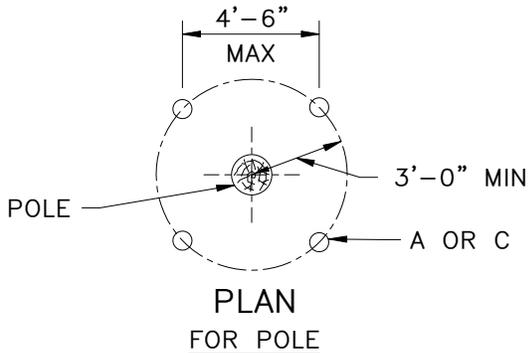
**INFORMATION**

- 11 THIS TYPE OF BARRIER SHOULD BE USED WHERE DAMAGE TO EQUIPMENT, CUBICLES, OR POLE BY A VEHICLE IS PROBABLE.

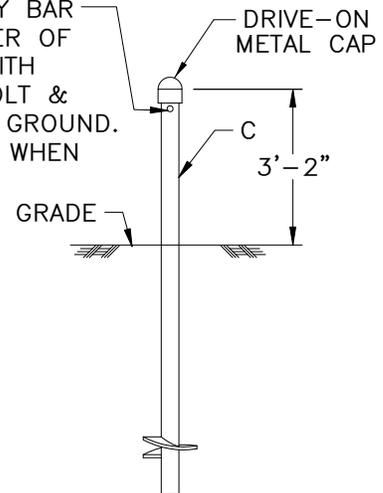
- ⑭ THIS IS A MINIMUM DIMENSION. ADJUST DIMENSION IF NECESSARY TO PROVIDE ADEQUATE CLEARANCE FOR OPENING EQUIPMENT DOORS.

- ⑮ PLACE CENTER BARRIER IN LINE WITH DOOR MIDPOST.

- ⑯ BARRIERS NOT REQUIRED ON SIDE WHERE EQUIPMENT FACES A BUILDING OR OTHER STRUCTURE WHICH RESTRICTS TRAFFIC.



INSERT KELLY BAR INTO DIAMETER OF POST, PIN WITH THROUGH BOLT & SCREW INTO GROUND. INSTALL CAP WHEN FINISHED.



## PAD MOUNTED SWITCHGEAR FOUNDATIONS 34.5kV AND BELOW SYSTEMS

TYPE OF EQUIPMENT

- C5302.A PRECAST FOUNDATION FOR SF6 SWITCHGEAR (C5330)
- .B PRECAST FOUNDATION FOR FOUR BAY SWITCHGEAR (C5309), FOUR BAY A.T.O. SWITCHGEAR (C5308), OR CAPACITOR BANK (C5331)
- .C PRECAST FOUNDATION FOR SINGLE BAY SWITCHGEAR (C5309) (PMH STYLE LIVEFRONT PMH-3 OR PMH-4)
  
- .G PRECAST FOUNDATION FOR FOUR BAY SWITCHGEAR (C5327) OR FOUR BAY DEADFRONT A.T.O. SWITCHGEAR (C5325) (PME STYLE DEADFRONT PME-6 THRU PME-12)
- .J PRECAST FOUNDATION FOR SINGLE BAY SWITCHGEAR (C5327) (PME STYLE DEADFRONT PME-3, PME-4, & PME-5)
- .K PRECAST FOUNDATION FOR PAD MOUNTED METERING (C5332)
- .L PRECAST FOUNDATION FOR PAD MOUNTED VACUUM RECLOSER (C5349)
- .M PRECAST FOUNDATION FOR PAD MOUNTED INTELLIRUPTER (C5351)
  
- .N CAST-IN-PLACE CONCRETE FOUNDATION FOR PME-3 & PME-4 (C5327) OUTDOORS (2 LINE BAYS AND 2 FUSE BAYS)
- .P CAST-IN-PLACE CONCRETE FOUNDATION FOR PME-3 & PME-4 (C5327) OUTDOORS (2 LINE BAYS, 1 BUS TIE BAY, AND 2 FUSE BAYS)
- .Q CAST-IN-PLACE CONCRETE FOUNDATION FOR PME-3 & PME-4 (C5327) OUTDOORS (2 LINE BAYS AND 1 FUSE BAY)

} NEW  
CONSTRUCTION

ITEM	CAT ID DESCRIPTION TABLE-1	CAT ID	UNIT	QUANTITY											
				.A	.B	.C	.G	.J	.K	.L	.M	.N	.P	.Q	
A	<b>GROUNDING INSTALLATION C8550. _G0</b>			1	1	1	1	1	1	1	1	1	1	1	1
B	<b>CONDUIT CABLE SEALING FOAM C5194. A</b>			4	3	1	1	1	2	2	2	6	6	6	6
C	WIRE,COPPER, OVERHEAD, BARE, 1/0, 19 STR, SOFT DRAWN TINNED, 3	(3) 0000355082	FT	120	100	50	100	50	50	100	100	150	150	150	150
D	FOUNDATION, CONCRETE, 76" X 86" X 36" DEEP. WITH TWO 6" CONDUIT	(25) 0001615070	EA								1				
	FOUNDATION, CONCRETE, LIGHTWEIGHT, 86"X86"X36" DEEP FOR PADMOU	(25) 0001612174	EA							1					
	FOUNDATION, CONCRETE OR FIBERGLASS 36 INCHES DEEP FOR S&C DEAD	(25) 0001603997	EA					1	1						
	FOUNDATION, CONCRETE OR FIBERGLASS, 36" DEEP FOR PME-6, PME-9,	(25) 0001603996	EA				1								
	FOUNDATION, CONCRETE, 3 FT - 2 IN. X 3 FT - 7 IN. X 2 FT - 8 I	(25) 0000701116	EA			1									
	FOUNDATION, CONCRETE, 5 FT - 3 IN. X 5 FT - 9 IN. X 3 FT., FOR	(25) 0000701115	EA		1										
	FOUNDATION, CONCRETE, 6 FT - 6 IN. X 7 FT - 4 IN. X 3 FT, FOR	(25) 0000701118	EA	1											
E	CONNECTOR, COMPRESSION, 1/0 OR 2/0 STR CU. RUN & TAP, BURNDY C	0000368545	EA	4	2	1	2	1	2	2	2	4	4	4	4
F	GRAVEL, PEA, 100 PERCENT TO PASS THRU A 1/2 IN. SCREEN, KILN D	0000701069	BG	30	30	12	30	12	12	30	30	30	37	30	
G	COMPOUND, MECHANICAL, SEALING, 5 LB. PACKAGE, PER C-9493.	0000350004	EA	1	1	1	1	1	1	1	1	1	1	1	1

ESTIMATING DATA											
C5302._	.A	.B	.C	.G	.J	.K	.L	.M	.N	.P	.Q
CONCRETE (CU YD)	---	---	---	---	---	---	---	---	5	5.6	4.5
REBAR (FT)	---	---	---	---	---	---	---	---	451	586	342
GRAVEL OR CRUSHED STONE (CU YD)	1	1	.5	1	.5	1	1.5	1.5	2.5	8.7	2.1
5 IN. SCHEDULE 40 PLASTIC CONDUIT, PVC OR ABS (FT)	---	---	---	---	---	---	---	---	18	24	12

PRESSING TABLE (23)			
ITEM	DIE INDEX	TOOL & DIE	NO. OF CRIMPS
		12 TON	
E	O	U-O	1
	E	U-E	3

NOTES:

APPLICATION

- THIS STANDARD SHALL BE USED TO INSTALL FOUNDATIONS FOR 12kV 3Ø SINGLE AND FOUR BAY SWITCHGEAR, FOUR BAY A.T.O. SWITCHGEAR, METERING, VACUUM RECLOSER, INTELLIRUPTER, AND 34.5kV 3Ø SF6 SWITCHGEAR.

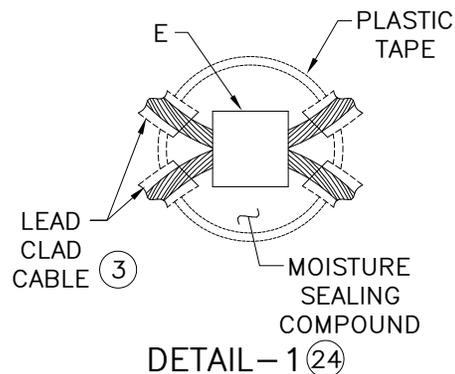
SUPPLEMENTARY MATERIAL

- ① ON INSTALLATIONS OTHER THAN ELECTRIC SERVICE STATIONS, ComEd SHALL SUPPLY AND INSTALL ALL MATERIAL INCLUDING FOUNDATION AND CONDUIT.  
  
FOR ELECTRIC SERVICE STATIONS, CUSTOMER SHALL SUPPLY AND INSTALL CAST-IN-PLACE OR PRECAST FOUNDATION (CAT ID 0000701115, CAT ID 0000701116, CAT ID 0000701118, OR CAT ID 0001603996) AND CONDUIT. CUSTOMER SHALL ALSO SUPPLY CONDUIT SLEEVE AND TRENCH FOR ComEd GROUND WIRE, AND SUPPLY CONDUIT SLEEVE FOR REMOTE INDICATION.
- ② IF STEEL CONDUIT IS USED, SUPPLY GROUND CLAMPS FOR #2 WIRE (O-Z GEDNEY COMPANY "BLG" TYPE OR EQUIVALENT). ALTERNATE METHODS OF MAKING CONNECTIONS ARE: CADWELD, SILFOS BRAZING.
- ③ WHEN BARE LEAD COVERED CABLES ARE IN THE VICINITY, REPLACE ITEM "c" WITH 1/0 LEAD CLAD COPPER CONDUCTOR (CAT ID 0000360809) AND SPECIFY GROUND RODS IN ACCORDANCE WITH **C8550**. ENGINEER TO SPECIFY WHEN THIS CONDITION EXISTS.
- ④ FOR GRADE CHANGES AT EXISTING SWITCHGEAR LOCATIONS, SPECIFY CAT ID 0001600733 (18" PRECAST EXTENSION) TO BE USED WITH CONCRETE FOUNDATION CAT ID 0000701115. ALSO AVAILABLE ARE ABOVE GROUND STEEL EXTENSIONS FOR LIVE FRONT FOUR BAY SWITCHGEAR CAT ID 0000286849 (12" STEEL SPACER EXTENSION), CAT ID 0000286534 (18" STEEL SPACER EXTENSION). FOR SINGLE BAY SWITCHGEAR USE CAT ID 0001606659 (12" STEEL SPACER EXTENSION) OR CAT ID 0001606660 (18" STEEL SPACER EXTENSION). STEEL EXTENSIONS ONLY FIT PMH STYLE SWITCHGEAR.

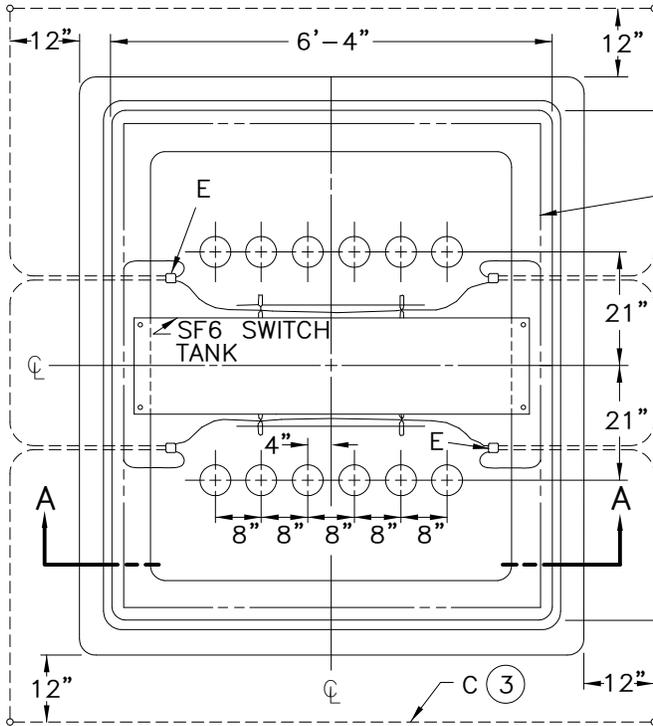
INFORMATION

- ⑪ ENGINEER TO SPECIFY SIZE AND DIRECTION OF CONDUIT.
- ⑫ ON CONDUIT RUNS, HOT GALVANIZED STEEL CONDUIT BENDS OR SCHEDULE 40 PLASTIC (PVC OR ABS) BENDS SHALL BE INSTALLED AND ENCASED IN 3 INCH CONCRETE ENVELOPE. STEEL BENDS CANNOT BE USED WITH 35kV 750kcmil 1/C EXCcJ CABLE (CAT ID 0000360859).
- ⑬ WHEN CONDUIT RUN IS NOT INSTALLED AND CABLE IS DIRECT BURIED, CONDUIT BENDS OF SCHEDULE 40 PVC OR HOT GALVANIZED STEEL SHALL BE INSTALLED. CONDUIT BEND SHALL TERMINATE A MINIMUM OF TWO FEET BEYOND FOUNDATION, CONCRETE ENCASEMENT IS NOT NECESSARY. STEEL BENDS CANNOT BE USED WITH 35kV 750kcmil 1/C EXCcJ CABLE (CAT ID 0000360859).
- ⑭ CONCRETE SHALL BE IN ACCORDANCE WITH THE LATEST APPLICABLE EDITION OF THE ACI CODE AND AIR ENTRAINMENT. IT SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 3000 PSI AT 28 DAYS. AIR ENTRAINMENT SHALL BE 4 TO 7 PERCENT OF THE VOLUME OF CONCRETE.
- ⑮ FINAL GRADE TO BE WELL DRAINED AT ALL TIMES.
- ⑯ WHEN POURING FOUNDATION, THE TOP SHALL BE SMOOTH AND LEVEL. ALL EDGES SHALL BE ROUNDED OFF.
- ⑰ MINIMUM CLEARANCE REQUIRED FOR OPERATING SWITCH HANDLE.
- ⑱ MINIMUM CLEARANCE REQUIRED FOR THE INSTALLATION OF GROUND.
- ⑲ MINIMUM OPERATING CLEARANCE IS BASED ON THE USE OF A 6 FOOT SWITCH STICK AT 12kV AND A 13 FOOT STICK AT 34kV. FOR ADDITIONAL CLEARANCE REQUIREMENTS SEE **C7500**.
- ⑳ THIS AREA MUST BE KEPT CLEAR FOR OPERATING PURPOSES. EQUIPMENT MUST BE PROTECTED BY BARRIER IF ACCESSIBLE TO VEHICLES PER **C5295**.

- ⑳ SEAL THE CONDUITS EXITING OR ENTERING THE SWITCHGEAR FOUNDATION WITH ITEM "B". THIS WILL PREVENT THE ENTRANCE OF RODENTS, GASES, OR DAMP AIR WHICH MAY CAUSE CONDENSATION IN THE SWITCHGEAR.
- ㉑ AFTER PRIMARY AND SECONDARY CONDUITS ARE IN PLACE, BACKFILL WITH SCREENINGS, SAND OR FINE EXCAVATED MATERIAL. COMPACT THOROUGHLY BEFORE PLACING AGGREGATE AND SETTING PRECAST FOUNDATION OR POURING CONCRETE FOUNDATION.
- ㉒ SEE **C7723** FOR BURNDY-HUSKY DIE SET CROSS REFERENCE.
- ㉓ GROUND GRID CONSISTS OF A CONTINUOUS COPPER GROUND LOOP. BRING ONE TAIL OF GROUND LOOP INTO OPENING IN FOUNDATION. CONNECT GROUND CABLE (ITEM "c") TO GROUND RODS AS SHOWN IN **C8550**. CLOSE LOOP WITH COMPRESSION CONNECTOR (ITEM "E").  
  
WHEN LEAD CLAD CABLE IS USED FOR THE GROUND CABLE, COVER THE ITEM "E" CONNECTION WITH MOISTURE SEALING COMPOUND (ITEM "g") AND PLASTIC TAPE AS SHOWN IN DETAIL-1.
- ㉔ AFTER PRECAST CONCRETE FOUNDATION IS SET IN PLACE, REMOVE LIFTING EYELETS AND PLUG INSERTS WITH SEALING COMPOUND (ITEM "g").
- ㉕ FOUNDATION MUST BE LEVEL BEFORE BACKFILLING.
- ㉖ COVER FLANGE WITH 2 TO 3 INCHES OF PEA GRAVEL (ITEM "f") PRIOR TO BACKFILL.
- ㉗ ALL CONCRETE REINFORCING STEEL SHALL CONFORM TO THE REQUIREMENTS OF EM52014.
- ㉘ SEAL BOTH ENDS OF CONDUITS BETWEEN DISCONNECT BAYS OR BETWEEN DISCONNECT AND FUSE BAYS WITH SEALING FOAM (ITEM "B").
- ㉙ FOUNDATION LENGTH VARIES DEPENDING ON THE QUANTITY AND TYPE OF SINGLE BAY SWITCHGEAR USED. ADJUST AS REQUIRED, BUT ALWAYS ALLOW A MINIMUM OF 2 FEET FOR SWITCH OPERATING HANDLE.
- ㉚ 5/8 INCH ANCHOR BOLT LOCATIONS ARE TO BE DRILLED INTO THE FOUNDATION AFTER EQUIPMENT IS SET IN PLACE.
- ㉛ CUSTOMER TO INSTALL, OWN AND MAINTAIN A 1 INCH CONDUIT FROM REMOTE METER LOCATION TO PRIMARY METERING BAY. ComEd TO FURNISH, OWN, MAINTAIN AND CONNECT WIRES FROM METER LOCATION TO PRIMARY METERING BAY.
- ㉜ ADDITIONAL DUCT ENTRANCES CAN BE CORE DRILLED BY AVOIDING THE INNER VERTICAL RIBS AND BOTTOM LIP. PLACE ON EITHER SIDE OF THE EXISTING KNOCKOUTS.
- ㉝ MINIMUM CLEARANCE REQUIRED TO GAIN ACCESS TO CAPACITOR FOR REPLACEMENT.



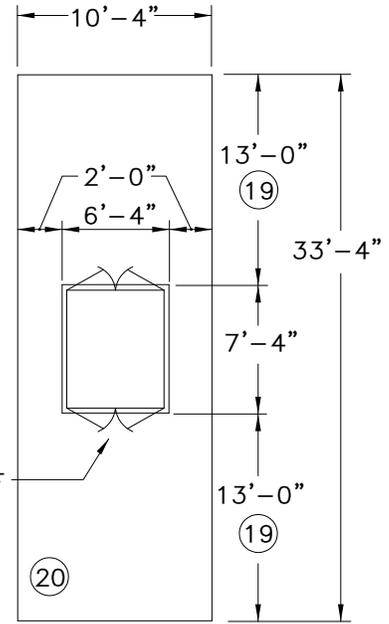
C5302.A PRECAST FOUNDATION  
34.5kV SF6 SWITCHGEAR



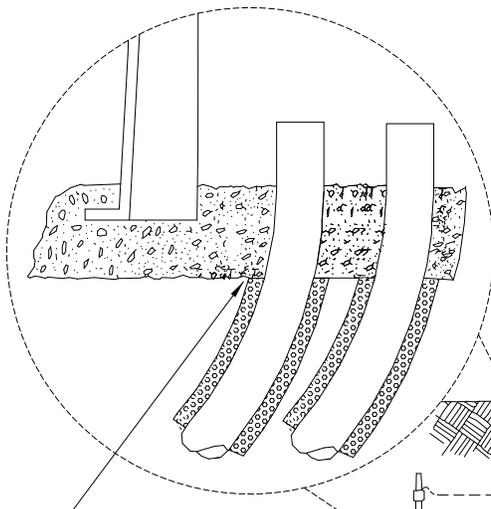
PLAN

ENCLOSURE

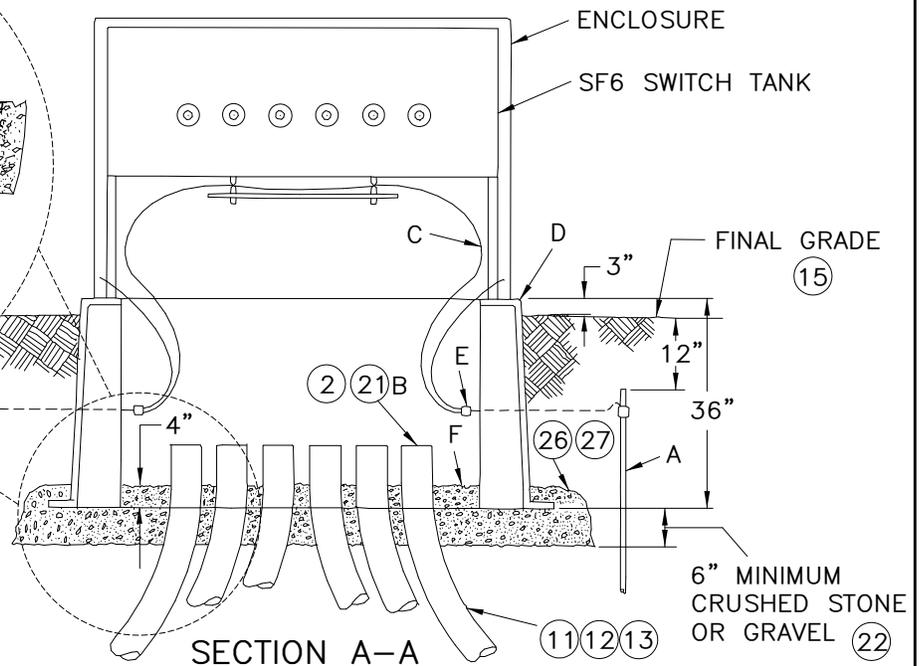
FRONT SIDE OF SWITCHGEAR



MINIMUM CLEARANCE REQUIREMENTS



CONCRETE ENCASEMENT TO EXTEND TO GRAVEL LINE. (12)



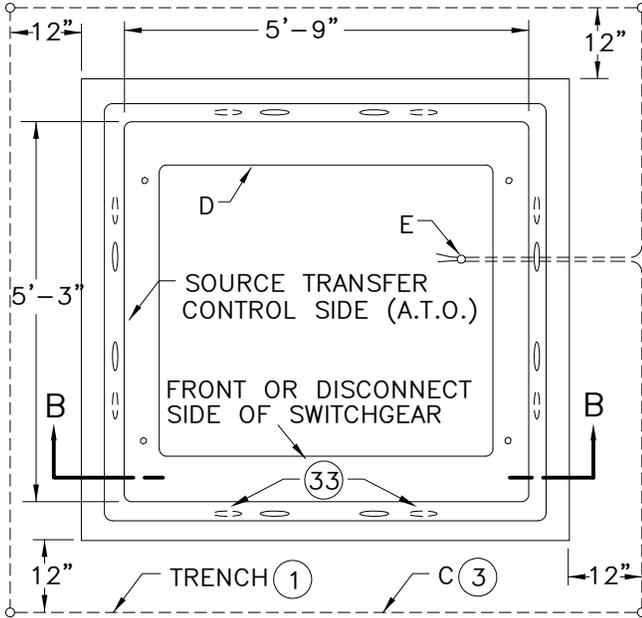
SECTION A-A

6" MINIMUM CRUSHED STONE OR GRAVEL (22)

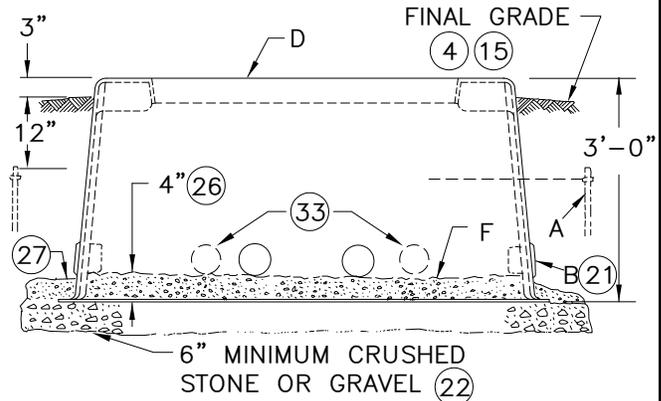
ACAD

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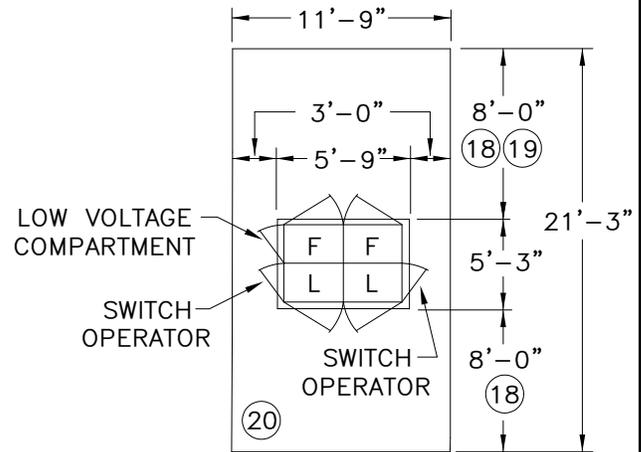
**C5302.B PRECAST FOUNDATIONS**  
**12kV 3Ø FOUR BAY SWITCHGEAR OR**  
**12kV 3Ø FOUR BAY A.T.O. SWITCHGEAR**  
**OR CAPACITOR BANK**



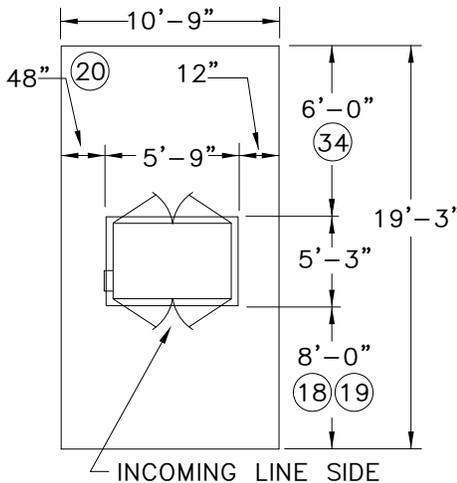
**PLAN**



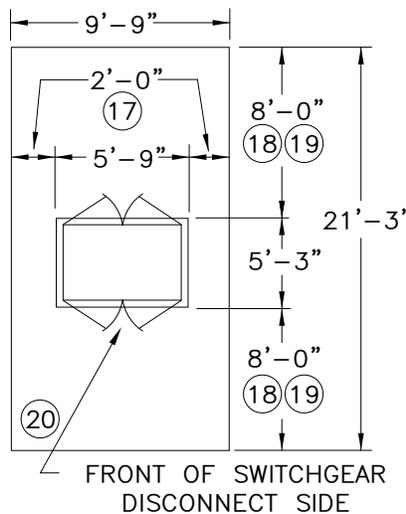
**SECTION B-B**



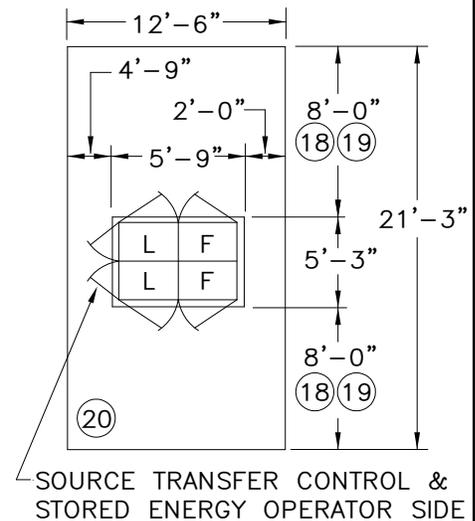
**MINIMUM CLEARANCE REQUIREMENTS**  
**FOUR BAY RADIO CONTROLLED A.T.O. SWITCHGEAR**



**MINIMUM CLEARANCE REQUIREMENTS**  
**CAPACITOR BANK**



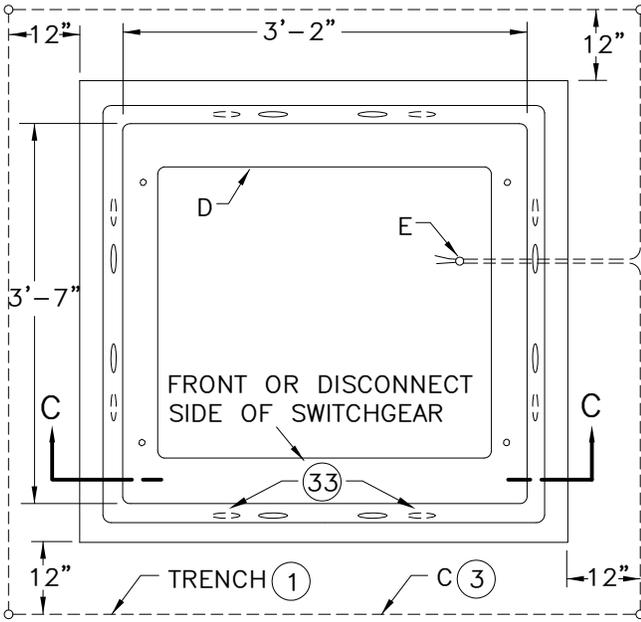
**MINIMUM CLEARANCE REQUIREMENTS**  
**FOUR BAY SWITCHGEAR**



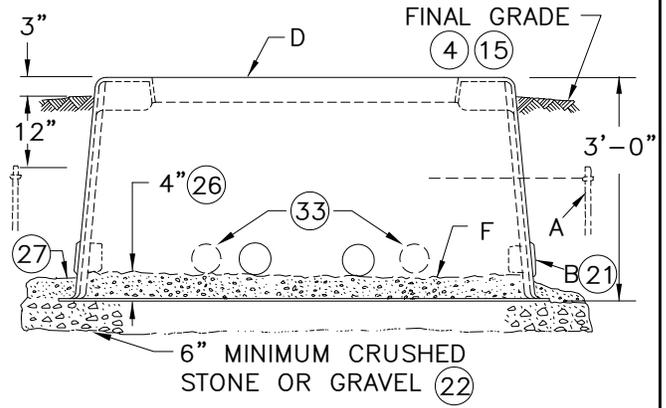
**MINIMUM CLEARANCE REQUIREMENTS**  
**FOUR BAY A.T.O. SWITCHGEAR**

ACAD

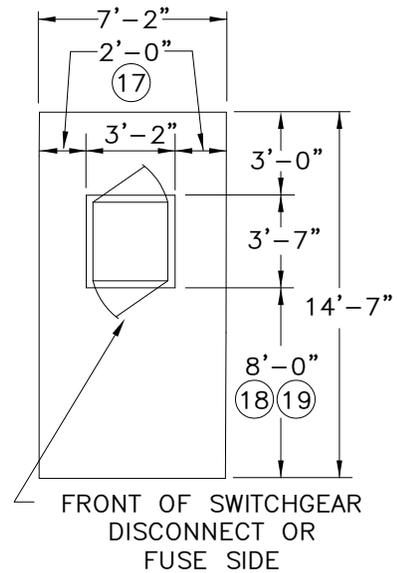
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PLAN

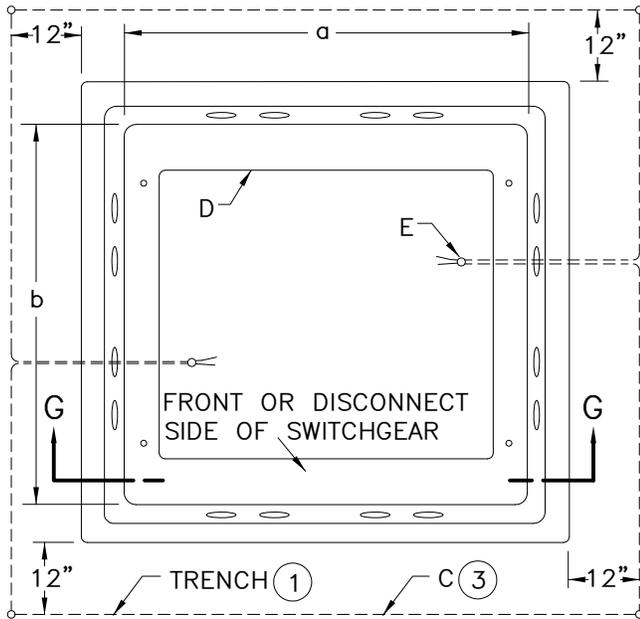


SECTION C-C

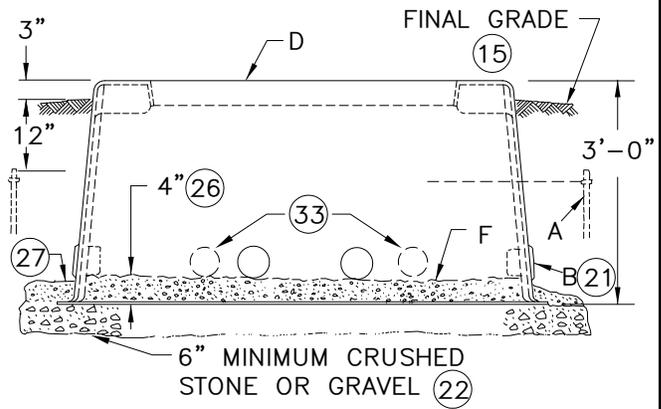


MINIMUM  
CLEARANCE  
REQUIREMENTS  
 SINGLE BAY SWITCHGEAR

C5302.G & .J PRECAST FOUNDATIONS  
 12kV 3Ø SINGLE AND FOUR BAY DEADFRONT SWITCHGEAR  
 OR 3Ø DEADFRONT A.T.O. SWITCHGEAR

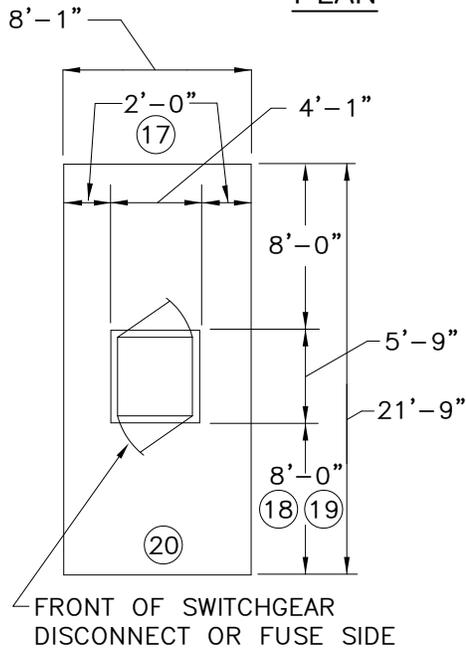


FOUNDATION	a	b
C5302.G	6'-4"	6'-2"
C5302.J	4'-1"	5'-9"



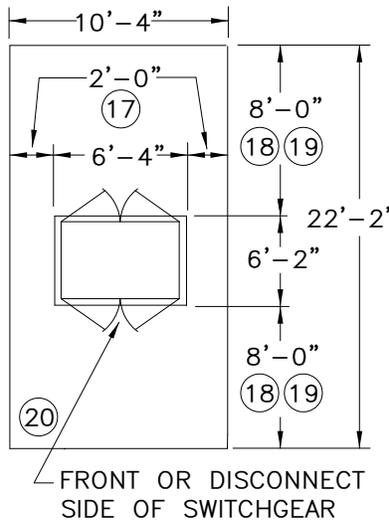
SECTION G-G

PLAN



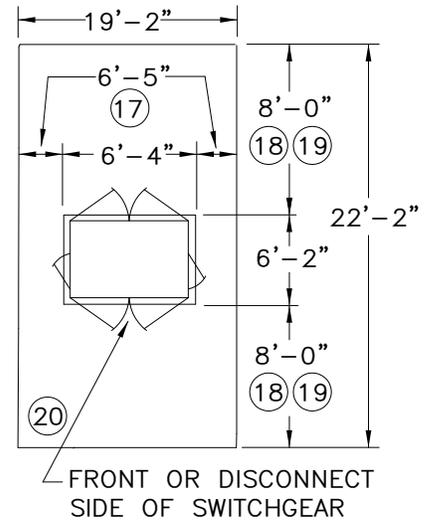
MINIMUM  
 CLEARANCE  
 REQUIREMENTS

SINGLE BAY SWITCHGEAR



MINIMUM  
 CLEARANCE  
 REQUIREMENTS

FOUR BAY SWITCHGEAR



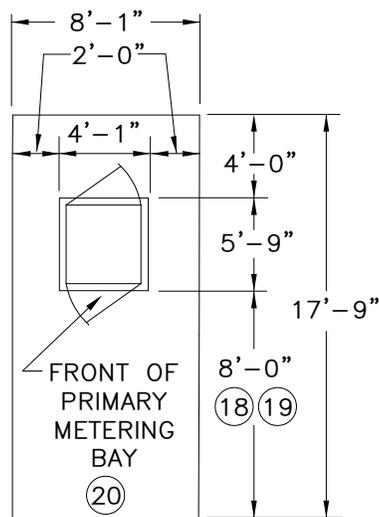
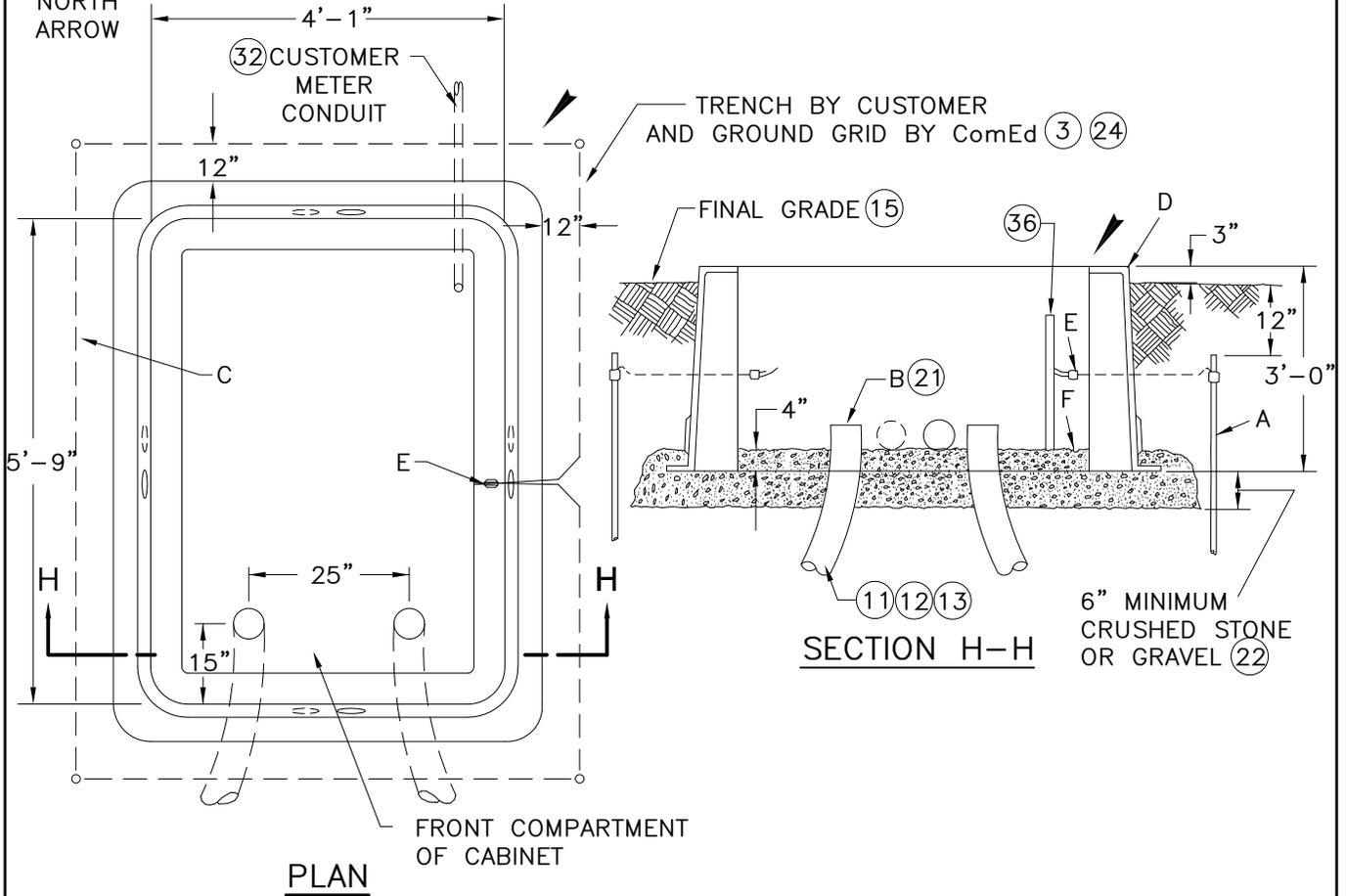
MINIMUM  
 CLEARANCE  
 REQUIREMENTS

FOUR BAY ATO

C5302.K PRECAST FOUNDATION  
12kV PRIMARY METERING BAY

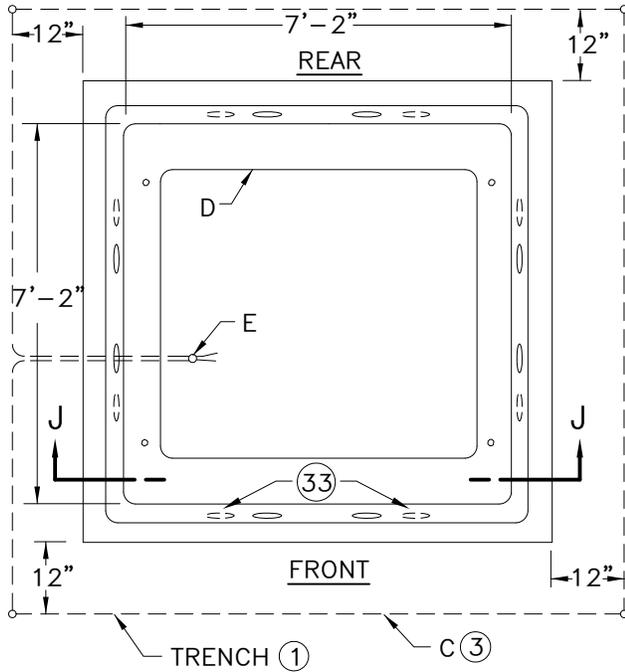


NORTH  
ARROW

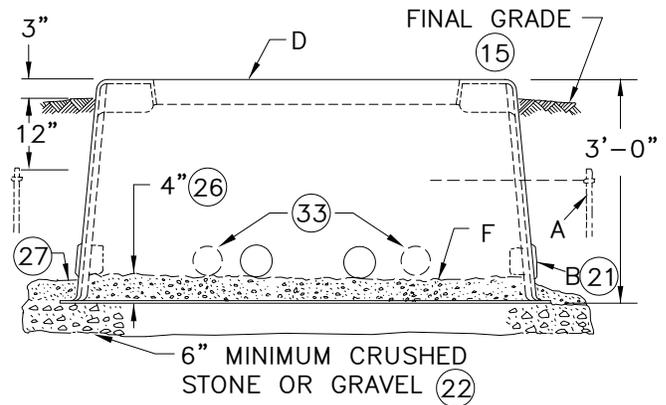


MINIMUM  
CLEARANCE REQUIREMENTS  
PRIMARY METERING BAY

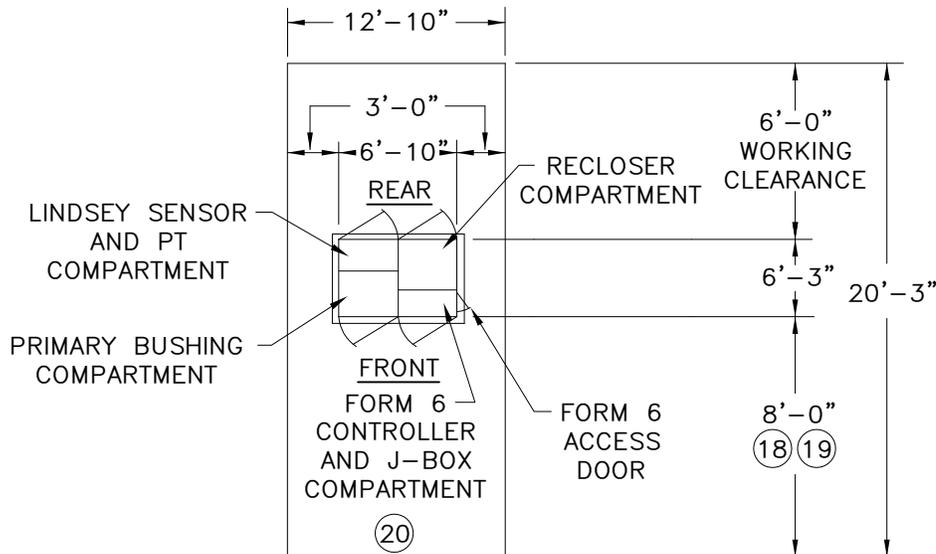
C5302.L PRECAST FOUNDATION  
3Ø PAD MOUNTED VACUUM RECLOSER



PLAN



SECTION J-J



MINIMUM CLEARANCE REQUIREMENTS  
PAD MOUNTED VACUUM RECLOSER

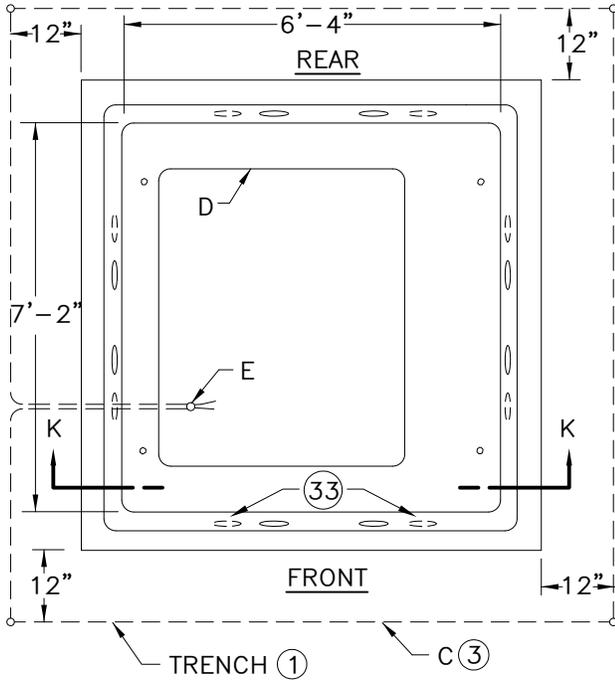
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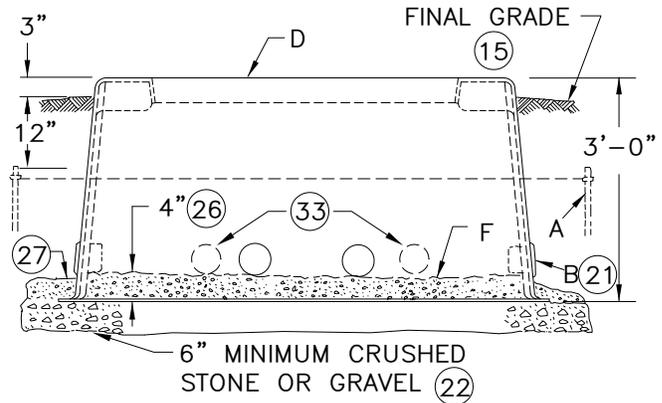
**C5302.M PRECAST FOUNDATION  
 3Ø PAD MOUNTED INTELLIRUPTER**



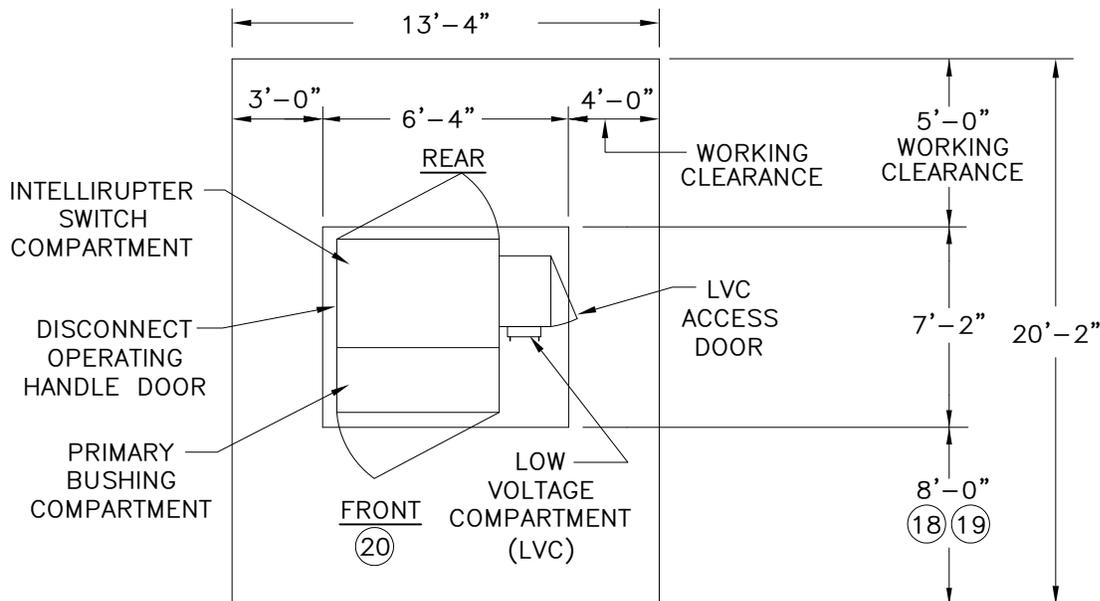
NORTH  
 ARROW



PLAN



SECTION K-K



MINIMUM CLEARANCE REQUIREMENTS  
 PAD MOUNTED INTELLIRUPTER

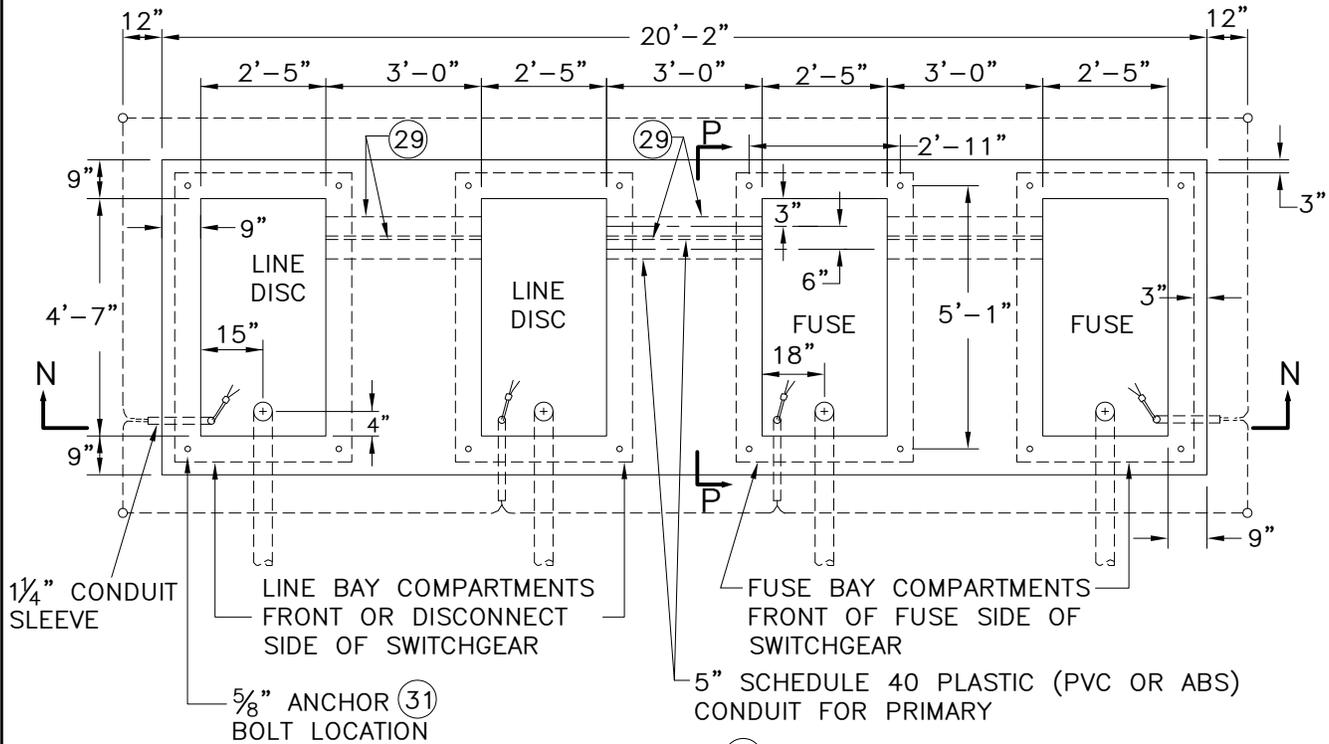
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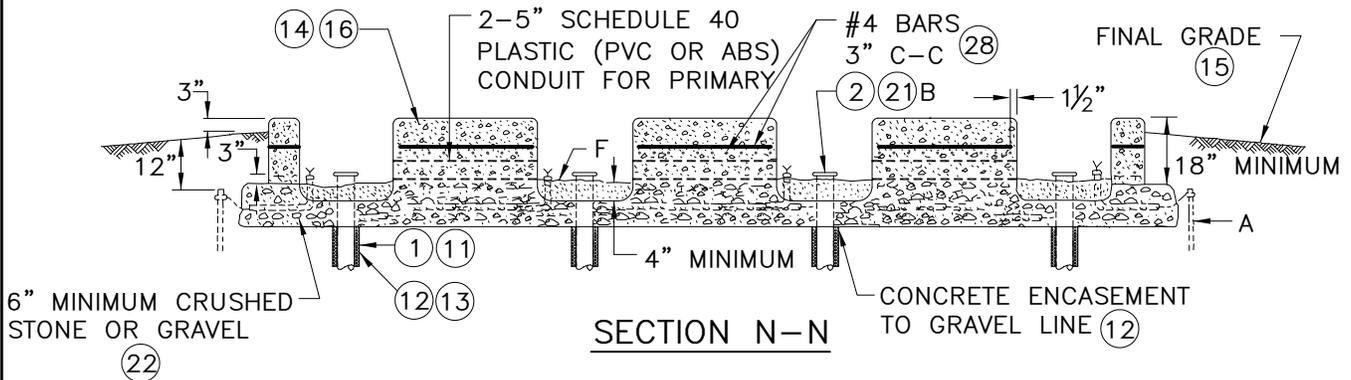
**C5302.N CAST-IN-PLACE CONCRETE (14)**  
**12kV 3Ø SINGLE BAY SWITCHGEAR OUTDOORS**  
**(2 LINE BAYS & 2 FUSE BAYS)**



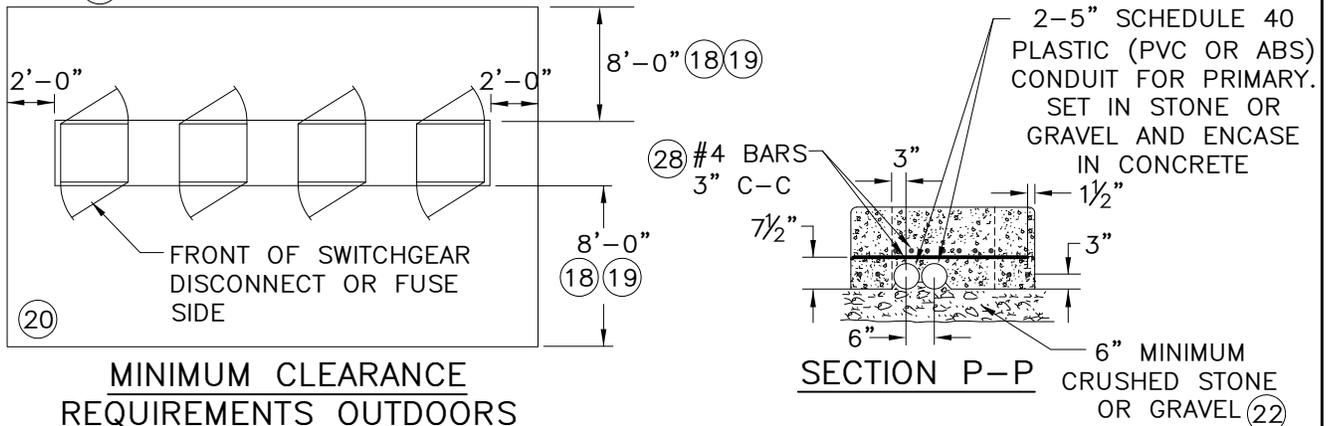
NORTH  
 ARROW



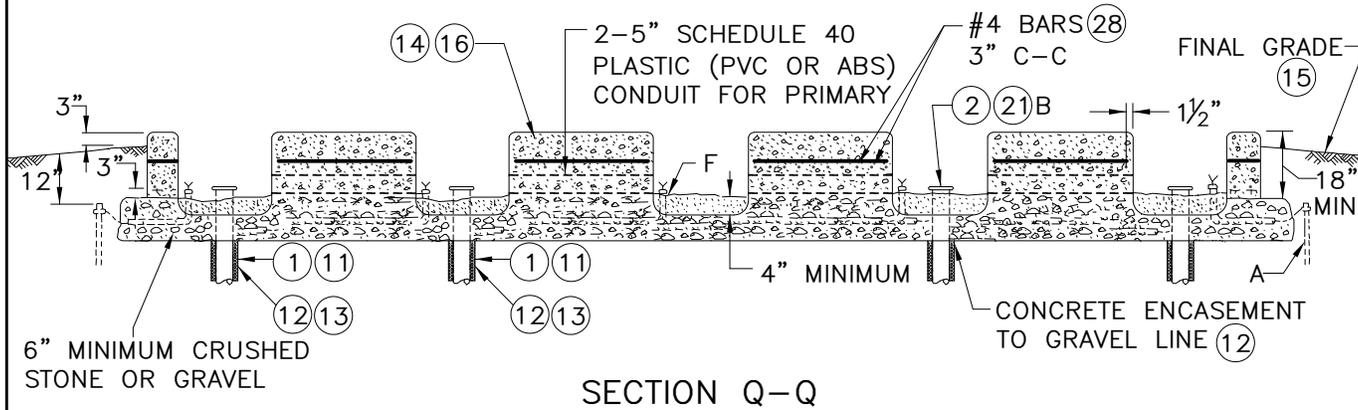
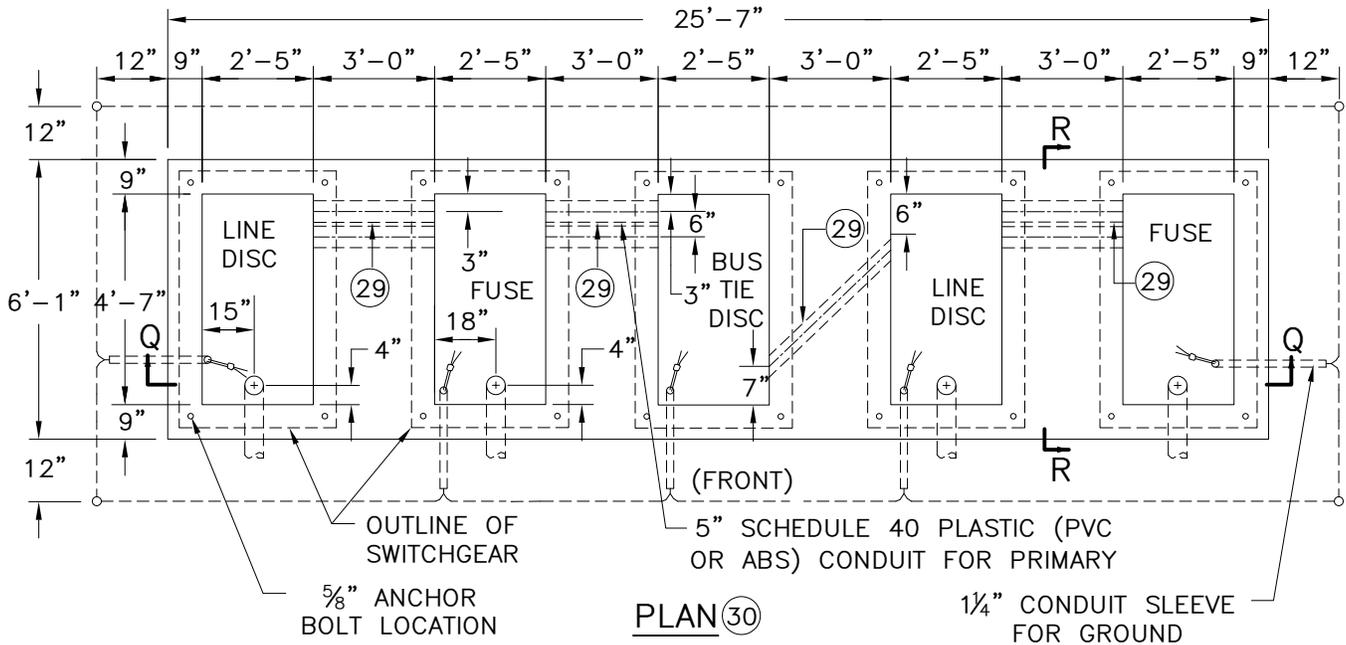
PLAN (30)



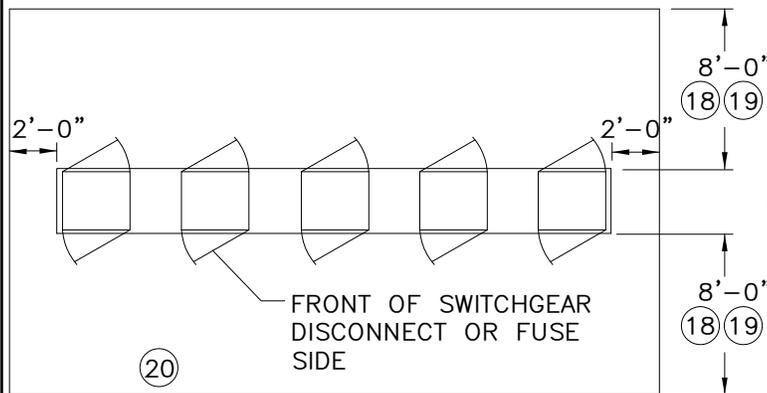
SECTION N-N



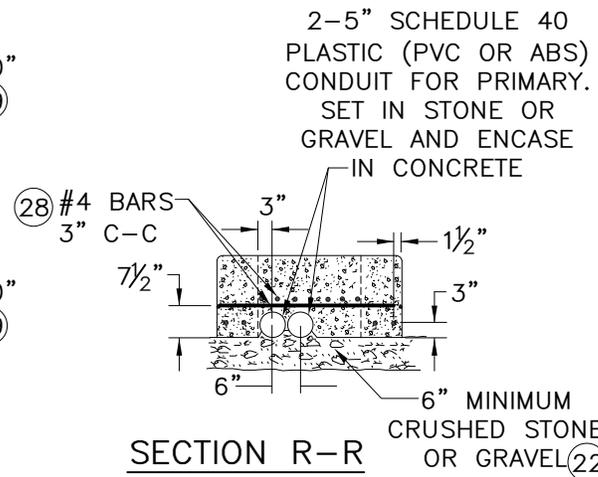
C5302.P CAST-IN-PLACE CONCRETE (14)  
 12KV 3Ø SINGLE BAY SWITCHGEAR OUTDOORS  
 (2 LINE BAYS, 1 BUS TIE BAY, & 2 FUSE BAYS)



SECTION Q-Q



MINIMUM CLEARANCE  
 REQUIREMENTS OUTDOORS

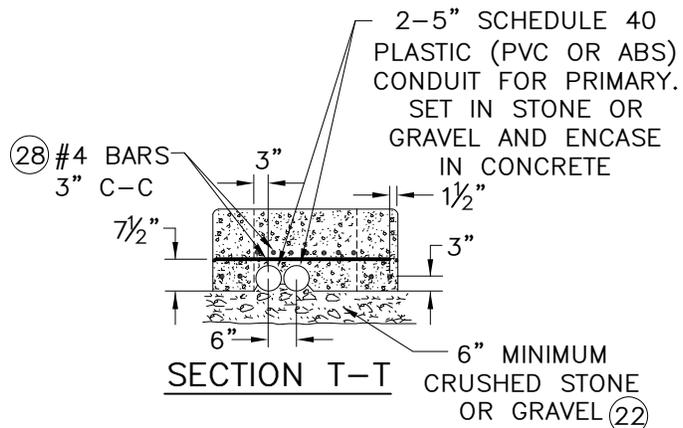
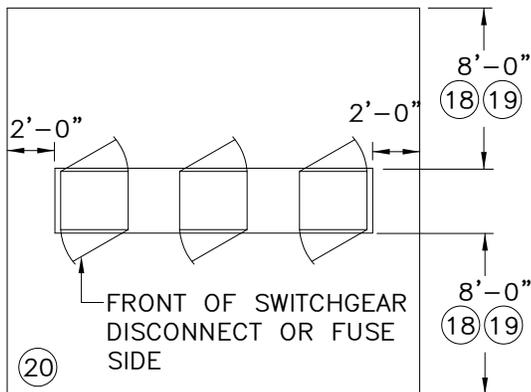
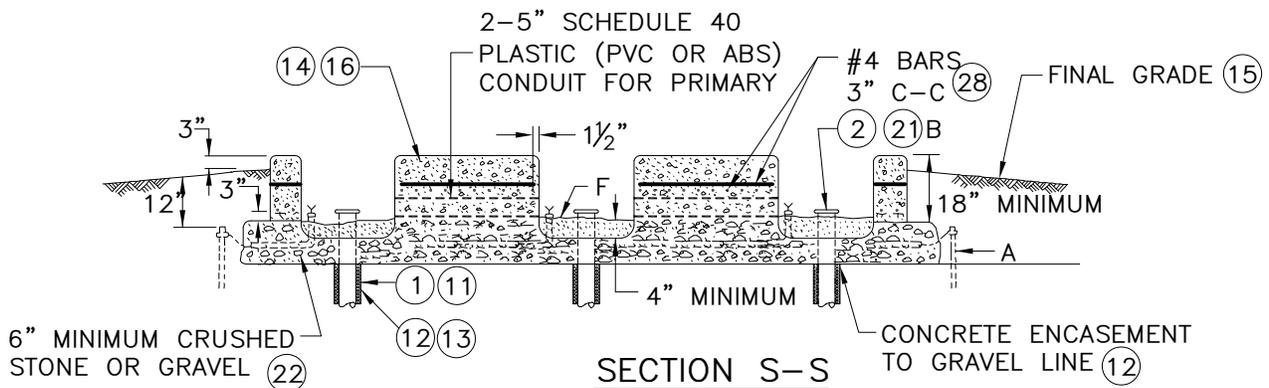
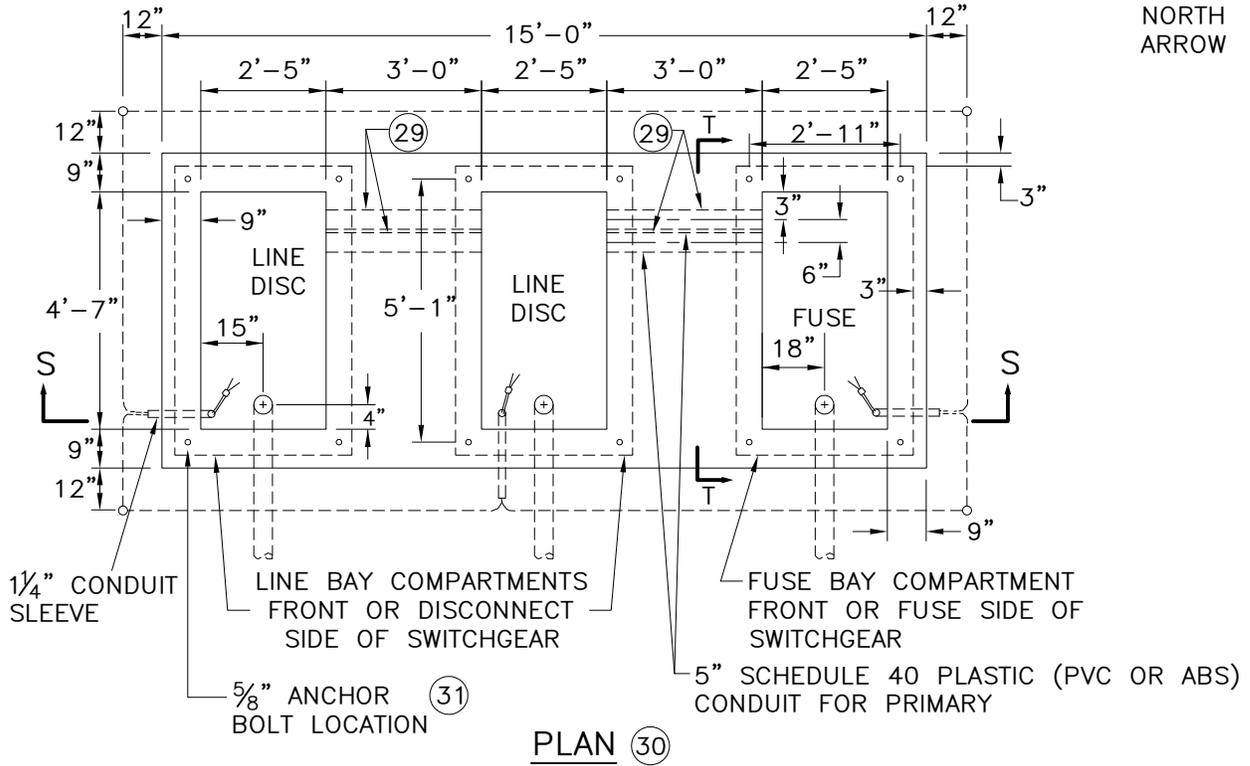


SECTION R-R

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C5302.Q CAST-IN-PLACE CONCRETE (14)  
12kV 3Ø SINGLE BAY SWITCHGEAR OUTDOORS  
(2 LINE BAYS & 1 FUSE BAY)



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# GROUNDING INSTALLATION

## 34.5kV AND BELOW SYSTEMS

	TYPE OF GROUND ROD (21)	
	APPLICATION	
	GROUND WIRE LENGTH, FOR OVERHEAD INSTALLATION (TABLE-3)	
C8550.A	COPPER BONDED GROUND ROD, THREADLESS (1)	0 NO POLE HEIGHT
.B	COPPER BONDED GROUND ROD, THREADED (1)	.A 30 FT.
.C	STAINLESS STEEL GROUND ROD (1)	.B 35 FT.
.D	STRAIGHT WIRE COUNTERPOISE (8)(9)	.C 40 FT.
.E	STRAIGHT WIRE COUNTERPOISE WITHIN 200 FEET OF BARE LEAD COVERED CABLE (8)(9)	.D 45 FT.
..A	OVERHEAD, SINGLE GROUND, ONE GROUND ROD LOCATION (6)(9)	.E 50 FT.
..B	OVERHEAD, SINGLE GROUND, COUNTERPOISE (4)(6)(9)	.F 55 FT.
..C	OVERHEAD, DOUBLE GROUND, TWO GROUND ROD LOCATIONS (5)(6)(7)(15)	.G 60 FT.
..D	OVERHEAD, DOUBLE GROUND, COUNTERPOISES (4)(5)(6)(7)(15)	.H 65 FT.
..E 0	UNDERGROUND, SINGLE GROUND, ONE GROUND ROD LOCATION	.J 70 FT.
..F 0	UNDERGROUND, SINGLE GROUND, COUNTERPOISE	.K 75 FT.
..G 0	UNDERGROUND, DOUBLE GROUND, FOUR GROUND ROD LOCATIONS	.L 80 FT.
..H 0	UNDERGROUND, TELEPHONE COMPANY INSTALLS ONE GROUND ROD (14)	
..J 0	UNDERGROUND, DOUBLE GROUND, COUNTERPOISES	

ITEM	CAT ID DESCRIPTION	TABLE-1	CAT ID	UNIT	QUANTITY							
					.AA	.AB	.AC	.AD	.BA	.BB	.BC	.BD
A	<b>WEDGE CONNECTORS</b>	<b>C7724</b> , ---- (7#10 - NEUT)			1	1	2	2	1	1	2	2
C	ROD, GROUND, 9/16 IN. (OR 5/8 IN) X 8 FT. LONG, THREADLESS, CO		0000368979	EA	4	4	8	8				
	ROD, GROUND, 9/16 IN. X 8 FT. LONG, 5/8 IN. THREADS BOTH ENDS,		0000384198	EA					4	4	8	8
E	COUPLING, GROUND ROD, INSIDE DIAMETER FOR 5/8 IN. ROD X 2-1/2		0000368982	EA	3	2	6	4				
	COUPLING, GROUND ROD, 5/8-11 TAP X 2-3/4 IN. LONG, THREADED, C		0000384197	EA					3	2	6	4
L	CONNECTOR, COMPRESSION, 1/0 OR 2/0 STR CU. RUN & TAP, BURNDY C		0000368545	EA	1	1	1	1	1	1	1	1
M	CONNECTOR, GROUND, (5/8) #8 SOL. TO #1/0, BRONZE, SHEAR HEAD B	(1)(19)	0000384191	EA	1	5	4	10	1	5	4	10
N	WIRE,COPPER, OVERHEAD, BARE, 1/0, 19 STR, SOFT DRAWN TINNED, 3		0000355082	FT			20	10	50		20	10

ITEM	CAT ID DESCRIPTION	TABLE-1 (CONT'D)	CAT ID	UNIT	QUANTITY							
					.CA	.CB	.CC	.CD	.DB	.DD	.EB	.ED
A	<b>WEDGE CONNECTORS</b>	<b>C7724</b> , ---- (7#10 - NEUT)			1	1	2	2	1	2	1	2
C	ROD, GROUND, 9/16 IN. X 10 FT. LONG, 5/8 IN. THREADS BOTH ENDS		0000384085	EA	3	3	6	6				
E	COUPLING, GROUND ROD, 5/8 IN.-11 X 2-3/4 IN. LONG, THREADED, 1	(3)	0000384142	EA	2	1	4	2				
L	CONNECTOR, COMPRESSION, 1/0 OR 2/0 STR CU. RUN & TAP, BURNDY C		0000368545	EA	1	1	1	1	1	1	1	1
M	CONNECTOR, GROUND, (5/8) #8 SOL. TO #1/0, BRONZE, SHEAR HEAD B	(1)(19)	0000384191	EA	1	4	4	8				
N	WIRE,COPPER, OVERHEAD, BARE, 1/0, 19 STR, SOFT DRAWN TINNED, 3		0000355082	FT					100	200		
	CABLE,COPPER, GROUND, UNINSULATED, 1/0, 19 STR, 47MIL LEAD SHE		0000360809	FT		20	10	50			100	200
P	CONNECTOR, COMPRESSION, 1/0 OR 2/0 STR CU. RUN & TAP, BURNDY C		0000368545	EA					1	2	1	2
R	COMPOUND, ELECTRICAL, MOISTURE SEALING, 1/8" X 3-3/4" X 10 FT	(13)	0000350074	RL	1	1	1	1			1	1
S	TAPE, PLASTIC, 3/4 IN. X .0085 IN. X 66 FEET, 1.5" CORE 3M TYP	(13)	0000348171	RL	1	1	1	1			1	1

ITEM	CAT ID DESCRIPTION	TABLE-2	CAT ID	UNIT	QUANTITY				
					..A	..B	..C	..D	..E
AA	WIRE, GROUND, COPPER CLAD STEEL, BARE, #10, 7 STRANDS, 50FT HA		(7) 0001636760	FT	30	35	40	45	50
AB	MOLDING, GROUND WIRE, 1/2 IN. X 8 FT. LONG, RIGID BLACK OR GRA		(7) 0000384272	EA	3	4	5	5	6
AC	STAPLE, WIRE, 2 IN. LONG X 5/9 IN. WIDE X 0.165 DIAMETER, SQUA		(7) 0000384269	EA	25	28	31	34	37

ITEM	CAT ID DESCRIPTION	TABLE-2 (CONT'D)	CAT ID	UNIT	QUANTITY					
					..F	..G	..H	..J	..K	..L
AA	WIRE, OVERHEAD, COPPER CLAD STEEL, BARE, #10, 7 STRANDS, 40%		(7) 0001613185	FT	55	60	65	70	75	80
AB	MOLDING, GROUND WIRE, 1/2 IN. X 8 FT. LONG, RIGID BLACK OR GRA		(7) 0000384272	EA	7	8	8	9	10	11
AC	STAPLE, WIRE, 2 IN. LONG X 5/9 IN. WIDE X 0.165 DIAMETER, SQUA		(7) 0000384269	EA	40	43	46	49	52	55

ACAD

ITEM	CAT ID DESCRIPTION	TABLE-3	CAT ID	UNIT	QUANTITY													
					.AEO	.AFO	.AGO	.AJO	.BEO	.BFO	.BGO	.BHO	.BJO					
BA	ROD, GROUND, 9/16 IN. X 8 FT. LONG, 5/8 IN. THREADS BOTH ENDS,		0000384198	EA														
	ROD, GROUND, 9/16 IN. (OR 5/8 IN) X 8 FT. LONG, THREADLESS, CO		0000368979	EA	4	4	8	8										
BC	COUPLING, GROUND ROD, 5/8-11 TAP X 2-3/4 IN. LONG, THREADED, C		0000384197	EA					3	2	4	3	4					
	COUPLING, GROUND ROD, INSIDE DIAMETER FOR 5/8 IN. ROD X 2-1/2		0000368982	EA	3	2	4	4										
BE	CONNECTOR, GROUND, (5/8) #8 SOL. TO #1/0, BRONZE, SHEAR HEAD B	①⑱	0000384191	EA	1	4	4	8	1	4	4	1	8					

ITEM	CAT ID DESCRIPTION	TABLE-3 (CONT'D)	CAT ID	UNIT	QUANTITY				
					.CEO	.CFO	.CGO	.CHO	.CJO
BA	ROD, GROUND, 9/16 IN. X 10 FT. LONG, 5/8 IN. THREADS BOTH ENDS	③	0000384085	EA	3	3	8	3	6
BC	COUPLING, GROUND ROD, 5/8 IN.-11 X 2-3/4 IN. LONG, THREADED, 1		0000384142	EA	2	1	4	2	2
BE	CONNECTOR, GROUND, (5/8) #8 SOL. TO #1/0, BRONZE, SHEAR HEAD B	①⑱	0000384191	EA	1	3	4	1	6
BF	COMPOUND, ELECTRICAL, MOISTURE SEALING, 1/8" X 3-3/4" X 10 FT	⑬	0000350074	RL	1	1	1	1	1
BG	TAPE, PLASTIC, 3/4 IN. X .0085 IN. X 66 FEET, 1.5" CORE 3M TYP	⑬	0000348171	RL	1	1	1	1	1

NOTES:

APPLICATION

- THIS STANDARD SHALL BE USED FOR THE INSTALLATION OF DRIVEN GROUNDS. GROUNDS SHALL BE INSTALLED A MINIMUM OF EIGHT LOCATIONS WITHIN A MILE. MAXIMUM DISTANCE BETWEEN GROUNDS SHALL BE 600 FEET.
- USING DEEP DRIVEN GROUND RODS SHALL BE THE FIRST CHOICE IN INSTALLING A GROUND. A MINIMUM OF 30 FEET OF GROUND ROD SHALL BE DRIVEN INTO THE GROUND. THE GROUND RODS SHALL ALL BE COUPLED TOGETHER (IN TANDEM) AS THEY ARE DRIVEN. WHEN OBSTRUCTIONS UNDER THE GROUND SURFACE PREVENTS THE RODS FROM BEING DRIVEN DEEP, GROUND RODS SHALL BE COUNTERPOISED TOGETHER. WHEN OBSTRUCTIONS (SUCH AS SOLID ROCK) ARE JUST BELOW THE GROUND'S SURFACE, MAKING IT IMPRACTICAL TO DRIVE GROUND RODS, USE A STRAIGHT WIRE COUNTERPOISE.
- WHERE BARE LEAD COVERED CABLES ARE LOCATED OR PLANNED WITHIN 200 FEET OF THE GROUNDING LOCATION, USE STAINLESS STEEL GROUND RODS. USE COPPER BONDED GROUND RODS FOR ALL OTHER APPLICATIONS.
- FOR COPPER BONDED GROUND RODS, THE THREADLESS GROUND RODS SHALL BE USED FOR ALL GROUNDING EXCEPT IN LOCATIONS WHERE THE LOCAL SOIL CONDITION PREVENTS THE THREADLESS RODS FROM COUPLING TIGHTLY TOGETHER.

RELIABILITY

- ① SEE C0004.B - SHEAR-HEAD BOLT
- ② SEE C0004.E - ARRESTER GROUND WIRE CONNECTION

SUPPLEMENTARY MATERIAL

- ① DRIVE THREADLESS RODS WITH DRIVING ATTACHMENT CAP (CAT ID 0000368983). DRIVE THREADED RODS WITH A COUPLING AND A DRIVING STUD (CAT ID 0000384143). SEE FIGURE 3.
- 2 SPECIFY GROUND ROD DRIVING POINT (CAT ID 0000384112) WHEN INSTALLING GROUND RODS IN ROCKY SOIL CONDITIONS.
- ③ STAINLESS STEEL GROUND ROD EXTENSIONS (5/8 IN. X 5 FT.) ARE AVAILABLE BY SPECIFYING CAT ID 0000384084.
- ④ FOR OPTION C8550.DB\_, .DD\_, .EB\_ OR .ED\_, TWO LOCATION NOTES ON WORK TASK ARE REQUIRED. EACH OPTION PROVIDES HALF THE QUANTITY REQUIRED FOR THE INSTALLATION OF STRAIGHT WIRE COUNTERPOISE.

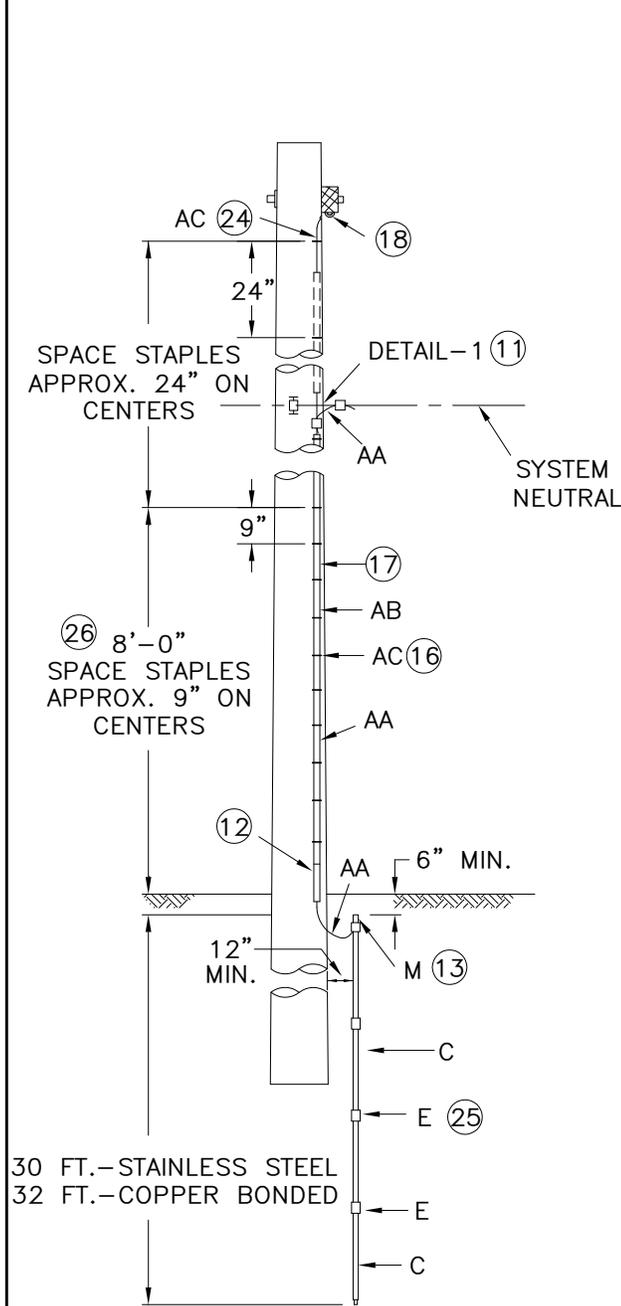
- ⑤ FOR OPTIONS C8550.\_C\_ & \_D\_, WHEN THE INDIVIDUAL NEUTRAL SYSTEMS ARE TO BE SEPARATE, OMIT ITEM "L", ONE OF ITEM "A" AND 10 FEET OF ITEM "N". DO NOT DOUBLE THE QUANTITY OF ITEM "AA" AS PER NOTE 7. INSTEAD, ADD THE SAME QUANTITY OF #2 COPPER 600V INSULATED WIRE (CAT ID 0000363608). SPECIFY ITEM "A" FOR #2 STRD COPPER TO NEUTRAL CONNECTION.
- ⑥ WHEN THE POLE GROUND LEAD (ITEM "AA") CONNECTS DIRECTLY TO AN ARRESTER, SPECIFY CAT ID 0001613266 (1-HOLE 7#10 LUG FOR 3/8 INCH BOLT), CAT ID 0000531113 (LOCK WASHER), AND CAT ID 0000531114 (FLAT WASHER), IF OTHER STANDARD DOES NOT PROVIDE THE 1-HOLE LUG CONNECTOR.
- ⑦ FOR C8550.\_C\_ AND \_D\_, DOUBLE THE QUANTITY OF ITEMS "AA", "AB", AND "AC".
- ⑧ WHEN A STRAIGHT WIRE COUNTERPOISE IS REQUIRED FOR UNDERGROUND APPLICATIONS, SPECIFY REQUIRED LENGTH OF 1/0 BARE COPPER CONDUCTOR (CAT ID 0000355082) AND 2 CRIMPITS (CAT ID 0000368544 FOR 1/0 - #2 OR CAT ID 0000368545 FOR 1/0 - 1/0) DEPENDING ON THE SIZE WIRE SPECIFIED BY OTHER STANDARD. FOR AREAS WITHIN 200 FEET OF LEAD CLAD CABLE, SPECIFY 1/0 LEAD COPPER CONDUCTOR (CAT ID 0000360809) INSTEAD OF THE BARE CONDUCTOR AND ADD 1 ROLL OF MOISTURE SEALING COMPOUND (CAT ID 0000350074) AND 1 ROLL OF PLASTIC TAPE (CAT ID 0000348171) AND MOISTURE SEAL PER NOTE 13; FOR DOUBLE GROUND STRAIGHT WIRE COUNTERPOISE, DOUBLE QUANTITIES MENTIONED ABOVE. SEE NOTE 21.
- ⑨ WHEN SPECIFYING OVERHEAD SECONDARY GROUNDING ONLY, SPECIFY THE GROUND WIRE LENGTH OPTION THAT IS 5 FEET LESS THAN ACTUAL POLE HEIGHT AND OMIT ITEM "L".

ACAD

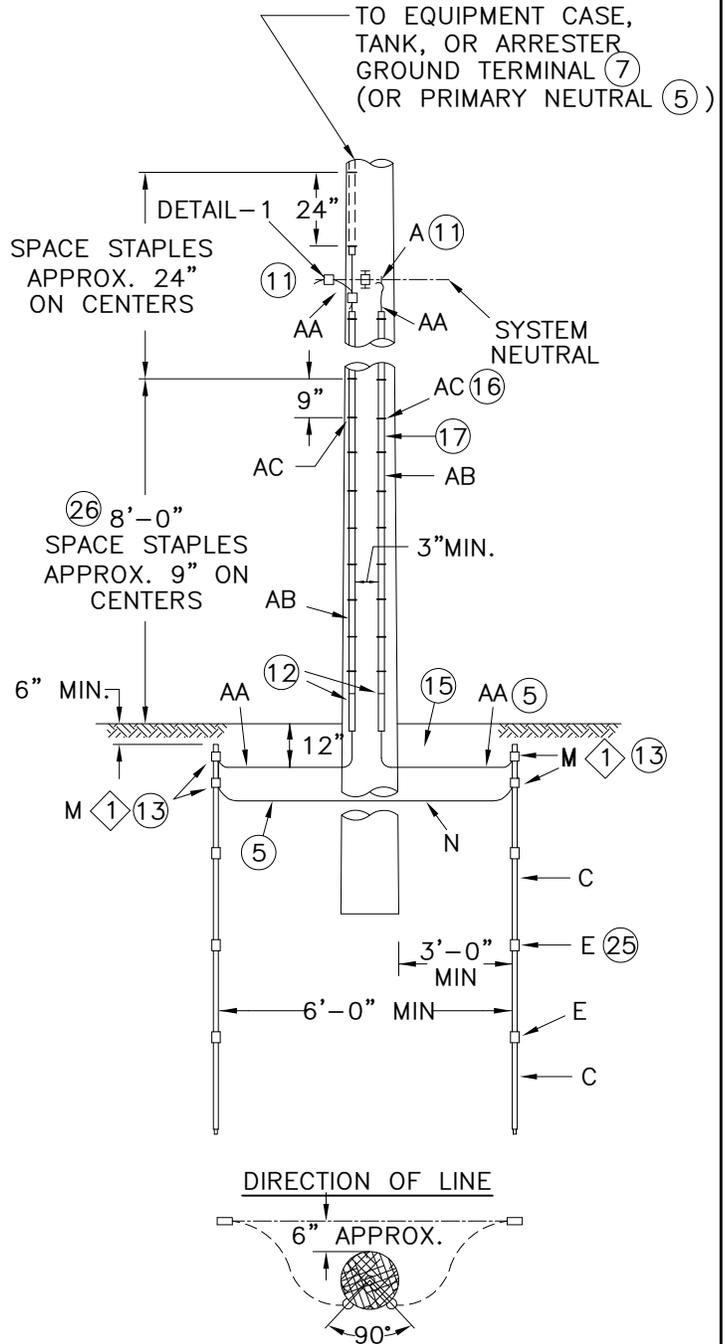
INFORMATION

- (11) ALL CONNECTIONS TO THE SYSTEM NEUTRAL SHALL BE MADE WITH WEDGE CONNECTIONS. SEE DETAIL-1.
- (12) WHEN INSTALLING GROUNDS MORE THAN 200 FEET FROM LEAD CLAD CABLES, STRIP THE END OF THE GROUND LEAD BACK SO THAT AT LEAST 6 INCHES OF BARE WIRE EXTENDS ABOVE GRADE UNDER THE MOLDING (WIRE BURIED IN GROUND SHALL BE BARE).
- (13) WHEN INSTALLING GROUNDS WITHIN 200 FEET OF LEAD CLAD CABLES, STRIP COVERED GROUND WIRE JUST ENOUGH TO MAKE THE CONNECTION AND MOISTURE SEAL ALL CONNECTIONS AND AREAS OF EXPOSED COPPER (INCLUDING THE ENDS OF LEAD CLAD GROUND CONDUCTORS); COVER WITH SEALING COMPOUND (ITEM "R" OR "BF") COMPRESS FIRMLY OVERLAPPING THE GROUND ROD, AND/OR CONNECTOR AND GROUND CONDUCTOR(S) COMPLETELY TO FORM A SMOOTH SURFACE. APPLY ONE HALF-LAPPED LAYER OF TAPE (ITEM "S" OR "BG") OVER THE COMPOUND. SEE DETAIL-2.
- (14) WHEN THE TELEPHONE COMPANY INSTALLS THE FIRST 8 FEET OF COPPER BONDED GROUND ROD, ComEd WILL INSTALL THREE ADDITIONAL 8 FOOT COPPER BONDED GROUND RODS. WHEN STAINLESS STEEL GROUND RODS ARE REQUIRED, REMOVE THE PHONE COMPANY INSTALLED GROUND ROD, AND INSTALL THE STAINLESS STEEL GROUND RODS THAT ARE PROVIDED.
- (15) USE C8550.\_C\_ OR .\_D\_ AT THE END OF A MULTIGROUNDED SYSTEM NEUTRAL IF IT ENDS AT AN EQUIPMENT POLE. SEE **C8549**.
- (16) INSTALL GROUND WIRE UNDER MOLDING. AVOID CONTACTING GROUND WIRE WITH STAPLES WHEN INSTALLING STAPLES OVER MOLDING.
- (17) LOCATE MOLDING ON SIDE OF POLE OPPOSITE OF VEHICULAR TRAFFIC IN EITHER PUBLIC OR PRIVATE WAYS. REFER TO **C7085**.
- (18) USE CARE WHEN INSTALLING GROUND WIRES ON ARMS TO AVOID CONTACT WITH STEEL PINS OR HARDWARE; SPACE STAPLES 1 FOOT APART.
- (19) TO INSURE GROUND ROD CONNECTOR IS NOT INSTALLED ON THREADED PORTION OF GROUND ROD, INSTALL THE CONNECTOR 3 INCHES MINIMUM BELOW THE TOP OF THREADED GROUND ROD.
- (20) FIRST ATTEMPT TO DRIVE AT LEAST 30 FEET OF GROUND ROD IN TANDEM. IF OBSTRUCTIONS ARE ENCOUNTERED, COUNTERPOISE (WHILE STILL TRYING TO DRIVE RODS IN TANDEM) UNTIL A MINIMUM OF 30 FEET OF GROUND ROD IS DRIVEN INTO THE GROUND. THE DISTANCE BETWEEN GROUND RODS SHALL BE A MINIMUM OF 6 FEET. SEE FIGURE 4 FOR EXAMPLES.
- (21) IN AREAS WHERE IT IS IMPOSSIBLE OR IMPRACTICAL TO DRIVE GROUND RODS, A STRAIGHT WIRE COUNTERPOISE SHALL BE INSTALLED BETWEEN SPANS. THE WIRE SHALL BE BURIED AT LEAST 18 INCHES DEEP; LEAVE SLACK IN WIRE. THIS OPTION SHALL BE THE LAST CHOSEN OPTION WHEN INSTALLING GROUNDS.
- (22) COUNTERPOISE ALONG POLE LINE OR WITHIN TRENCH LINE.
- (23) WHEN COUNTERPOISING, ADD AND/OR OMIT APPROPRIATE QUANTITIES OF WIRE (ITEM "N"), COUPLINGS (ITEMS "E", AND "BC"), AND GROUND CLAMPS (ITEMS "M" OR "BE") PER FIELD CONDITIONS.
- (24) MOLDING OVER THE POLE GROUND LEAD (ITEM "AA") IS NOT INSTALLED ABOVE THE SYSTEM NEUTRAL FOR TRANSFORMER OR REGULATOR INSTALLATIONS. SECURE POLE GROUND LEAD WITH ONE STAPLE (ITEM "AC") NEAR TOP OF THE LEAD.
- (25) USE BRONZE COUPLINGS WITH COPPER BONDED RODS, STAINLESS STEEL COUPLINGS WITH STAINLESS STEEL RODS. WHEN COUPLING THREADED GROUND RODS TOGETHER, SCREW BOTH SECTIONS OF THE ROD TIGHTLY INTO THE COUPLING TO INSURE MAXIMUM CONDUCTIVITY.
- (26) FOR REPAIR OF BROKEN OR STOLEN GROUNDS BELOW THE SYSTEM NEUTRAL, INSTALL NEW 7#10 CCS THEFT DETERRENT GROUND WIRE CONTINUOUSLY FROM GROUND ROD AND INTERCONNECT WITH SYSTEM NEUTRAL. FOR REPAIR OF BROKEN GROUNDS ABOVE THE SYSTEM NEUTRAL OR IF SYSTEM NEUTRAL IS NOT PRESENT, INSTALL 7#10 CCS GROUND WIRE FROM GROUND ROD AND MAKE A CONNECTION AT A LOCATION NOT COVERED BY MOLDING. MAKE COMPRESSION CONNECTION WITH CAT ID 0000368544 TO EXISTING #2 CU GROUND WIRE OR CAT ID 0000368545 TO EXISTING 7#10 CCS GROUND WIRE.
- 27 NEW GROUND WIRE INSTALLED ALONG THE LENGTH OF THE POLE SHALL BE INSTALLED AS ONE CONTINUOUS CONDUCTOR WITHOUT JOINT OR SPLICE.

CONNECTION TO OVERHEAD SYSTEM  
USING CCS GROUND WIRE

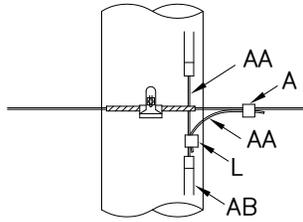


C8550.\_A\_  
SINGLE GROUND, ONE GROUND ROD LOCATION



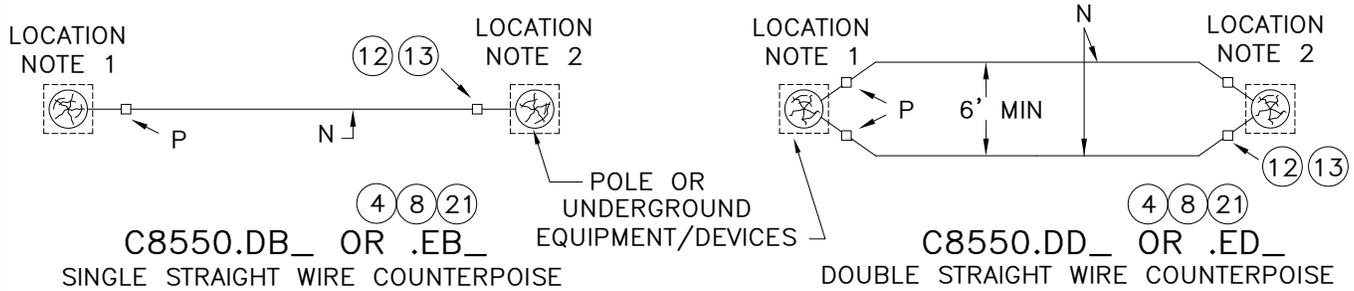
C8550.\_C\_  
DOUBLE GROUND, TWO GROUND ROD LOCATIONS

GENERAL OVERHEAD DETAILS

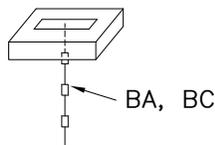


DETAIL-1

GROUND LEAD CONNECTION TO SYSTEM NEUTRAL (11)

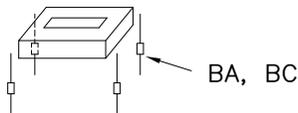


GENERAL URD DETAILS



C8550.\_E0 UNDERGROUND, SINGLE GROUND, ONE GROUND ROD LOCATION

C8550.\_H0 UNDERGROUND, TELEPHONE COMPANY INSTALLS ONE GROUND ROD (14)

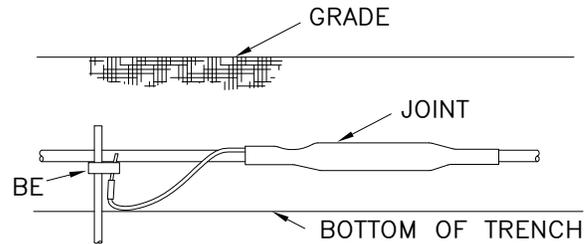


CTS, ESS, OR RSS

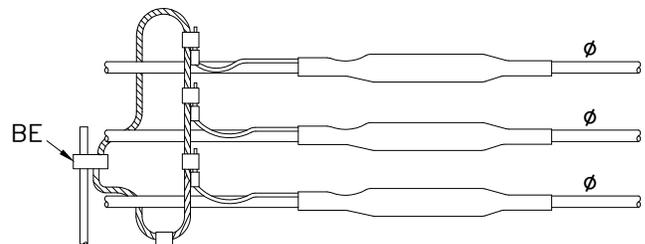
C8550.\_G0 UNDERGROUND, DOUBLE GROUND, FOUR GROUND ROD LOCATIONS

FIGURE 1

GROUND ROD PLACEMENT FOR PAD MOUNTED EQUIPMENT



SINGLE PHASE INSTALLATION  
SEE C5267 FOR PLUG CONNECTOR



MULTI PHASE INSTALLATION

FIGURE 2

URD CONNECTIONS TO GROUND ROD

GENERAL GROUNDING DETAILS

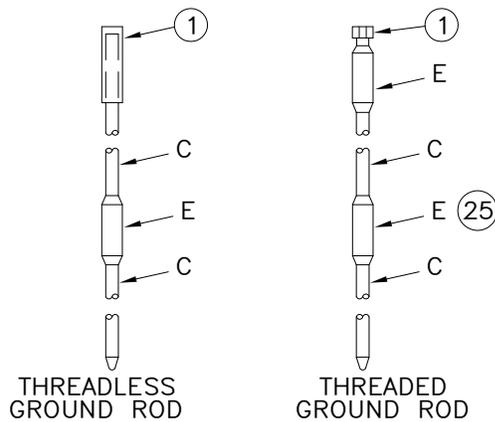
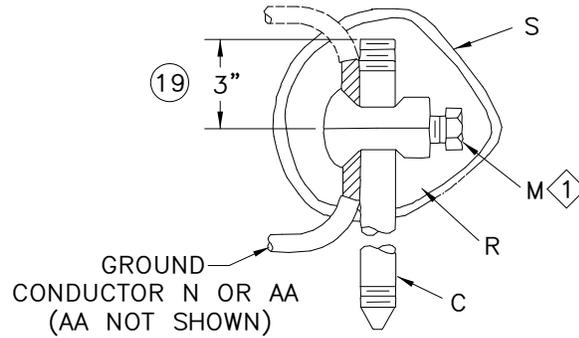


FIGURE 3

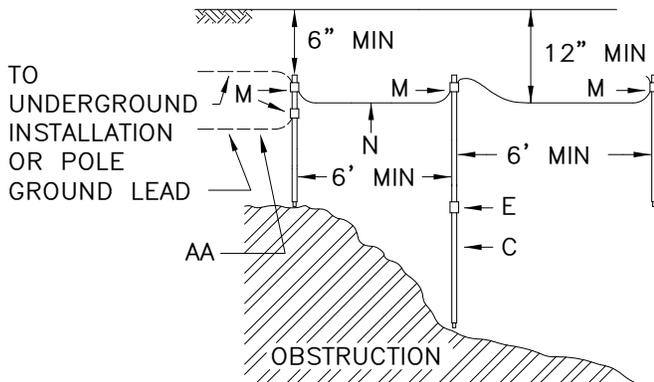
ASSEMBLIES FOR DRIVING GROUND RODS



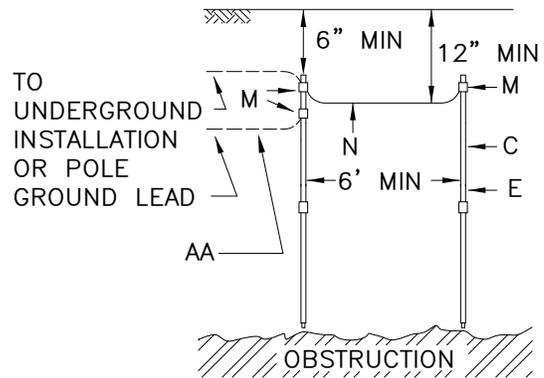
DETAIL-2

MOISTURE SEALED CONNECTION (13)

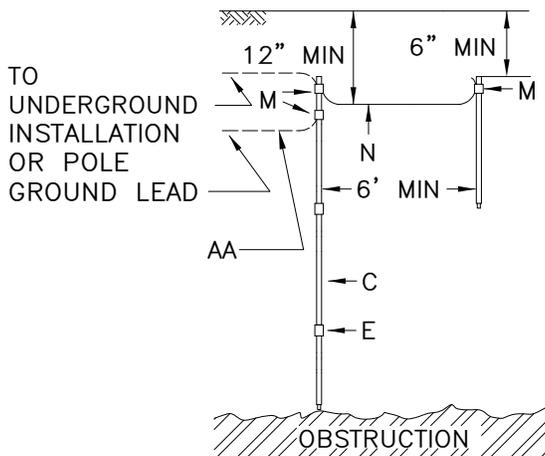
EXAMPLE 1:



EXAMPLE 2:



EXAMPLE 3:



EXAMPLE 4:

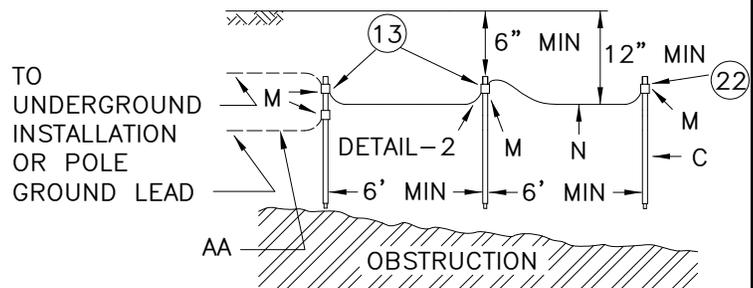


FIGURE 4

SOME EXAMPLES OF DIFFERENT COUNTERPOISES (20) (22) (23)  
C8550.AB\_, .BB\_, .CB\_, .AD\_, .BD\_, .CD\_, .FO OR .JO



SERVICE ENTRANCE LOCATION SKETCH

METRA  
95TH ST SUBSTATION

P.L.:N/A	SER/CWA:
DATE:9/22/17	PAGE 1 OF 5

ComEd TO:

1. MAKE NECESSARY CONNECTIONS IN COMED MANHOLE.
1. TO 2. INSTALL (2)-4" PVC SCHD. 40 CONCRETE ENCASED CONDUIT, PER C4090, C4050, AND C4171, BETWEEN COMED MANHOLE AND PROPERTY LINE, TO INTERCEPT CUSTOMER CONDUIT, LOCATION MARKED WITH "X". ~85'
1. TO 3. INSTALL (1) SET OF (1) 1/C-750-CU EX AND (1) 1/C-#6-CU EX CABLE FOR DRAIN FROM COMED MANHOLE TO CUSTOMER MANHOLE ~295'
1. TO 2. INSTALL (8)-5" PVC SCHD. 40 CONCRETE ENCASED CONDUIT, PER C4090, C4050, AND C4171, BETWEEN COMED MANHOLE AND PROPERTY LINE, TO INTERCEPT CUSTOMER CONDUIT, LOCATION MARKED WITH "X". ~85'
1. TO 5. INSTALL (2) SETS OF (3) 1/C-650-CU EXFSJ PRIMARY CABLE FROM COMED MANHOLE TO COMED SWITCHGEAR, SW-1. ~310'
1. TO 7. INSTALL (2) SETS OF (3) 1/C-650-CU EXFSJ PRIMARY CABLE FROM COMED MANHOLE TO COMED SWITCHGEAR, SW-2. ~330'
6. INSTALL, OWN AND MAINTAIN NEW DEADFRONT 4-BAY PADMOUNT SWITCHGEAR, SW-1. ALL TERMINATIONS AT COMED EQUIPMENT BY COMED.
7. INSTALL, OWN AND MAINTAIN NEW DEADFRONT 4-BAY PADMOUNT SWITCHGEAR, SW-2. ALL TERMINATIONS AT COMED EQUIPMENT BY COMED.
4. POINT UNUSED.
6. POINT UNUSED.

COMED TO OBTAIN ALL NECESSARY CITY AND/OR STATE PERMITS FOR ITS OWN CONSTRUCTION WORK. SERVICE LOCATION AND MODE OF DELIVERY DEPENDS UPON THE GRANTING OF ALL SUCH PERMITS. COMED TO OWN, OPERATE AND MAINTAIN ALL EQUIPMENT.

CUSTOMER TO:

- A. SIGN THIS SERVICE ENTRANCE LOCATION (SEL) SKETCH. FACILITIES WILL NOT BE INSTALLED UNTIL THIS SEL SKETCH IS SIGNED AND RETURNED TO COMED
- B. 1. C. INSTALL (2)-4" PVC SCHD. 40 CONCRETE ENCASED CONDUIT, PER C4090, C4050, AND C4171, BETWEEN CUSTOMER MANHOLE AND PROPERTY LINE, TO INTERCEPT COMED CONDUIT, LOCATION MARKED WITH "X". CUSTOMER TO FIELD MARK LOCATION AT PROPERTY LINE. ~210'
- C. MAKE NECESSARY CONNECTIONS IN CUSTOMER MANHOLE WITH COMED PROVIDED DRAIN WIRE AND DRAIN SIGNAL WIRE.
- B. 1. E. INSTALL (3)-5" PVC SCHD. 40 CONCRETE ENCASED CONDUIT, PER C4090, C4050, AND C4171, BETWEEN COMED SWITCHGEAR, SW-1, AND PROPERTY LINE, TO INTERCEPT COMED CONDUIT, LOCATION MARKED WITH "X". CUSTOMER TO FIELD MARK LOCATION AT PROPERTY LINE. ~225'
- E. INSTALL PAD MOUNTED SWITCHGEAR FOUNDATION PER C5302.G AND NOTES "AD" & "AE".
- E. 1. F. INSTALL (2)-5" PVC SCHD. 40 CONCRETE ENCASED CONDUIT AND (1)-3/C-650-CU EXFSJ BETWEEN COMED SWITCHGEAR, SW-1, AND CUSTOMER EQUIPMENT. TERMINATIONS AT CUSTOMER EQUIPMENT BY CUSTOMER. CUSTOMER TO FIELD MARK LOCATION AT PROPERTY LINE. ~70'
- B. 1. H. INSTALL (3)-5" PVC SCHD. 40 CONCRETE ENCASED CONDUIT, PER C4090, C4050, AND C4171, BETWEEN COMED SWITCHGEAR, SW-2, AND PROPERTY LINE, TO INTERCEPT COMED CONDUIT, LOCATION MARKED WITH "X". ~245'
- H. INSTALL PAD MOUNTED SWITCHGEAR FOUNDATION PER C5302.G AND NOTES "AD" & "AE".
- H. 1. I. INSTALL (2)-5" PVC SCHD. 40 CONCRETE ENCASED CONDUIT AND (1)-3/C-650-CU EXFSJ BETWEEN COMED SWITCHGEAR, SW-2, AND CUSTOMER EQUIPMENT. TERMINATIONS AT CUSTOMER EQUIPMENT BY CUSTOMER. ~30'
- D. POINT UNUSED.
- G. POINT UNUSED.
- AD. INSTALL GROUND RODS PER C8550.CG0, TO BE LOCATED 12" (MIN) FROM TRANSFORMER AND SWITCHGEAR FOUNDATIONS. COMED TO PROVIDE GROUND RODS
- AE. MAINTAIN CLEARANCES PER STANDARDS C5285 AND C5302. OPERATING CLEARANCE MUST BE FREE OF CURBS, STEPS, OVERHANGING STRUCTURES, AND OTHER OBSTRUCTIONS. MAINTAIN 24/7 COMED ACCESS TO COMED EQUIPMENT BY COMED.
- AF. CUSTOMER IS RESPONSIBLE FOR LOCATING ALL UNDERGROUND UTILITIES ON THEIR PROPERTY AND WITHIN SIDEWALK. CUSTOMER IS RESPONSIBLE FOR ALL REPAIR OR REPLACEMENT OF TREES, SHRUBS, PAVEMENT, ETC. RESULTING FROM THE INSTALLATION, REPAIR OR REPLACEMENT OF COMED FACILITIES ON CUSTOMER PROPERTY. ANY CHARGES ASSOCIATED WITH THIS SERVICE ENTRANCE LOCATION, REFLECTS WORK DONE BY COMED ONLY. OTHER CHARGES MAY APPLY FROM OTHER UTILITY COMPANIES; CUSTOMER TO CONTACT THEM FOR CHARGES. IF ANY, CUSTOMER TO PERFORM ALL WORK IN FULL COMPLIANCE WITH CITY OF CHICAGO ELECTRICAL CODE. INSTALL PULLING ROPE IN ALL CUSTOMER CONDUIT.
- AG. OFF PROPERTY LINE/FEEDER CAPACITY IS NOT GUARANTEED INDEFINITELY. COMED EVALUATES LINE/FEEDER LOADS ANNUALLY. IF CUSTOMER LOAD DOES NOT REACH THE LEVEL ORIGINALLY REQUESTED OR STATED ON THE ELECTRIC FACILITIES SERVICE ACKNOWLEDGEMENT (EFSA) WITHIN 5 YEARS OF INITIAL LIVENING, COMED CANNOT GUARANTEE SUCH CAPACITY WILL BE SUBSEQUENTLY AVAILABLE.

LOCATION PLAN FOR ELECTRICAL FACILITIES  
APPROVED BY:

CUSTOMER  
X \_\_\_\_\_

COMMONWEALTH EDISON COMPANY  
CHICAGO LARGE PROJECT GROUP  
DEPARTMENT BY ENGINEER:

X \_\_\_\_\_

PHONE: \_\_\_\_\_

REV 1

NO.	DATE	REVISION DESCRIPTION	BY APPD.
0	9/22/17	ISSUED FOR APPROVAL	RAZ
1	11/8/17	REVISED DUCT SECTIONS PER CUSTOMER REQUEST	RAZ

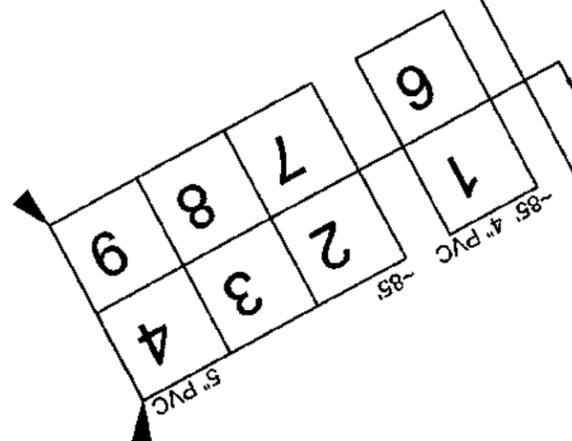


SERVICE ENTRANCE  
LOCATION SKETCH

METRA  
95TH ST SUBSTATION

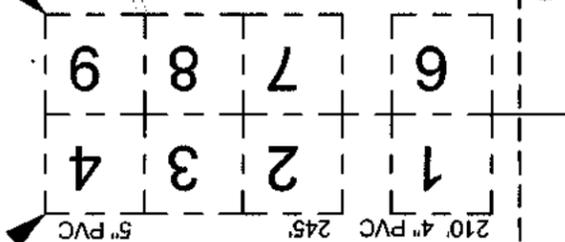
P.L.: N/A	SER./CWA:
DATE: 9/22/17	PAGE 2 OF 5

COMED MANHOLE



E 95TH STREET

13'-4"  
7'-3"



BRICK BUILDING

DRIVEWAY

CONT. SHT 3

REV 1

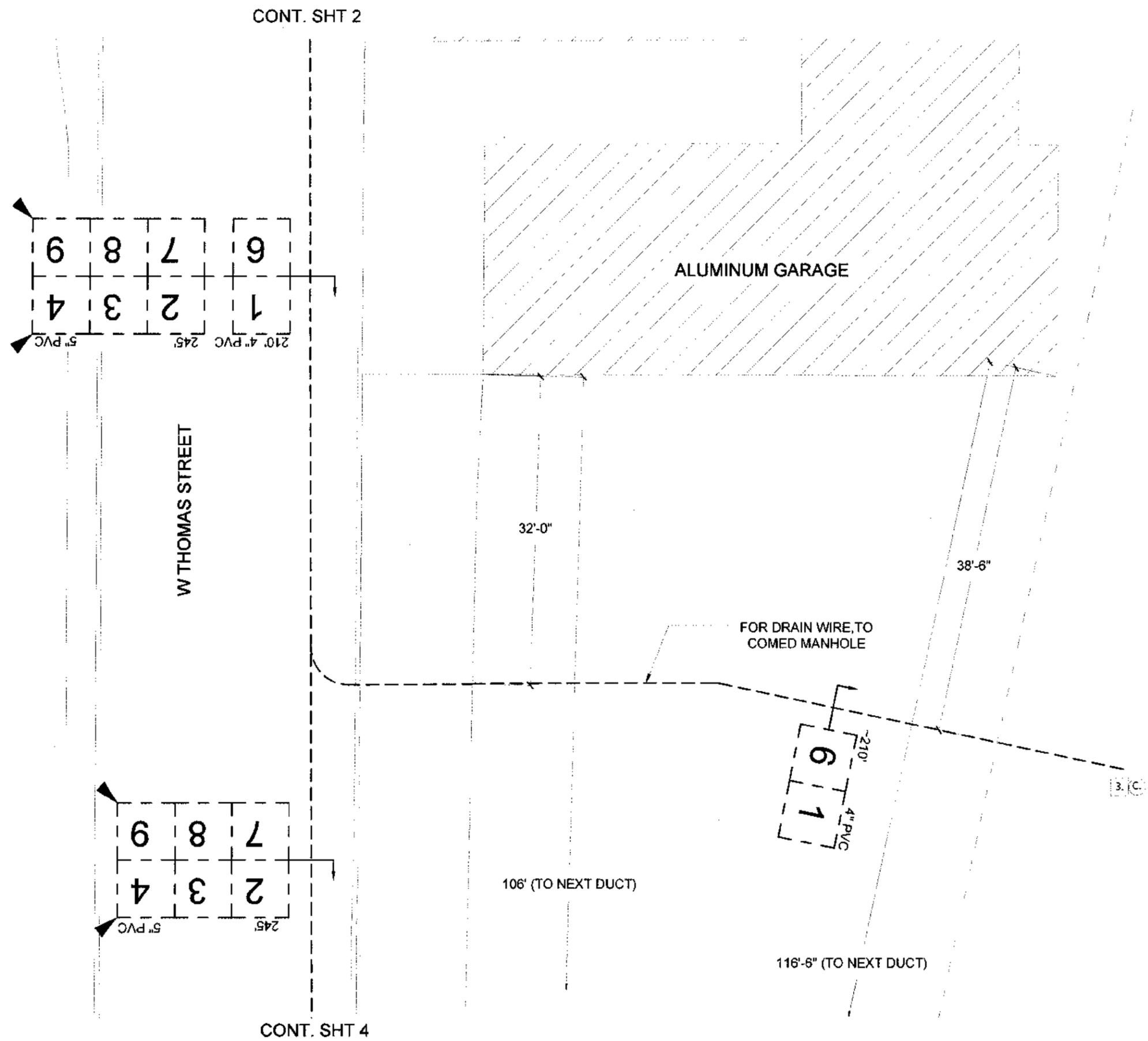
NO.	DATE	REVISION DESCRIPTION	BY APPD
0	9/22/17	ISSUED FOR APPROVAL	RAZ
1	11/8/17	REVISED DUCT SECTIONS PER CUSTOMER REQUEST	RAZ



SERVICE ENTRANCE  
LOCATION SKETCH

METRA  
95TH ST SUBSTATION

P.L.: N/A	SER/CWA:
DATE: 9/22/17	PAGE 3 OF 5

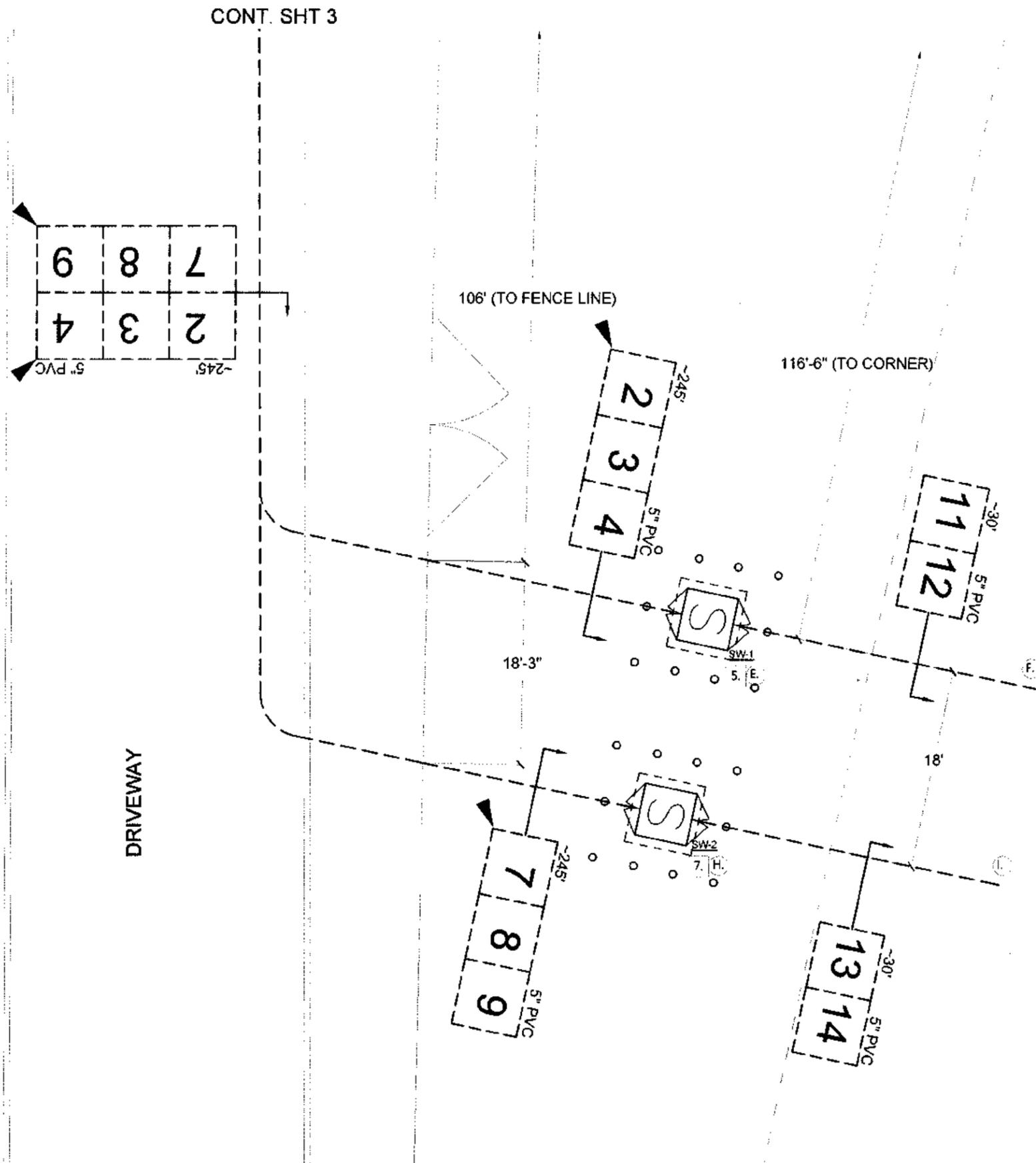


CONT. SHT 2

CONT. SHT 4

REV 1		REVISION DESCRIPTION	BY APPD
NO.	DATE		
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1	11/8/17	REVISED DUCT SECTIONS PER CUSTOMER REQUEST	RAZ

<b>ComEd</b> <small>An Exelon Company</small>	
SERVICE ENTRANCE LOCATION SKETCH	
METRA 95TH ST SUBSTATION	
P.L.: N/A	SER/CWA:
DATE: 9/22/17	PAGE 4 OF 5



REV 1			
NO.	DATE	REVISION DESCRIPTION	BY APPD
0	9/22/17	ISSUED FOR APPROVAL	RAZ
1	11/8/17	REVISED DUCT SECTIONS PER CUSTOMER REQUEST	RAZ



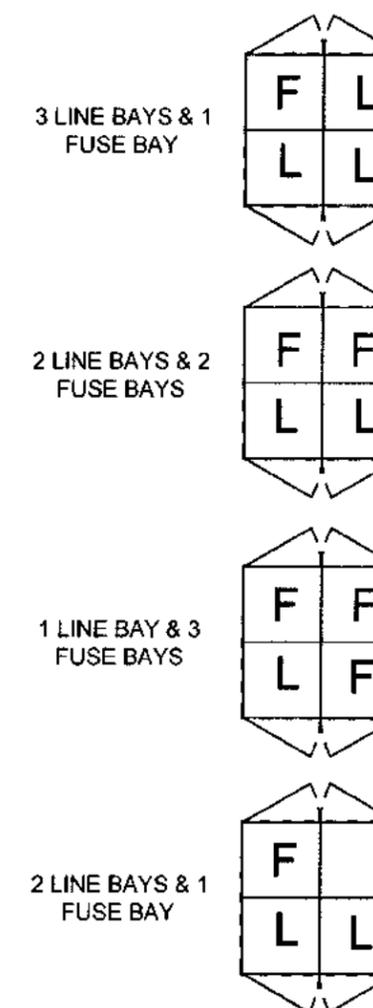
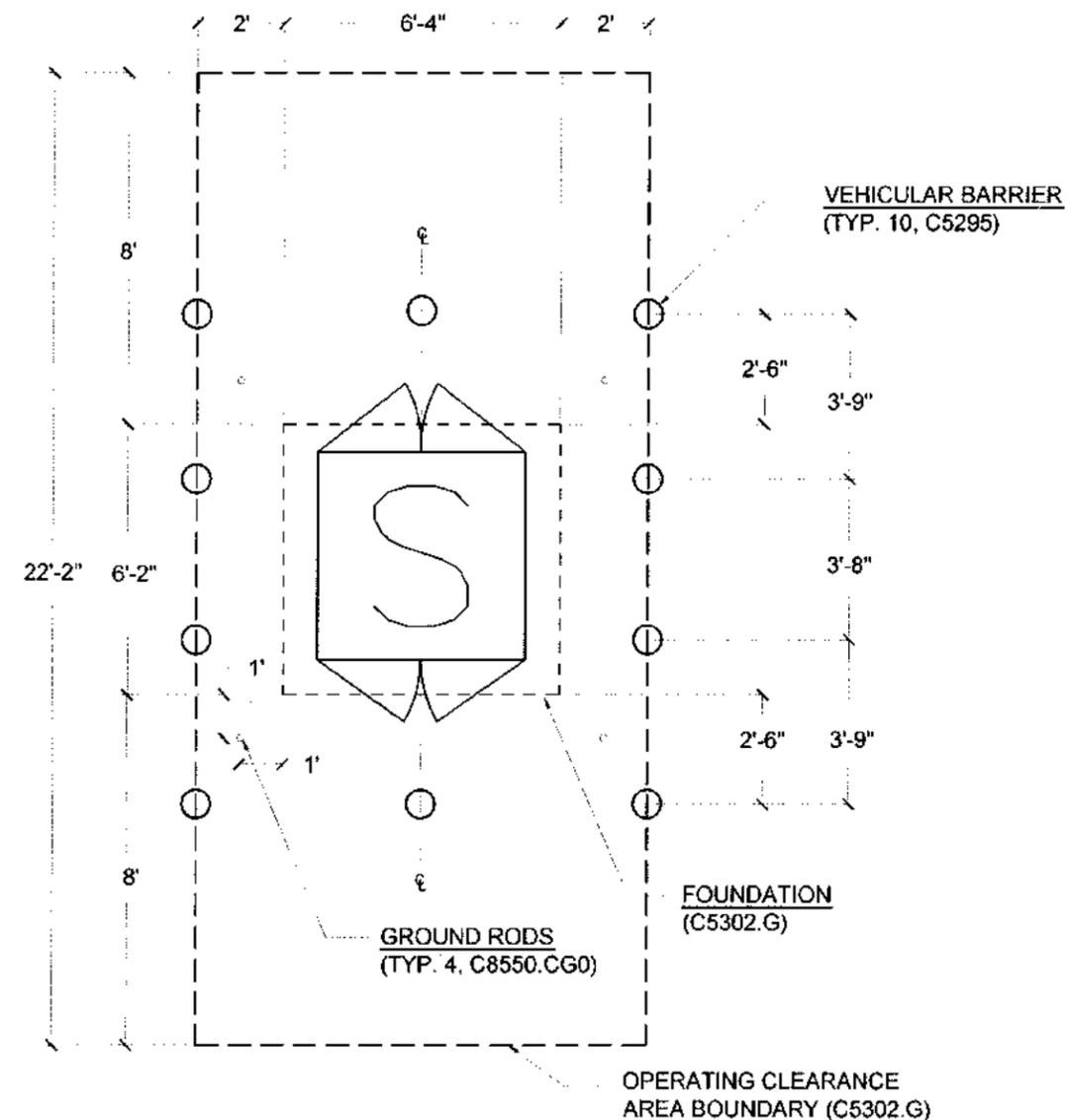
SERVICE ENTRANCE  
LOCATION SKETCH

METRA  
95TH ST SUBSTATION

P.L.: N/A      SER/CWA:  
DATE: 9/22/17      PAGE 5 OF 5

NOTES:

1. INSTALL 5" PVC CONDUIT, 90° SWEEP. SECURE WITH CONCRETE OR GRAVEL TO RESIST UPLIFT DURING CABLE PULLING.
2. DOORS OPEN THIS WAY, 8' CLEARANCE REQUIRED.
3. LOCATE CONDUITS APPROPRIATELY PER STANDARD CONFIGURATIONS SHOWN BELOW.



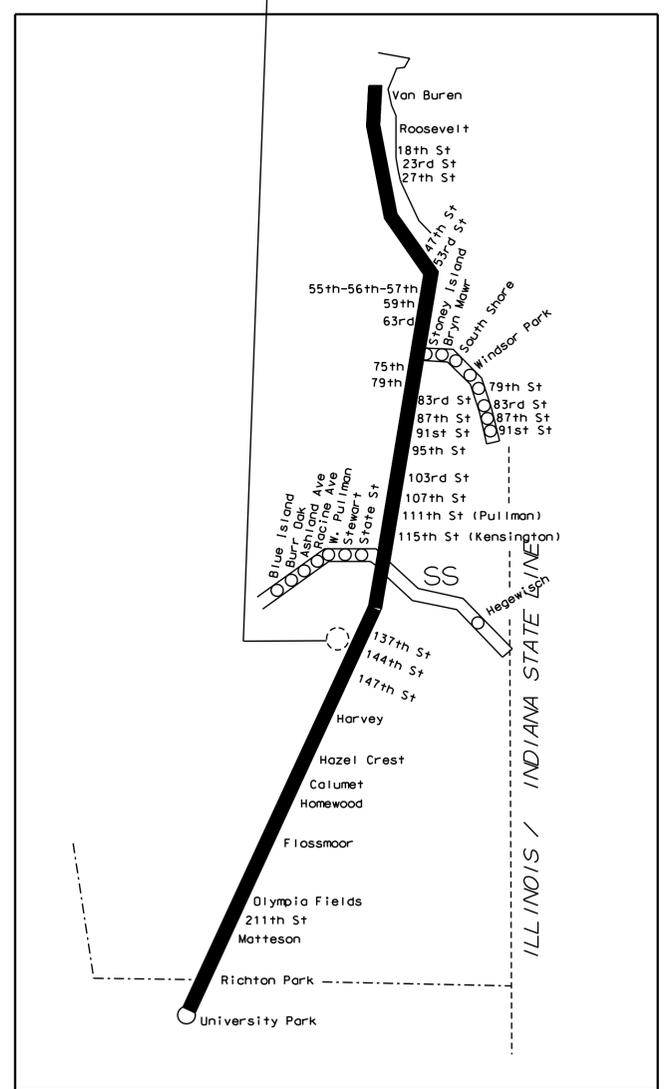
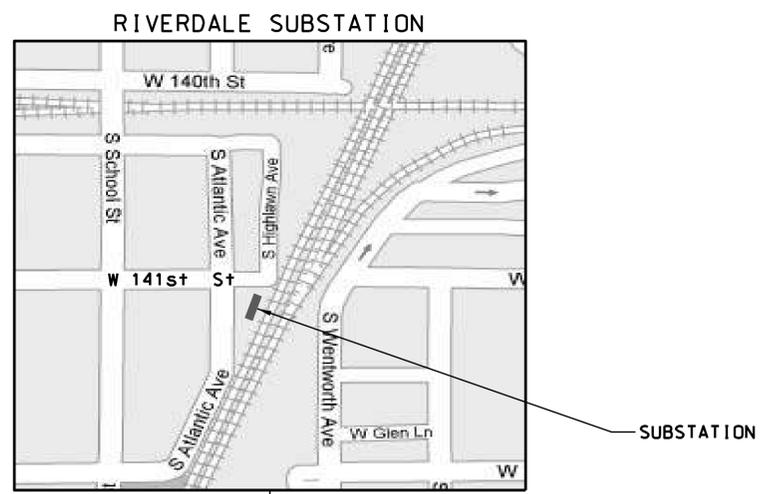
**FOUNDATION, C5302.G**  
CLEARANCES, GROUNDING, & TYPICAL  
VEHICULAR BARRIERS

**DETAIL, PADMOUNT SWITCHGEAR FOUNDATION**  
STUB UP LOCATIONS, CLEARANCES, GROUNDING, & TYPICAL VEHICULAR BARRIERS

REV 1			
NO.	DATE	REVISION DESCRIPTION	BY APPD
0	9/22/17	ISSUED FOR APPROVAL	RAZ
1	11/8/17	REVISED DUCT SECTIONS PER CUSTOMER REQUEST	RAZ



# RIVERDALE SUBSTATION



SYSTEM MAP  
ELECTRIC DISTRICT



### DRAWING LIST

CS-17.5-1000	COVER SHEET
SS-17.5-1001	TOPOGRAPHICAL SURVEY
SS-17.5-1001G	GENERAL NOTES
SS-17.5-1017	SITE PLAN, SECTION AND NOTES
SS-17.5-1017A	LANDSCAPING PLAN, DETAILS, SCHEDULES AND NOTES
SS-17.5-1018	FRAMING PLAN
SS-17.5-1019	FOUNDATION AND FRAMING DETAILS
SS-17.5-1020A	STAIR, RAILING AND GATE DETAILS
SS-17.5-1020B	CHAIN LINK FENCE DETAILS
SS-17.5-1020C	CHAIN LINK SWING GATE DETAILS
SS-17.5-1050	SUBSTATION EQUIPMENT LAYOUT PLAN
SS-17.5-1070	ELECTRICAL SITE PLAN
SS-17.5-1071	UNDERGROUND CONDUIT AND DUCTBANK LAYOUT
SS-17.5-1072	DUCTBANK PROFILES
SS-17.5-1073	DUCTBANK DETAILS
SS-17.5-1074	NOT USED
SS-17.5-1075	SUBSTATION GROUNDING LAYOUT
SS-17.5-1080	ELECTRICAL NOTES & SYMBOLS
SS-17.5-1081	ELECTRICAL DETAILS
SS-17.5-1082	NEGATIVE AND DRAIN ENCLOSURES
SS-17.5-1085	ENLARGED PLANS, ELEVATIONS AND DETAILS
SS-17.5-4001	12.5KV AC SINGLE LINE DIAGRAM
SS-17.5-4002	NOT USED
SS-17.5-4003	TRACTION POWER ONE LINE DIAGRAM
SS-17.5-4004	NOT USED
SS-17.5-4005	NOT USED
SS-17.5-4006	TRANSF'S, RECTIFIERS & DC SWGR SINGLE LINE DIAGRAM
SS-17.5-4101	12.5KV AC THREE LINE DIAGRAM, SHEET 1 OF 3
SS-17.5-4102	12.5KV AC THREE LINE DIAGRAM, SHEET 2 OF 3
SS-17.5-4103	12.5KV AC THREE LINE DIAGRAM, SHEET 3 OF 3
SS-17.5-4104	NOT USED
SS-17.5-4105	12.5KV AC SCHEMATIC DIAGRAM INC. LINE BKRS. 152-1 & 152-2
SS-17.5-4106	12.5KV AC SCHEMATIC DIAGRAM BUS TIE BKR. 52BT
SS-17.5-4107	12.5KV AC SCHEMATIC DIAGRAM RECT. TRANSF. BKR. 52-T1 & 52-T2
SS-17.5-4108	NOT USED
SS-17.5-4109	NOT USED
SS-17.5-4110	12.5KV AC SCHEMATIC DIAGRAM BUS-1 DIFFERENTIAL LOCKOUT
SS-17.5-4111	12.5KV AC SCHEMATIC DIAGRAM BUS-2 DIFFERENTIAL LOCKOUT
SS-17.5-4201	1500V DC SCHEMATIC DIAGRAM RECTIFIER-1 POWER & AUXILIARIES
SS-17.5-4202	1500V DC SCHEMATIC DIAGRAM RECTIFIER-1 CONTROLS & ANNUNCIATOR
SS-17.5-4203	NOT USED
SS-17.5-4204	1500V DC SCHEMATIC DIAGRAM RECTIFIER-2 POWER & AUXILIARIES
SS-17.5-4205	1500V DC SCHEMATIC DIAGRAM RECTIFIER-2 CONTROLS & ANNUNCIATOR
SS-17.5-4206	RECTIFIER PLC LOGIC DIAGRAM SHEET 1
SS-17.5-4207	RECTIFIER PLC LOGIC DIAGRAM SHEET 2
SS-17.5-4208	RECTIFIER PLC LOGIC DIAGRAM SHEET 3
SS-17.5-4209	RECTIFIER PLC LOGIC DIAGRAM SHEET 4
SS-17.5-4210	1500V DC SCHEMATIC DIAGRAM RECTIFIER-1 BREAKER 72-1
SS-17.5-4211	1500V DC SCHEMATIC DIAGRAM RECTIFIER-2 BREAKER 72-2
SS-17.5-4226	1500V DC SCHEMATIC DIAGRAM DC SWITCHGEAR GROUND RELAY
SS-17.5-4304A	DC FEEDER BREAKER SECTION NO. 174 SCHEMATIC DIAGRAM
SS-17.5-4305A	DC FEEDER BREAKER SECTION NO. 175 SCHEMATIC DIAGRAM
SS-17.5-4306A	DC FEEDER BREAKER SECTION NO. 176 SCHEMATIC DIAGRAM
SS-17.5-4307A	DC FEEDER BREAKER SECTION NO. 177 SCHEMATIC DIAGRAM
SS-17.5-4308A	DC FEEDER BREAKER SECTION NO. T-BKR SCHEMATIC DIAGRAM
SS-17.5-5000	STATION CONTROL ARCHITECTURE NEW BUILDING INTERFACES
SS-17.5-5001	STATION CONTROL ARCHITECTURE EXISTING BUILDING INTERFACES

PRINTED ON: \$DATES

REV	DATE	BY	APP	DESCRIPTION	REV	DATE	BY	APP	DESCRIPTION
2	06-08-2018	JMC	HS	ISSUED FOR BID					
1	03-30-2018	HS	HS	ISSUED FOR ADDENDUM 1					
0	07-28-2017	HS	HS	ISSUED FOR BID					

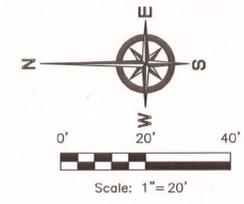
**LTK**  
LTK Engineering Services

**KMI**  
Kaltouni Mehdi, Inc.  
ARCHITECTS • ENGINEERS  
223 W. Jackson Blvd., Suite 1010 Chicago, IL 60606  
Tel.: (312)987-9800 Fax: (312)987-9892

**LDP** A Company of **Gannett Fleming**  
Consulting Engineers  
20 N. Wacker Dr. Ste. 1500 Chicago IL 60606

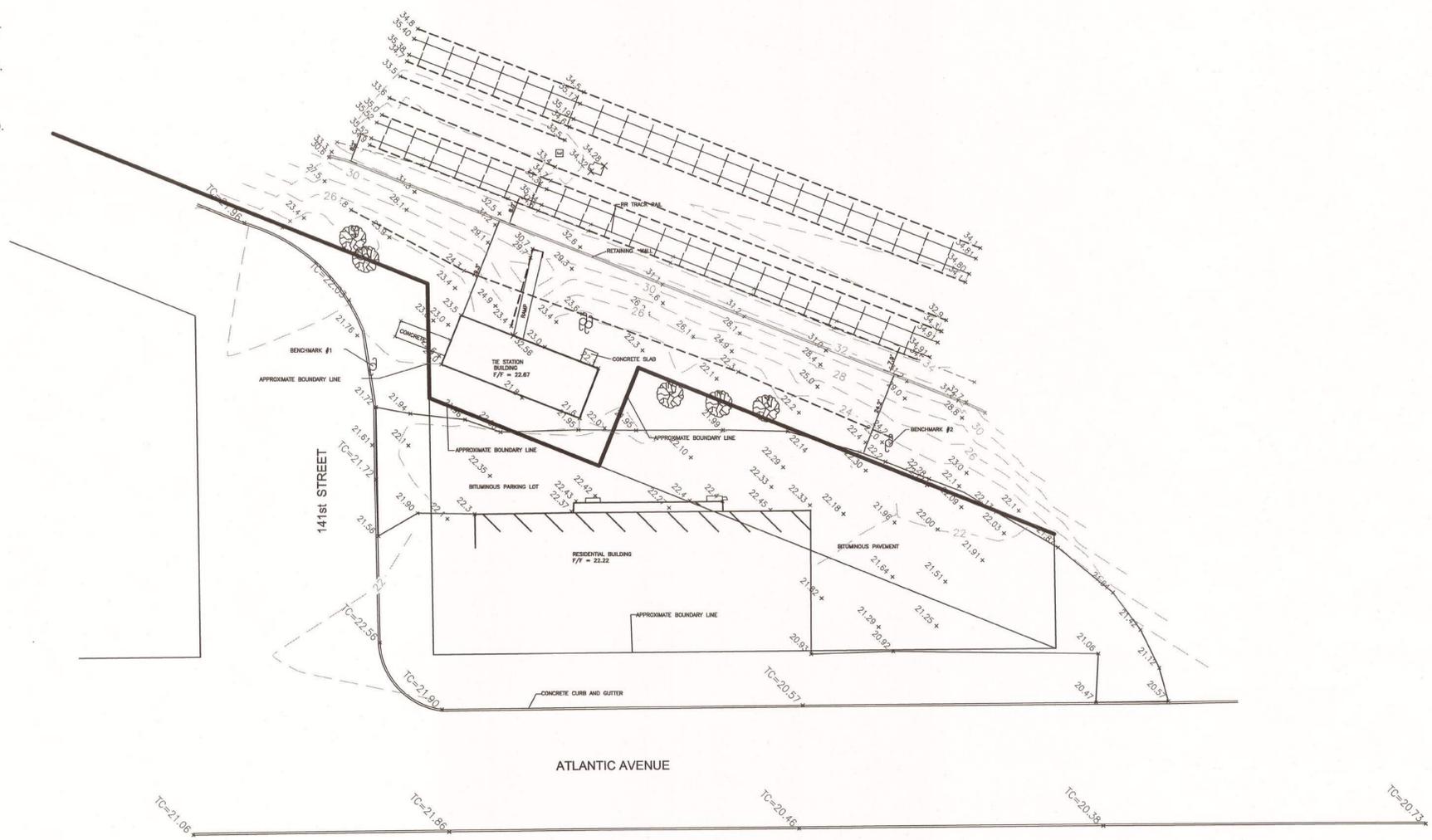
**Metra**  
ENGINEERING DEPARTMENT  
547 W. JACKSON BOULEVARD  
CHICAGO, ILLINOIS 60661

LOCATION NAME: <b>RIVERDALE SUBSTATION</b>	CAD FILE NUMBER: CS-17.5-1000.DGN
TITLE: <b>COVER SHEET</b>	SCALE: NTS
	DISTRICT: MED
	PROJECT NO. GW4254-57102002
	SHEET NO. <b>CS-17.5-1000</b>
	MILE POST NO. 17.5



**SURVEYOR'S NOTES:**

1. ALL DIMENSIONS ARE GIVEN IN FEET AND DECIMAL PARTS THEREOF.
2. BEARINGS BASED ON ILLINOIS STATE PLANE COORDINATES, EAST ZONE, NAD83(2011), GPS DERIVED.
3. VERTICAL DATUM IS ASSUMED.
4. ONLY THOSE BUILDING LINE SETBACKS AND EASEMENTS WHICH ARE SHOWN ON THE RECORDED PLAT OF SUBDIVISION ARE SHOWN HEREON, UNLESS OTHERWISE INDICATED. REFER TO THE DEED, TITLE INSURANCE POLICY AND LOCAL ORDINANCES FOR OTHER RESTRICTIONS WHICH MAY OR MAY NOT EXIST.
5. COMPARE DEED DESCRIPTION AND SITE CONDITIONS WITH THE DATA GIVEN ON THIS PLAT AND REPORT ANY DISCREPANCIES TO THE SURVEYOR AT ONCE.
6. NO DIMENSIONS SHALL BE DERIVED FROM SCALE MEASUREMENT.
7. DISTANCES ALONG CURVES ARE ARC DISTANCES UNLESS OTHERWISE NOTED.
8. THIS SURVEY WAS PERFORMED ON THE GROUND AND COMPLETED 05/04/2017.
9. ONLY THE IMPROVEMENTS THAT WERE VISIBLE FROM ABOVE GROUND AT TIME OF SURVEY AND THROUGH A NORMAL SEARCH AND WALK THROUGH OF THE SITE ARE SHOWN ON THE FACE OF THIS PLAT. LAWN SPRINKLER SYSTEMS, IF ANY, ARE NOT SHOWN ON THIS SURVEY.
10. SURFACE INDICATIONS OF UTILITIES ON THE SURVEYED PARCEL HAVE BEEN SHOWN. UNDERGROUND AND OFFSITE OBSERVATIONS HAVE NOT BEEN MADE TO DETERMINE THE EXTENT OF UTILITIES SERVING OR EXISTING ON THE PROPERTY. PUBLIC AND/OR PRIVATE RECORDS HAVE NOT BEEN SEARCHED TO PROVIDE ADDITIONAL INFORMATION. OVERHEAD WIRES, IF ANY, ARE EXISTING AND THEIR POLES HAVE BEEN SHOWN, HOWEVER THEIR FUNCTION AND DIMENSIONS HAVE NOT BEEN NOTED.
11. OTHER THAN VISIBLE OBSERVATIONS NOTED HEREON, THIS SURVEY MAKES NO STATEMENT REGARDING THE ACTUAL PRESENCE OR ABSENCE OF ANY SERVICE OR UTILITY LINE. CONTROLLED UNDERGROUND EXPLORATORY EFFORT TOGETHER WITH J.U.L.I.E. LOCATIONS IS RECOMMENDED TO DETERMINE THE FULL EXTENT OF UNDERGROUND SERVICE AND UTILITY LINES. CONTACT J.U.L.I.E. AT: 1-800-892-0123.



BENCHMARK #1  
BENCH TIE NAIL  
IN UTILITY POLE  
ELEV.=23.94

BENCHMARK #2  
BENCH TIE NAIL  
IN UTILITY POLE  
ELEV.=24.97

LEGEND	
SYMBOL	DESCRIPTION
ΔBM	BENCHMARK LOCATION
⊗	WATER VALVE
⊠	ELECTRIC MANHOLE
⊙	GUY WIRE ANCHOR
⊕	POWER POLE
⊗	GAS VALVE
⊠G	GAS METER
⊙	CATCH BASIN ROUND
○	DRAIN
○	BOLLARD
⊙	STREET LIGHT STANDARD
⊙	STREET LIGHT W/MAST ARM
—	SIGN
⊙	STEEL POST
⊙	SHRUB
⊙ 0"	DECIDUOUS TREE W/SIZE
X 100.00	SPOT GRADE
(R)	RECORD BEARING OR DISTANCE
(M)	MEASURED BEARING OR DISTANCE
TC	TOP OF CURB
FL	FLOWLINE
TW	TOP OF WALL
FF	FINISHED FLOOR
⊠	BUILDING FOOT PRINT
—>	COMBINATION SEWER LINE
—OHW—	OVERHEAD WIRES
—x—	CHAINLINK FENCE LINE
—	WOOD/IRON FENCE LINE
—•••••	STEEL GUARDRAIL

STATE OF ILLINOIS  
)SS  
COUNTY OF COOK)

THIS IS TO CERTIFY THAT THE TOPOGRAPHIC IMPROVEMENTS DEPICTED HEREON WERE SURVEYED UNDER THE DIRECT SUPERVISION OF AN ILLINOIS PROFESSIONAL LAND SURVEYOR, AND THAT THIS PLAT REPRESENTS THE CONDITIONS FOUND AT THE TIME OF SAID SURVEY.

GIVEN UNDER MY HAND AND SEAL THIS 17TH OF JANUARY, 2018 IN CHICAGO, ILLINOIS.

ENVIRONMENTAL DESIGN INTERNATIONAL, INC.  
PROFESSIONAL DESIGN FIRM NO. 184-001224

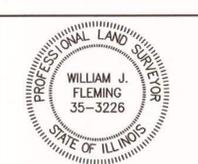
*William J. Fleming*  
WILLIAM FLEMING, IPLS NO. 035.003226  
LICENSE EXPIRES: 11/30/2018

THIS PROFESSIONAL SERVICE CONFORMS TO THE CURRENT ILLINOIS MINIMUM STANDARDS FOR TOPOGRAPHIC SURVEYS.

THIS PLAT IS VALID ONLY WITH AN ORIGINAL SIGNATURE AND EMBOSSED SEAL.

PRINTED ON: 01/17/2018

REV	DATE	BY	APP	DESCRIPTION
0	01-17-2018	MW	WF	ISSUED FOR BID



**EDI**  
Environmental Design International, Inc.  
Civil, Survey, Environmental and  
Construction Inspection Services  
33 W. Monroe St., Suite 1825  
Chicago, IL 60603  
Ph: (312) 345-1400 Fax: (312) 345-0529  
www.envdesign.com MBE/WBE/DBE

DESIGNED: WF  
DRAWN: MW  
CHECKED: WF  
METRA P.M.: R. CERANT  
DATE: JANUARY 17, 2018

**Metra**  
ENGINEERING DEPARTMENT  
547 W. JACKSON BOULEVARD  
CHICAGO, ILLINOIS 60661

LOCATION NAME: RIVERDALE SUBSTATION  
TITLE: TOPOGRAPHIC SURVEY

CAD FILE NUMBER: SS-17.5-1001.DGN  
SCALE: AS SHOWN  
PROJECT NO. GW4254-57102002  
MILE POST NO. 17.5  
DISTRICT: MED  
SHEET NO. SS-17.5-1001

GENERAL NOTES:

- ALL ITEMS OF THIS PROJECT SHALL BE GOVERNED BY THE CODES AND SPECIFICATIONS LISTED BELOW:
  - INTERNATIONAL BUILDING CODE-2012
  - CHICAGO BUILDING CODE-2017
  - "STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION" PREPARED BY THE DEPARTMENT OF TRANSPORTATION OF THE STATE OF ILLINOIS AND ADOPTED BY SAID DEPARTMENT (LATEST VERSION).
  - "SUPPLEMENTAL SPECIFICATIONS AND RECURRING SPECIAL PROVISIONS" ADOPTED BY THE ILLINOIS DEPARTMENT OF TRANSPORTATION (LATEST VERSION).
  - "STANDARDS AND SPECIFICATIONS FOR SOIL EROSION AND SEDIMENT CONTROL" (LATEST VERSION).
  - "STANDARD SPECIFICATIONS FOR WATER AND SEWER MAIN CONSTRUCTION IN ILLINOIS" (LATEST VERSION).
- CONTRACTOR SHALL BE RESPONSIBLE FOR SECURING AND PAYING FOR ALL REQUIRED PERMITS INCLUDING MUNICIPAL PERMITS.
- ALL IMPROVEMENTS WILL BE SUBJECT TO OBSERVATION BY METRA AUTHORIZED REPRESENTATIVE AND/OR QUALIFIED AGENTS ACTING ON BEHALF OF METRA BOTH DURING THE COURSE OF CONSTRUCTION AND AFTER CONSTRUCTION IS COMPLETE. THE AGENT SHALL HAVE AUTHORITY OVER MATERIALS OF CONSTRUCTION AND WORKMANSHIP TO INSURE COMPLIANCE WITH CONSTRUCTION DOCUMENTS. THE CONTRACTOR SHALL PROVIDE FOR REASONABLE TESTS AND PROOF OF QUALITY OF MATERIALS AS REQUESTED BY THE AGENT. THE AGENT SHALL HAVE FORTY-EIGHT (48) HOURS NOTICE PRIOR TO CONSTRUCTION OR INSPECTION.
- THE CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING ALL EXISTING CONDITIONS, DIMENSIONS AND ELEVATIONS AT THE SITE AND MUST ADAPT HIS WORK TO ACTUAL CONDITIONS IN A MANNER APPROVED BY THE ENGINEER AT NO ADDITIONAL COST TO THE OWNER. IF THERE ARE ANY DISCREPANCIES FROM WHAT IS SHOWN ON THE CONSTRUCTION PLANS, HE MUST IMMEDIATELY REPORT SAME TO THE ENGINEER BEFORE DOING ANY WORK, OTHERWISE THE CONTRACTOR ASSUMES FULL RESPONSIBILITY. IN THE EVENT OF DISAGREEMENT BETWEEN THE CONSTRUCTION PLANS, STANDARD SPECIFICATIONS AND/OR SPECIAL DETAILS, THE CONTRACTOR SHALL SECURE WRITTEN INSTRUCTIONS FROM THE ENGINEER PRIOR TO PROCEEDING WITH ANY PART OF THE WORK AFFECTED BY OMISSIONS OR DISCREPANCIES. FAILING TO SECURE SUCH INSTRUCTIONS, THE CONTRACTOR WILL BE CONSIDERED TO HAVE PROCEEDED AT HIS OWN RISK AND EXPENSE. IN THE EVENT OF ANY DOUBT OR QUESTION ARISING WITH RESPECT TO THE TRUE MEANING OF THE CONSTRUCTION PLANS OR SPECIFICATIONS, THE DECISION OF THE ENGINEER SHALL BE FINAL AND CONCLUSIVE.
- ALL EXISTING UTILITIES SHALL BE FIELD VERIFIED BY CONTRACTOR PRIOR TO CONSTRUCTION. CONTRACTOR SHALL COORDINATE AND COMPLY WITH ALL UTILITY COMPANIES INVOLVED IN THE PROJECT AND PAY ALL REQUIRED FEES AND COSTS.
- TRAFFIC SHALL BE MAINTAINED ON ALL STREETS AT ALL TIMES.
- IN THE EVENT, THE COUNTY/CITY STANDARD DETAILS CONFLICT WITH "TYPICAL SITE DETAILS", THE COUNTY/CITY STANDARD DETAILS SHALL GOVERN.
- DUST SHALL BE CONTROLLED BY THE UNIFORM APPLICATION OF SPRINKLED WATER AS DIRECTED BY THE ENGINEER.
- ALL ADJACENT ROADWAYS SHALL BE CLEANED OF CONSTRUCTION DEBRIS AT THE END OF EACH CONSTRUCTION DAY.
- CONTRACTOR SHALL COORDINATE WITH IDOT, METRA, AND THE CITY/VILLAGE TO LOCATE SIGNAL CABLES.
- SPOT ELEVATIONS SHOWN ARE AT EDGE OF PAVEMENT UNLESS OTHERWISE NOTED ON PLAN.
- ALL DEBRIS SHALL BE REMOVED PRIOR TO CONSTRUCTION OF NEW WORK & LEGALLY DISPOSED OF OFFSITE.
- THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE CONSTRUCTION LAYOUT STAKING. THE COST FOR ALL ASSOCIATED WORK SHALL BE INCLUDED IN THE CONTRACT SUM.

UTILITY WARNING:

THE UNDERGROUND UTILITIES SHOWN HAVE BEEN LOCATED FROM FIELD SURVEY INFORMATION AND EXISTING DRAWINGS. KMI MAKES NO GUARANTEE THAT THE UNDERGROUND UTILITIES SHOWN COMPRISE ALL SUCH UTILITIES IN THE AREA, EITHER IN SERVICE OR ABANDONED. KMI FURTHER DOES NOT WARRANT THAT THE UNDERGROUND UTILITIES SHOWN ARE IN THE EXACT LOCATION INDICATED ALTHOUGH HE DOES CERTIFY THAT THEY ARE LOCATED AS ACCURATELY AS POSSIBLE FROM THE INFORMATION AVAILABLE. KMI HAS NOT PHYSICALLY LOCATED THE UNDERGROUND UTILITIES. CALL J.U.L.I.E. (1-800-892-0123) AND/OR DIGGER (312-744-7000) PRIOR TO CONSTRUCTION OR EXCAVATION.

TEMPORARY EXCAVATION SUPPORT:

- TEMPORARY EXCAVATION SUPPORT, SHALL BE DESIGNED BY CONTRACTOR AND APPROVED BY THE RAILROAD OWNER. EXCAVATION SUPPORT IS SHOWN SYMBOLICALLY ON THE DRAWINGS, IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO DETERMINE TYPE, SIZE, AND LOCATION OF ALL REQUIRED SUPPORTS.
- REFER TO SPECIFICATION SECTION 02260-EXCAVATION SUPPORT AND PROTECTION AND APPENDIX "A"-METRA SHORING GUIDELINES FOR ADDITIONAL REQUIREMENTS.

MINIMUM DESIGN LOADS:

FLOOR LOADS	ROOF LOADS	WIND LOAD
DL= 75 LB/SQ.FT.	DL= 20 LB/SQ.FT.	WL= 20 LB/SQ.FT.
+ EQUIPMENT WEIGHT	LL= 30 LB/SQ.FT.	
LL= 100 LB/SQ.FT.		

EXCAVATION AND EARTHWORK:

- ALL FOOTING EXCAVATIONS SHALL BE INSPECTED, PRIOR TO CONCRETE PLACEMENT, BY A SOILS ENGINEER TO VERIFY SUITABLE BEARING MATERIAL OF CAPACITY AS SPECIFIED.
- NOTIFY THE OWNER'S REPRESENTATIVE WHEN ADDITIONAL EXCAVATION IS REQUIRED TO REACH SUITABLE BEARING MATERIAL.
- THE SOILS ENGINEER SHALL CERTIFY IN WRITING THAT ALL FOUNDATIONS WERE PLACED ON SOIL WITH THE BEARING VALUE AS SPECIFIED.
- WITHIN THE EXCAVATION AREA OF THE FOUNDATIONS, ALL VEGETATION, TOPSOIL, PREVIOUSLY PLACED FILL AND UNSUITABLE SOILS SHALL BE REMOVED. ALL FOOTINGS TO BEAR ON VIRGIN SOIL OR PROPERLY PLACED AND COMPACTED ENGINEERED FILL.
- FOUNDATION DESIGN DOES NOT ACCOUNT FOR WINTER CONSTRUCTION. ANY UNENCLOSED/UNHEATED SPACES SHALL BE ADEQUATELY PROTECTED AGAINST FROST DURING WINTER CONSTRUCTION BY CONTRACTOR.

CONCRETE NOTES:

- MATERIAL: NORMAL WEIGHT CONCRETE.  $f'_c = 4000$ psi AT 28 DAYS.
- ALL REINFORCED CONCRETE CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE ACI BUILDING CODE 318, AREMA, CHAPTER 8 AND SPECIFICATIONS FOR STRUCTURAL CONCRETE FOR BUILDINGS ACI 301.
- CONTRACTOR SHALL SUBMIT MIX DESIGN FOR APPROVAL PRIOR TO ORDERING CONCRETE.
- ALL REINFORCING BARS SHALL BE ASTM A615, GRADE 60, EPOXY COATED.
- ALL WELDED WIRE FABRIC SHALL BE ASTM A185, EPOXY COATED.
- THE ARRANGEMENT OF ACCESSORIES SHALL BE IN ACCORDANCE WITH THE ACI MANUAL OF STANDARD PRACTICE FOR DETAILING REINFORCED CONCRETE STRUCTURES. ANY PART OF AN ACCESSORY WHICH WILL BE EXPOSED ON THE CONCRETE SURFACE AFTER REMOVAL OF THE FORMS SHALL BE GALVANIZED OR PLASTIC TIPPED.
- SUPPORT BARS SHALL BE MINIMUM #4 IN SIZE AND SPACED NOT MORE THAN 3'-6" O.C. HIGH CHAIRS SHALL BE PLACED NOT MORE THAN 3'-0" O.C. THERE SHALL BE A MINIMUM OF THREE CHAIRS PER BAR.
- CONTINUOUS BARS SHALL BE LAPPED MIN. 40 BAR DIAMETERS AT ALL SPLICES.
- THE MINIMUM PROTECTIVE COVERING FOR MAIN REINFORCING STEEL SHALL BE AS FOLLOWS:
  - 3" WHERE THE CONCRETE IS PLACED AGAINST THE GROUND
  - 2" WHERE THE CONCRETE IS PLACED AGAINST FORM
  - 1 1/2" FOR STIRRUPS AND TIES
- ALL SLABS ON GRADE, EXCEPT AS SHOWN OR NOTED OTHERWISE, SHALL BE REINFORCED WITH 6x6-W2.1xW2.1 WELDED WIRE FABRIC USING 1'-0" LAPS AT SPLICES. REINFORCING SHALL BE PLACED 1 1/2" CLEAR FROM THE TOP OF THE SLAB.

CONCRETE NOTES CONTINUED:

- SIZE OF THE CONCRETE POUR SHALL NOT EXCEED 2,000 S.F. FOR SLABS ON GRADE AND 90 FEET FOR WALLS, UNLESS CONSTRUCTION JOINTS ARE PROVIDED.
- EACH CONTRACTOR AND SUBCONTRACTOR SHALL PROVIDE SLEEVES IN CONCRETE FORM WORK FOR HIS OWN WORK. NO CORING OF THE CONCRETE WILL BE ALLOWED WITHOUT THE WRITTEN CONSENT OF THE STRUCTURAL ENGINEER.
- NO REINFORCEMENT SHALL BE CUT TO ACCOMMODATE ANY OPENINGS. NO OPENING LARGER THAN ONE SQUARE FOOT IS TO BE PROVIDED UNLESS SHOWN ON THE STRUCTURAL DRAWINGS OR APPROVED BY THE STRUCTURAL ENGINEER.
- PRIOR TO POURING CONCRETE, CONTRACTOR SHALL ARRANGE FOR AN INSPECTION OF REINFORCING STEEL (PLACEMENT) BY THE STRUCTURAL ENGINEER. CONTRACTOR SHALL PROVIDE THE ENGINEER WITH A MINIMUM OF 48 HOUR NOTICE AS TO WHEN STEEL IS OR WILL BE READY FOR INSPECTION. THIS REQUIREMENT DOES NOT APPLY FOR SLABS ON GRADE.
- PRIOR TO THE PLACEMENT OF ANY PIPE SLEEVES, BOX-OUTS OR OTHER SLAB PENETRATIONS, EACH MECHANICAL OR ELECTRICAL TRADE SHALL PREPARE AND SUBMIT SHOP DRAWINGS OF PROPOSED SLEEVE LAYOUT FOR STRUCTURAL ENGINEER'S REVIEW AND APPROVAL. NO CORING OF THE COMPLETED REINFORCED CONCRETE SHALL BE PERMITTED WITHOUT WRITTEN AUTHORIZATION OF THE ENGINEER.
- ALL CONCRETE SURFACES EXPOSED TO WEATHERING SHALL BE SEALED AS SPECIFIED IN SPECIFICATIONS.
- FRESHLY PLACED CONCRETE SHALL BE PROTECTED FROM PREMATURE DRYING AND EXCESSIVELY HOT OR COLD TEMPERATURES, AND SHALL BE MAINTAINED WITH MINIMUM MOISTURE LOSS AT A RELATIVELY CONSTANT TEMPERATURE FOR THE TIME REQUIRED FOR PROPER SETTING AND HARDENING OF CONCRETE, OR FOR AT LEAST 7 DAYS.
- DESIGN SOIL BEARING PRESSURE IS ASSUMED TO BE 3000 PSF. VERIFY ACTUAL BEARING PRESSURE AS RECOMMENDED BY THE GEOTECHNICAL REPORT FOR A SPECIFIC SITE.
- CONCRETE SLAB ON GRADE SHALL HAVE A MINIMUM OF 600 PSF LOADING CAPACITY.
- CONCRETE TESTS:
  - COMPRESSION TESTS: ASTM C31 AND C39. SAMPLE AT POINT OF DEPOSIT. 1 SET OF 6 CYLINDERS MADE FROM A SINGLE CONCRETE SAMPLING FOR EVERY 50 CU. YDS. OR AT LEAST FROM EACH TYPE OF CONCRETE USED EACH DAY. TEST ONE CYLINDER AT 3 DAYS, ONE AT 7 DAYS, ONE AT 14 DAYS AND TWO AT 28 DAYS.
  - SLUMP TESTS: ASTM C143. FIRST TRUCK EACH DAY, EACH SAMPLE FOR CYLINDERS, AND AS OFTEN AS NECESSARY THEREAFTER.

EROSION CONTROL NOTES:

- ALL EROSION AND SEDIMENT CONTROL WORK SHALL CONFORM TO THE ILLINOIS URBAN MANUAL STANDARDS AND PROCEDURES FOR EROSION CONTROL AND WITH ALL COUNTY ORDINANCES PERTAINING TO EROSION CONTROL.
- ALL EROSION AND SEDIMENT CONTROL MEASURES SHALL BE INSTALLED AND OPERATIONAL PRIOR TO ANY GROUND DISTURBANCE.
- SILT FILTER FABRIC SHALL BE PLACED BETWEEN FRAME AND GRATE OF SEWER STRUCTURES UNTIL VEGETATION IS ESTABLISHED.
- ALL DISTURBED AREAS SHALL BE TEMPORARILY STABILIZED WITHIN 7 DAYS OF ACTIVE DISTURBANCE.
- UTILIZE EXCELSIOR BLANKET ON ALL SLOPES OF 4:1 OR GREATER.
- ALL EROSION AND SEDIMENT CONTROL PRACTICES SHALL BE MAINTAINED AND REPAIRED AS NEEDED TO ENSURE EFFECTIVE PERFORMANCE OF THE REQUIRED EROSION CONTROL MEASURES.
- DURING THE CONSTRUCTION OPERATION, WHEN ANY LOOSE MATERIAL IS DEPOSITED IN THE FLOW LINE OF DITCHES, GUTTERS OR DRAINAGE STRUCTURES SO THE NATURAL FLOW OF WATER IS OBSTRUCTED, THE MATERIAL SHALL BE REMOVED AT THE END OF EACH CONSTRUCTION DAY. ALL DRAINAGE STRUCTURES SHALL BE CLEANED AND BE FREE FROM ALL DIRT AND DEBRIS. THIS WORK WILL NOT BE PAID FOR SEPARATELY, BUT SHALL BE CONSIDERED INCIDENTAL TO OTHER ITEMS.
- ALL EROSION CONTROL MEASURES SHALL BE DISPOSED OF WITHIN 30 DAYS OF FINAL STABILIZATION OF THE SITE.
- GROUND COVER FOR 3:1, 4:1, & 5:1 SLOPES SHALL BE ESTABLISHED WITHIN SEVEN DAYS OF FINAL GRADING.
- ALL TOPSOIL SHALL BE STRIPPED AND STOCKPILED PRIOR TO FILLING.
- CONTRACTOR SHALL PLACE STOCKPILED TOPSOIL OR IMPORTED MATERIAL ON ALL DISTURBED AREAS WITH 6" TOPSOIL UNLESS OTHERWISE NOTED ON PLANS, RAKED SMOOTH TO BE READY FOR SEEDING (LANDSCAPING, ETC.).
- SEEDING SHALL BE PER I.D.O.T. MANUAL, SECTION 250 STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION, LATEST REVISION. PROVIDE SALT TOLERANT ROADSIDE/SLOPE MIXTURE. MULCH / HYDROSEED SHALL BE PER I.D.O.T. MANUAL, SECTION 251, STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION, LATEST REVISION DATE. MULCH / HYDROSEED METHOD 2, PROCEDURE 3.
- ALL NEW SEEDED AREA TO BE WATERED BY THE CONTRACTOR UNTIL GRASS IS A MINIMUM OF 5" HIGH OR METRA HAS RELEASED THE WATERING REQUIREMENTS.

CAISSON NOTES:



- CONTRACTOR SHALL SUBMIT TO THE ENGINEER THE RECORDS OF TEST BORINGS FOR REVIEW & EXAMINATION PRIOR TO CONSTRUCTION.
- IF ANY EXISTING SERVICE LINES, UTILITIES AND UTILITY STRUCTURES WHICH ARE TO REMAIN IN SERVICE ARE UNCOVERED OR ENCOUNTERED DURING CONSTRUCTION, THEY SHALL BE SAFEGUARDED, PROTECTED FROM DAMAGE AND SUPPORTED IF NECESSARY.
- THE CONTRACTOR SHALL NOTIFY THE ENGINEER IN THE EVENT ANY EXISTING UTILITIES, UTILITY STRUCTURES OR ANY OBSTRUCTION WHICH INTERFERES WITH THE PROPER INSTALLATION OF THE FOUNDATION WORK.
- THE CONTRACTOR SHALL SUBMIT TO THE ENGINEER FOR APPROVAL, THE CAISSON CONSTRUCTION METHOD (INCLUDING THE SEQUENCE OF OPERATIONS), METHOD OF EXCAVATION, DETAILS OF CASING AND LINER REQUIRED, METHOD OF POURING CONCRETE, ETC.
- ALL TEMPORARY AND PERMANENT CASINGS SHALL EXTEND ABOVE THE GROUND. TEMPORARY LINER MUST EXTEND BELOW SOFT CLAY MATERIAL. FINAL LENGTH OF TEMPORARY LINER TO BE DETERMINED BY THE GEOTECHNICAL ENGINEER.
- NO CAISSON EXCAVATION SHALL BE LEFT UNSUPPORTED OR NOT FILLED FOR MORE THAN EIGHT HOURS.
- ALL CAISSONS SHALL BEAR ON THE MATERIAL CAPABLE OF SAFELY SUPPORTING THE CAISSON LOAD LISTED ON DRAWINGS. SEE TYPICAL CAISSON DETAILS.
- ALL CAISSON CONCRETE SHALL HAVE A COMPRESSIVE STRENGTH OF 4000 P.S.I. AT 28 DAYS.
- ALL REINFORCING BARS SHALL BE A.S.T.M. A615, GRADE 60, EPOXY COATED.
- CONCRETE SHALL BE VIBRATED IN UPPER 10'-0" OF CAISSON SHAFT.
- THE CAISSON CONTRACTOR SHALL REMOVE ALL LAITANCE FROM THE TOP OF THE CAISSON SHAFT A MINIMUM OF 24 HOURS AFTER THE CONCRETE POUR FOR EACH CAISSON. ALL NECESSARY PRECAUTIONS SHALL BE TAKEN SO THAT THERE IS NO DAMAGE TO THE CONCRETE BELOW.
- SUBMIT THE ACTUAL CAISSON LOCATION PLAN PREPARED BY A REGISTERED SURVEYOR IN STATE OF ILLINOIS AND FULL DETAILS OF CORRECTIVE MEASURES FOR CAISSONS EXCEEDING THE TOLERANCE LIMIT OF PLUS OR MINUS 3".
- THE CONTRACTOR SHALL SETUP REFERENCE POINTS FOR OBSERVING OF FOUNDATION SETTLEMENT ON ALL BUILDINGS CLOSER THAN 50 FEET PRIOR TO ANY CAISSON INSTALLATION. THE CONTRACTOR SHALL CLOSELY OBSERVE ANY SETTLEMENT DURING CAISSON INSTALLATION AND SHALL REPORT ALL FINDINGS TO THE ENGINEER.
- PUMPING OF WATER FROM THE CAISSON SHAFT SHALL NOT BE PERMITTED UNLESS APPROVED BY THE GEOTECHNICAL ENGINEER.

STRUCTURAL STEEL NOTES CONTINUED:

- SHOP AND FIELD TESTING OF WELDS SHALL BE AS FOLLOWS:
  - VISUAL INSPECTION SHALL BE MADE ON 100% OF ALL WELDS.
  - MAGNETIC PARTICLE TEST SHALL BE MADE ON 100% OF ALL FILLET WELDS.
  - ULTRASONIC TESTS SHALL BE MADE ON 100% OF ALL FULL PENETRATION WELDS.
  - TWENTY FIVE (25) PERCENT OF BOLTS IN EACH SHEAR CONNECTION BUT NOT LESS THAN TWO (2) BOLTS PER CONNECTION SHALL BE CHECKED BY CALIBRATED TORQUE WRENCH.
- SUBMIT REQUIRED CALCULATIONS AND SHOP DRAWINGS PREPARED AND SEALED BY A STRUCTURAL ENGINEER LICENSED IN THE STATE OF ILLINOIS FOR REVIEW AND APPROVAL BY THE ENGINEER.
- SHOP DRAWINGS SHALL BE PREPARED USING ACTUAL FIELD SURVEY OF CAISSON LOCATIONS. CONTACT METRA FOR ANY DISCREPANCIES BETWEEN FIELD LOCATION OF CAISSONS AND DESIGN DRAWINGS.

STEEL BAR GRATE NOTES

- STEEL SHALL BE ASTM-A569 OR ASTM-A36 FOR BARS IN THICKNESS OF 3/16" OR LESS AND ASTM-A36 FOR ALL OTHERS.
- PANELS SHALL BE HOT DIPPED GALVANIZED AFTER FABRICATION.
- GRATING IS TO SAFELY SUSTAIN A UNIFORMLY DISTRIBUTED LOAD OF 150 PSF ON A 6'-0" SPAN.
- ATTACHMENT TO SUPPORTING STEEL SHALL BE WITH STAINLESS STEEL SADDLE CLIPS AND #12 SELF-TAPPING SCREWS AT 1'-6" CENTER TO CENTER (MAXIMUM).
- UNLESS NOTED OTHERWISE, STEEL BAR GRATE SHALL BE 1 1/4"x 3/16" BARS SPACED AT 1 3/16" O.C. WITH WELDED LOCK BARS AT 4" O.C. (McNICHOLS "GW-125" OR EQUAL)

STANDARD ABBREVIATIONS

B.C.	- BACK OF CURB
C.B.	- STORM CATCH BASIN
O.C., C-C OR C/C	- CENTER TO CENTER
CONC.	- CONCRETE
CONT.	- CONTINUOUS
DIA.	- DIAMETER
DET.	- DETAIL
ELEC.	- ELECTRIC
ELEV.	- ELEVATION
EXIST.	- EXISTING
EXT.	- EXTERIOR
FT	- FOOT/FEET
GALV.	- GALVANIZED
IDOT	- ILLINOIS DEPARTMENT OF TRANSPORTATION
LT	- LEFT
MAX.	- MAXIMUM
M.E.	- MATCH EXISTING
M.H.	- MANHOLE
MIN.	- MINIMUM
NO. OR #	- NUMBER
N.T.S.	- NOT TO SCALE
P.C.C.	- PORTLAND CEMENT CONCRETE
REINF.	- REINFORCED
R.O.W.	- RIGHT OF WAY
R.R.	- RAILROAD
RT	- RIGHT
SIM.	- SIMILAR
S.S.	- STAINLESS STEEL
STA.	- STATION
STD.	- STANDARD
STL.	- STEEL
T&B	- TOP AND BOTTOM
T.C.	- TOP OF CURB
TH.	- THICK
TYP.	- TYPICAL
V.I.F.	- VERIFY IN FIELD
W/	- WITH

STRUCTURAL STEEL NOTES:

- ALL STRUCTURAL STEEL SHALL BE DETAILED, FABRICATED AND ERECTED IN ACCORDANCE WITH THE LATEST A.I.S.C. SPECIFICATIONS AND AREMA, CHAPTER 15.
- ELEVATIONS SHOWN FOR STRUCTURAL STEEL ARE TO THE TOP OF STEEL MEMBERS. (U.N.O.)
- STRUCTURAL STEEL WIDE FLANGE SHAPES SHALL BE ASTM A992 (Fy=50 KSI). STRUCTURAL TUBES SHALL BE ASTM A500, GRADE B (Fy=46 KSI). STRUCTURAL PIPES SHALL BE ASTM A53, GRADE B, TYPE S (Fy=35 KSI). ALL OTHER STRUCTURAL STEEL SHALL BE ASTM A36 (Fy=36 KSI).
- ALL STEEL SHALL BE HOT DIPPED GALVANIZED AFTER FABRICATION.
- ALL BOLTS SHALL BE ASTM A325. ALL BOLTS SHALL BE 3/4" DIA. UNLESS NOTED OTHERWISE.
- WELDING SHALL BE DONE BY MANUAL SHIELDED METAL ARC PROCESS USING A.W.S. A5.1 OR A5.5, E70XX ELECTRODES OR BY SUBMERGED ARC WELDING USING A.W.S. A5.17, F7X3XXX, FLUX ELECTRODE COMBINATION.
- WELDS NOT OTHERWISE SPECIFIED SHALL BE CONTINUOUS 1/4" FILLET WELDS BUT NOT LESS THAN MINIMUM SIZE REQUIRED BY A.I.S.C. SPECIFICATIONS.
- NO CONNECTION SHALL CONSIST OF LESS THAN 2-3/4" DIA. BOLTS OR WELD DEVELOPING LESS THAN 10 KIPS.
- CUTS, HOLES, OPENINGS, ETC., REQUIRED IN STRUCTURAL STEEL MEMBERS FOR THE WORK OF OTHER TRADE SHALL BE SHOWN ON SHOP DRAWINGS FOR STRUCTURAL STEEL AND SHALL BE MADE IN THE SHOP. BURNING OF HOLES, OR CUTS IN STRUCTURAL STEEL MEMBERS IN THE FIELD WILL NOT BE PERMITTED EXCEPT BY THE WRITTEN PERMISSION FROM THE STRUCTURAL ENGINEER.

PRINTED ON: 06/05/2018

2	06-08-2018	OT	EG	ISSUED FOR BID						
1	04-03-2018	OT	EG	ADDENDUM 1						
0	01-18-2018	OT	EG	ISSUED FOR BID						
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CONSULTANT SEAL & SIGNATURE



CONSULTANT

**KMI**  
Kaltsouni Mehdi, Inc.  
ARCHITECTS ■ ENGINEERS  
223 W. Jackson Blvd., Suite 1010 Chicago, IL 60606  
Tel.: (312)987-9800 Fax.: (312)987-9892

DESIGNED: EG  
DRAWN: DC  
CHECKED: MK  
METRA P.M.: R. CERANT  
DATE: JUNE 12, 2017



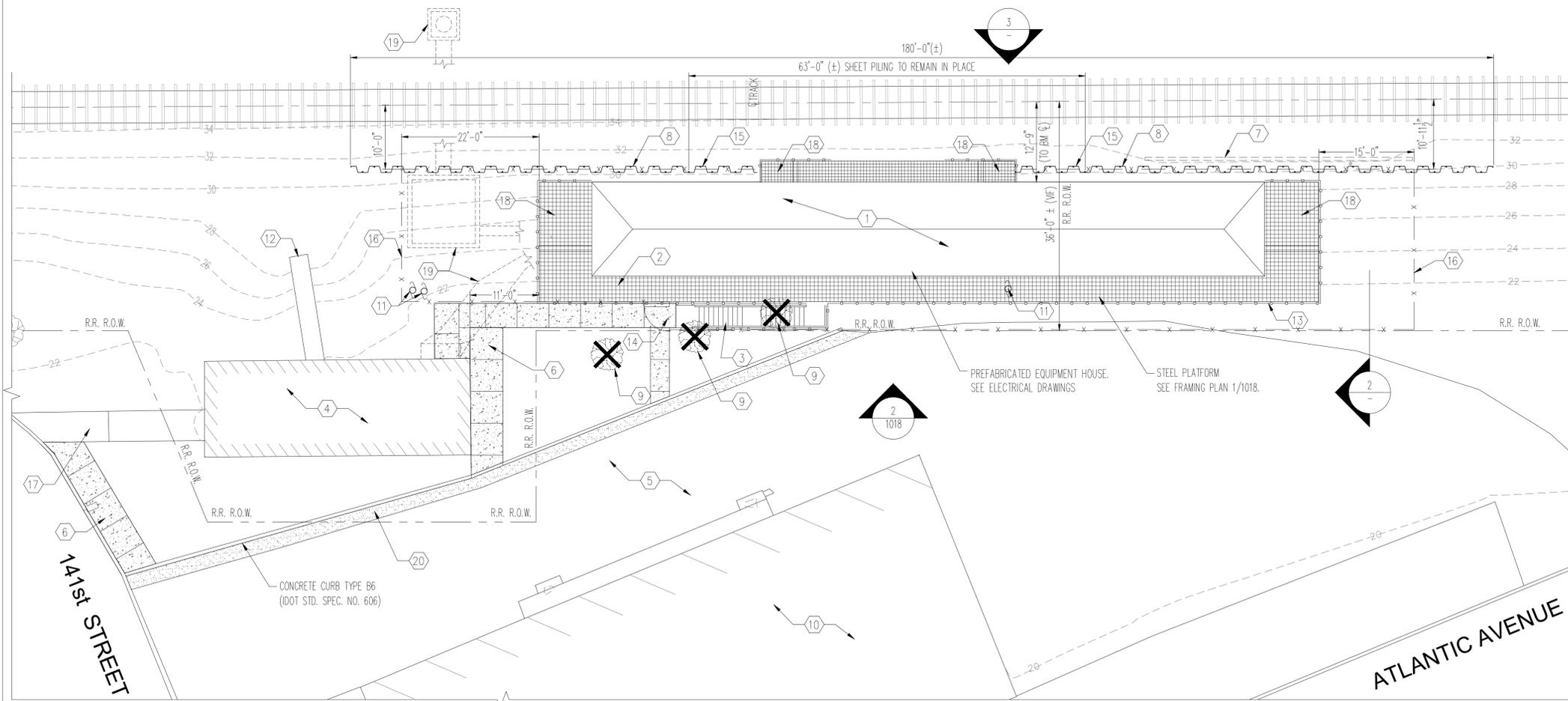
LOCATION NAME: RIVERDALE SUBSTATION

TITLE:

GENERAL NOTES

CAD FILE NUMBER: SS-17.5-1001G.DGN

SCALE: AS SHOWN	DISTRICT: MED
PROJECT NO.	SHEET NO.
GW4254-57102002	SS-17.5-1001G
MILE POST NO. 11.9	



- KEY NOTES**
- ① REMOVE TREES, SHRUBS AND TOPSOIL WITHIN THE REMOVAL AREA.
  - ② PLATFORM GRATING
  - ③ STAIR AND LANDING
  - ④ EXISTING TIE-STATION BUILDING TO REMAIN
  - ⑤ EXISTING ACCESS DRIVE TO REMAIN
  - ⑥ 5" TH. PCC SIDEWALK
  - ⑦ EXISTING RAILROAD TIE RETAINING WALL TO BE REMOVED
  - ⑧ TEMPORARY SHEET PILING TO BE REMOVED AFTER CONSTRUCTION
  - ⑨ REMOVE EXISTING TREE AND STUMP
  - ⑩ EXISTING APARTMENT BUILDING N.I.C.
  - ⑪ REMOVE EXISTING UTILITY POLES AND OVERHEAD WIRES
  - ⑫ EXISTING CONCRETE ENCASED CONDUIT TO REMAIN
  - ⑬ GUARD RAILING-3 SIDES
  - ⑭ 4'-0" Wx8'-0" H CHAIN LINK GATE W/ PADLOCK
  - ⑮ SHEET PILING TO REMAIN AFTER CONSTRUCTION
  - ⑯ 8'-0" H CHAIN LINK FENCE
  - ⑰ EXISTING CONCRETE WALKWAY TO REMAIN
  - ⑱ DOOR LANDING
  - ⑲ ELECTRICAL MANHOLE AND DUCTBANK. SEE SHEETS 1070, 1071.
  - ⑳ SAW CUT, REMOVE PORTION OF EXISTING PAVEMENT. INSTALL PAVEMENT PATCH PER IDOT STD. SPEC. SECT. 440 AND 442.

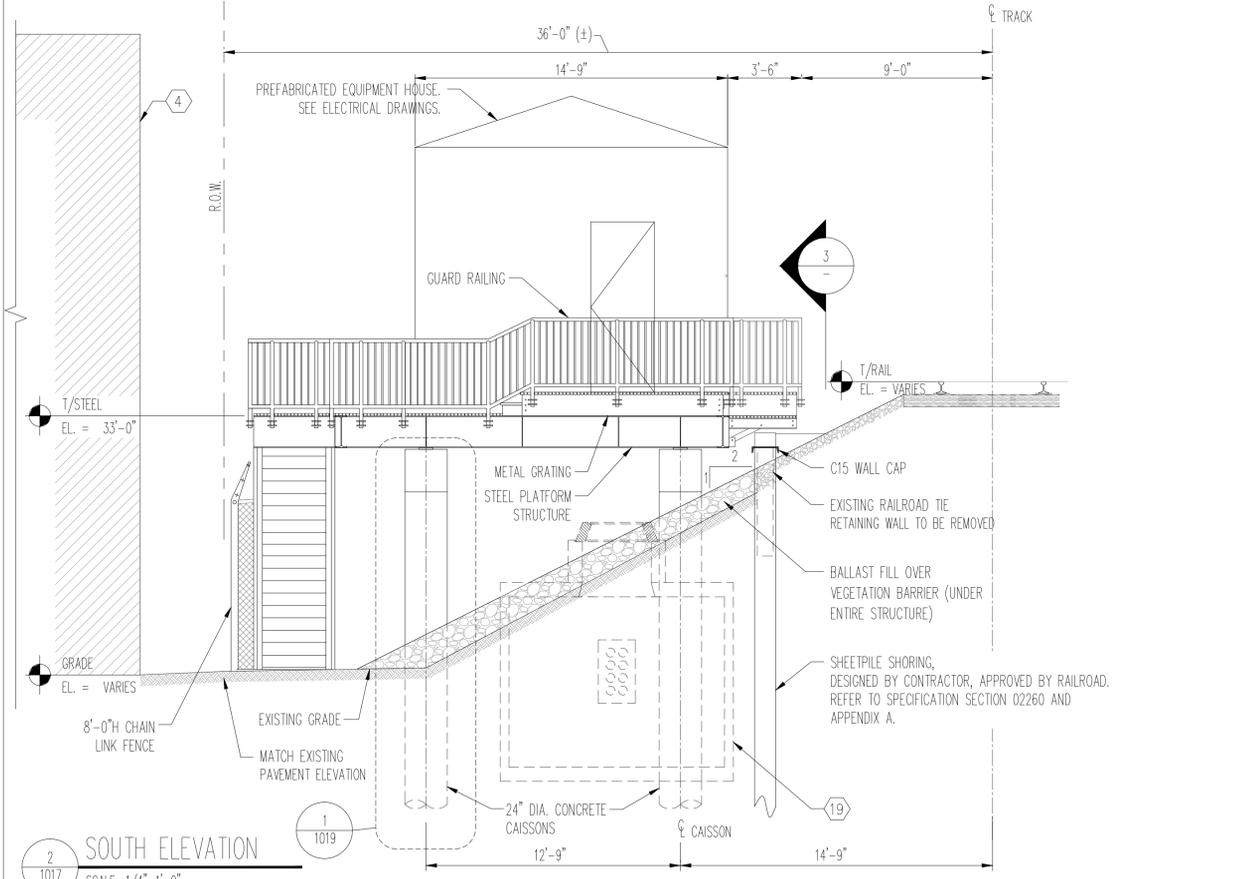
- SYMBOLS**
- PROPERTY LINE
  - - - SILT FENCE
  - x - x - 8'-0" H CHAIN LINK FENCE
  - - - CONTINUOUS RAILING
  - ⊗ EXISTING TREE TO REMAIN
  - ⊗ EXISTING TREE TO BE REMOVED
  - ▨ 2.0' WIDE ASPHALT PAVEMENT PATCH

- DEMOLITION/REMOVAL NOTES:**
1. REMOVE EXISTING VEGETATION, TREES, STUMPS AND TOPSOIL WITHIN THE AREA SHOWN ON PLAN. REGRADE AFTER CAISSON INSTALLATION. INSTALL VEGETATION BARRIER FABRIC AND 6" TH. CA-7 ON TOP OF FABRIC.
  2. EXACT EXTENT OF REMOVAL MAY NOT BE FULLY INDICATED BY THE DRAWINGS. THE CONTRACTOR SHALL CONFIRM WITH METRA AND DETERMINE THE NATURE AND EXTENT OF REMOVAL THAT WILL BE REQUIRED BY COMPARING THE DRAWINGS WITH THE EXISTING FIELD CONDITIONS. IT IS EXPRESSLY UNDERSTOOD THAT THIS CONTRACT INCLUDES ALL WORK OF A REMOVAL NATURE THAT MAY BE REQUIRED OR NECESSARY FOR A FULL AND COMPLETE EXECUTION OF THE WORK, WHETHER PARTICULARLY REFERRED TO HEREIN OR NOT.

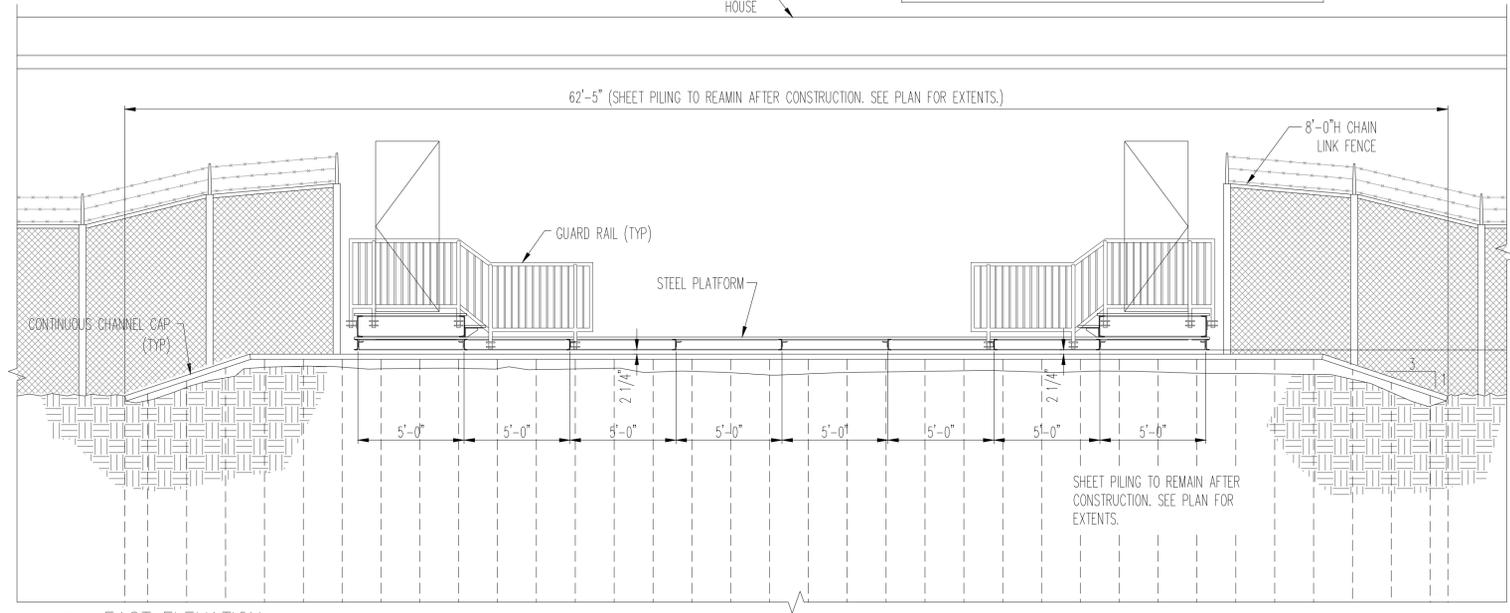
**CHAIN LINK FENCE:**

CHAIN LINK FENCE AND GATES SHALL BE DESIGNED AND INSTALLED AS SPECIFIED IN SPECIFICATION SECTION 02443. REFER TO SHEET SS-17.5-1020B AND SS-17.5-1020C FOR TYPICAL FENCE AND SWING GATE DETAILS.

**1 SITE PLAN**  
SCALE: 1"=10'-0"



**2 SOUTH ELEVATION**  
SCALE: 1/4"=1'-0"



**3 EAST ELEVATION**  
SCALE: 1/4"=1'-0"

PRINTED ON: 07/28/2017

REV	DATE	BY	APP	DESCRIPTION
0	07-28-2017	OT	EG	ISSUED FOR BID

CONSULTANT SEAL & SIGNATURE

CONSULTANT

**KMI**  
Kaltsouni Mehdi, Inc.  
ARCHITECTS ■ ENGINEERS

223 W. Jackson Blvd., Suite 1010 Chicago, IL 60606  
Tel.: (312)987-9800 Fax.: (312)987-9892

DESIGNED: EG  
DRAWN: DC  
CHECKED: MK  
METRA P.M.: R. CERANT  
DATE: JUNE 12, 2017

**Metra**  
ENGINEERING DEPARTMENT  
547 W. JACKSON BOULEVARD  
CHICAGO, ILLINOIS 60661

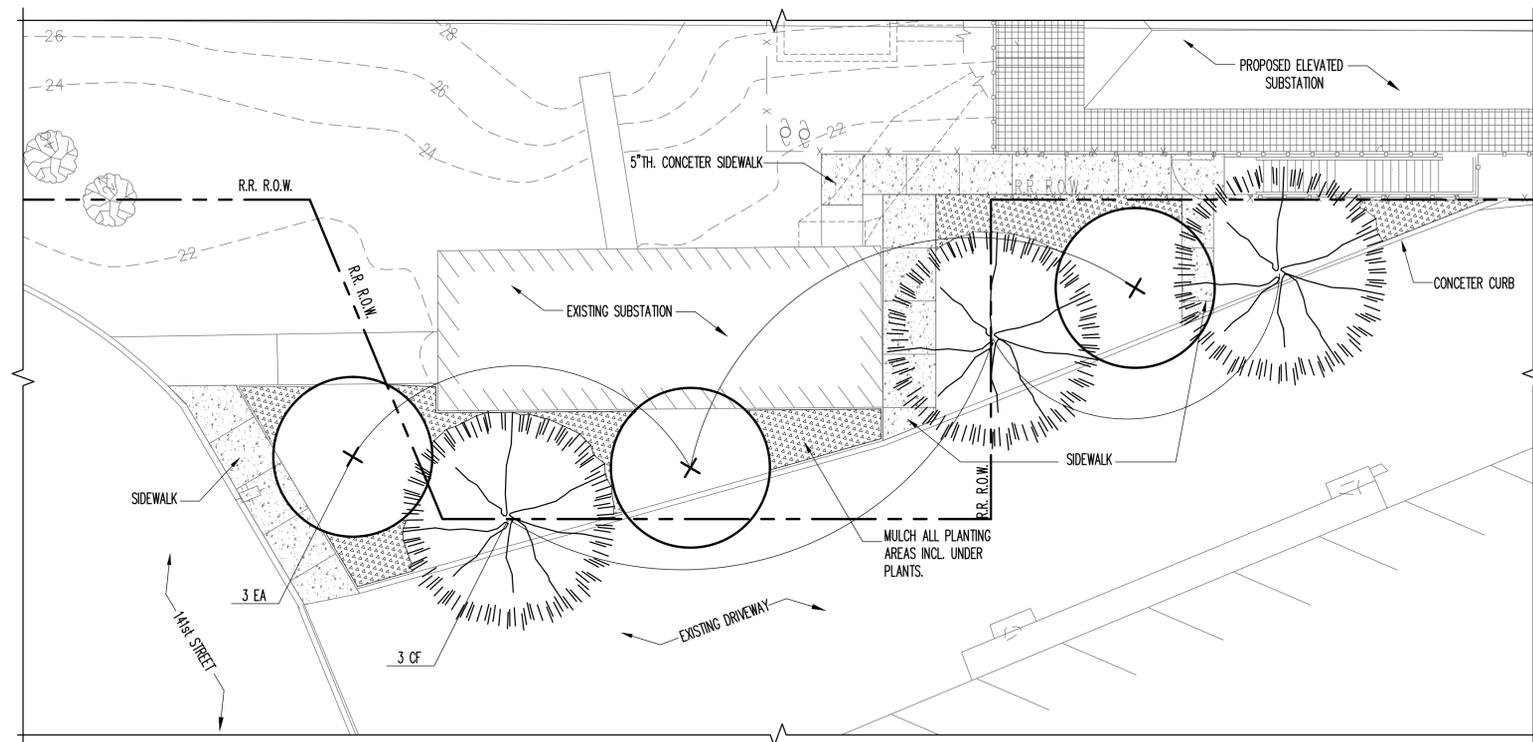
LOCATION NAME: **RIVERDALE SUBSTATION**

TITLE: **SITE PLAN, SECTION AND NOTES**

CAD FILE NUMBER: SS-17.5-1017.DGN

SCALE: AS SHOWN  
PROJECT NO. GW4254-57102002  
MILE POST NO. 17.5

DISTRICT: MED  
SHEET NO. **SS-17.5-1017**

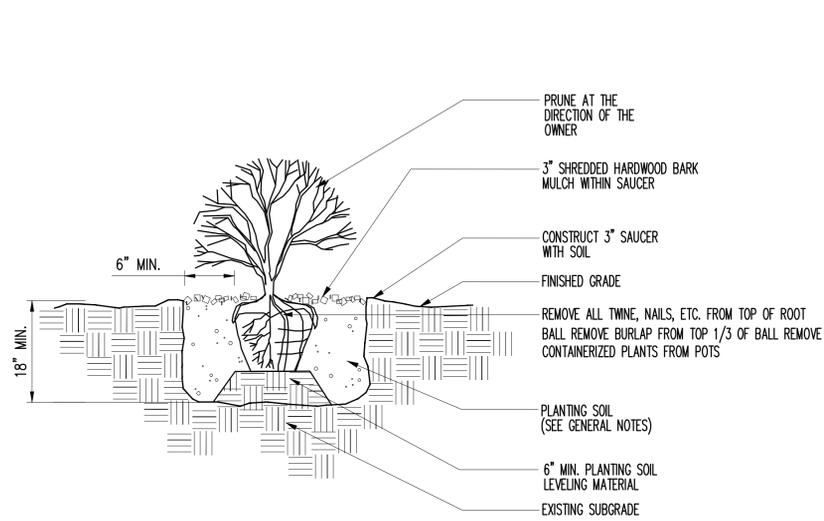


1 PARTIAL LANDSCAPING PLAN  
1017A SCALE: 1/8"=1'-0"

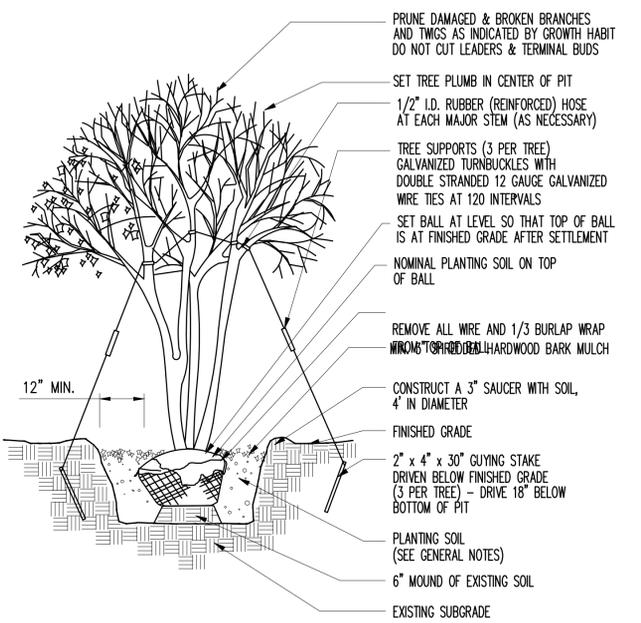
LANDSCAPING SCHEDULE						
SYMBOL	QUANTITY	BOTANICAL NAME	COMMON NAME	SIZE	SPACING	NOTES/SPECIAL CONDITIONS
UNDERSTORY TREES CF	3	CORNUS FLORIDA	FLOWERING DOGWOOD	6'-9" HT.	SEE PLAN	B&B/MULTI-STEM
DECIDUOUS SHRUBS EA	3	EVONYMUS ALATUS	WINGED EVONYMUS	4'-8" HT.	SEE PLAN	B&B OR C.G.

GENERAL NOTES

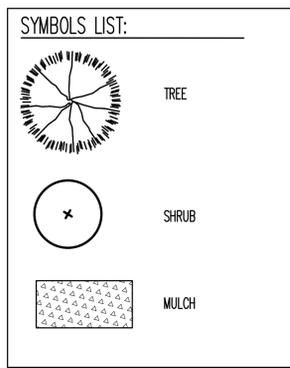
- GENERAL NOTES SHALL APPLY TO ALL NEW LANDSCAPE WORK IN THIS CONTRACT.
- PRIOR TO COMMENCEMENT OF ANY CONSTRUCTION ACTIVITIES, CONTRACTOR SHALL NOTIFY THE LOCAL UTILITY ALERT NETWORK FOR EACH MUNICIPALITY IN WHICH SITE WORK OCCURS, TO DETERMINE THE LOCATION OF ANY UNDERGROUND UTILITIES, WHICH MAY AFFECT PROPOSED SITE WORK. CONTRACTOR SHALL NOTIFY THE OWNER IMMEDIATELY OF ANY DISCREPANCIES, OBSTACLES AND/OR PROBLEMS.
- VERIFICATION OF DIMENSIONS AND GRADES, BOTH EXISTING AND PROPOSED, SHALL BE THE CONTRACTOR'S RESPONSIBILITY PRIOR TO COMMENCEMENT OF WORK. THE CONTRACTOR SHALL NOTIFY THE OWNER OF ANY DISCREPANCIES.
- ALL SURFACE DRAINAGE SHALL BE DIRECTED AWAY FROM STRUCTURES. SURFACE DRAINAGE SHALL BE DIRECTED TO EXISTING CATCH BASINS DESIGNATED FOR THE COLLECTION OF SURFACE RUN-OFF.
- CONTRACTOR SHALL REPAIR IN KIND ANY AREAS DAMAGED AS A RESULT OF LANDSCAPE OPERATIONS.
- ALL TREE, SHRUB PERENNIAL AND ORNAMENTAL GRASS BEDS TO RECEIVE A MINIMUM 2" OF SHREDDED HARDWOOD MULCH.
- ALL PERENNIAL, ORNAMENTAL GRASSES AND GROUND COVER BEDS TO RECEIVE A MINIMUM 2" MUSHROOM COMPOST.
- PLANT MATERIAL SIZES SHOWN ON PLANT SCHEDULE ARE MINIMUM ACCEPTABLE SIZES.
- PLANTING SOIL SHALL BE USED FOR THE PLANTING MEDIUM FOR THE PROJECT AND SHALL COMPLY WITH SPECIFICATIONS.
- THE CONTRACTOR SHALL PREPARE PLANTING BEDS BY ADDING SOIL AMENDMENTS UNLESS NOTED OTHERWISE PER PLANTING DETAILS ON SHT. L4. PLANTING SOIL SHALL BE 12" MIN. THICK IN ALL LANDSCAPING AREAS EXCEPT SEED AND SOD AREAS WHICH SHALL RECEIVE 6" THICK PLANTING SOIL. TREES AND SHRUBS SHALL RECEIVE 18" MIN. THICK PLANTING SOIL.
- ALL PLANTS TO BE BALLED AND BURLAPPED OR CONTAINER GROWN AS SPECIFIED IN PLANT SCHEDULE. ALL PLASTIC ROOT WRAPPING MATERIAL AND METAL WIRE BASKETS SHALL BE REMOVED.
- CONTRACTOR SHALL WATER ALL PLANTS IMMEDIATELY AFTER PLANTING. FLOOD PLANTS TWICE DURING FIRST TWENTY-FOUR HOURS AFTER PLANTING.
- ALL NEW TRANSPLANTED SHRUBS TO BE SPRAYED WITH AN ANTIDESSICANT WITHIN TWENTY-FOUR HOURS AFTER PLANTING. ANTI-TRANSPIRANT SHALL BE EQUAL TO "WILTRUF".
- ALL ROAD AND WALK SURFACES SHALL BE KEPT CLEAR OF MUD AND DEBRIS AT ALL TIMES.
- ALL AREAS THAT HAVE BEEN DISRUPTED DURING THE CONSTRUCTION PROCESS, AND HAVE NOT BEEN DESIGNATED WITH NEW LANDSCAPE PLANTINGS, SHALL BE RESTORED WITH IDOT CLASS 2 SEEDING AND EROSION CONTROL BLANKET.
- THE FOLLOWING GUIDELINES SHALL BE FOLLOWED WHEN PLACING TREES. NO TREE SHALL BE PLANTED CLOSER THAN:
  - 5 FEET FROM DRIVEWAYS, HYDRANTS, B-BOXES & UNDERGROUND UTILITY SERVICES
  - 15 FEET FROM STREET LIGHTS
  - 100 FEET FROM ANY TRAFFIC CONTROL DEVICE (TRAFFIC LIGHT)
 ADJUST TREE LOCATIONS AS REQUIRED.
- TREES SELECTED FOR PLANTING SHALL BE LOCALLY GROWN WITHIN A 100 MILE RADIUS OF THE PROJECT LOCATION. SPECIES AND VARIETY SHALL BE VERIFIED AGAINST THE CITY PLANTING LIST AND SHALL BE TAGGED WITH THE SCIENTIFIC AND COMMON NAMES. THE CONTRACTOR INSTALLING THE TREES SHALL SUPPLY THE CITY WITH A LETTER STATING WHERE THE TREES WERE GROWN. THEY SHALL BE HEALTHY, FREE OF INSECTS AND DISEASE AND SHALL BE CONFORM TO THE AMERICAN ASSOCIATION OF NURSERYMAN'S STANDARD FOR NURSERY STOCK ANSI Z 60.1 - 2004 STANDARD.



2 SHRUB PLANTING DETAIL  
1017A SCALE: N.T.S.



3 TREE PLANTING DETAIL  
1017A SCALE: N.T.S.



PRINTED ON: 01/17/2018

REV	DATE	BY	APP	DESCRIPTION	REV	DATE	BY	APP	DESCRIPTION
0	01-18-2018	OT	EG	ISSUED FOR BID					

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ARCHITECTS ■ ENGINEERS

223 W. Jackson Blvd., Suite 1010 Chicago, IL 60606  
Tel.: (312)987-9800 Fax.: (312)987-9892

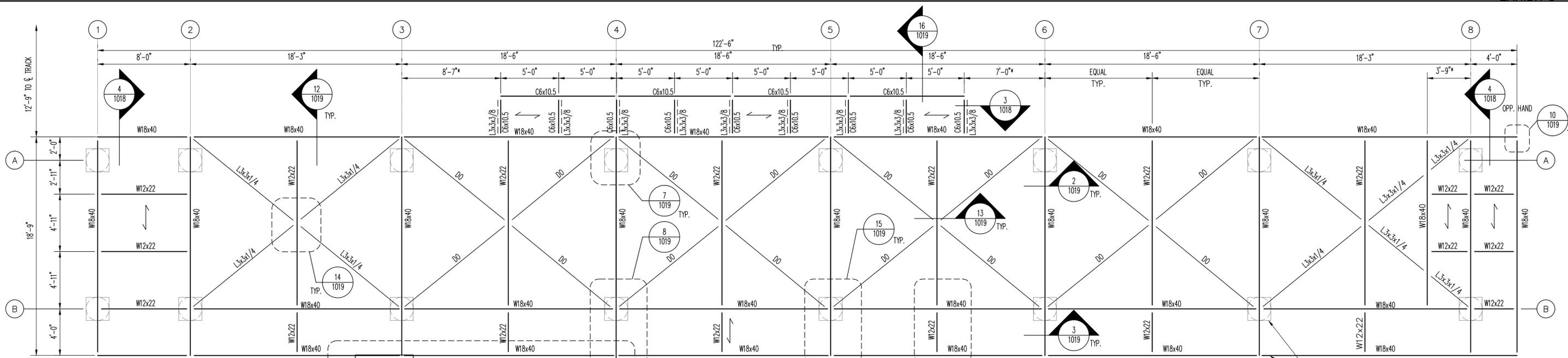
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DRAWN: DC
CHECKED: MK
METRA P.M.: R. CERANT
DATE: JUNE 12, 2017

**Metra**

ENGINEERING DEPARTMENT  
547 W. JACKSON BOULEVARD  
CHICAGO, ILLINOIS 60661

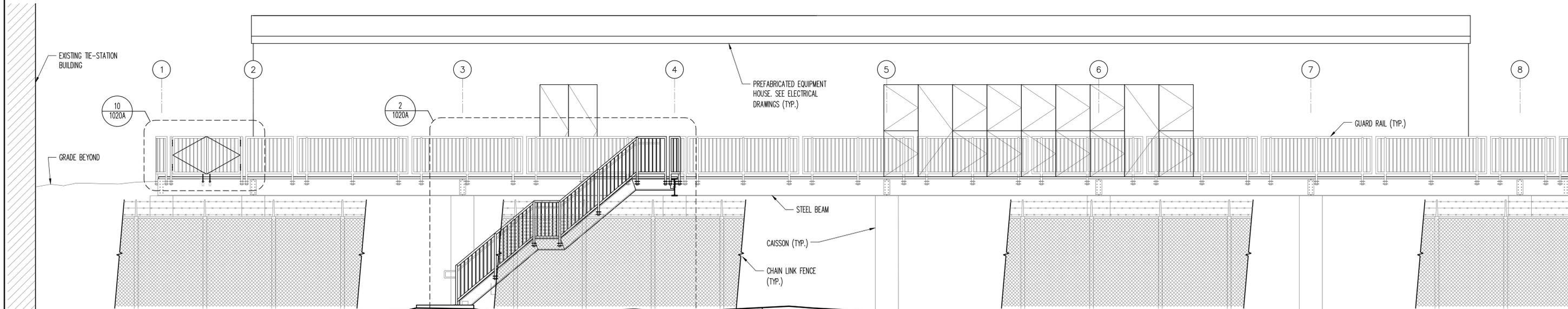
LOCATION NAME: RIVERDALE SUBSTATION
TITLE: LANDSCAPING PLAN, DETAILS, SCHEDULES AND NOTES

CAD FILE NUMBER: SS-17.5-1017A.DGN	
SCALE: AS SHOWN	DISTRICT: MED
PROJECT NO. GW4254-57102002	SHEET NO. SS-17.5-1017A
MILE POST NO. 17.5	

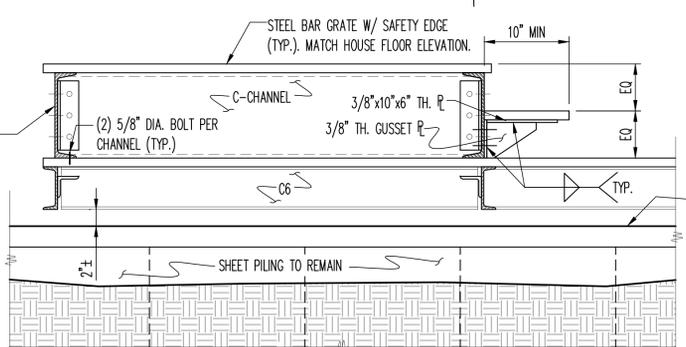


**NOTES:**  
 → DENOTES SPAN OF GRATING  
 \*\* COORDINATE W/ HOUSE MANUFACTURER  
**1 1017** PLATFORM FRAMING PLAN  
 SCALE: 1/4"=1'-0"  
 10' 0 10' 20'

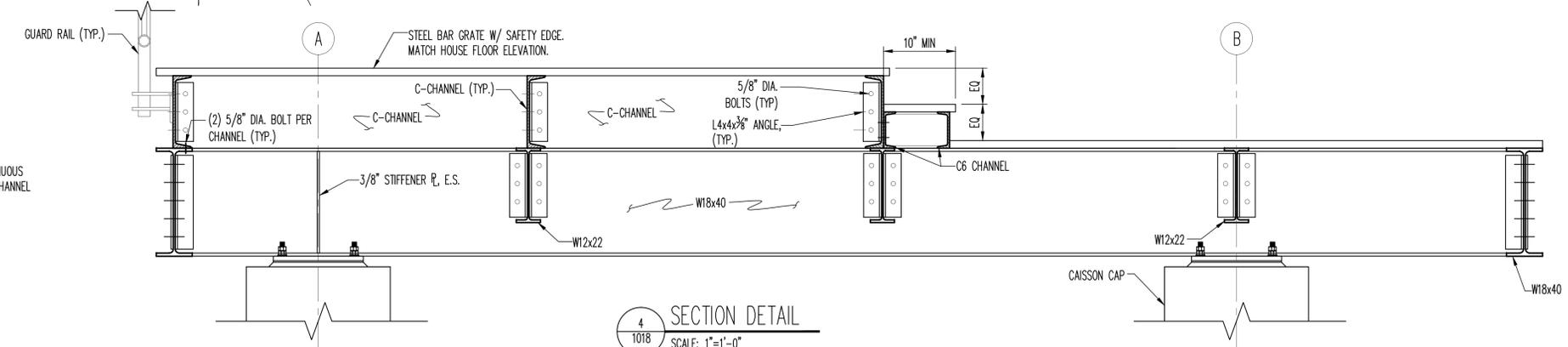
T/CONC. CAP EL. = 31'-4" (TYP)  
 T/STEEL BEAM EL. = 33'-0" (TYP)



**2 1017** WEST ELEVATION  
 SCALE: 1/4"=1'-0"



**3 1018** SECTION AT TRACKSIDER PLATFORM  
 SCALE: 1"=1'-0"



**4 1018** SECTION DETAIL  
 SCALE: 1"=1'-0"

PRINTED ON: 07/28/2017

REV	DATE	BY	APP	DESCRIPTION
0	07-28-2017	OT	EG	ISSUED FOR BID

REV	DATE	BY	APP	DESCRIPTION

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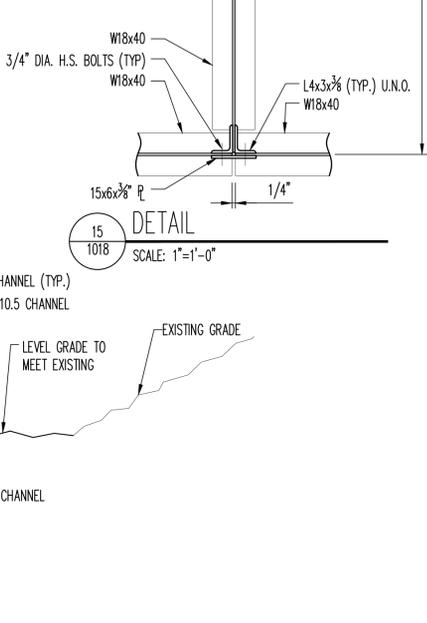
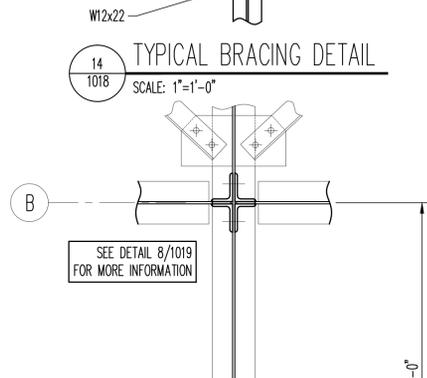
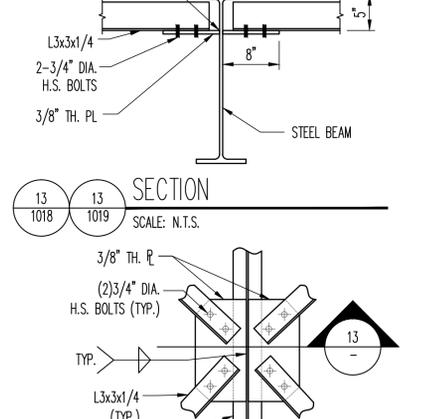
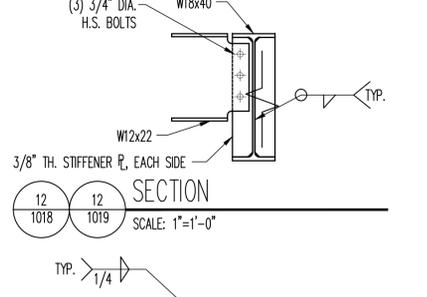
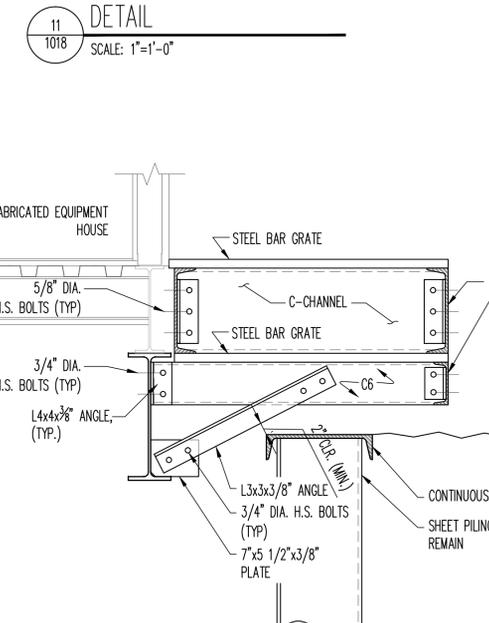
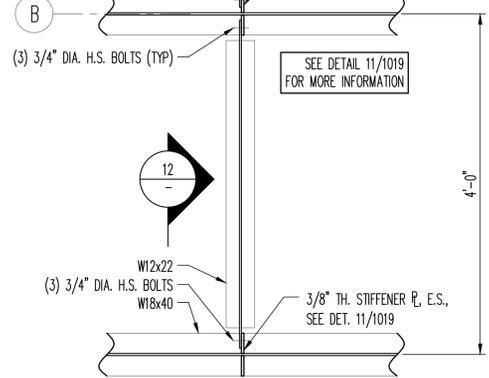
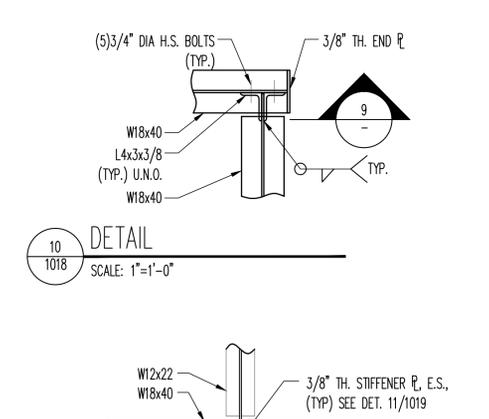
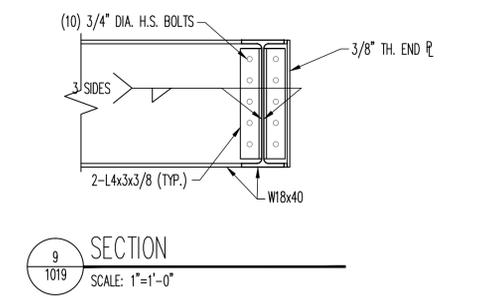
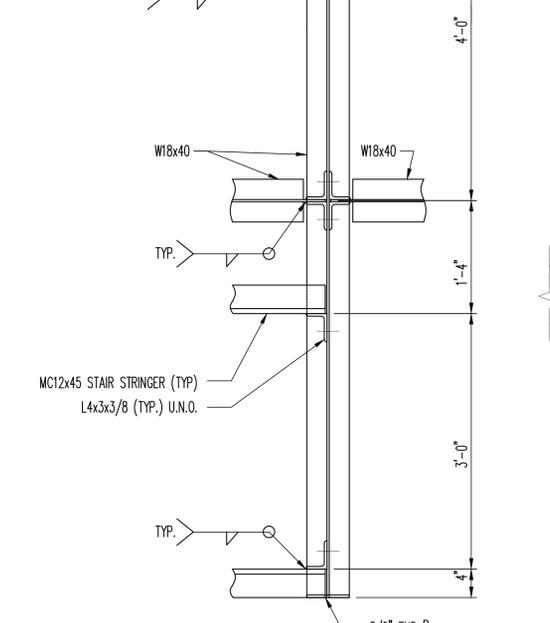
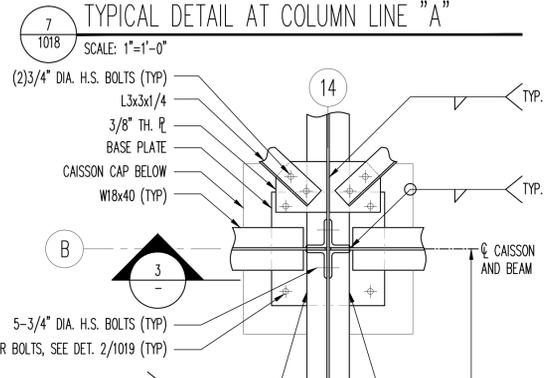
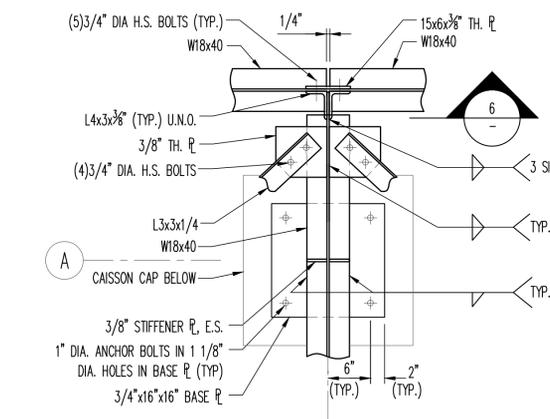
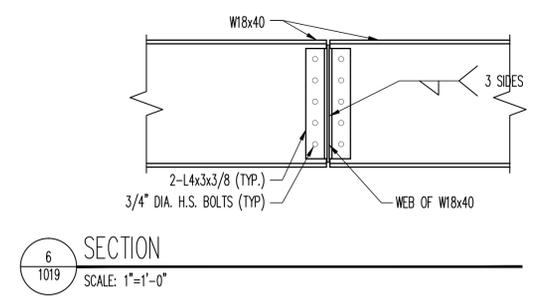
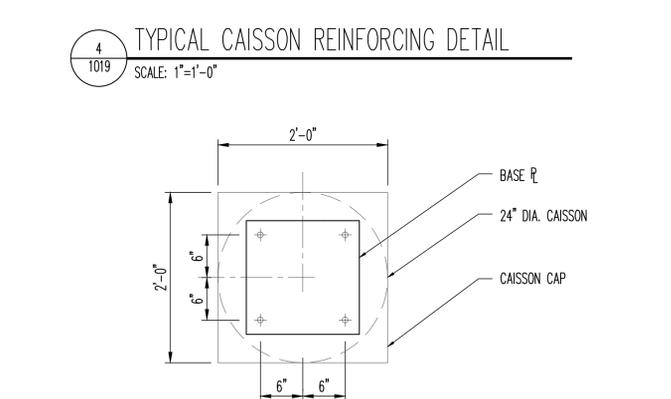
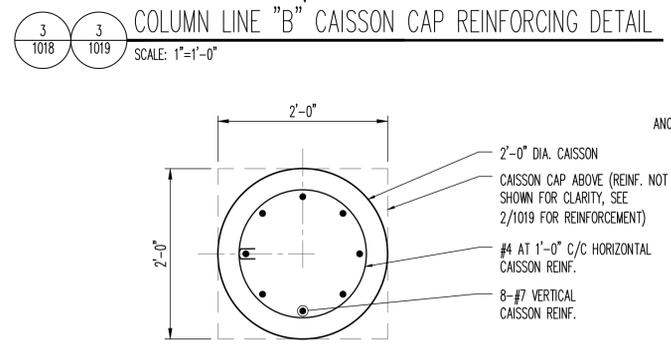
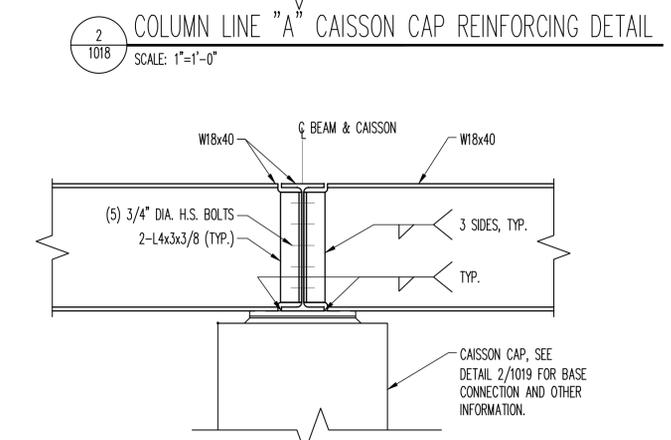
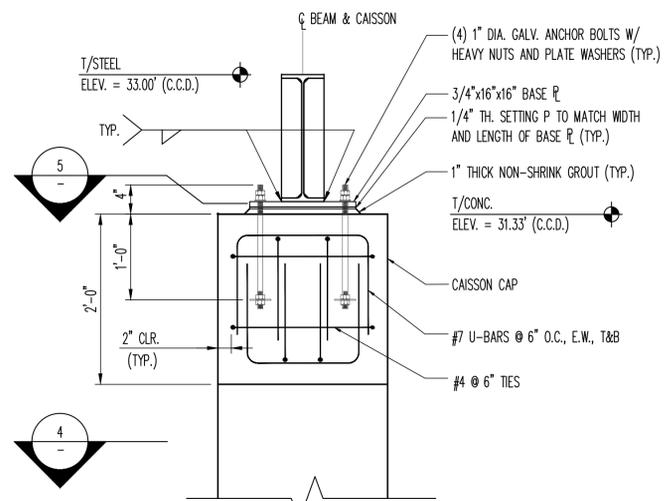
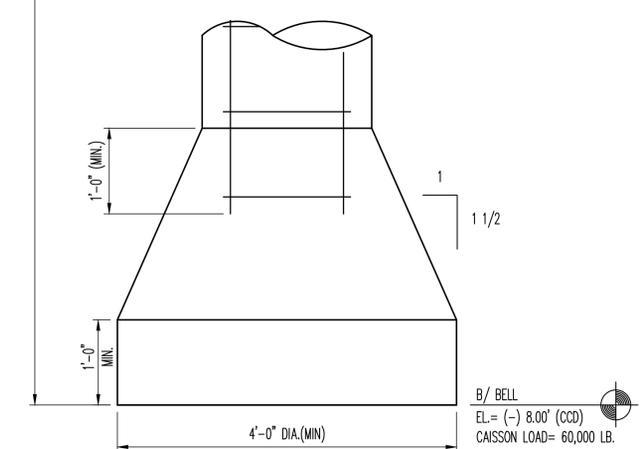
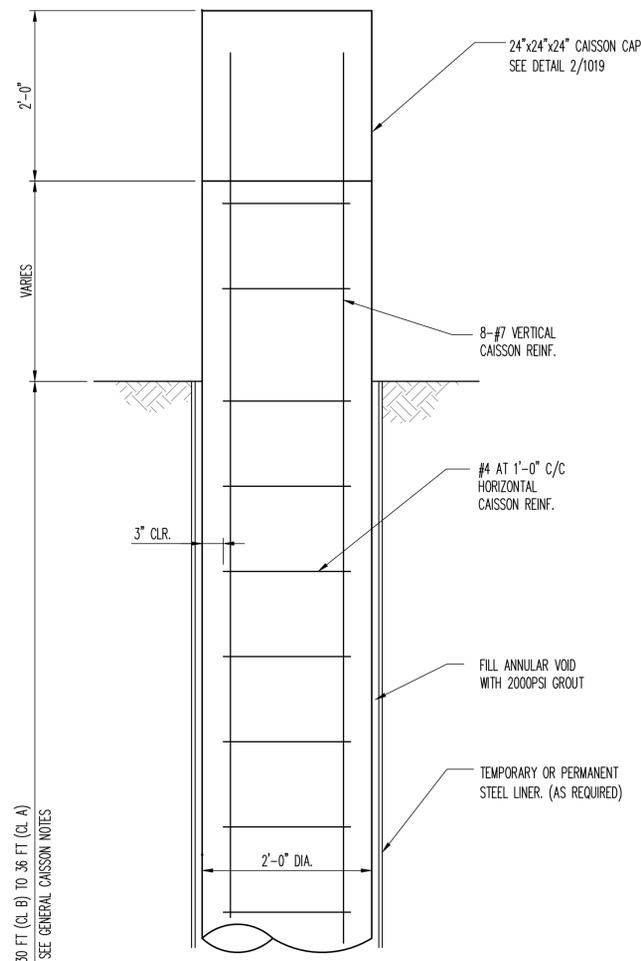
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**KMI**  
 Kaltsouni Mehdi, Inc.  
 ARCHITECTS ■ ENGINEERS  
 223 W. Jackson Blvd., Suite 1010 Chicago, IL 60606  
 Tel.: (312)987-9800 Fax: (312)987-9892

DESIGNED: EG  
 DRAWN: DC  
 CHECKED: MK  
 METRA P.M.: R. CERANT  
 DATE: JUNE 12, 2017

**Metra**  
 ENGINEERING DEPARTMENT  
 547 W. JACKSON BOULEVARD  
 CHICAGO, ILLINOIS 60661

LOCATION NAME: **RIVERDALE SUBSTATION**  
 TITLE: **FRAMING PLAN**

CAD FILE NUMBER: SS-17.5-1018.DGN  
 SCALE: AS SHOWN  
 PROJECT NO. GW4254-57102002  
 MILE POST NO. 17.5  
 DISTRICT: MED  
 SHEET NO. **SS-17.5-1018**



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MARIA KALTSOUNI  
081-005244

CONSULTANT

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223 W. Jackson Blvd., Suite 1010 Chicago, IL 60606  
Tel.: (312)987-9800 Fax.: (312)987-9892

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DATE: JUNE 12, 2017

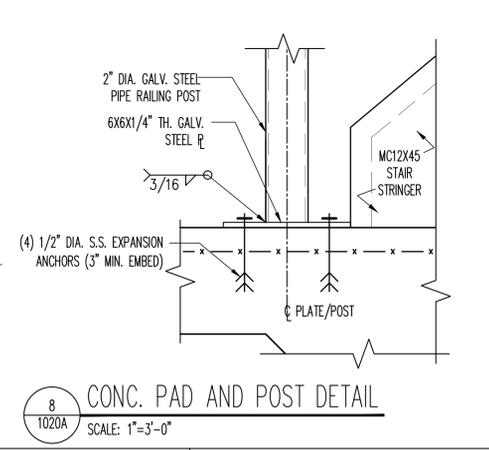
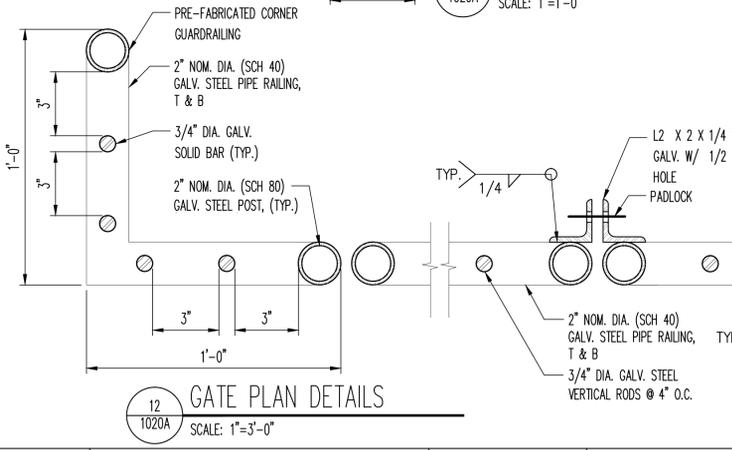
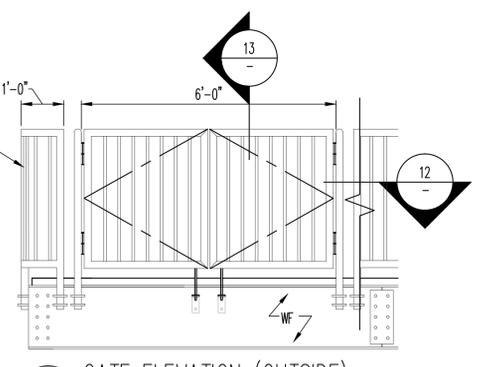
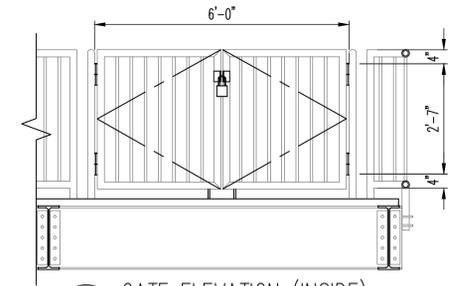
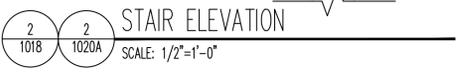
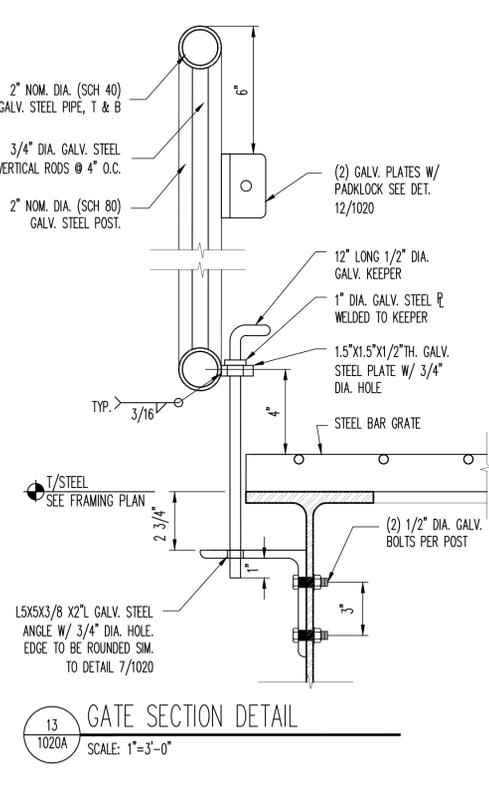
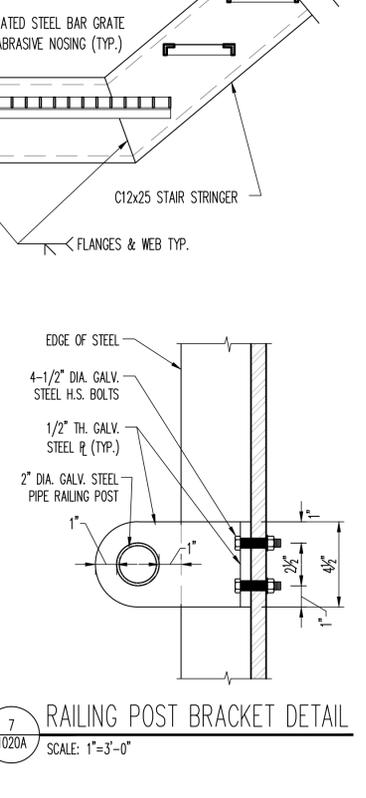
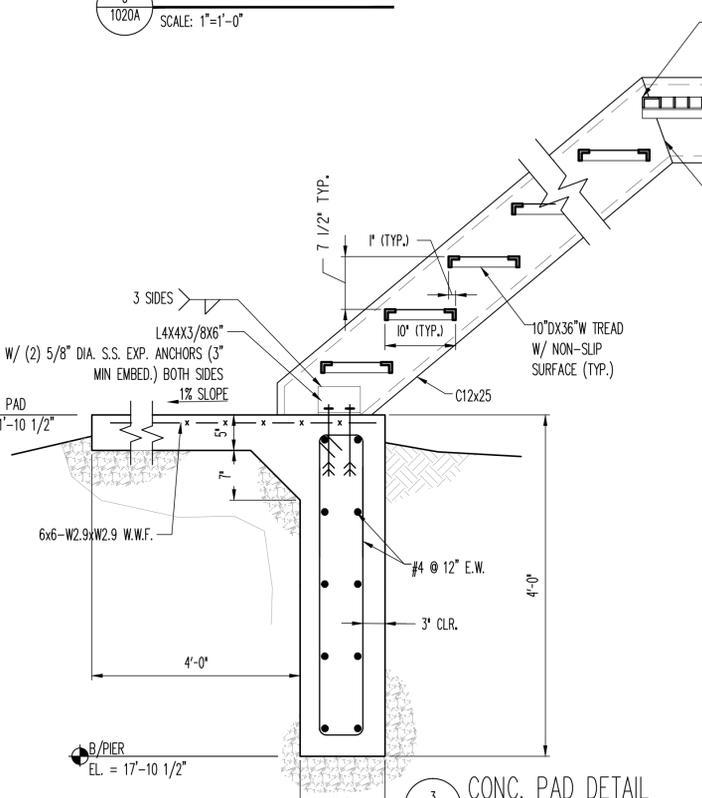
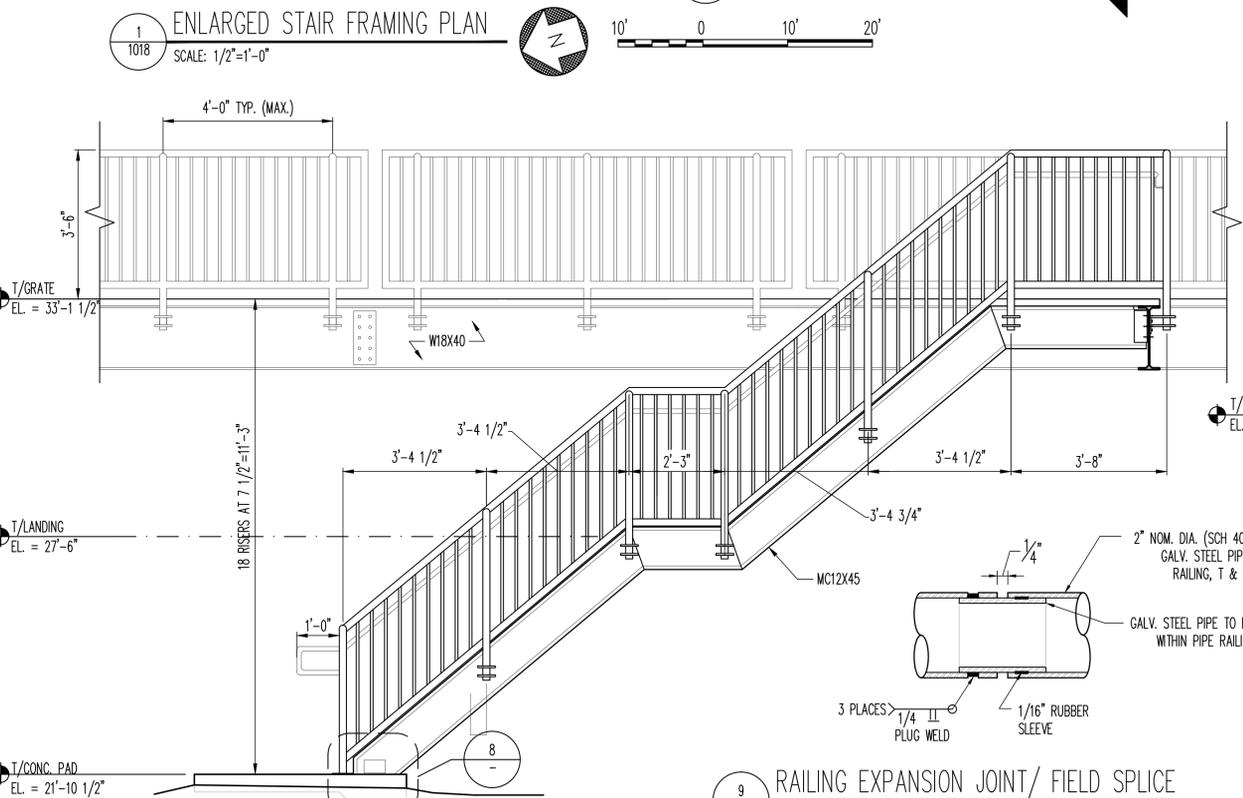
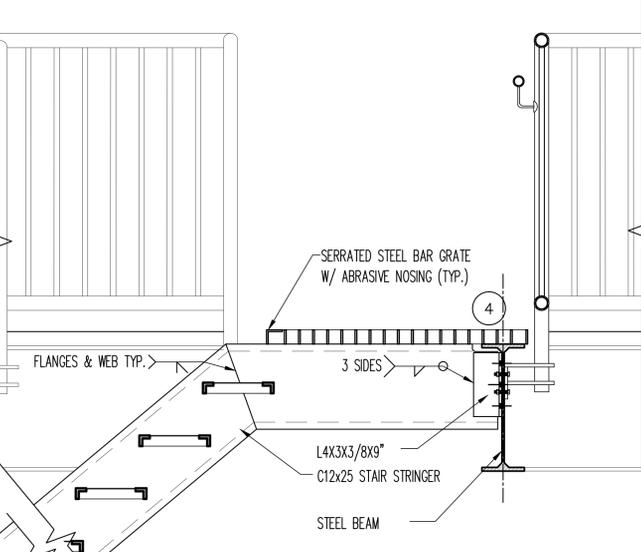
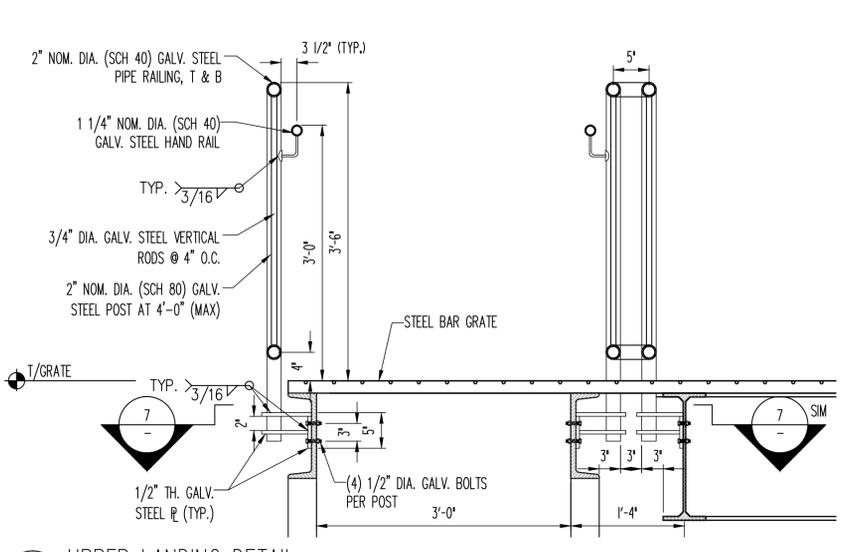
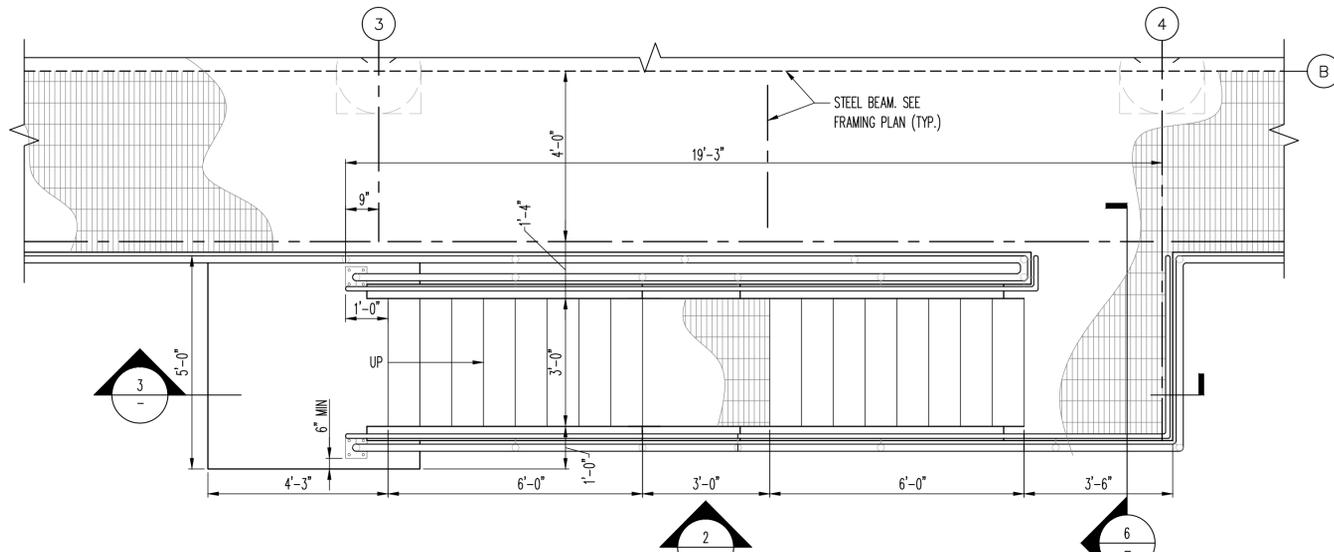
LOCATION NAME: RIVERDALE SUBSTATION

TITLE: FOUNDATION AND FRAMING DETAILS

CAD FILE NUMBER: SS-17.5-1019.DGN

SCALE: AS SHOWN  
PROJECT NO. GW4254-57102002  
MILE POST NO. 17.5

DISTRICT: MED  
SHEET NO. SS-17.5-1019



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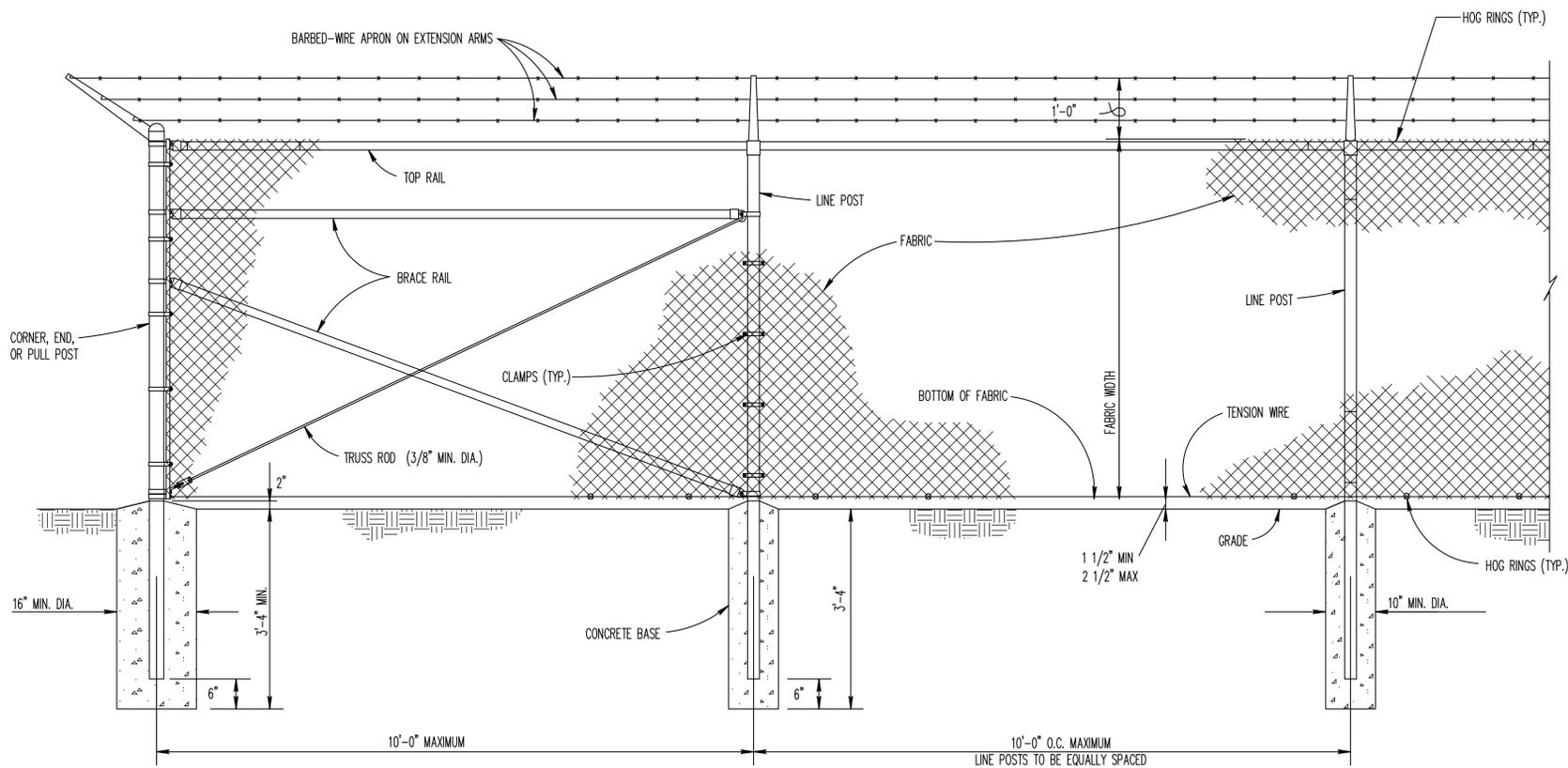


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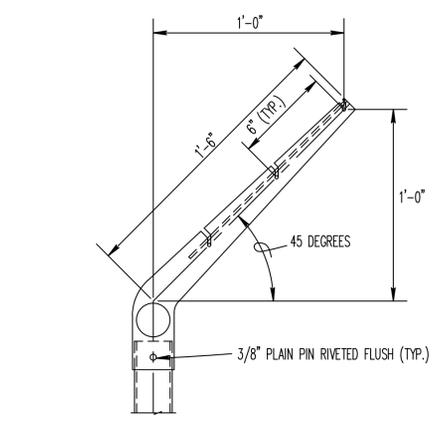
**Metra**  
ENGINEERING DEPARTMENT  
547 W. JACKSON BOULEVARD  
CHICAGO, ILLINOIS 60661

DESIGNED: EG	LOCATION NAME: RIVERDALE SUBSTATION
DRAWN: DC	TITLE: STAIR, RAILING AND GATE DETAILS
CHECKED: MK	
METRA P.M.: R. CERANT	
DATE: JUNE 12, 2017	

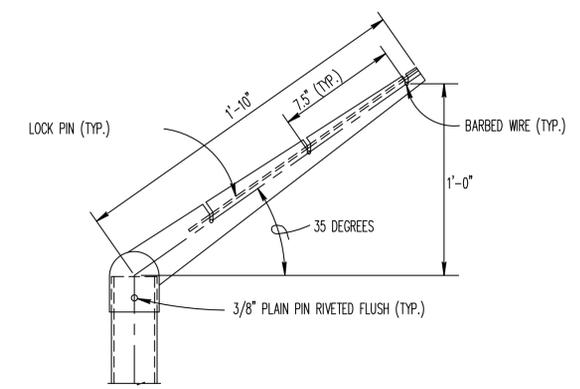
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SCALE: AS SHOWN	SHEET NO.
PROJECT NO. GW4254-57102002	SS-17.5-1020A
MILE POST NO. 17.5	



1 CHAIN LINK SECURITY FENCE DETAIL  
N.T.S.

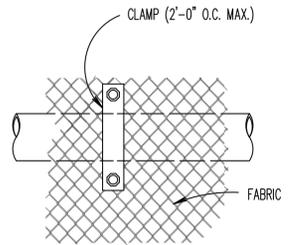


2 LINE POST  
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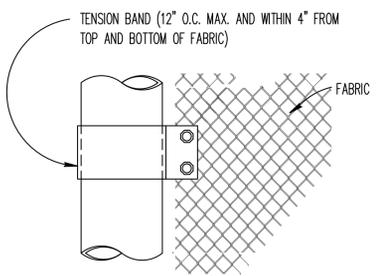


3 CORNER POST  
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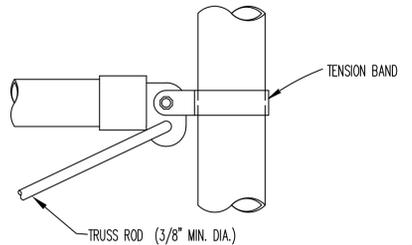
EXTENSION ARM DETAILS  
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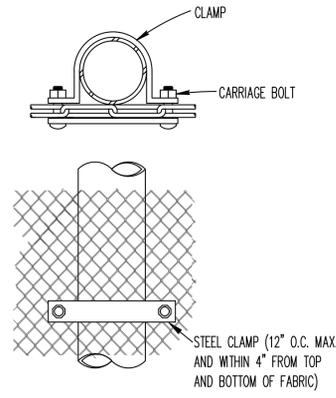
4 TOP OR BRACE RAIL ATTACHMENT  
N.T.S.



7 END OR GATE POST DETAIL  
N.T.S.



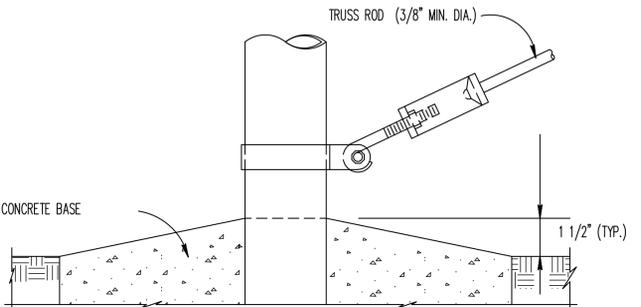
6 ROUND POST  
N.T.S.



9 LINE POST ATTACHMENTS  
N.T.S.

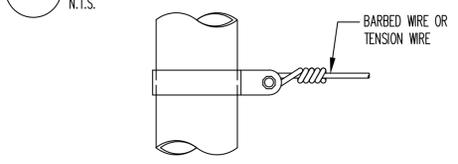
NOTES:

- DETAILS SHOWN ARE TO CLARIFY REQUIREMENTS AND ARE NOT INTENDED TO LIMIT OTHER TYPES OF FENCE SECTIONS AND METHODS OF INSTALLATION THAT COMPLY WITH THE SPECIFICATIONS.
- WIRE TIES, RAILS, POSTS, AND BRACES SHALL BE CONSTRUCTED ON THE SECURE SIDE OF THE FENCE ALIGNMENT. CHAIN LINK FABRIC SHALL BE PLACED ON THE SIDE OPPOSITE THE SECURE AREA.
- UNLESS SPECIFICALLY SHOWN OR SPECIFIED, FENCE SHALL HAVE AN APRON EXTENDED OUTWARD FROM THE AREA BEING PROTECTED.



5 TRUSS ROD AND BAND  
N.T.S.

BRACE RAIL CLAMP DETAILS  
N.T.S.



8 TENSION BAND DETAIL  
N.T.S.

FASTENING DETAILS  
N.T.S.

USE AND SECTION	STEEL POST SCHEDULE		
	MINIMUM OUTSIDE DIMENSIONS (NOMINAL)		
	FABRIC WIDTH 72" OR LESS	FABRIC WIDTH 84" TO 96"	FABRIC WIDTH 108" AND OVER
CORNER, END & PULL POSTS			
TUBULAR - ROUND	2.375" O.D.	2.875" O.D.	4.00" O.D.
TUBULAR - SQUARE	2.00" SQ.	2.50" SQ.	3.00" SQ.
LINE POSTS			
TUBULAR - ROUND	1.90" O.D.	2.375" O.D.	2.875" O.D.
TOP, BOTTOM & BRACE RAILS			
TUBULAR - ROUND	1.66" O.D.		
TUBULAR - SQUARE	1.50" SQ.		

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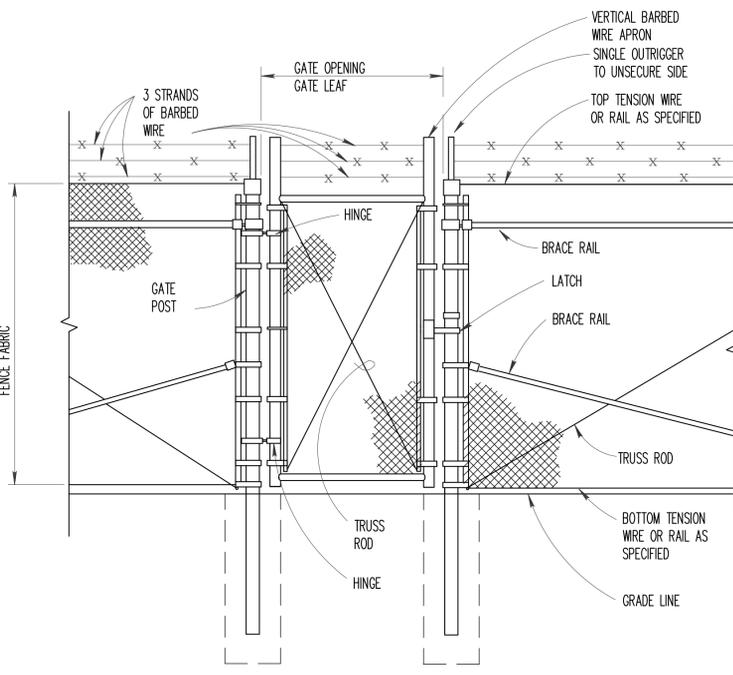
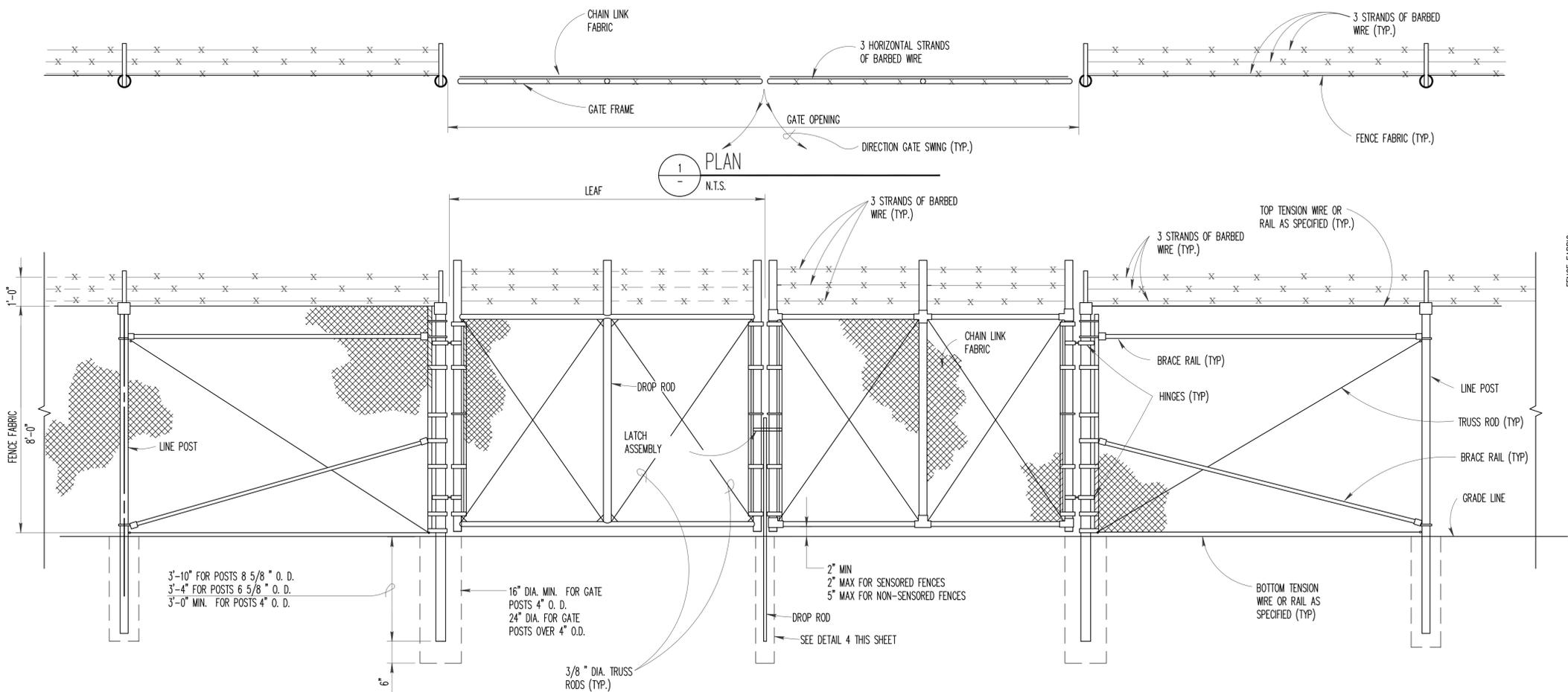
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**KMI**  
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 ARCHITECTS ■ ENGINEERS  
 223 W. Jackson Blvd., Suite 1010 Chicago, IL 60606  
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DATE: JUNE 12, 2017

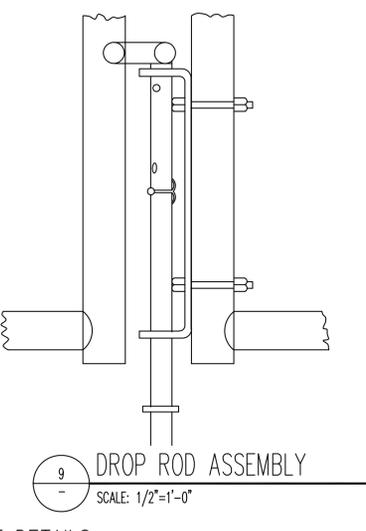
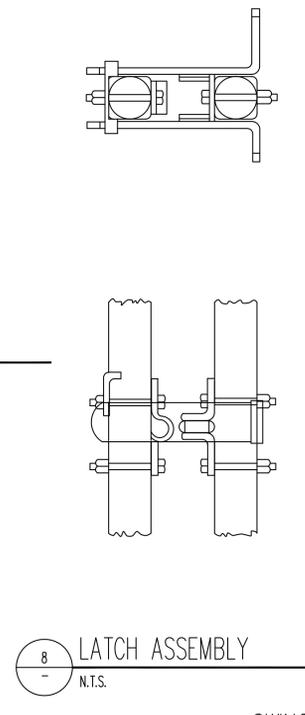
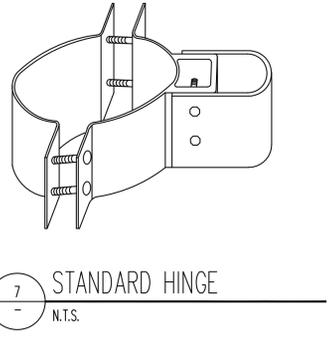
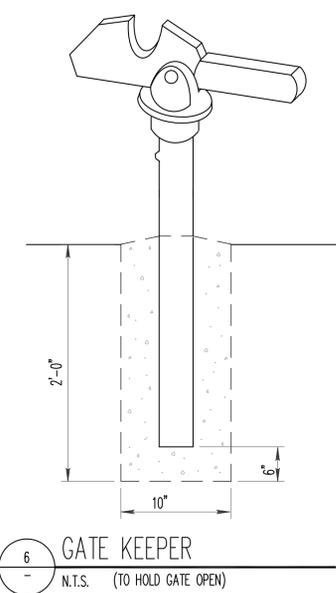
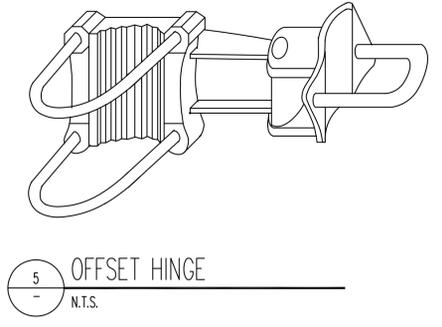
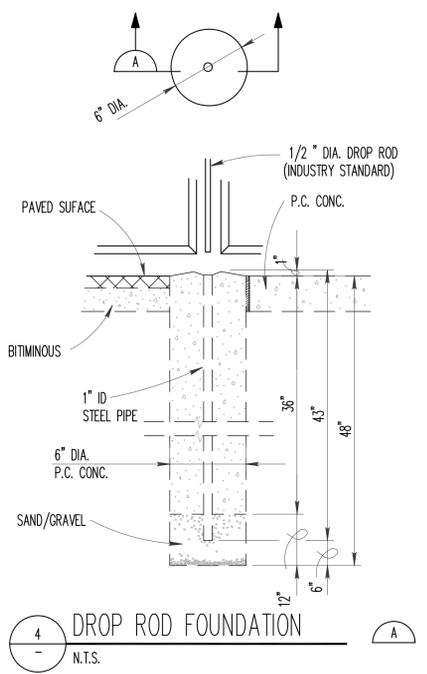
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 ENGINEERING DEPARTMENT  
 547 W. JACKSON BOULEVARD  
 CHICAGO, ILLINOIS 60661

LOCATION NAME: <b>ALL SUBSTATIONS</b>
TITLE: <b>CHAIN LINK FENCE DETAILS</b>

CAD FILE NUMBER: SS-17.5-1020B.DGN	SCALE: AS SHOWN	DISTRICT: MED
PROJECT NO. GW4254-57102002	MILE POST NO. N/A	SHEET NO. <b>SS-17.5-1020B</b>



- NOTES:
1. DETAILS SHOWN ARE TO CLARIFY REQUIREMENTS AND ARE NOT INTENDED TO LIMIT OTHER TYPE OF FENCE SECTIONS AND METHODS OF INSTALLATION WHICH COMPLY WITH THE SPECIFICATIONS.
  2. SWING GATES SHALL BE CONSTRUCTED WITH DROP RODS, PADLOCKS, LATCH ASSEMBLY AND GATE KEEPERS EXCEPT AS NOTED.
  3. ALL GATE FRAMES SHALL MEET THE MINIMUM REQUIREMENTS OF ASTM F900 1.90" NOMINAL (ROUND) OR 2.00" NOMINAL (SQUARE); GATE FRAMES SHALL BE OF WELDED CONSTRUCTION OR SHALL BE ASSEMBLED USING HEAVY FITTINGS. AT CONTRACTOR'S OPTION A WELDED HORIZONTAL BRACE MAY BE USED IN LIEU OF TRUSS RODS TO BRACE ALL-WELDED GATE FRAMES. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROPER RIGID CONSTRUCTION OF ALL GATES SUPPLIED.



GATE POST SCHEDULE	
GATE LEAF WIDTH (NOMINAL)	OUTSIDE DIMENSION (NOMINAL)
12' OR LESS	4.0" OD
GREATER THAN 12' TO 18'	6.625" OD
MORE THAN 18'	8.625" OD

**SWING GATE DETAILS**  
N.T.S.

PRINTED ON: 07/28/2017

REV	DATE	BY	APP	DESCRIPTION	REV	DATE	BY	APP	DESCRIPTION
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**KMI**  
Kaltsouni Mehdi, Inc.  
ARCHITECTS • ENGINEERS

223 W. Jackson Blvd., Suite 1010 Chicago, IL 60606  
Tel.: (312)987-9800 Fax.: (312)987-9892

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CHICAGO, ILLINOIS 60661

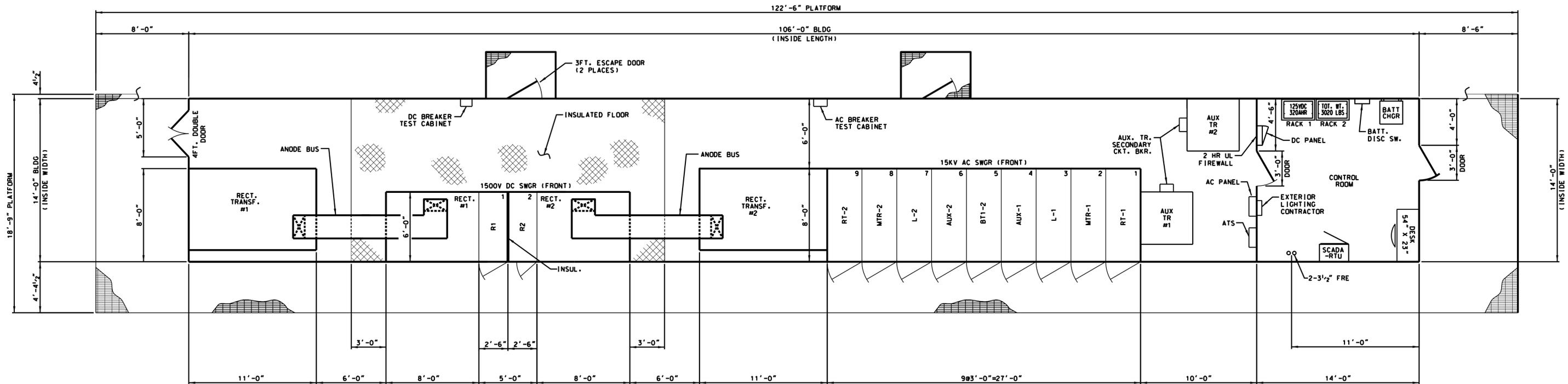
LOCATION NAME: **ALL SUBSTATIONS**

TITLE: **CHAIN LINK SWING GATE DETAILS**

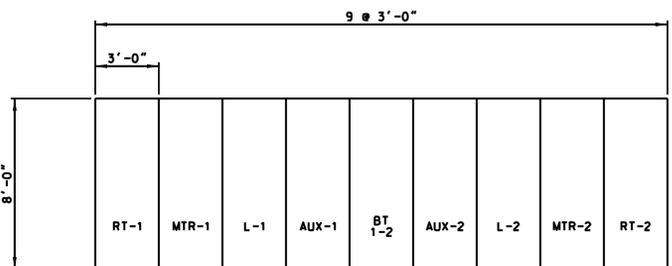
CAD FILE NUMBER: SS-17.5-1020C.DGN

SCALE: AS SHOWN  
PROJECT NO. GW4254-57102002  
MILE POST NO. N/A

DISTRICT: MED  
SHEET NO. **SS-17.5-1020C**



PLAN  
SCALE: 1/4" = 1'-0"



AC SWITCHGEAR ELEVATION  
SCALE: 1/4" = 1'-0"

- NOTES:**
1. SUBSTATION BUILDING ENCLOSURE SHALL BE MAXIMUM 14 FEET HIGH.
  2. FOR UNDERGROUND DUCTBANKS AND CONDUITS SEE DWG. SS-17.5-1071.
  3. THE REAR OF TRANSFORMER AND RECTIFIER SHALL BE PROVIDED WITH REMOVABLE PANELS.

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METRA P.M.: R. CERANT  
DATE: JUNE 12, 2017



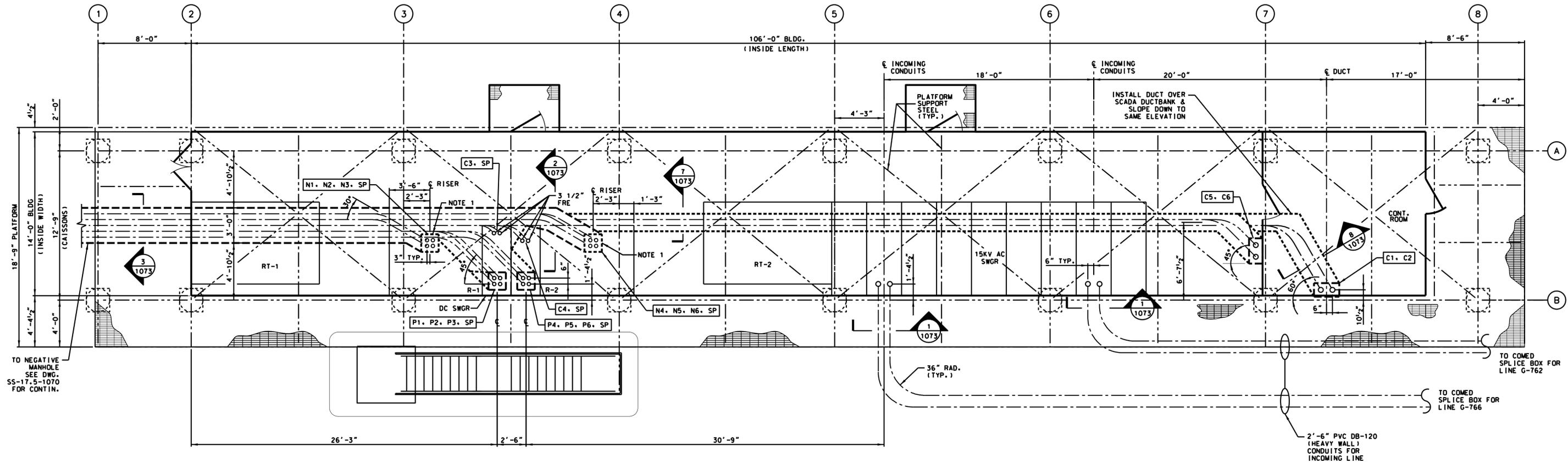
LOCATION NAME:  
**RIVERDALE SUBSTATION**

TITLE:  
**SUBSTATION EQUIPMENT LAYOUT PLAN**

CAD FILE NUMBER: SS-17.5-1050.DGN

SCALE: NTS	DISTRICT: MED
PROJECT NO. GW4254-57102002	SHEET NO. <b>SS-17.5-1050</b>
MILE POST NO. 17.5	





PLAN  
SCALE: 1/4" = 1'-0" N

- NOTES:**
1. LOCATE (4) 3 1/2" FRE CONDUITS IN AREA DESIGNATED FOR OUTGOING NEGATIVE FEEDERS - SEE RECTIFIER MFR'S DRAWINGS.
  2. THE CONTRACTOR SHALL INCLUDE IN THE BID 150 LF OF UNDERGROUND PVC CONDUIT AND CONDUCTOR TO EXTEND THE INCOMING LINES TO COMED SERVICE SPLICE BOXES.
  3. THE CONTRACTOR SHALL SUBMIT FOR APPROVAL THE DUCTBANK LAYOUT AFTER THE EQUIPMENT MANUFACTURER'S DWGS ARE APPROVED. THE CONTRACTOR SHALL BE RESPONSIBLE FOR EXACT LOCATION OF CONDUIT RISER AT EACH PIECE OF EQUIPMENT.
  4. FOR UNDERGROUND CABLE TABULATION SEE DWG. SS-17.5-1073

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REV	DATE	BY	APP	DESCRIPTION	REV	DATE	BY	APP	DESCRIPTION
0	07-28-2017	HS	HS	ISSUED FOR BID					

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Kaltsouni Mehdi, Inc.  
ARCHITECTS • ENGINEERS  
223 W. Jackson Blvd., Suite 1010 Chicago, IL 60606  
Tel.: (312)987-9800 Fax.: (312)987-9892

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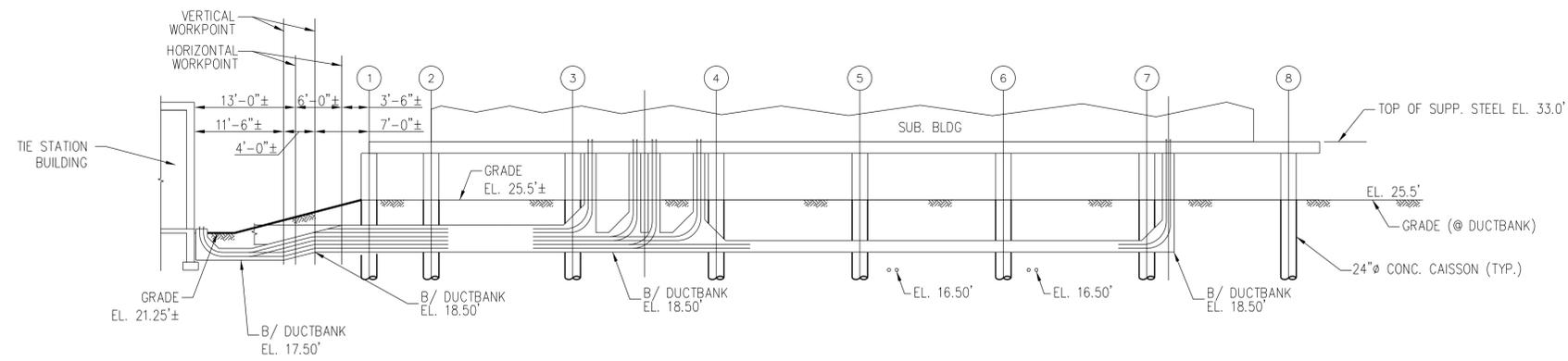
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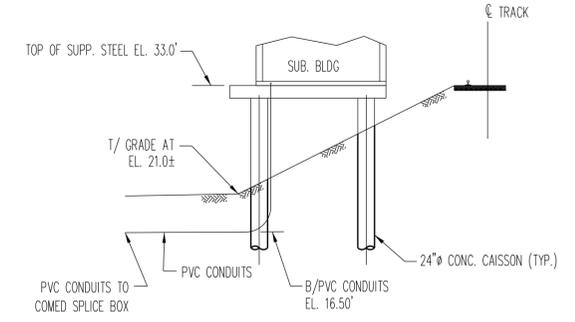
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DRAWN: JMC
CHECKED: FM
METRA P.M.: R. CERANT
DATE: JUNE 12, 2017

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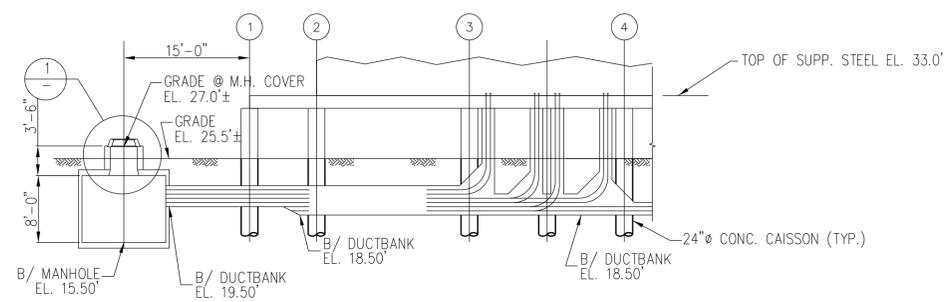
LOCATION NAME: <b>RIVERDALE SUBSTATION</b>	CAD FILE NUMBER: SS-17.5-1071.DGN
TITLE: <b>UNDERGROUND CONDUIT AND DUCTBANK LAYOUT</b>	SCALE: 1/4" = 1'-0" DISTRICT: MED
	PROJECT NO. GW4254-57102002 SHEET NO. <b>SS-17.5-1071</b>
	MILE POST NO. 17.5



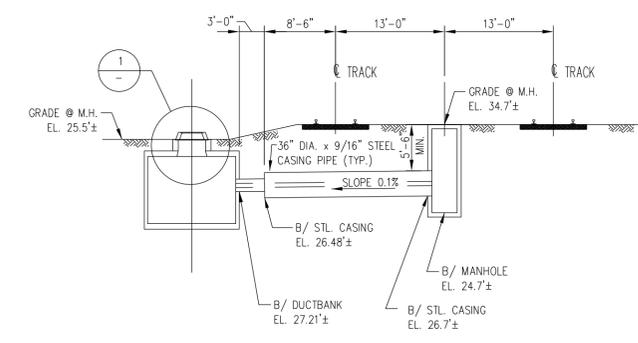
**A**  
1070  
DUCTBANK PROFILE  
SCALE: 1"=10'-0"



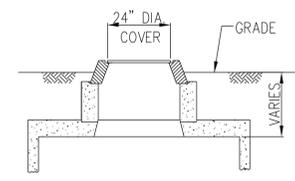
**B**  
1070  
INCOMING COMED SERVICE  
SCALE: 1"=10'-0"



**C**  
1070  
DUCTBANK PROFILE  
SCALE: 1"=10'-0"



**D**  
1070  
DUCTBANK PROFILE  
SCALE: 1"=10'-0"



**1**  
SCALE: N.T.S.

- NOTES:**
1. DUCTBANK LOCATIONS SHOWN ARE APPROXIMATE AND SHALL BE ADJUSTED AS REQUIRED TO SUIT FIELD CONDITIONS.
  2. THE DEPTHS OF DUCTBANKS SHOWN ARE BASED ON EXISTING CONTOUR LINES AND REQUIRE MINIMUM OF 3'-6" COVERAGE FROM GRADE TO BOTTOM OF DUCTBANK.
  3. FOR DUCTBANK AND CONDUIT LOCATIONS IN NEW SUBSTATION BUILDING AREA SEE DWG. SS-17.5-1071.

REV	DATE	BY	APP	DESCRIPTION	REV	DATE	BY	APP	DESCRIPTION
2	06-08-2018	JMC	HS	ISSUED FOR BID					
1	03-30-2018	HS	HS	ISSUED FOR ADDENDUM 1					
0	07-28-2017	HS	HS	ISSUED FOR BID					

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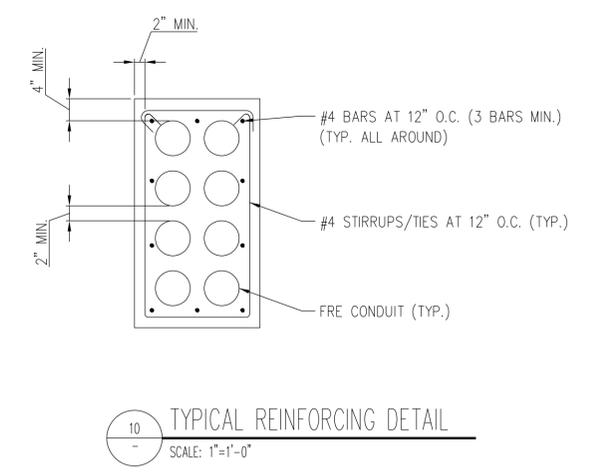
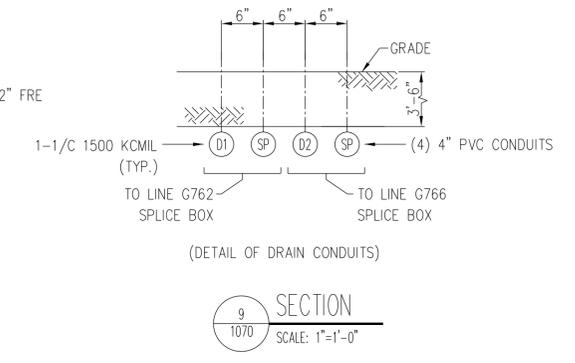
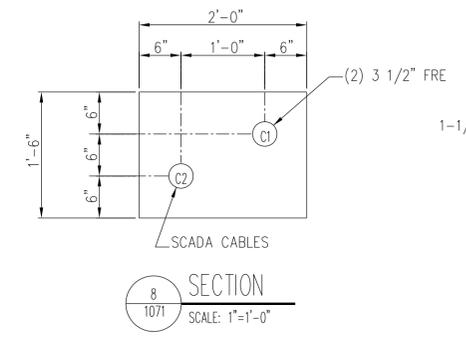
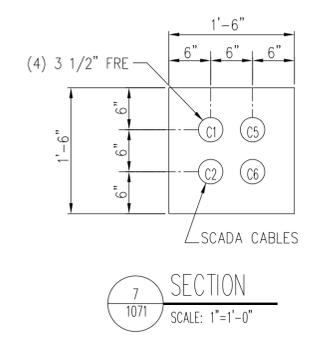
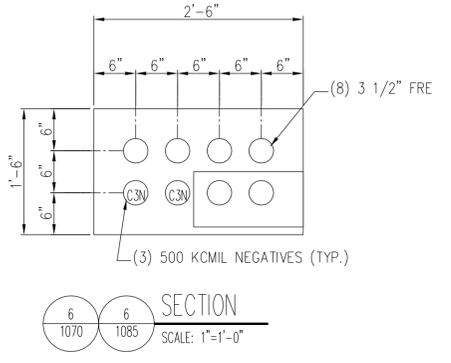
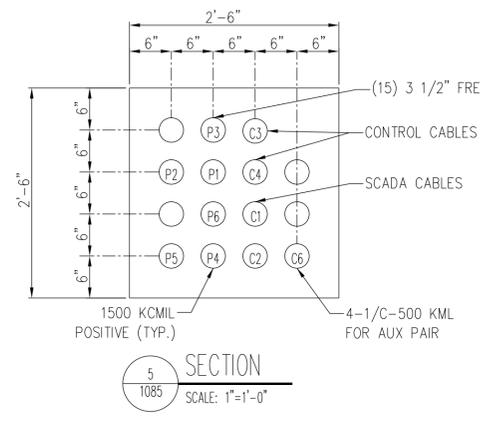
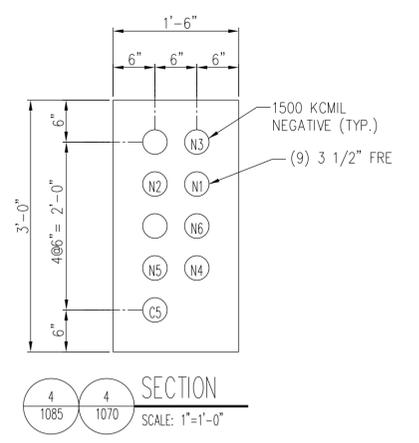
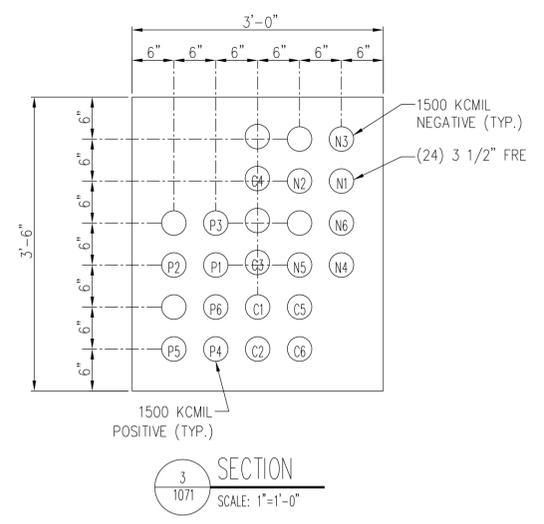
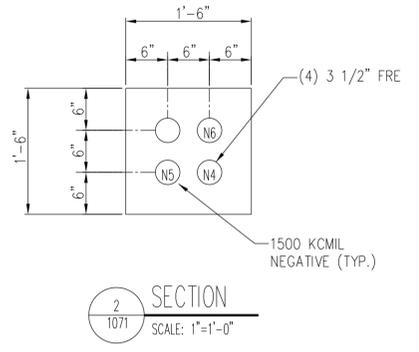
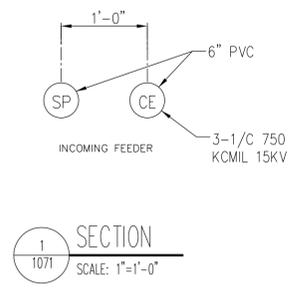
DESIGNED: HS  
 DRAWN: JC  
 CHECKED: FM  
 METRA P.M.: R. CERANT  
 DATE: JUNE 12, 2017

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 CHICAGO, ILLINOIS 60661

LOCATION NAME:  
**RIVERDALE SUBSTATION**  
 TITLE:  
**DUCTBANK PROFILES**

CAD FILE NUMBER: SS-17.5-1072.DGN  
 SCALE: AS NOTED  
 DISTRICT: MED  
 PROJECT NO. GW4254-57102002  
 SHEET NO. SS-17.5-1072  
 MILE POST NO. 17.5

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CABLE TABLE		
CABLE I.D.	FROM	TO
CE	COMED INCOMING LINE	15KV AC SWITCHGEAR CUBICLE 2 OR 8
P1, P2, ETC.	CATHODE BREAKERS IN DC SWITCHGEAR	DC SWITCHGEAR IN TIE STATION
N1, N2, ETC.	RECTIFIER #1 OR #2	NEGATIVE ENCLOSURE ON TOP OF NEGATIVE MANHOLE
C3N	NEGATIVE ENCLOSURE ON TOP OF NEGATIVE MANHOLE	TRACK-RUNNING RAIL
C1, C2	CONTROL ROOM	SCADA IN TIE STATION
C3, C4	CATHODE BREAKERS IN DC SWITCHGEAR	SWITCH ENCLOSURE ON OUTSIDE WALL OF TIE STATION
C5	AC PANEL	NEGATIVE DRAINAGE PANEL
C6	AC PANEL	CONTROL BOX AT TIE BREAKER STATION (AUX PWR TO TIE BKR STATION)

**NOTES:**  
1. ALL DUCT BANKS SHALL BE REINFORCED.

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2	06-08-2018	JMC	HS	ISSUED FOR BID					
1	03-30-2018	JMC	HS	ISSUED FOR ADDENDUM 1					
0	07-28-2017	HS	HS	ISSUED FOR BID					

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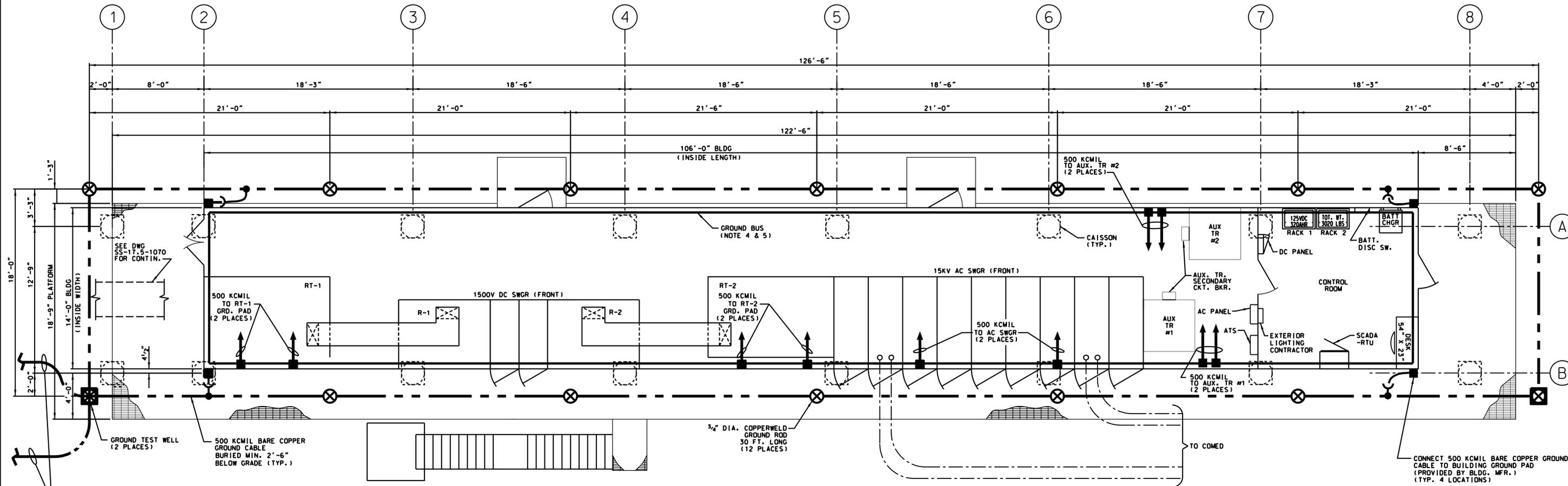
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LOCATION NAME: <b>RIVERDALE SUBSTATION</b>
TITLE: <b>DUCTBANK DETAILS</b>

CAD FILE NUMBER: SS-17.5-1073.DGN	DISTRICT: MED
SCALE: 1" = 1'-0"	SHEET NO. <b>SS-17.5-1073</b>
PROJECT NO. GW4254-57102002	
MILE POST NO. 17.5	



PLAN  
SCALE: 1/4" = 1'-0"

- LEGEND:**
- GROUND CABLE BURIED IN EARTH OR EMBEDDED IN CONCRETE
  - GROUND CADWELD CONNECTION
  - GROUND BOLTED CONNECTION
  - GROUND CABLE CHANGE OF ELEVATION
  - GROUND ROD  
3/4" DIA. 5' LONG COPPERWELD GROUND RODS, MIN. 30 FT. TOTAL LENGTH (6 SECTIONS)
  - GROUND TEST WELL  
3/4" DIA. 5' LONG COPPERWELD GROUND RODS, MIN. 30 FT. TOTAL LENGTH (6 SECTIONS)

- NOTES:**
1. BARE COPPER GROUND CABLE SHALL BE BURIED MINIMUM 2'-6" BELOW GRADE.
  2. ALL GROUNDING CONNECTIONS BELOW GRADE SHALL BE MADE USING CADWELD PROCESS. ONLY INSIDE TEST WELL CLAMP CONNECTIONS SHALL BE USED.
  3. GROUND ROD LOCATIONS SHOWN ARE APPROXIMATE. CONTRACTOR MAY RELOCATE RODS AS REQUIRED TO CLEAR FIELD OBSTRUCTIONS.
  4. 1/2" x 2" COPPER GROUND BUS SHALL BE INSTALLED AROUND THE ENTIRE BUILDING ON THE INSIDE FACE OF BUILDING WALL, AND SHALL BE CONNECTED TO GROUND PADS OF THE BUILDING AT FOUR LOCATIONS.
  5. ALL SUBSTATION EQUIPMENT REQUIRING GROUNDING SHALL BE CONNECTED TO SUBSTATION GROUND BUS PER NATIONAL ELECTRICAL CODE.
  6. ALL GROUNDING RISERS ABOVE GRADE FOR CONNECTION TO THE BUILDING GROUND PADS SHALL BE INSTALLED IN THE RIGID STEEL CONDUIT SUPPORTED ALONG THE CAISSONS.

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0	07-28-2017	HS	HS	ISSUED FOR BID					

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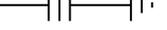
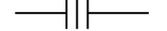
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 METRA P.M.: R. CERANT  
 DATE: JUNE 12, 2017

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LOCATION NAME:  
**RIVERDALE SUBSTATION**  
 TITLE:  
**SUBSTATION GROUNDING LAYOUT**

CAD FILE NUMBER: SS-17.5-1075.DGN  
 SCALE: 1/4" = 1'-0"  
 DISTRICT: MED  
 PROJECT NO. GW4254-57102002  
 SHEET NO. SS-17.5-1075  
 MILE POST NO. 17.5

SYMBOLS			GROUNDING NOTES	GENERAL NOTES
<p><b>GENERAL</b></p>  POWER TRANSFORMER  POTENTIAL TRANSFORMER  CURRENT TRANSFORMER  AIR CIRCUIT BREAKER  DRAWOUT TYPE  FUSE  RESISTOR  SHUNT  STATION CLASS ARRESTER  DISTRIBUTION CLASS ARRESTER  CAPACITOR FIXED  BATTERY  RECTIFIER  DISCONNECT SWITCH  AUTOMATIC TRANSFER SWITCH	<p><b>GENERAL CONT'D</b></p>  MAGNETIC OVERLOAD DEVICE  THERMAL OVERLOAD DEVICE  ELECTRICAL EQUIPMENT, SUCH AS CONTROL PANELS, PULLBOXES, ETC.  JUNCTION BOX (ALSO IDENTIFIED AS J.B. OR JCT. BOX)  POWER OUTLET  CONDUIT EMBEDDED IN CONCRETE OR BURIED IN EARTH.  CONDUIT EXPOSED  CONDUIT TURNING UP OR TOWARD OBSERVER  CONDUIT TURNING DOWN OR AWAY FROM OBSERVER  FLEXIBLE ELECTRICAL CONDUIT <p><b>METERING/INDICATING DEVICES</b></p>  AMMETER  VOLTMETER  AMMETER SWITCH  VOLTMETER SWITCH  INDICATING LIGHT AIL-AMBER    BIL-BLUE GIL-GREEN    RIL-RED WIL-WHITE	<p><b>GROUNDING</b></p>  GROUND CABLE BURIED IN EARTH OR EMBEDDED IN CONCRETE  GROUND CADWELD CONNECTION  GROUND BOLTED CONNECTION  GROUND CABLE CHANGE OF ELEVATION  GROUND ROD 3/4" DIA. 5' LONG COPPERWELD GROUND RODS, MIN. 30 FT. TOTAL LENGTH (6 SECTIONS)  GROUND TEST WELL 3/4" DIA. 5' LONG COPPERWELD GROUND RODS, MIN. 30 FT. TOTAL LENGTH (6 SECTIONS)  EXPOSED COPPER GROUND BAR BUS UNLESS OTHERWISE NOTED	<ol style="list-style-type: none"> <li>GROUND CABLE RUNS ARE SHOWN DIAGRAMMATICALLY. EXACT RUNS SHALL BE DETERMINED IN FIELD TO SUIT CONDITIONS.</li> <li>ALL OUTDOOR UNDERGROUND CABLE SHALL BE 500KCMIL BARE COPPER, UNLESS NOTED OTHERWISE.</li> <li>UNDERGROUND GRID TO BE RUN MINIMUM 2'-6" BELOW GRADE AND SHALL BE INSTALLED WITH SUFFICIENT SLACK TO PREVENT DAMAGE DUE TO GROUND FAULTS AND/OR EARTH SETTLEMENT.</li> <li>AT POINTS OF CROSSING, UNDERGROUND CABLE SHALL BE RUN ABOVE FOUNDATION FOOTINGS, EXISTING DUCTBANKS, SEWER LINES AND OTHER BURIED UTILITIES.</li> <li>GROUND WELLS AND RODS SHALL BE INSTALLED AT APPROXIMATE LOCATIONS SHOWN BY DRIVING (NOT DRILLING OR JETTING) USING DRIVING STUD FITTINGS TO ABSORB IMPACT.</li> <li>ALL SURFACES TO BE GROUNDED SHALL BE THOROUGHLY CLEANED TO BARE METAL BEFORE MAKING CONNECTIONS.</li> <li>ALL GROUND GRID CONNECTIONS BELOW GRADE SHALL BE CADWELD TYPE &amp; SHALL BE MADE IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS. ALL CADWELD CONNECTIONS SHALL BE INSPECTED BEFORE BACKFILLING. IF PUFFY OR POROUS WELDS ARE FOUND, THEY SHALL BE CUT OUT AND THE CONNECTIONS REMADE.</li> <li>ALL GROUNDING CABLE CONNECTIONS TO EQUIPMENT ABOVE GRADE AND INSIDE THE SUBSTATION BUILDING SHALL BE THE BOLTED TYPE.</li> <li>BAR TO BAR AND LUG TO BAR BOLTED CONNECTIONS SHALL BE MADE WITH 1/2" SILICON BRONZE BOLTS, NUTS AND WASHERS. ALL CONNECTIONS SHALL BE MADE ELECTRICALLY CLEAN. SILVER-PLATE ALL BAR AND LUG CONNECTIONS.</li> <li>ALL METAL CONDUITS, EQUIPMENT AND JUNCTION BOXES SHALL BE GROUNDED WITH MINIMUM #2 COPEER CABLE. COAT GROUND CABLE CONNECTIONS TO ALUMINUM TRAY WITH NO-OXIDE COMPOUND.</li> <li>AFTER THE ENTIRE GROUNDING SYSTEM HAS BEEN INSTALLED, INCLUDING RODS, THE SYSTEM SHALL BE TESTED TO MEET SPECIFICATION REQUIREMENTS.</li> </ol>	<ol style="list-style-type: none"> <li>ALL DISTANCES OF EXISTING STRUCTURES SHOWN ON THE DRAWINGS ARE APPROXIMATE. THE CONTRACTOR SHALL VERIFY DIMENSIONS BEFORE PROCEEDING WITH THE INSTALLATIONS.</li> <li>CONDUIT USED SHALL BE AS FOLLOWS:             <ol style="list-style-type: none"> <li>EXPOSED CONDUIT INSIDE SUBSTATION BUILDING SHALL BE IMC (INTERMEDIATE METAL CONDUIT), UNLESS NOTED OTHERWISE.</li> <li>OUTDOOR CONDUIT FOR GENERAL USE SHALL BE HOT-DIP GALVANIZED RIGID STEEL.</li> <li>CONDUIT FOR TRACTION POWER POSITIVE AND NEGATIVE FEEDERS, WHETHER EXPOSED OR CONCRETE ENCASED, SHALL BE FRE (FIBERGLASS REINFORCED EPOXY) AS SHOWN ON PLANS.</li> <li>CONCRETE ENCASED CONDUIT FOR INCOMING 12KV COMED FEEDERS SHALL BE FRE. (FIBERGLASS REINFORCED EPOXY)</li> <li>WHEN CONDUITS OF VARIOUS SERVICES ARE ENCASED IN COMMON CONCRETE DUCTBANK, THE CONDUIT TYPE IS SPECIFIED ON PLANS.</li> <li>DIRECT BURIED UNDERGROUND CONDUIT SHALL BE HEAVY WALL PVC, TYPE DB-120, MANUFACTURED PER NEMA-6 AND 8.</li> </ol> </li> <li>EXPOSED CONDUIT SHALL BE SUPPORTED AT APPROX. 6'-0" INTERVALS (MAXIMUM INTERVAL NOT TO EXCEED 10'-0").</li> <li>RADIUS OF CURVATURE TO THE INSIDE EDGE OF FIELD BENDS SHALL BE A MINIMUM OF EIGHT-TIMES THE TRADE SIZE OF CONDUIT, UNLESS NOTED OTHERWISE.</li> <li>EXPOSED CONDUIT SHALL, IN GENERAL, BE RUN PARALLEL TO OR AT RIGHT ANGLES TO WALLS AND STRUCTURAL MEMBERS.</li> <li>CONDUITS INSTALLED PARALLEL TO HOT SURFACES SHALL BE RUN A MINIMUM OF 12 INCHES AWAY FROM SUCH SURFACES.</li> <li>AT EQUIPMENT ENCLOSURES, CONDUIT SHALL BE TERMINATED WITH 2-LOCKNUTS AND BUSHINGS OR INSULATED GROUNDING BUSHING INDOORS AND GASKETED CONDUIT HUB PLATES OUTDOORS, EXCEPT WHERE ENCLOSURES ARE FURNISHED WITH INTEGRAL THREADED HUBS.</li> <li>CONDUIT TERMINATIONS AT MOTORS, ELECTRICAL INSTRUMENTS AND WHERE SPECIFIED SHALL BE LIQUIDTITE (SEALTITE TYPE "UA" OR EQUAL) AND SHALL BE INSTALLED WITH LIQUIDTITE CONNECTORS, WITH A MAXIMUM LENGTH OF TWO FEET.</li> <li>ALL INDOOR JCT. &amp; TERM. BOXES SHALL BE NEMA 12 TYPE, ALL OUTDOOR BOXES NEMA 4R TYPE, UNLESS OTHERWISE NOTED, AND SHALL BE LOCATED CLEAR OF INTERFERENCES FOR READY ACCESS.</li> <li>UNLESS SPECIFIED, JUNCTION BOXES SHALL BE SIZED BY THE CONTRACTOR WHEN TOTAL DEGREES OF CONDUIT BENDS EXCEED 270°. CONTRACTOR SHALL ADD AND LOCATE PULL BOX AS NEEDED.</li> <li>WHEREVER THE TERMS "DRAWING" OR "SHEET" ARE USED FOR REFERENCE ON A DRAWING, THE TWO TERMS SHOULD BE CONSIDERED SYNONYMOUS.</li> </ol>

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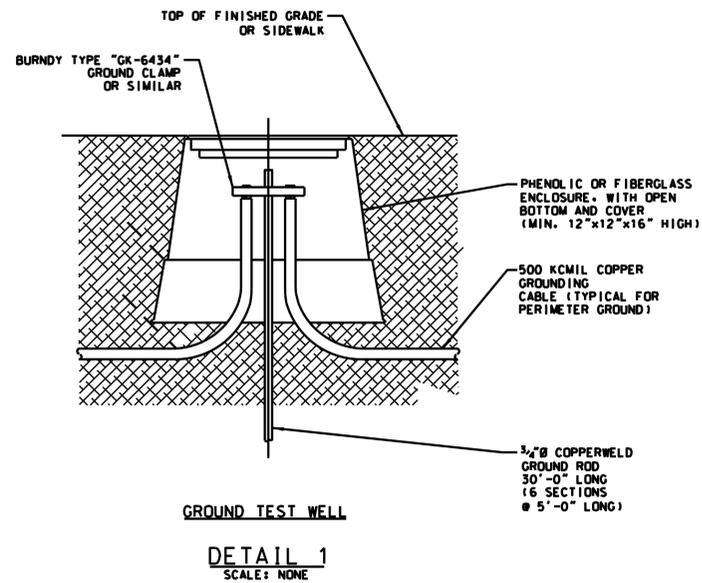
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METRA P.M.: R. CERANT
DATE: JUNE 12, 2017



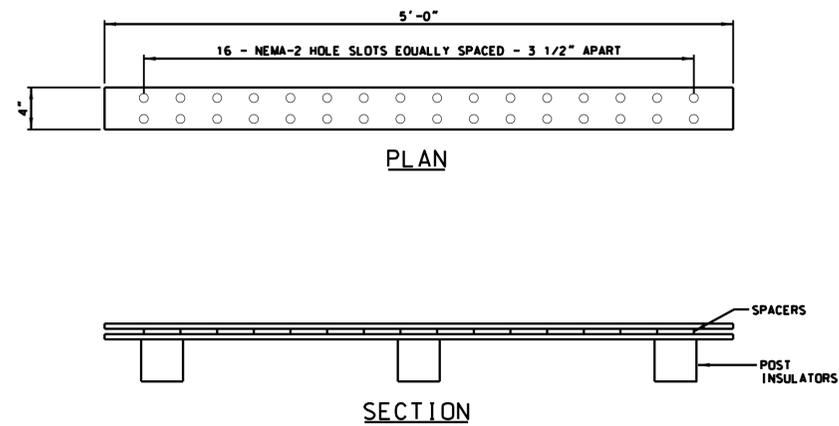
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547 W. JACKSON BOULEVARD  
CHICAGO, ILLINOIS 60661

LOCATION NAME: <b>RIVERDALE SUBSTATION</b>
TITLE: <b>ELECTRICAL NOTES &amp; SYMBOLS</b>

CAD FILE NUMBER: SS-17.5-1080.DGN	
SCALE: NTS	DISTRICT: MED
PROJECT NO. GW4254-57102002	SHEET NO. <b>SS-17.5-1080</b>
MILE POST NO. 17.5	



INSTALLATION DETAIL OF NEGATIVE BUS INSIDE WAYSIDE MANHOLE.



NOTES:

1. INSTALL NEGATIVE BUS 12" BELOW MANHOLE CEILING
2. SILVER PLATED NEGATIVE COPPER BUS SHALL BE 5 FEET LONG; WITH (2)-1/2" X 4" BUS BARS WITH 1/2" SPACER RATED FOR MINIMUM 4000 AMPS.
3. BUS BARS SHALL BE MOUNTED ON 5KV POST INSULATORS INSTALLED ON UNISTRUT MOUNTED ON MANHOLE WALL.
4. PROVIDE NEMA-2 NOLE PATTERN SLOT EQUALLY SPACED 3 1/2" APART.
5. INSTALL VIEW WINDOWS IN MANHOLE COVER.

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2	06-08-2018	JMC	HS	ISSUED FOR BID					
1	03-30-2018	JMC	HS	ISSUED FOR ADDENDUM 1					
0	07-28-2017	HS	HS	ISSUED FOR BID					

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DESIGNED: HS  
 DRAWN: JMC  
 CHECKED: FM  
 METRA P.M.: R. CERANT  
 DATE: JUNE 12, 2017



LOCATION NAME:  
**RIVERDALE SUBSTATION**

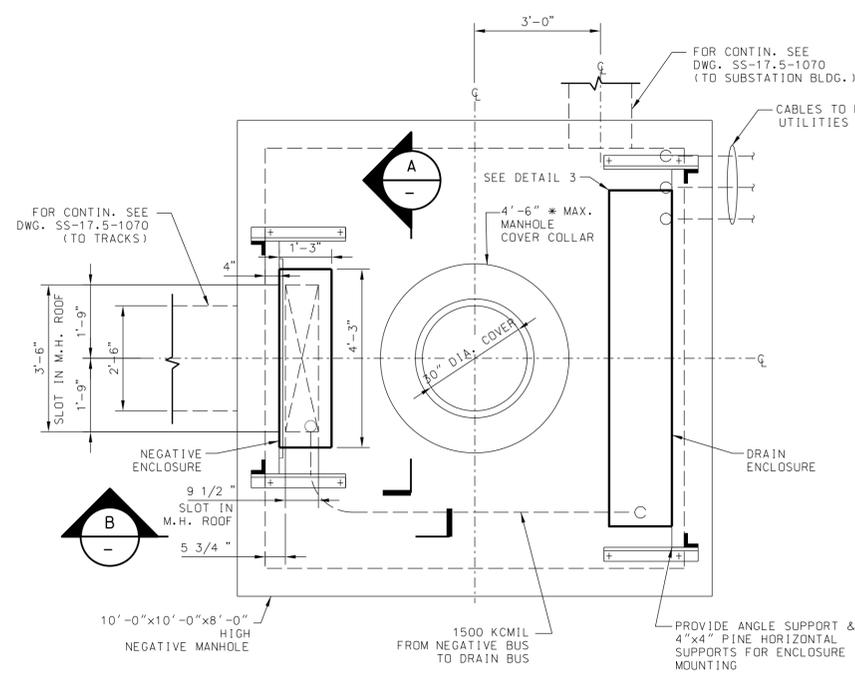
TITLE:  
**ELECTRICAL DETAILS**

CAD FILE NUMBER: SS-17.5-1081.DGN

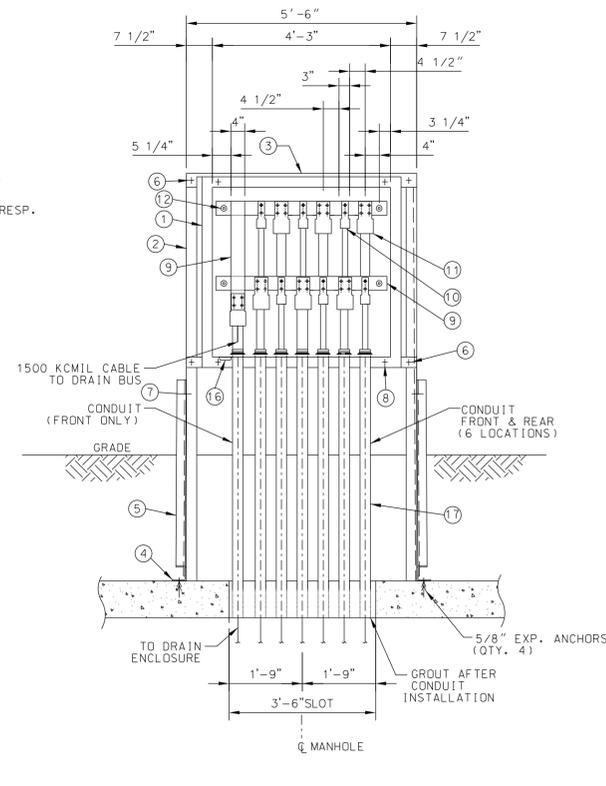
SCALE: NTS  
 DISTRICT: MED

PROJECT NO. GW4254-57102002  
 SHEET NO. CS-17.5-1081

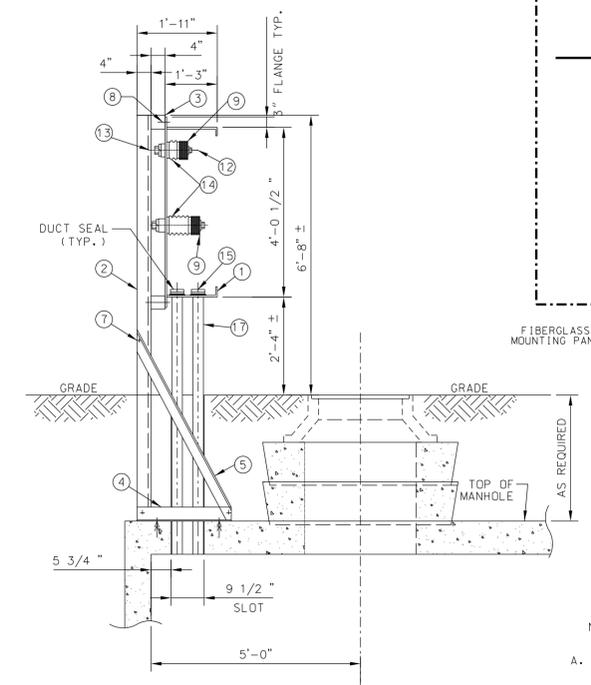
MILE POST NO. 17.5



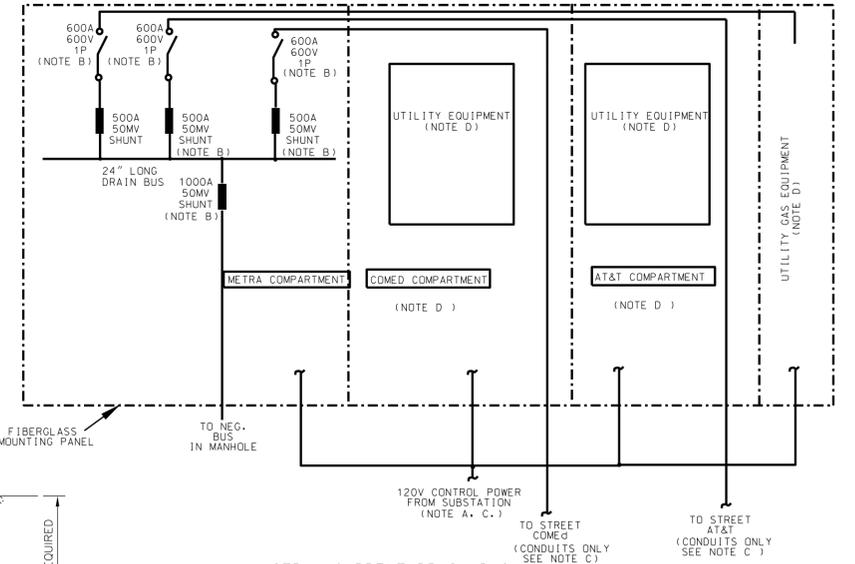
**NEGATIVE MANHOLE PLAN**  
SCALE: 1/2"=1'-0"



**ELEVATION**  
SCALE: 1/2"=1'-0"



**SECTION**  
SCALE: 1/2"=1'-0"



**STRAY CURRENT DRAIN BUS EQUIPMENT MOUNTING PANEL (DRAIN ENCLOSURE)**  
(SEE NOTES A, B, C, D.)

**DETAIL**  
SCALE: NONE

**NOTES:**

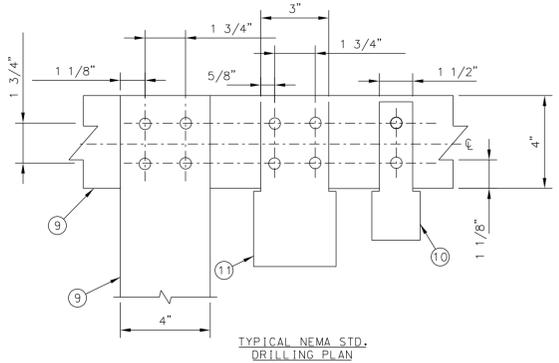
- A. THE CONTRACTOR SHALL PROVIDE A FIBERGLASS MOUNTING PANEL FOR THE UTILITIES DRAIN EQUIPMENT. THE NEW PANEL SHALL HAVE FOUR (4) COMPARTMENTS ONE EACH FOR METRA, AT&T, GAS, AND COMED. EACH COMPARTMENT SHALL BE 42"X24" WITH 120V, 15A DUPLEX OUTLET IN EACH COMPARTMENT.
- B. THE CONTRACTOR SHALL PROVIDE THE FOUR (4) SHUNTS AND THREE (3) DISCONNECT SWITCHES AS PER THIS SKETCH. THE DISCONNECT SWITCHES SHALL BE FILINOR TYPE A, CAT A-6716, THE SHUNTS SHALL BE CANADIAN SHUNT IND. E SERIES, MANIGAN SHUNTS. BOTH SHUNTS AND SWITCHES MANUFACTURERS ARE "OR APPROVED EQUAL".
- C. THE STRAY CURRENT CONDUITS SHALL BE FURNISHED AND INSTALLED BY THE CONTRACTOR AND CABLES BY THE UTILITIES. THE 120V CONTROL POWER CIRCUITS SHALL BE PROVIDED AND INSTALLED BY THE CONTRACTOR.
- D. THE UTILITIES WILL PROVIDE AND INSTALL THEIR DRAINAGE CABLES AND EQUIPMENT ON THIS PANEL.

**BILL OF MATERIAL-NEGATIVE BUS ENCLOSURE**

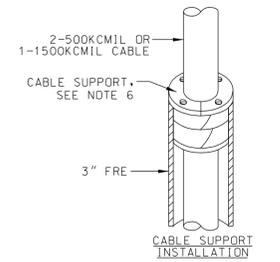
- ① (1) FIBERGLASS ENCLOSURE WITH FLANGE LIP 51" WIDE x 48 1/2" HIGH x 15" MIN. DEEP
- ② (2) 4" x 4" x 3/8" ANGLE, LENGTH AS REQUIRED (ASTM A36 STRUCTURAL STEEL) GALVANIZED
- ③ (2) 4" x 4" PINE 5'-6" LG. TREATED WITH AWPA TYPE P1(95) FOR CREO-PINE
- ④ (2) 4" x 4" x 3/8" ANGLE, 2'-3" LG (ASTM A36 STRUCTURAL STEEL) GALVANIZED
- ⑤ (2) 3" x 3" x 1/4" (BRACE ANGLE), LENGTH AS REQUIRED (ASTM A36 STRUCTURAL STEEL) GALVANIZED
- ⑥ (4) 3/4" Ø THROBOLT, NUT & 2 WASHERS (IN 13/16" Ø HOLES) A307 GALVANIZED
- ⑦ (4) 1/2" Ø BOLT & WASHERS A307 GALVANIZED
- ⑧ (4) 1/2" Ø STAINLESS STEEL BOLT, NUT, SQUARE WASHER & LOCKWASHER
- ⑨ (4) 1/4" x 4" COPPER BUS BARS (44 FT. TOTAL NEEDED)
- ⑩ (12) COPPER ALLOY BOLTED POWER CONNECTOR FOR 500 KCMIL CABLE
- ⑪ (7) COPPER ALLOY BOLTED POWER CONNECTOR FOR 1500 KCMIL CABLE
- ⑫ (4) 5/8" HEX HEAD SILICON BRONZE BOLT WITH STAINLESS STEEL BELLEVILLE WASHER
- ⑬ (4) 3/4" HEX HEAD STAINLESS STEEL BOLT WITH FLAT & SPLIT WASHERS
- ⑭ (2) 7 1/2" & (2) 14" FIBERGLASS REINFORCED STANDOFF INSULATOR CLASS A-40
- ⑮ (13) CABLE SUPPORT, SEE DETAIL 2
- ⑯ (3) DRAIN PLUG
- ⑰ (13) 3" FRE CONDUIT LENGTH AS REQUIRED

**NOTES:**

- 1. CONTRACTOR SHALL FIELD VERIFY ALL DIMENSIONS.
- 2. PROVIDE KNOCKOUTS IN BOTTOM OF ENCLOSURE FOR 3" FRE CONDUIT AS DIMENSIONED.
- 3. SEAL ALL MOUNTING BOLTS AND ANY PENETRATION THROUGH THE ENCLOSURE WITH RTV SILICON SEALER PER ENCLOSURE MANUFACTURER'S INSTRUCTIONS.
- 4. BUS SHALL BE ADEQUATELY BRACED. SPACING BETWEEN BUS BARS SHALL BE 1/4" AND MAINTAINED ENTIRE LENGTH.
- 5. ENCLOSURE DOORS ARE NOT SHOWN FOR CLARITY.
- 6. FOR CABLE SUPPORT USE CONDUIT SEALING BUSHING TYPE CSBE-300P-SEG (500KCMIL) AND CSBE-300P (1500KCMIL) MANUFACTURED BY O-Z/GEDNEY OR APPROVED EQUAL.
- 7. ALL MILD STEEL STRUCTURAL SHAPES, BOLTS, NUTS, AND WASHERS ARE TO BE GALVANIZED.
- 8. ALL EQUIPMENT SHALL BE FURNISHED AND INSTALLED BY THE CONTRACTOR UNLESS NOTED OTHERWISE.



**DETAIL**  
SCALE: NONE



**DETAIL**  
SCALE: NONE

PRINTED ON: \$DATES

REV	DATE	BY	APP	DESCRIPTION	REV	DATE	BY	APP	DESCRIPTION
2	06-08-2018	JMC	HS	ISSUED FOR BID					
1	03-30-2018	HS	HS	ISSUED FOR ADDENDUM 1					
0	07-28-2017	HS	HS	ISSUED FOR BID					

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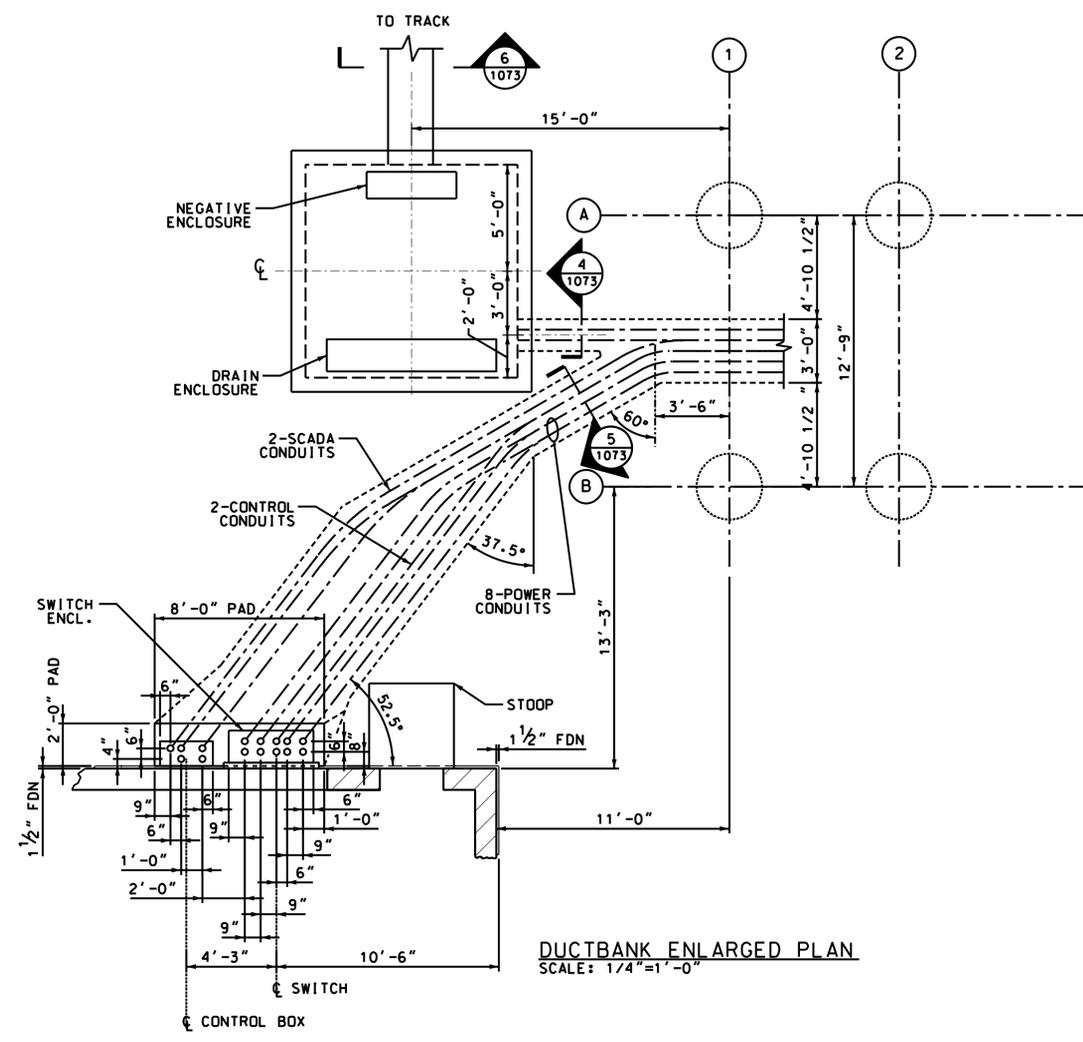
DESIGNED: HS
DRAWN: JMC
CHECKED: FM
METRA P.M.: R. CERANT
DATE: JUNE 12, 2017

**Metra**

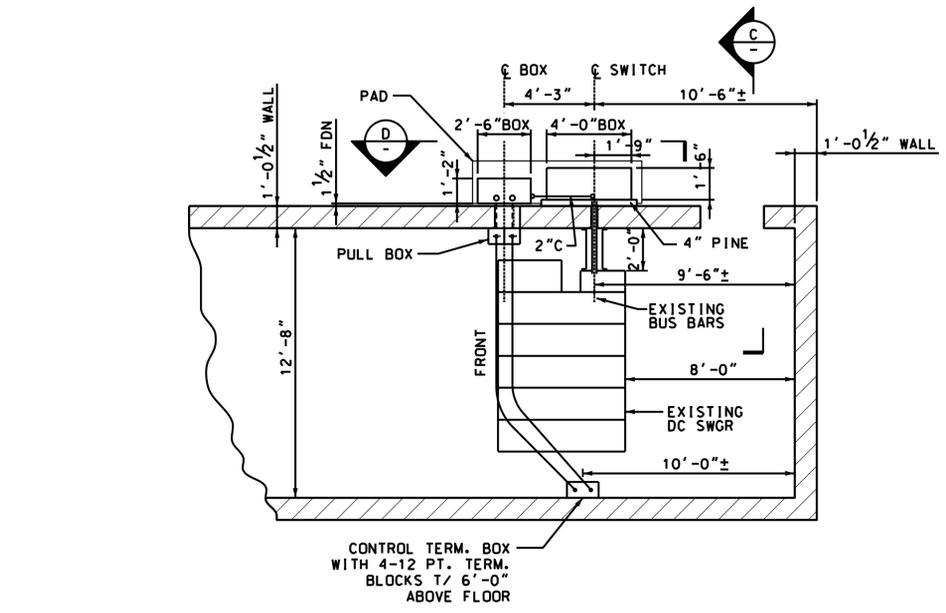
ENGINEERING DEPARTMENT  
547 W. JACKSON BOULEVARD  
CHICAGO, ILLINOIS 60661

LOCATION NAME: <b>RIVERDALE SUBSTATION</b>
TITLE: <b>NEGATIVE AND DRAIN ENCLOSURES</b>

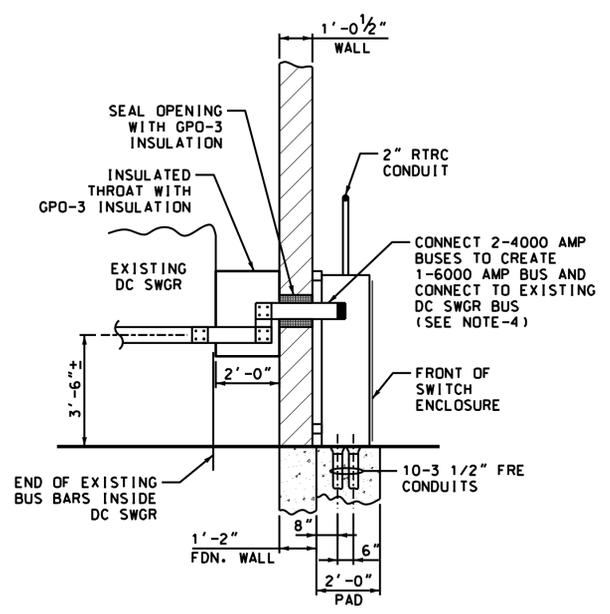
CAD FILE NUMBER: SS-17.5-1082.DGN	
SCALE: AS NOTED	DISTRICT: MED
PROJECT NO. GW4254-57102002	SHEET NO. SS-17.5-1082
MILE POST NO. 17.5	



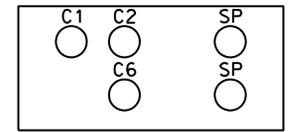
DUCTBANK ENLARGED PLAN  
SCALE: 1/4"=1'-0"



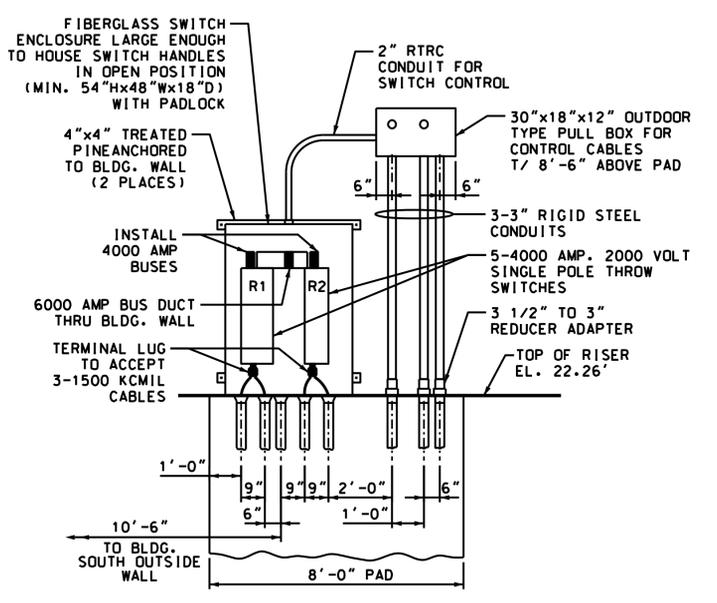
BUILDING PARTIAL PLAN  
SCALE: 1/4"=1'-0"



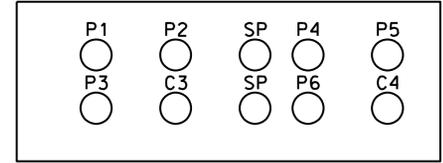
(C) ELEVATION  
SCALE: 3/8"=1'-0"



ENLARGED PLAN OF CONDUIT  
RISER FOR THE PULL BOX



(D) SWITCHBOX FRONT VIEW  
SCALE: 3/8"=1'-0"



ENLARGED PLAN OF CONDUIT  
OPENINGS FOR THE SWITCH ENCLOSURE

- NOTES:**
1. CONTRACTOR SHALL FIELD VERIFY ALL EXISTING INSTALLATIONS AND MAKE NECESSARY ADJUSTMENTS.
  2. ALL EQUIPMENT SHOWN IS NEW, UNLESS IDENTIFIED AS EXISTING.
  3. FOR CABLE TABULATION SEE DWG. SS-17.5-1073.
  4. THE 600 AMP BUS BETWEEN THE SWITCH ENCLOSURE AND EXISTING DC SWITCHGEAR SHALL BE INSTALLED IN A WEATHERPROOF, WATER TIGHT FIBERGLASS DUCT.

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REV	DATE	BY	APP	DESCRIPTION
0	07-28-2017	HS	HS	ISSUED FOR BID

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20 N. Wacker Dr. Ste. 1500 Chicago IL 60606

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DRAWN: JMC  
CHECKED: FM  
METRA P.M.: R. CERANT  
DATE: JUNE 12, 2017

**Metra**

ENGINEERING DEPARTMENT  
547 W. JACKSON BOULEVARD  
CHICAGO, ILLINOIS 60661

LOCATION NAME:  
**RIVERDALE SUBSTATION**

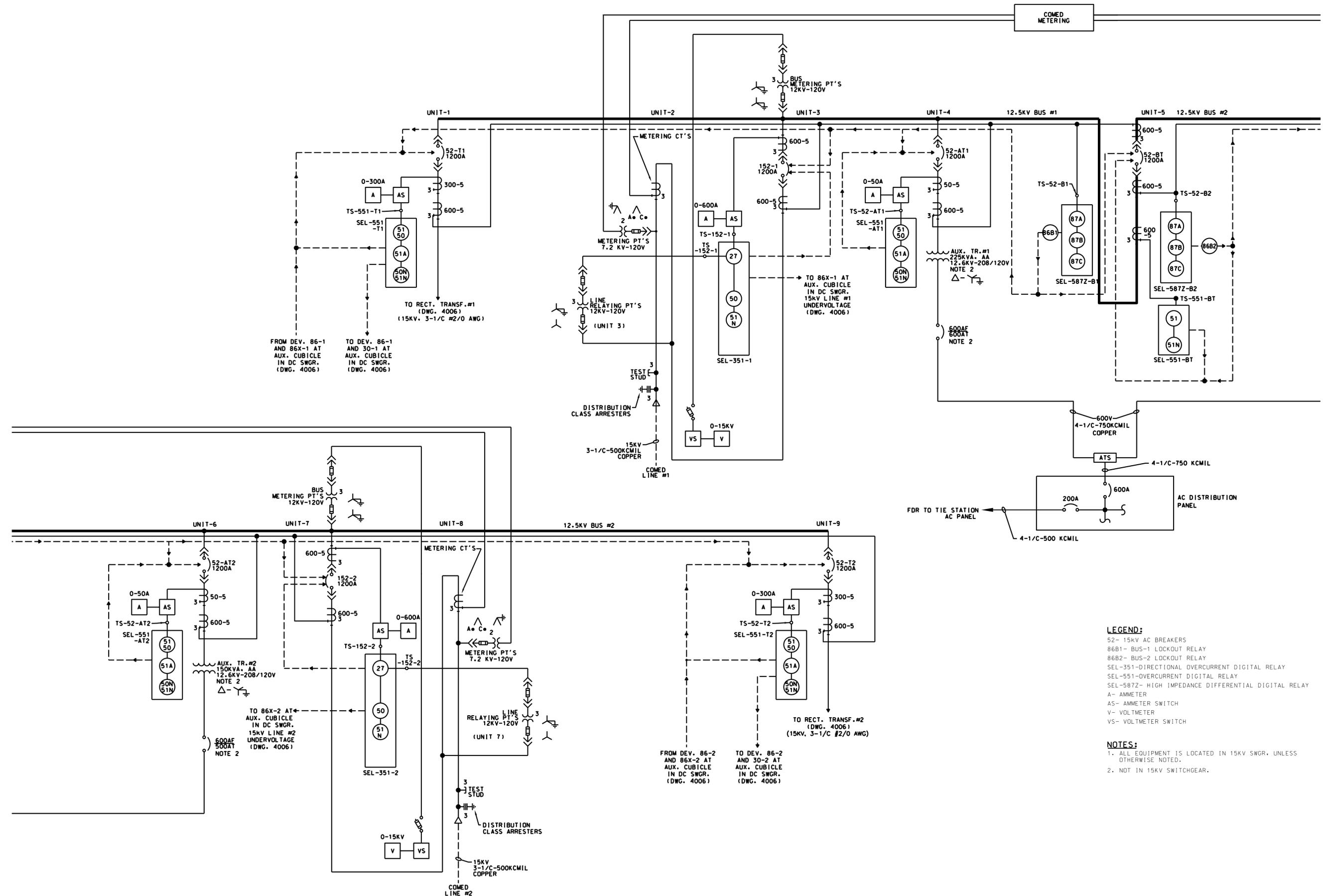
TITLE:  
**ENLARGED PLANS,  
ELEVATIONS AND DETAILS**

CAD FILE NUMBER: SS-17.5-1085.DGN

SCALE: AS NOTED  
DISTRICT: MED

PROJECT NO. GW4254-67102002  
SHEET NO. **SS-17.5-1085**

MILE POST NO. 17.5



CONTINUED BELOW

CONTINUED FROM ABOVE

- LEGEND:**
- 52- 15KV AC BREAKERS
  - 86B1- BUS-1 LOCKOUT RELAY
  - 86B2- BUS-2 LOCKOUT RELAY
  - SEL-351-DIRECTIONAL OVERCURRENT DIGITAL RELAY
  - SEL-551-OVERCURRENT DIGITAL RELAY
  - SEL-587Z- HIGH IMPEDANCE DIFFERENTIAL DIGITAL RELAY
  - A- AMMETER
  - AS- AMMETER SWITCH
  - V- VOLTMETER
  - VS- VOLTMETER SWITCH

- NOTES:**
1. ALL EQUIPMENT IS LOCATED IN 15KV SWGR, UNLESS OTHERWISE NOTED.
  2. NOT IN 15KV SWITCHGEAR.

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REV	DATE	BY	APP	DESCRIPTION	REV	DATE	BY	APP	DESCRIPTION
0	07-28-2017	HS	HS	ISSUED FOR BID					



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 CHECKED: FM  
 METRA P.M.: R. CERANT  
 DATE: JUNE 12, 2017



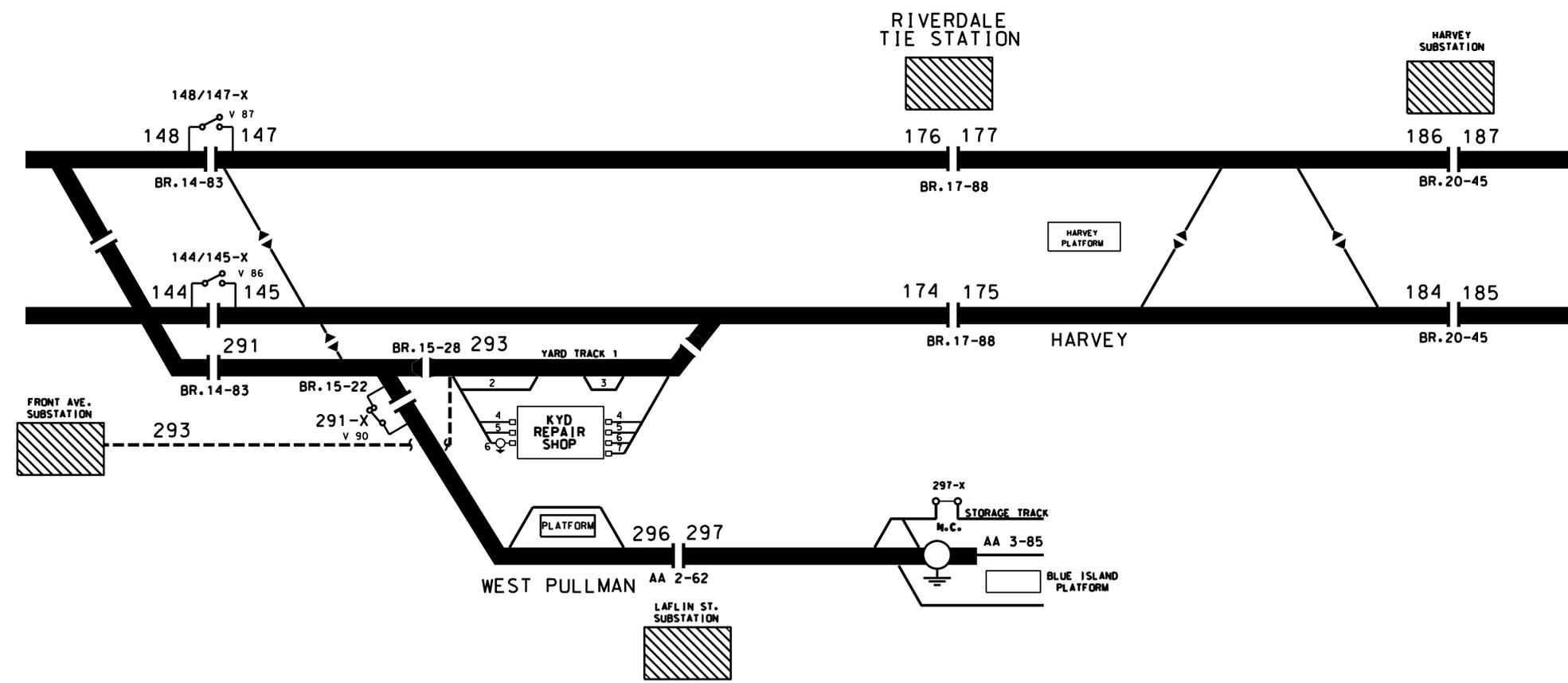
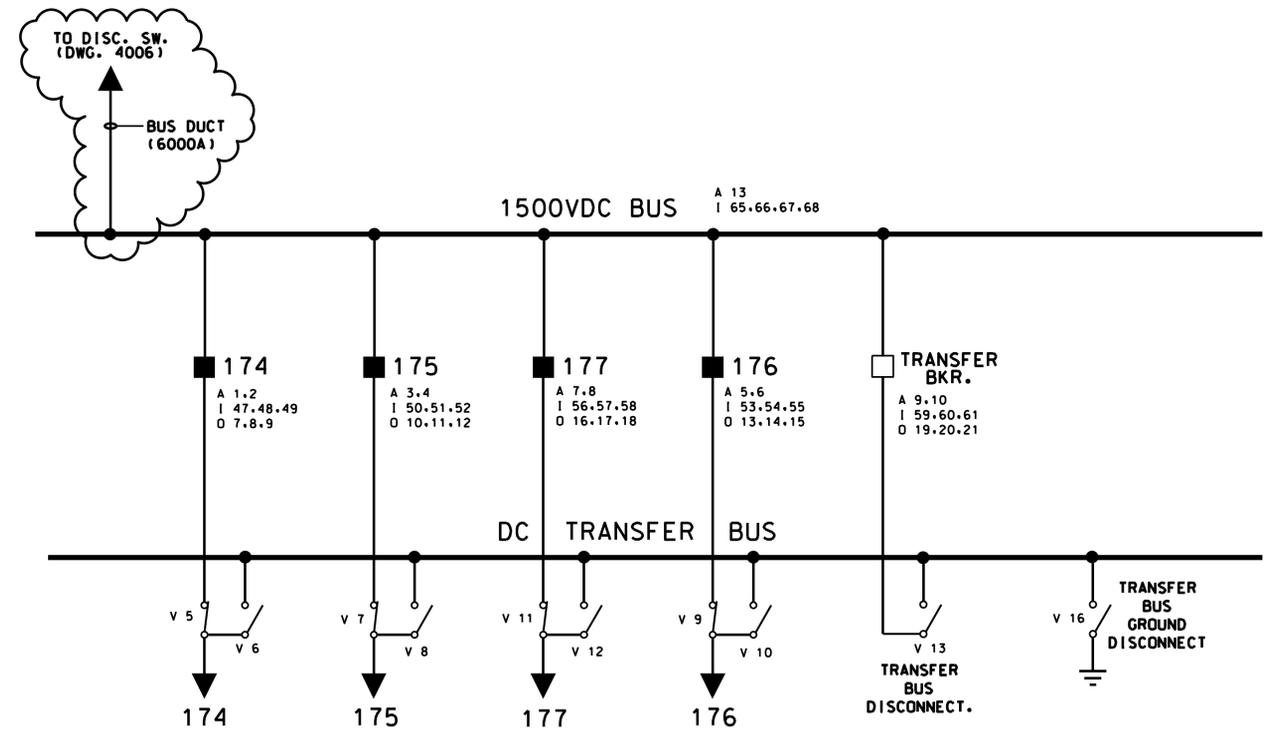
LOCATION NAME:  
**RIVERDALE SUBSTATION**  
 TITLE:  
**12.5KV AC SINGLE LINE DIAGRAM**

CAD FILE NUMBER: SS-17.9-4001.DGN  
 SCALE: NTS  
 DISTRICT: MED  
 PROJECT NO. GW4254-57102002  
 SHEET NO. SS-17.5-4001  
 MILE POST NO. 17.5

# RIVERDALE TIE STATION

FEEDER STRUCTURE 17-88

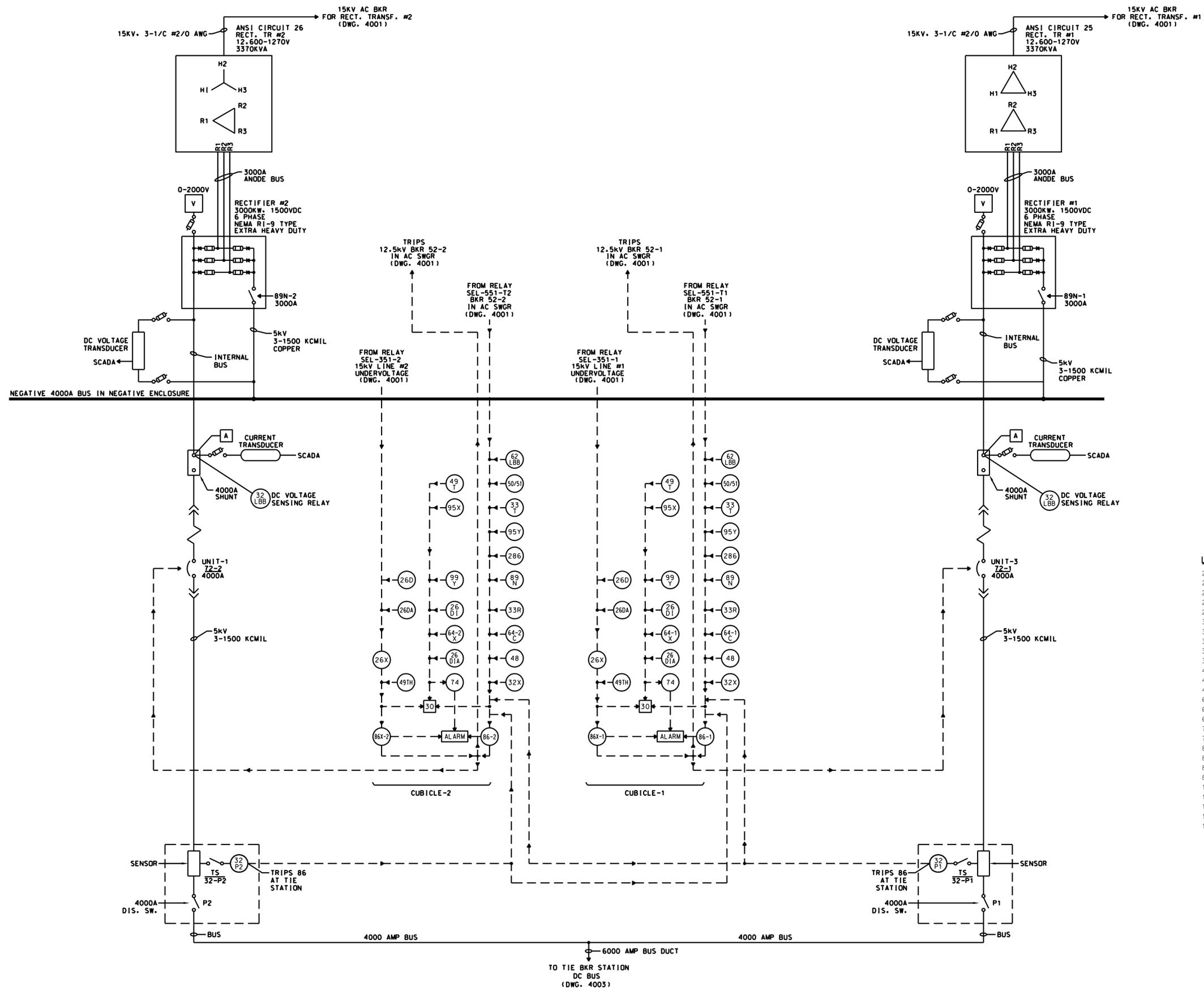
CIRCUIT WITHIN THE CLOUD INDICATES NEW WORK UNDER THIS CONTRACT



REV	DATE	DESCRIPTION	BY
-	07/28/17	ISSUED FOR BID	HS
-	2/12	MINOR CORRECTIONS	WPS
-	11/11	REVISED FOR SOUTH SHORE KENSINGTON INTERLOCKER PROJECT - AS-BUILTS.	WPS
-	3/04	REVISED DWG. NOS.	WPS
-	5/2/99	ADAPTED #4003 FROM DC GRAPHIC DISPLAY DWG.	RAS

BY LDP →

<b>Metra</b> ENGINEERING DEPARTMENT CHICAGO, ILLINOIS	
<b>TRACTION POWER ONE LINE DIAGRAM</b>	
<b>RIVERDALE TIE STATION</b>	
SCALE: NONE	DATE: 10/95
FILE NUMBER: F:\ELEC\EML\RIVERDALE\4003.dgn	DESIGNED: WDS
CHECKED: RAS	APPROVED: WPS
DISTRICT: METRA ELECT.	PROJECT NUMBER: SS-17.5-4003



- LEGEND:**
- 26D- RECT. POS. OVERTEMP-SECOND STEP
  - 26DA- RECT. NEG. OVERTEMP- SECOND STEP
  - 26D1- RECT. POS. OVERTEMP-FIRST STEP
  - 26D1A- RECT. NEG. OVERTEMP- FIRST STEP
  - 26X- AUXILIARY TO 26D AND 26DA
  - 30- RECTIFIER ANNUNCIATOR
  - 32- REVERSE CURRENT TRIP DEVICE
  - 32LBB- CURRENT SENSING RELAY FOR DEV.32 CXT
  - 33R- RECT. COMPT.DOOR POSITION SWITCH
  - 33T- RECT. TR. DOOR POSITION SWITCH
  - 48- INCOMPLETE SEQ. RELAY
  - 49T- TRANS. WINDING OVERTEMP-FIRST STEP
  - 49TH-TRANS WINDING OVERTEMP-SECOND STEP
  - 62LBB- BREAKER BACK-UP TIMING RELAY
  - 64M- RECT. GRD. REL.-GROUNDED STRUCTURE
  - 64X- RECT. GRD. REL.-HOT STRUCTURE
  - 72- CATHODE BREAKER
  - 74- TROUBLE ALARM RELAY
  - 86S- LOCKOUT RELAY-DC SWGR STRUCTURE HOT
  - 86X- CONDITIONAL LOCKOUT RELAY
  - 86-HAND RESET LOCKOUT RELAY
  - 89N- RECTIFIER NEG. DISC. SW.
  - 129- LOAD MEASURING CONTACTOR
  - 150RR- RATE OF RISE DIGITAL RELAY
  - 164M- DC SWGR GRD RELAY-GROUNDED STRUCTURE
  - 164X- DC SWGR GRD RELAY-HOT STRUCTURE
  - 164XX-AUX RELAY TO DEVICE 164X

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DRAWN: JMC  
CHECKED: FM  
METRA P.M.: R. CERANT  
DATE: JUNE 12, 2017



LOCATION NAME:  
**RIVERDALE SUBSTATION**

TITLE:  
**TRANSF'S, RECTIFIERS & DC SWGR  
SINGLE LINE DIAGRAM**

CAD FILE NUMBER: SS-17.5-4006.DGN

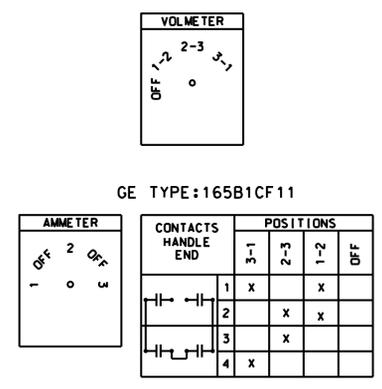
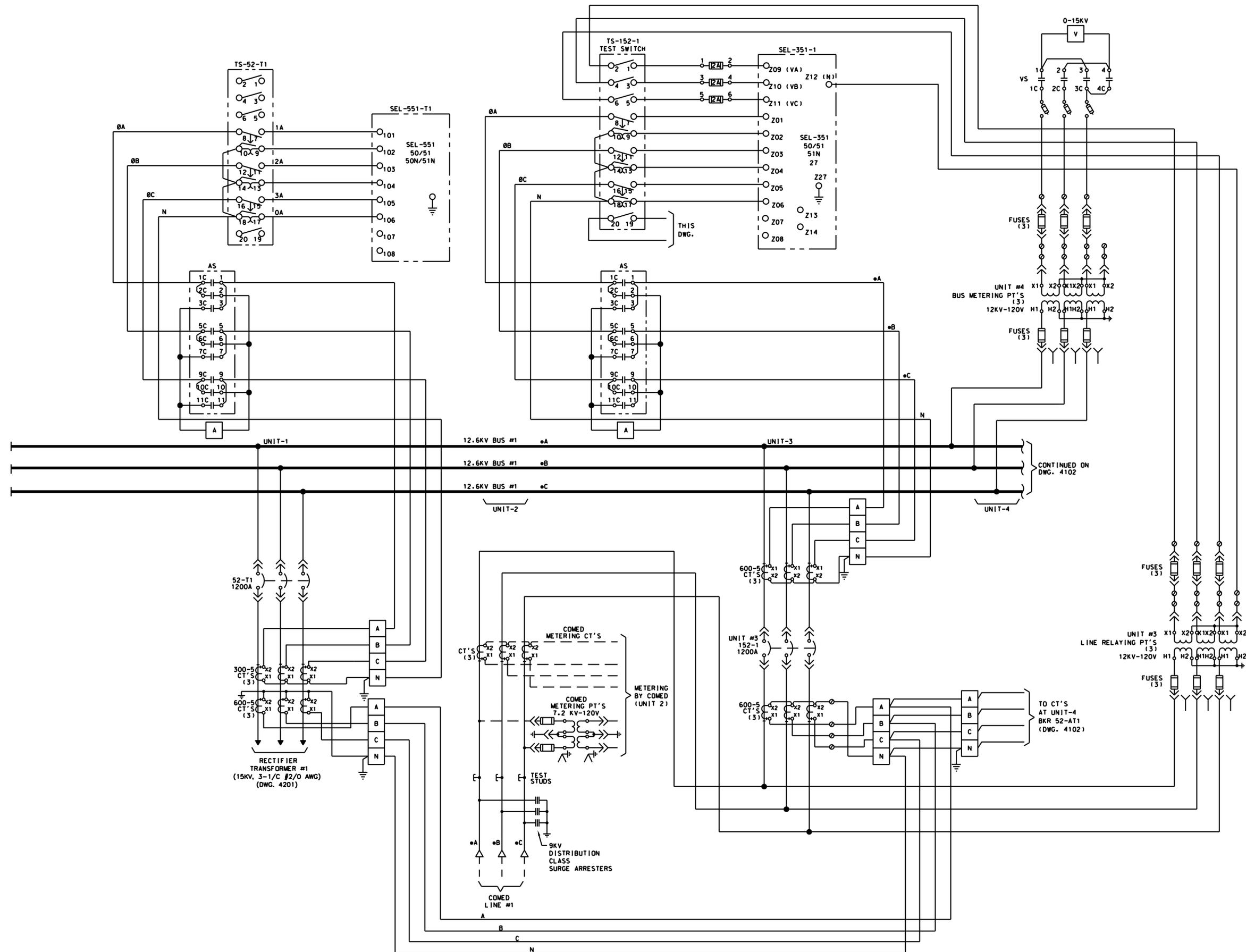
SCALE:  
NTS

DISTRICT:  
MED

PROJECT NO.  
GW4254-57102002

SHEET NO.  
**SS-17.5-4006**

MILE POST NO.  
17.5



GE TYPE:165B1CF11

CONTACTS HANDLE END	POSITIONS			
	3-1	2-3	1-2	Df
1	X		X	
2		X	X	
3		X		X
4	X			

GE TYPE:165B1CF15

CONTACTS HANDLE END	POSITIONS							
	3	•	Df	•	2	•	Df	1
1	X	X	X	X	X	X	X	X
2								X
3								X
5	X	X	X	X		X	X	X
6				X	X	X		
7				X	X	X		
9		X	X	X	X	X	X	X
10	X	X						
11	X	X						

**LEGEND:**  
 52 OR 152- 15KV AC BREAKER  
 SEL-351- DIRECTIONAL OVERCURRENT DIGITAL RELAY  
 SEL-551- OVERCURRENT DIGITAL RELAY  
 TS/52 OR 152- TEST SWITCH  
 AS- AMMETER SWITCH  
 A- AMMETER  
 VS-VOLTMETER SWITCH  
 V- VOLTMETER

**NOTES:**  
 1. ALL EQUIPMENT IS LOCATED IN 15KV SWGR. UNLESS OTHERWISE NOTED.  
 2. ALL CTS SHALL BE WIRED TO A SHORTING TERMINAL BLOCK PRIOR TO CONNECTING TO A DEVICE.

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REV	DATE	BY	APP	DESCRIPTION
0	07-28-2017	HS	HS	ISSUED FOR BID

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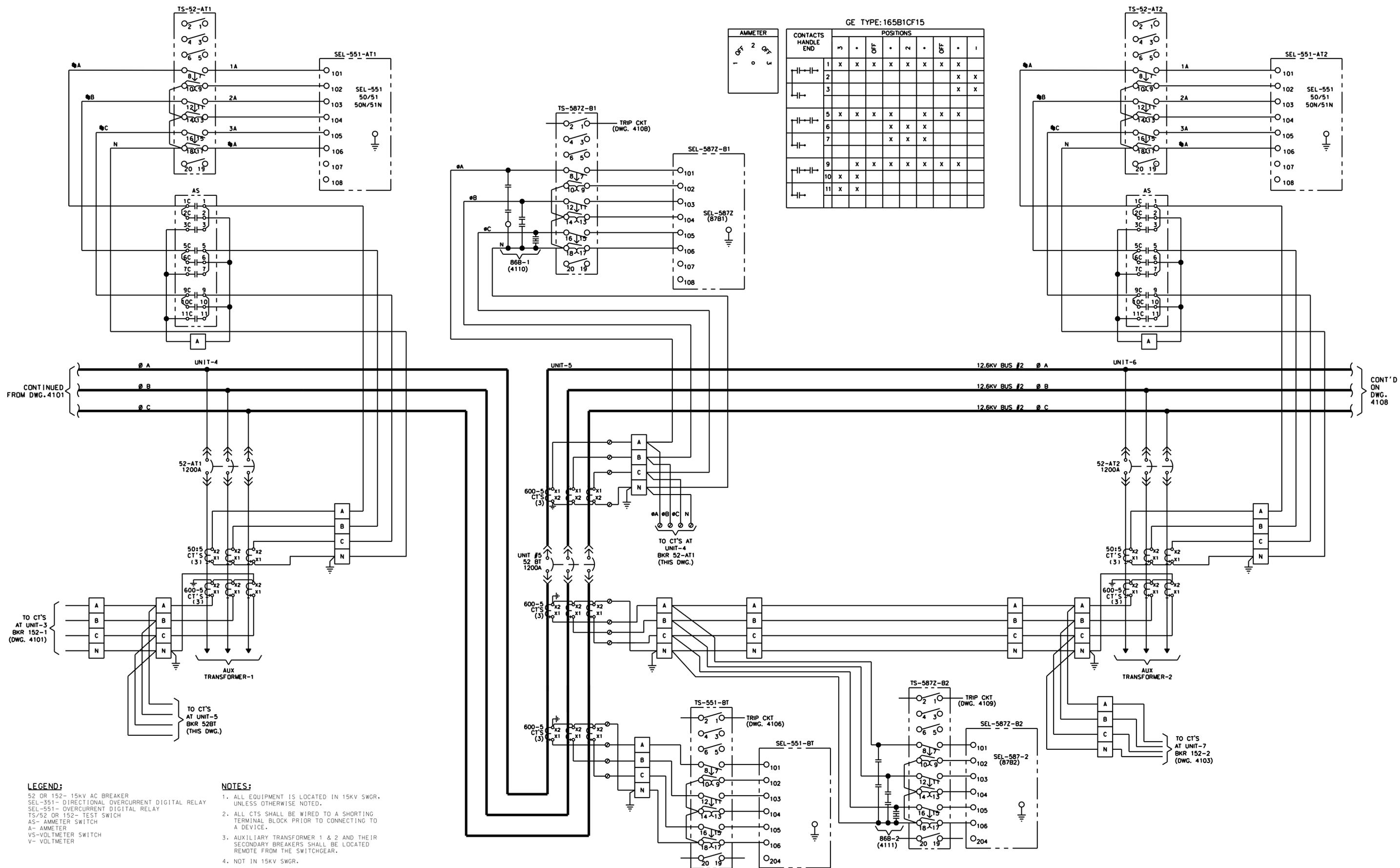
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 20 N. Wacker Dr. Ste. 1500 Chicago Il. 60606

DESIGNED: HS  
 DRAWN: JMC  
 CHECKED: FM  
 METRA P.M.: R. CERANT  
 DATE: JUNE 12, 2017



LOCATION NAME:  
**RIVERDALE SUBSTATION**  
 TITLE:  
**12.5KV AC THREE LINE DIAGRAM SHEET 1 OF 3**

CAD FILE NUMBER: SS-17.5-4101.DGN  
 SCALE: NTS  
 PROJECT NO. GW4254-57102002  
 MILE POST NO. 17.5  
 DISTRICT: MED  
 SHEET NO. **SS-17.5-4101**



AMMETER

OFF	2	OFF
1	0	3

GE TYPE: 165B1CF15

CONTACTS HANDLE END	POSITIONS										
	5	•	OFF	•	2	•	OFF	•	1		
1	X	X	X	X	X	X	X	X	X	X	X
2										X	X
3											
5	X	X	X	X	X	X	X	X	X	X	X
6					X	X	X	X			
7					X	X	X	X			
9	X	X	X	X	X	X	X	X	X	X	X
10	X	X									
11	X	X									

**LEGEND:**  
 52 OR 152- 15KV AC BREAKER  
 SEL-351- DIRECTIONAL OVERCURRENT DIGITAL RELAY  
 SEL-551- OVERCURRENT DIGITAL RELAY  
 TS/52 OR 152- TEST SWITCH  
 AS- AMMETER SWITCH  
 A- AMMETER  
 VS-VOLTMETER SWITCH  
 V- VOLTMETER

**NOTES:**  
 1. ALL EQUIPMENT IS LOCATED IN 15KV SWGR, UNLESS OTHERWISE NOTED.  
 2. ALL CTS SHALL BE WIRED TO A SHORTING TERMINAL BLOCK PRIOR TO CONNECTING TO A DEVICE.  
 3. AUXILIARY TRANSFORMER 1 & 2 AND THEIR SECONDARY BREAKERS SHALL BE LOCATED REMOTE FROM THE SWITCHGEAR.  
 4. NOT IN 15KV SWGR.

PRINTED ON: SDATES

REV	DATE	BY	APP	DESCRIPTION
0	07-28-2017	HS	HS	ISSUED FOR BID



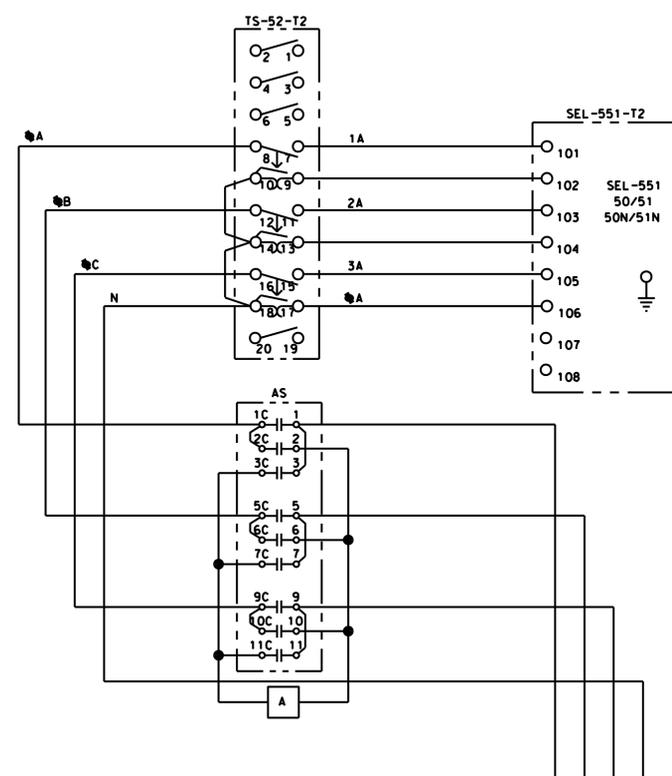
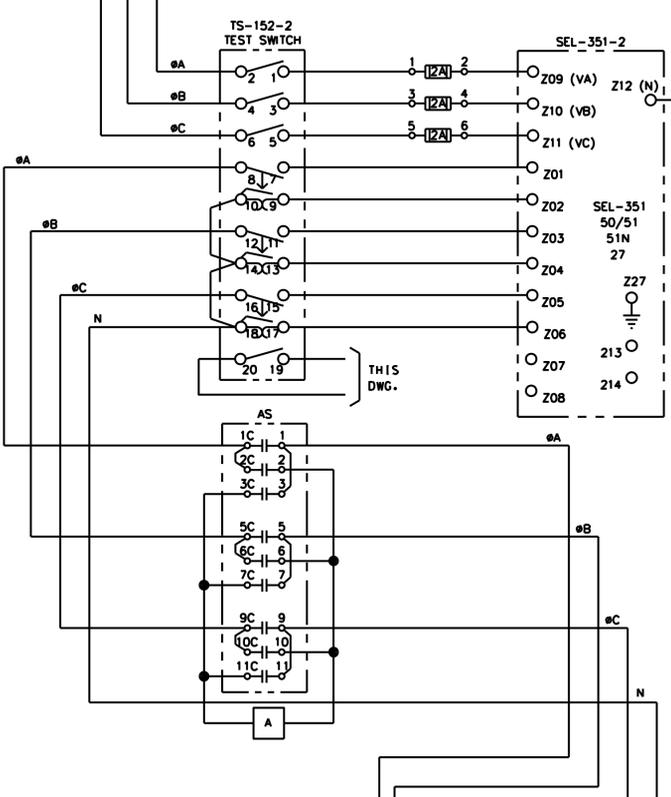
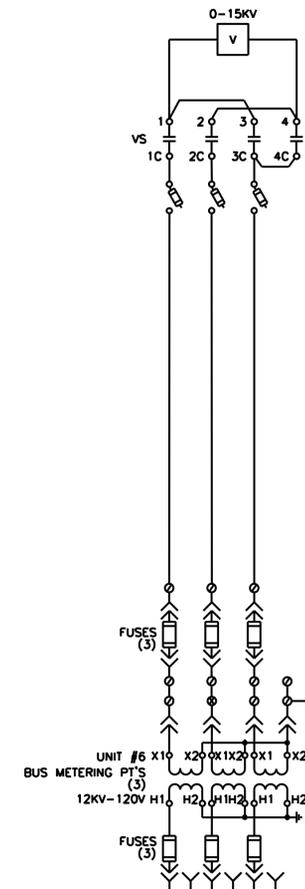
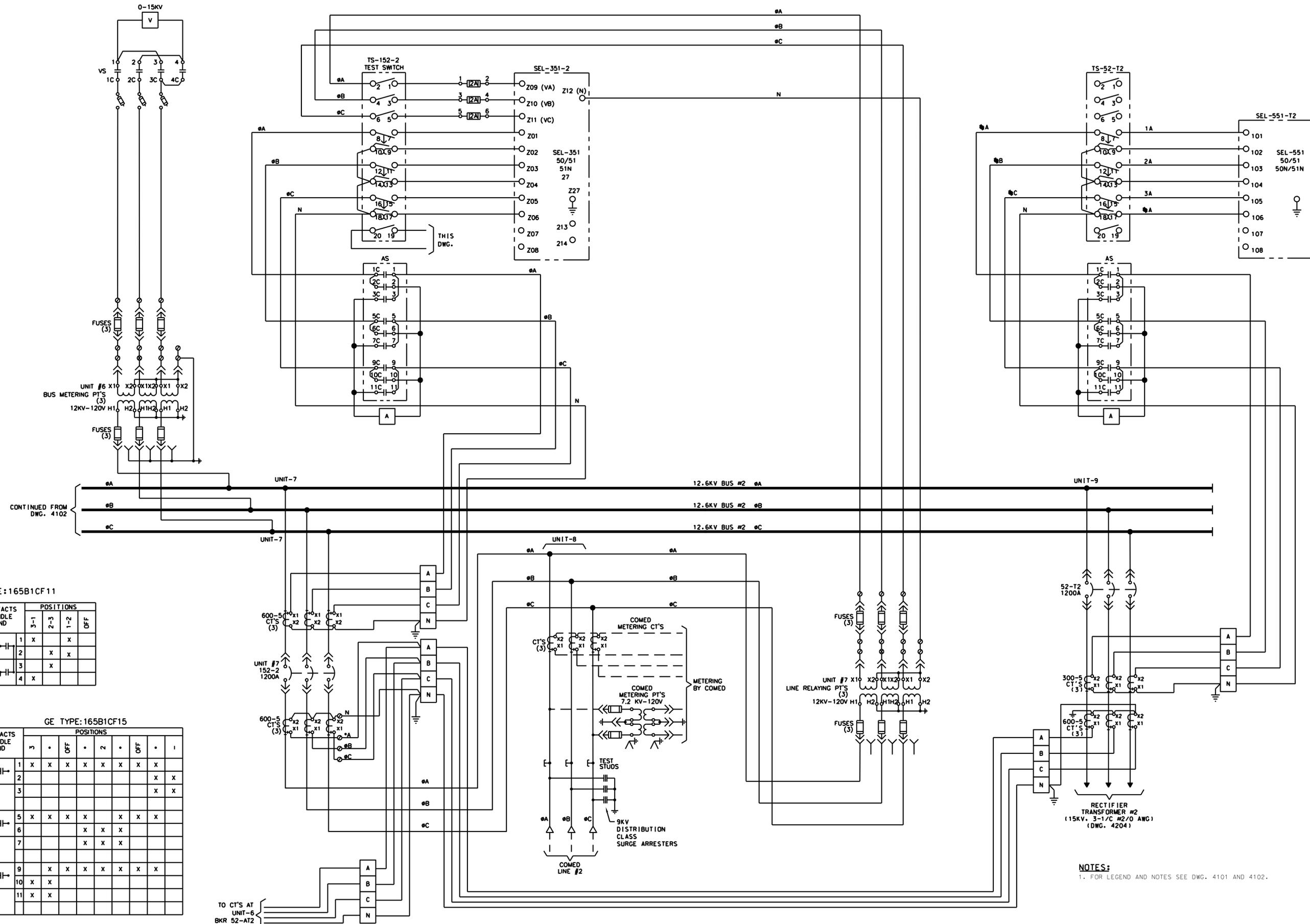
CONSULTANT SEAL & SIGNATURE  
 CONSULTANT  
**IDP**  
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 Consulting Engineers  
 20 N. Wacker Dr. Ste. 1500 Chicago Il. 60606

DESIGNED: HS  
 DRAWN: JMC  
 CHECKED: FM  
 METRA P.M.: R. CERANT  
 DATE: JUNE 12, 2017



LOCATION NAME:  
**RIVERDALE SUBSTATION**  
 TITLE:  
**12.5KV AC THREE LINE DIAGRAM SHEET 2 OF 3**

CAD FILE NUMBER: SS-17.5-4102.DGN  
 SCALE: NTS  
 DISTRICT: MED  
 PROJECT NO. GW4254-57102002  
 SHEET NO. SS-17.5-4102  
 MILE POST NO. 17.5



GE TYPE: 165B1CF11

CONTACTS HANDLE END	POSITIONS			
	3-1	2-3	1-2	DF
1	X		X	
2		X	X	
3			X	
4	X			

GE TYPE: 165B1CF15

CONTACTS HANDLE END	POSITIONS							
	3	.	OFF	.	2	.	OFF	1
1	X	X	X	X	X	X	X	X
2								X
3								X
5	X	X	X	X	X	X	X	X
6				X	X	X		
7				X	X	X		
9		X	X	X	X	X	X	X
10	X	X						
11	X	X						

NOTES:  
1. FOR LEGEND AND NOTES SEE DWG. 4101 AND 4102.

PRINTED ON: SDATES

REV	DATE	BY	APP	DESCRIPTION
0	07-28-2017	HS	HS	ISSUED FOR BID



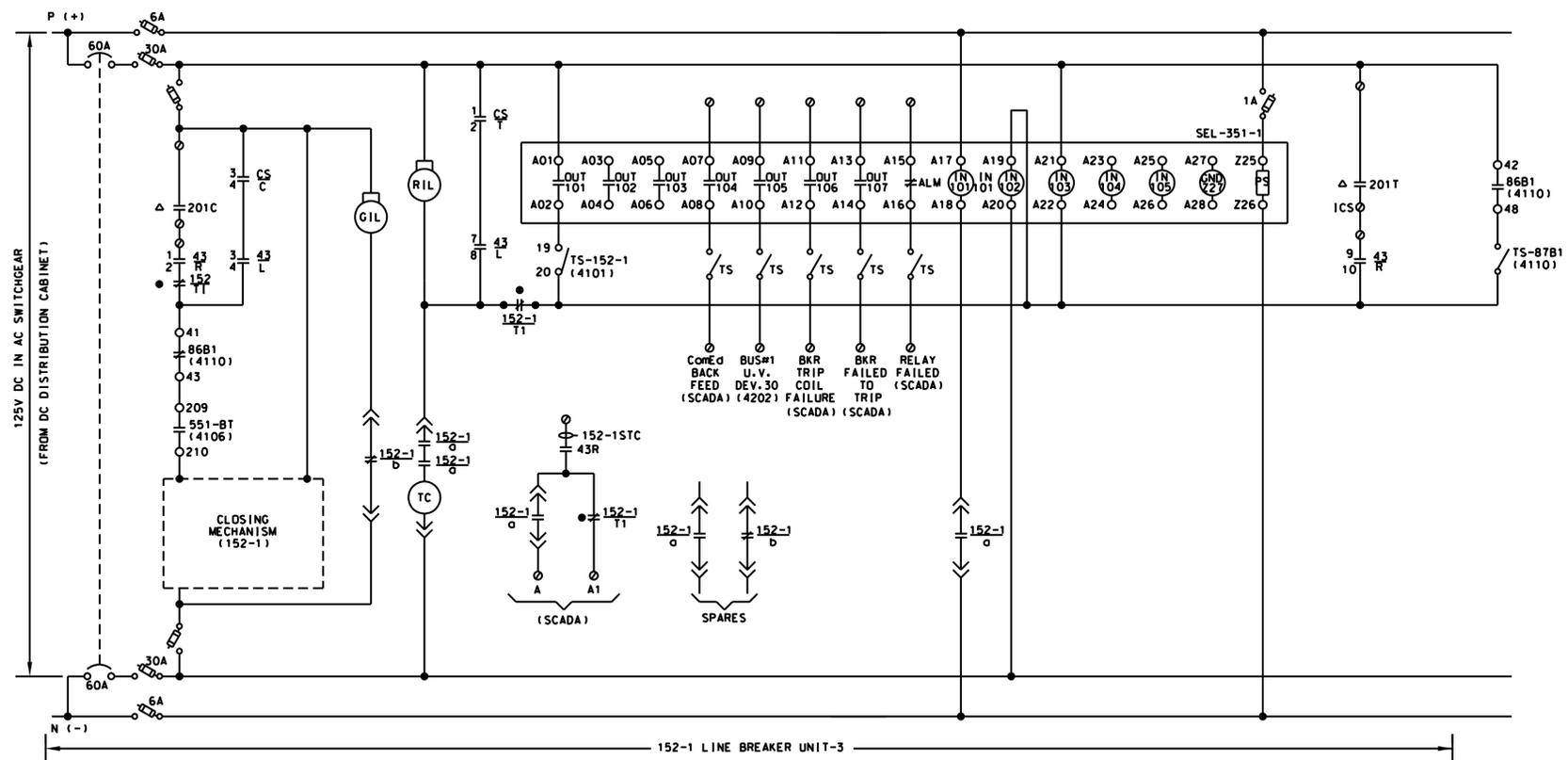
CONSULTANT SEAL & SIGNATURE  
CONSULTANT  
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Consulting Engineers  
20 N. Wacker Dr. Ste. 1500 Chicago IL 60606

DESIGNED: HS  
DRAWN: JMC  
CHECKED: FM  
METRA P.M.: R. CERANT  
DATE: JUNE 12, 2017

**Metra**  
ENGINEERING DEPARTMENT  
547 W. JACKSON BOULEVARD  
CHICAGO, ILLINOIS 60661

LOCATION NAME:  
**OVERSEAS SUBSTATION**  
TITLE:  
**12.5KV AC THREE LINE DIAGRAM  
SHEET 3 OF 3**

CAD FILE NUMBER: SS-17.9-4103.DGN  
SCALE: NTS  
DISTRICT: MED  
PROJECT NO. GW4254-57102002  
SHEET NO. SS-17.5-4103  
MILE POST NO. 17.5



CONTROL-SWITCH DEVICE-CS

CONTACTS	POSITION		
	TRIP	OFF AFTER TRIP	CLOSE
1-2	T	X	
3-4	C		X

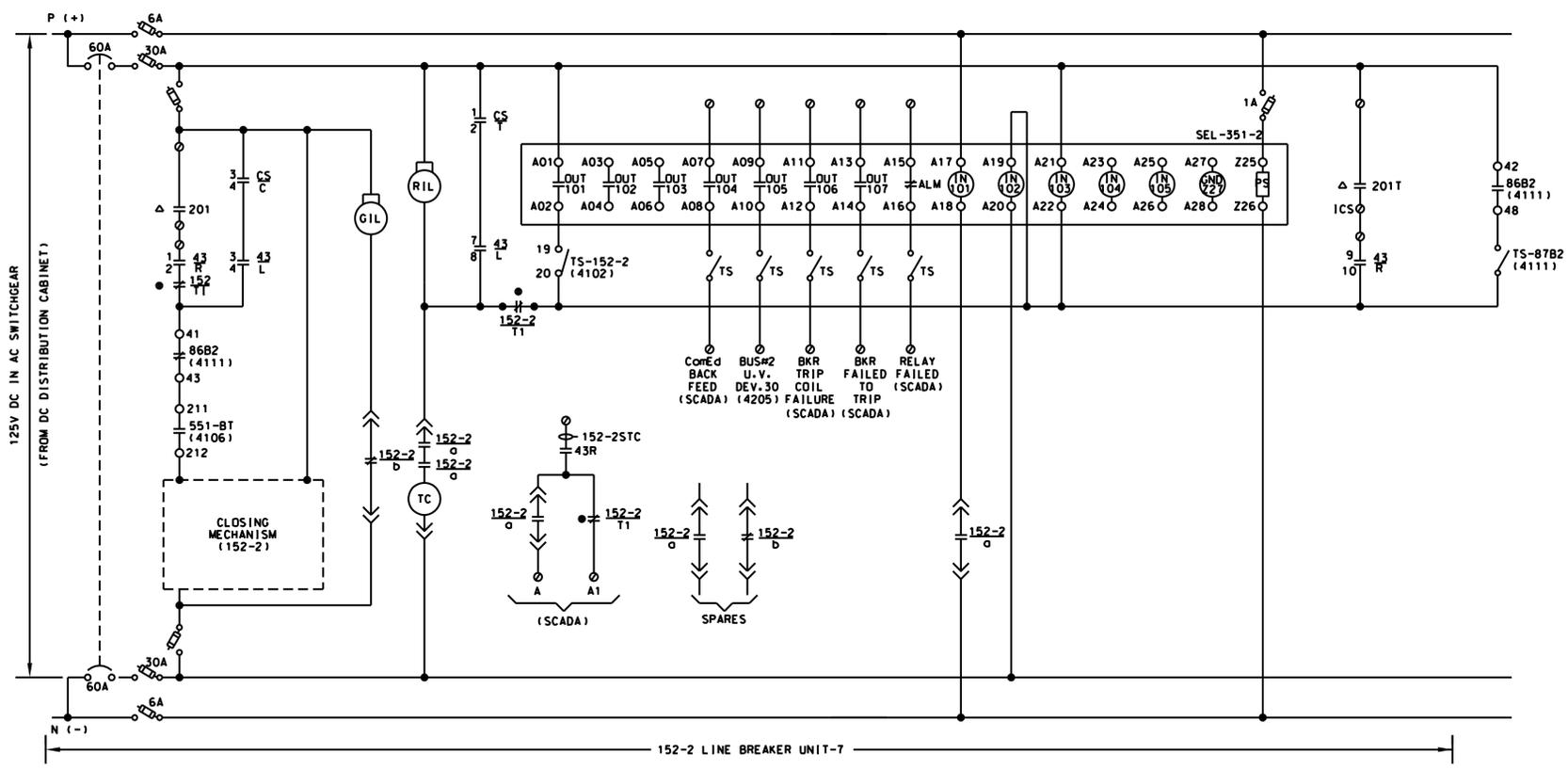
SPRING RETURN TO "OFF"

SELECTOR SWITCH DEVICE-43

CONTACTS	POSITION	
	REMOTE	LOCAL
1-2	R	X
3-4	L	X
5-6	R	X
7-8	L	X
9-10	R	X
11-12	L	X

NON-SPRING RETURN.  
REMOTE POSITION AT 12 O' CLOCK.  
LOCAL POSITION CLOCKWISE WHEN FACING FRONT OF SWITCH

LEGEND:  
 ▲-LOCATED IN SCADA RTU CABINET  
 ●-CLOSED ONLY WITH BREAKER IN CONNECTED POSITION  
 ▲-OPEN ONLY WITH BREAKER IN CONNECTED POSITION  
 ○-TERMINAL BLOCK



NOTES:  
 1. ALL EQUIPMENT IS LOCATED IN 15KV SWGR. UNLESS OTHERWISE NOTED.  
 2. NUMBER IN PARENTHESIS REFERS TO A DRAWING NUMBER.

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REV	DATE	BY	APP	DESCRIPTION
0	07-28-2017	HS	HS	ISSUED FOR BID



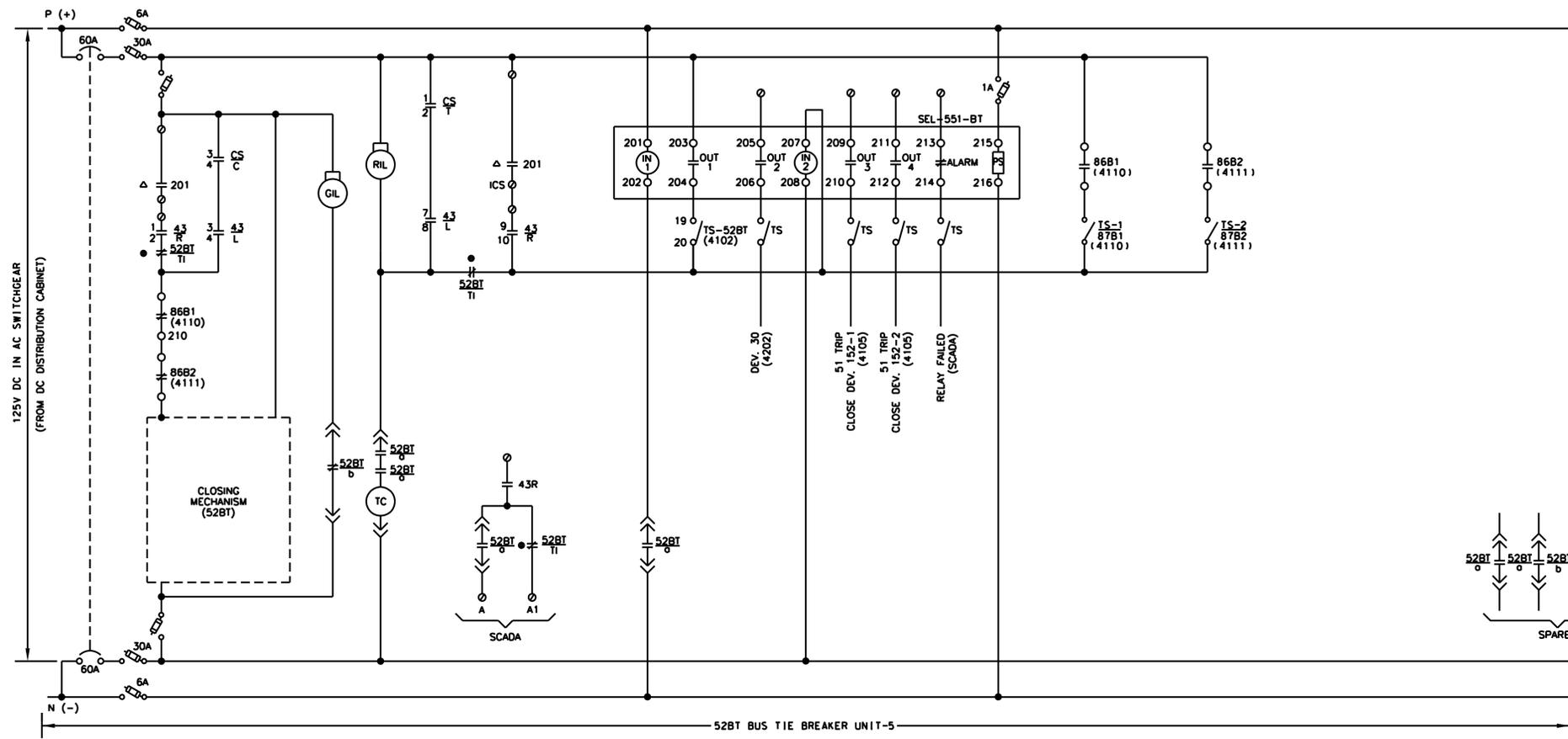
CONSULTANT SEAL & SIGNATURE  
 CONSULTANT  
**IDP**  
 A Company of  
**Gannett Fleming**  
 Consulting Engineers  
 20 N. Wacker Dr. Ste. 1500 Chicago Il. 60606

DESIGNED: HS  
 DRAWN: JMC  
 CHECKED: FM  
 METRA P.M.: R. CERANT  
 DATE: JUNE 12, 2017



LOCATION NAME:  
**RIVERDALE SUBSTATION**  
 TITLE:  
**12.5KV AC SCHEMATIC DIAGRAM  
 INC. LINE BKRS. 152-1 & 152-2**

CAD FILE NUMBER: SS-17.5-4105.DGN	
SCALE: NTS	DISTRICT: MED
PROJECT NO. GW4254-57102002	SHEET NO. <b>SS-17.5-4105</b>
MILE POST NO. 17.5	



CONTROL-SWITCH DEVICE-CS

CONTACTS	POSITION		
	TRIP	OFF AFTER TRIP	CLOSE
1-2	T	X	
3-4	C		X

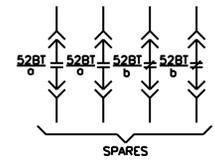
SPRING RETURN TO "OFF"

SELECTOR SWITCH DEVICE-43

CONTACTS	POSITION	
	REMOTE	LOCAL
1-2	R	X
3-4	L	X
5-6	R	X
7-8	L	X
9-10	R	X
11-12	L	X

NON-SPRING RETURN.  
 REMOTE POSITION AT 12 O' CLOCK.  
 LOCAL POSITION CLOCKWISE WHEN FACING FRONT OF SWITCH

**LEGEND:**  
 ▲-LOCATED IN SCADA RTU CABINET  
 ●-CLOSED ONLY WITH BREAKER IN CONNECTED POSITION  
 ▲-OPEN ONLY WITH BREAKER IN CONNECTED POSITION  
 ⊙-TERMINAL BLOCK



**NOTES:**  
 1. ALL EQUIPMENT IS LOCATED IN 15KV SWGR. UNLESS OTHERWISE NOTED.  
 2. NUMBER IN PARENTHESIS REFERS TO A DRAWING NUMBER.

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REV	DATE	BY	APP	DESCRIPTION
0	07-28-2017	HS	HS	ISSUED FOR BID

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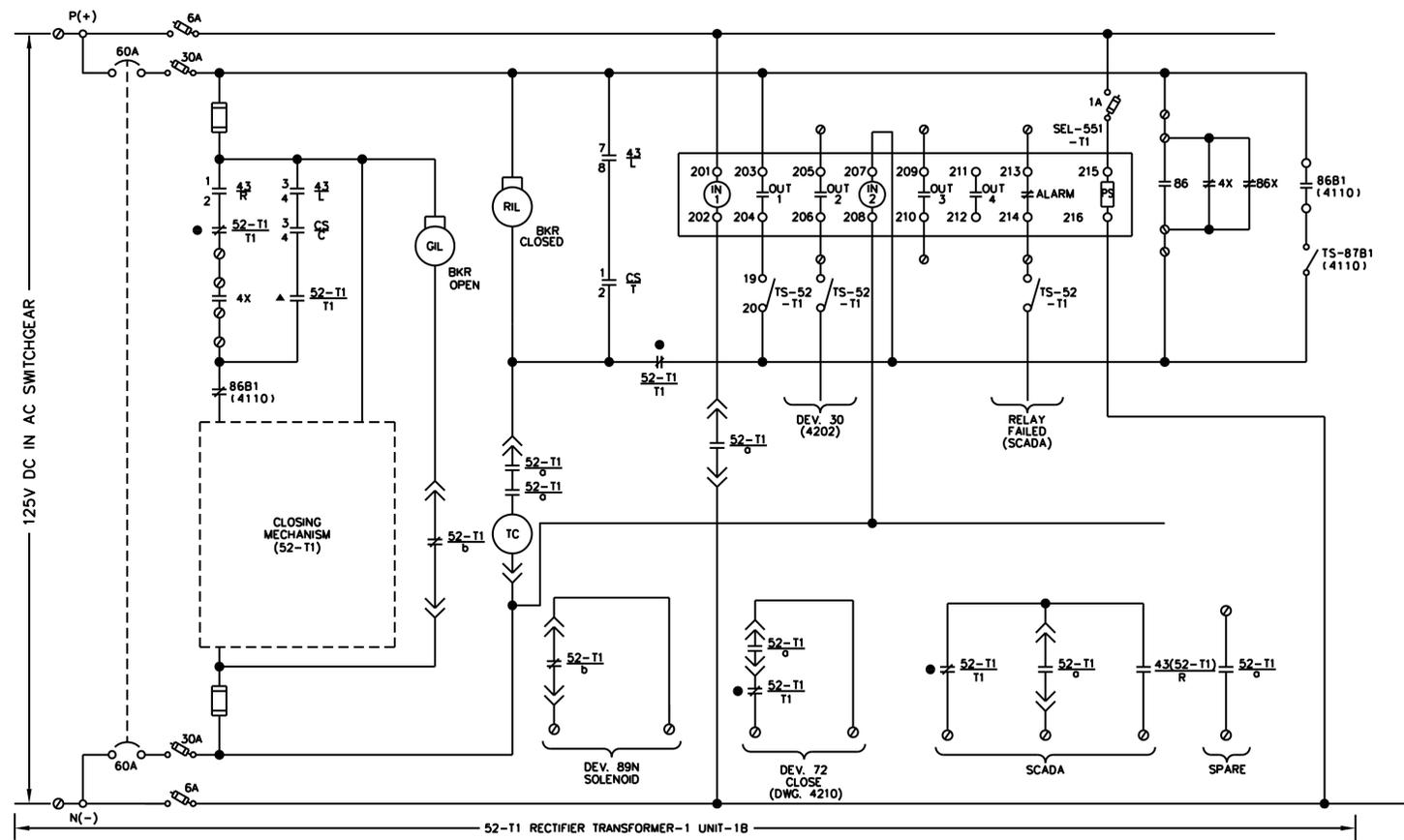
DESIGNED: HS  
 DRAWN: JMC  
 CHECKED: FM  
 METRA P.M.: R. CERANT  
 DATE: JUNE 12, 2017



LOCATION NAME:  
**RIVERDALE SUBSTATION**

TITLE:  
**12.5KV AC SCHEMATIC DIAGRAM  
 BUS TIE BKR. 52BT**

CAD FILE NUMBER: SS-17.5-4106.DGN	
SCALE: NTS	DISTRICT: MED
PROJECT NO. GW4254-57102002	SHEET NO. <b>SS-17.5-4106</b>
MILE POST NO. 17.5	



CONTROL-SWITCH DEVICE-CS

CONTACTS	POSITION		
	TRIP	OFF AFTER TRIP	CLOSE
1-2	T	X	
3-4	C		X

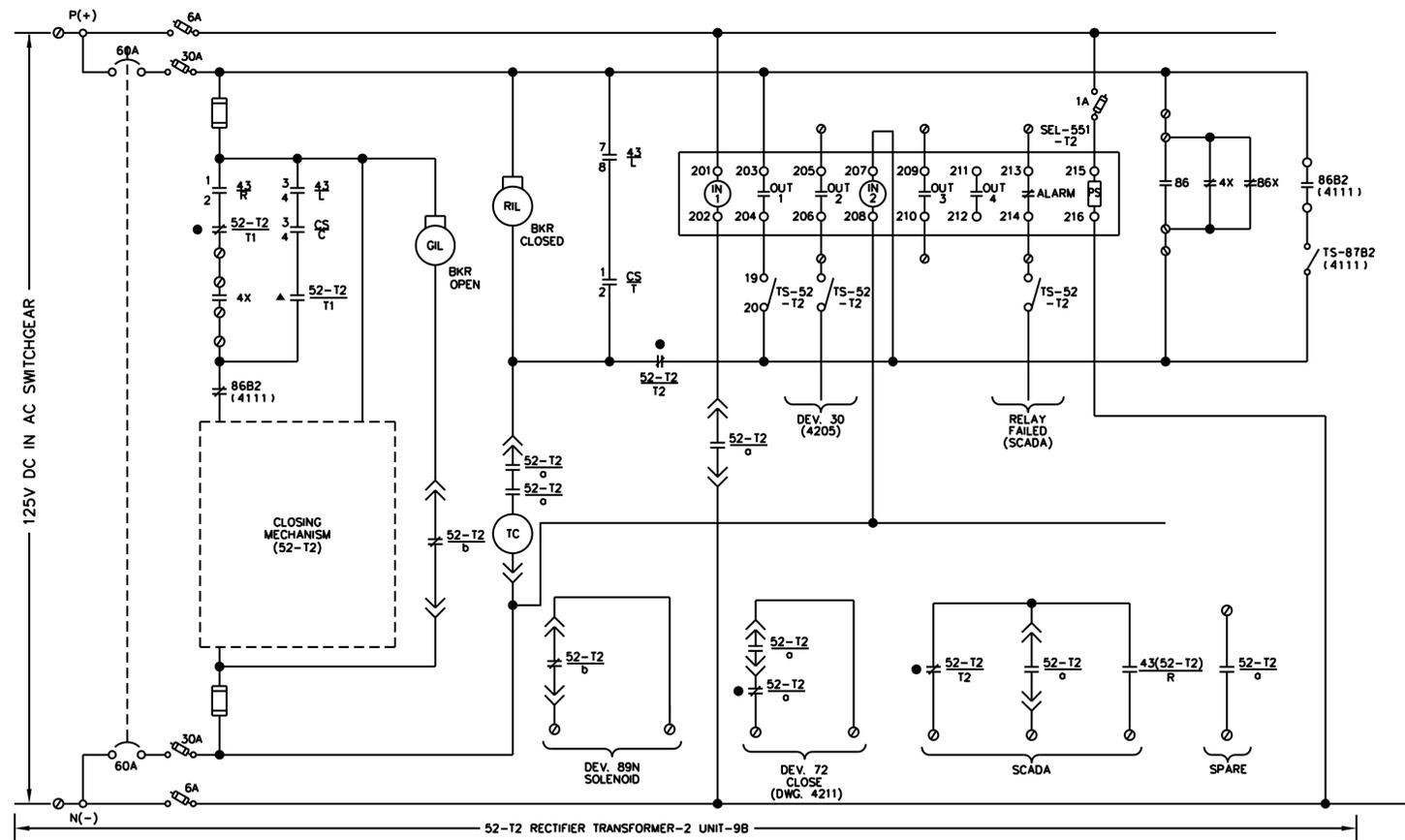
SPRING RETURN TO "OFF"

SELECTOR SWITCH DEVICE-43

CONTACTS	POSITION	
	REMOTE	LOCAL
1-2	R	X
3-4	L	X
5-6	R	X
7-8	L	X
9-10	R	X
11-12	L	X

NON-SPRING RETURN.  
REMOTE POSITION AT 12 O' CLOCK.  
LOCAL POSITION CLOCKWISE WHEN FACING FRONT OF SWITCH

LEGEND:  
 ▲-LOCATED IN SCADA RTU CABINET  
 ●-CLOSED ONLY WITH BREAKER IN CONNECTED POSITION  
 ▲-OPEN ONLY WITH BREAKER IN CONNECTED POSITION  
 ○-TERMINAL BLOCK



NOTES:  
 1. ALL EQUIPMENT IS LOCATED IN 15KV SWGR. UNLESS OTHERWISE NOTED.  
 2. NUMBER IN PARENTHESIS REFERS TO A DRAWING NUMBER.

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 20 N. Wacker Dr. Ste. 1500 Chicago Il. 60606

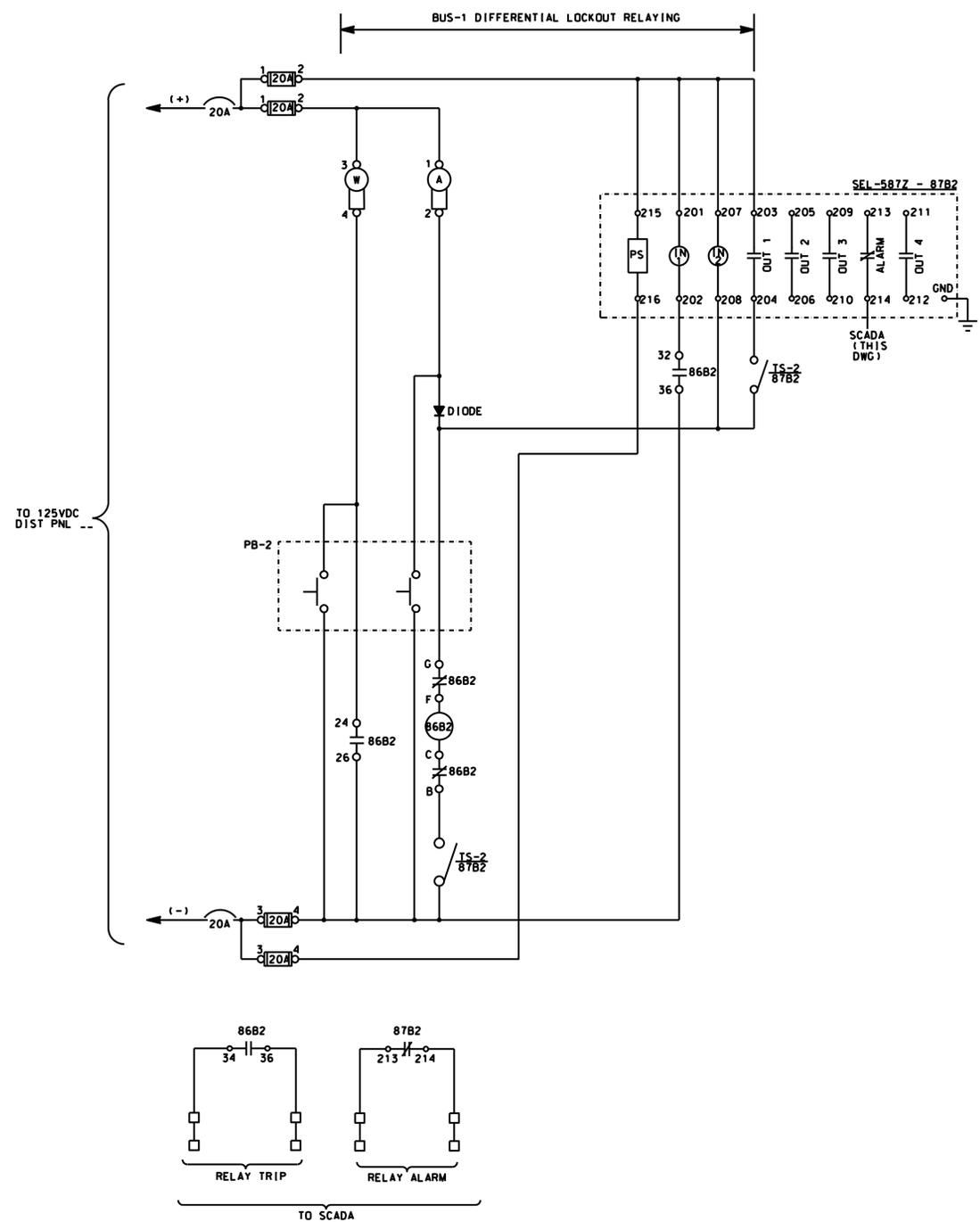
DESIGNED: HS  
 DRAWN: JMC  
 CHECKED: FM  
 METRA P.M.: R. CERANT  
 DATE: JUNE 12, 2017

**Metra**  
 ENGINEERING DEPARTMENT  
 547 W. JACKSON BOULEVARD  
 CHICAGO, ILLINOIS 60661

LOCATION NAME:  
**RIVERDALE SUBSTATION**  
 TITLE:  
**12.5KV AC SCHEMATIC DIAGRAM  
 RECT. TRANSF. BKR. 52-T1 & 52-T2**

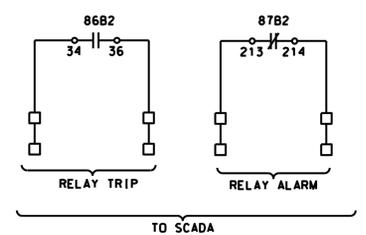
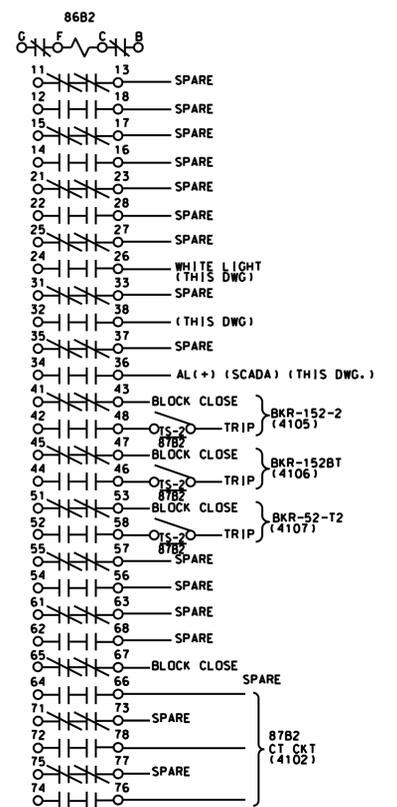
CAD FILE NUMBER: SS-17.5-4107.DGN  
 SCALE: NTS  
 DISTRICT: MED  
 PROJECT NO. GW4254-57102002  
 SHEET NO. **SS-17.5-4107**  
 MILE POST NO. 17.5





LOCKOUT RELAY 86B2  
X - DENOTES CLOSED IN POSITION

DECK	CONTACTS	POSITION
1	110-1-1-013	X
1	12-1-1-018	X
1	15-1-1-017	X
1	14-1-1-016	X
2	210-1-1-023	X
2	22-1-1-028	X
2	25-1-1-027	X
2	24-1-1-026	X
3	310-1-1-033	X
3	32-1-1-038	X
3	35-1-1-037	X
3	34-1-1-036	X
4	410-1-1-043	X
4	42-1-1-048	X
4	45-1-1-047	X
4	44-1-1-046	X
5	510-1-1-053	X
5	52-1-1-058	X
5	54-1-1-056	X
6	610-1-1-063	X
6	62-1-1-068	X
6	65-1-1-067	X
6	64-1-1-066	X
7	710-1-1-073	X
7	72-1-1-078	X
7	75-1-1-077	X
7	74-1-1-076	X



**LEGEND:**  
 87B2 BUS-2-DIFFERENTIAL RELAY  
 86B2 BUS-2-LOCKOUT RELAY  
 TS-2 TEST SWITCH FOR BUS DIFFERENTIAL AND LOCKOUT RELAY FOR BUS-2  
 PB MOMENTARY TEST PUSHBUTTON

**NOTES:**  
 1. NUMBER IN PARENTHESIS REFERS TO A DRAWING NUMBER

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0	07-28-2017	HS	HS	ISSUED FOR BID

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 20 N. Wacker Dr. Ste. 1500 Chicago IL 60606

DESIGNED: HS  
 DRAWN: JMC  
 CHECKED: FM  
 METRA P.M.: R. CERANT  
 DATE: JUNE 12, 2017

ENGINEERING DEPARTMENT  
 547 W. JACKSON BOULEVARD  
 CHICAGO, ILLINOIS 60661

LOCATION NAME:  
**RIVERDALE SUBSTATION**

TITLE:  
**12.5KV AC SCHEMATIC DIAGRAM  
 BUS-2 DIFFERENTIAL LOCKOUT**

CAD FILE NUMBER: SS-17.5-4111.DGN

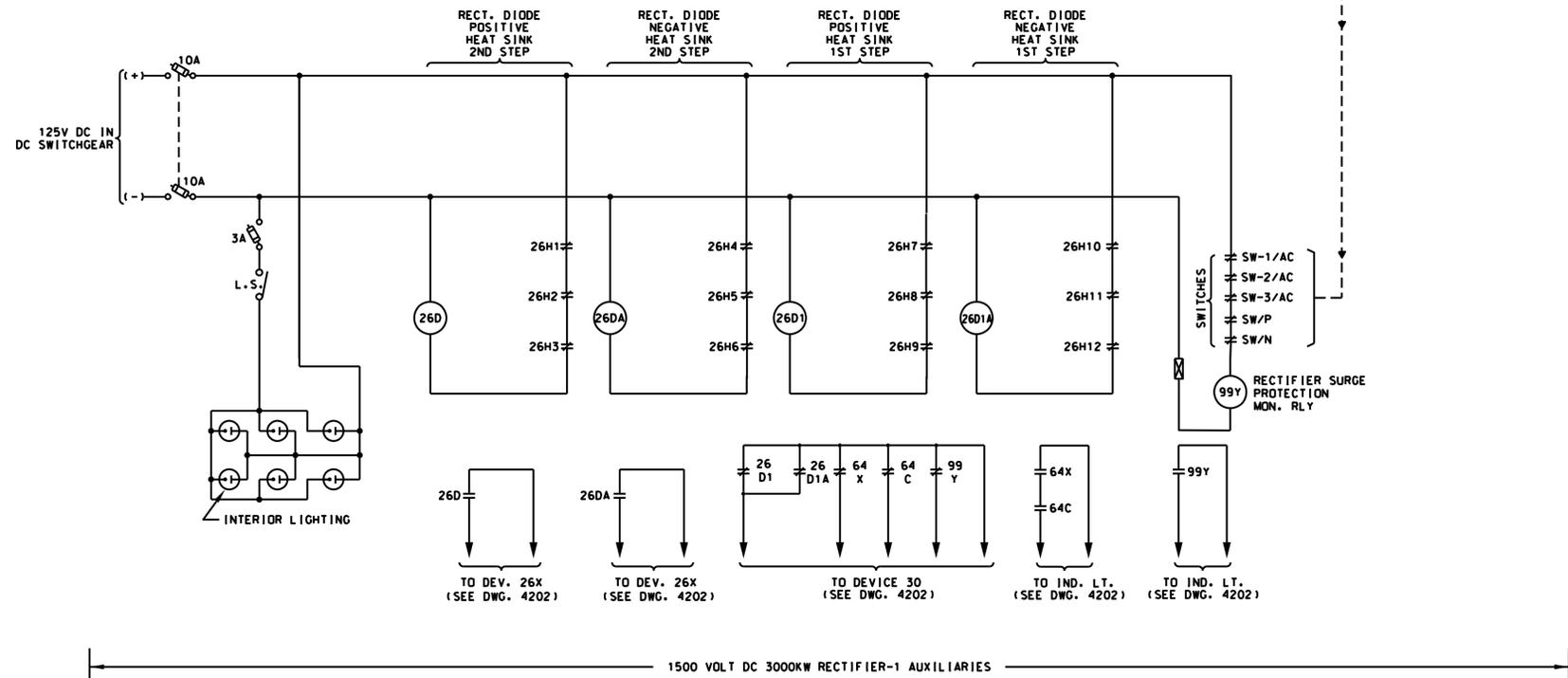
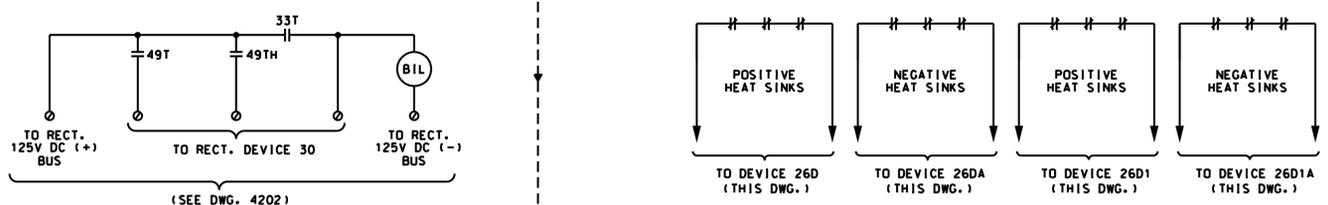
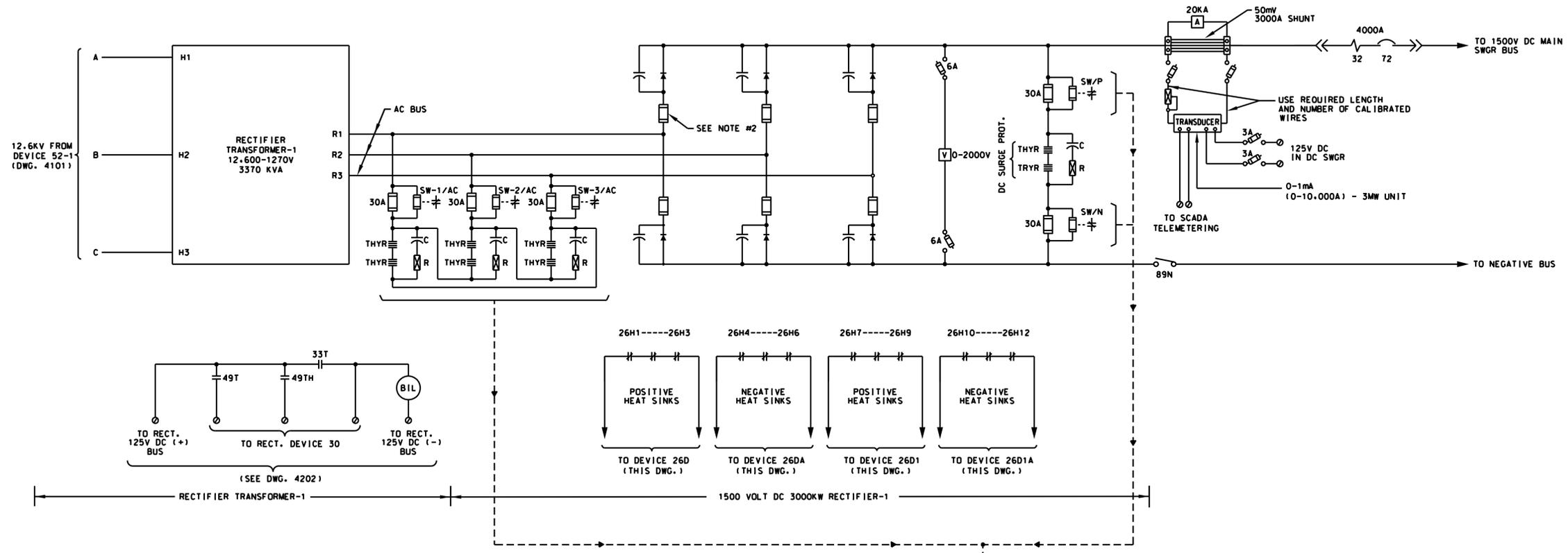
SCALE:  
 NTS

DISTRICT:  
 MED

PROJECT NO.  
 GW4254-57102002

MILE POST NO.  
 17.5

SHEET NO.  
**SS-17.5-4111**



- NOTES:**
1. DIODE THERMAL DEVICES CONNECTED TOGETHER MUST BE ON HEAT SINKS OF THE SAME POLARITY UNDER ALL CONDITIONS.
  2. PROVIDE TRIGGER TARGET TYPE DIODE FUSES.
  3. CONTACT WILL CLOSE IN NORMAL CONDITION & WILL OPEN IN FAULT CONDITION.
- SYMBOLS:**
- TERMINAL BLOCK

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Consulting Engineers  
20 N. Wacker Dr. Ste. 1500 Chicago IL 60606

DESIGNED: HS  
DRAWN: JMC  
CHECKED: FM  
METRA P.M.: R. CERANT  
DATE: JUNE 12, 2017

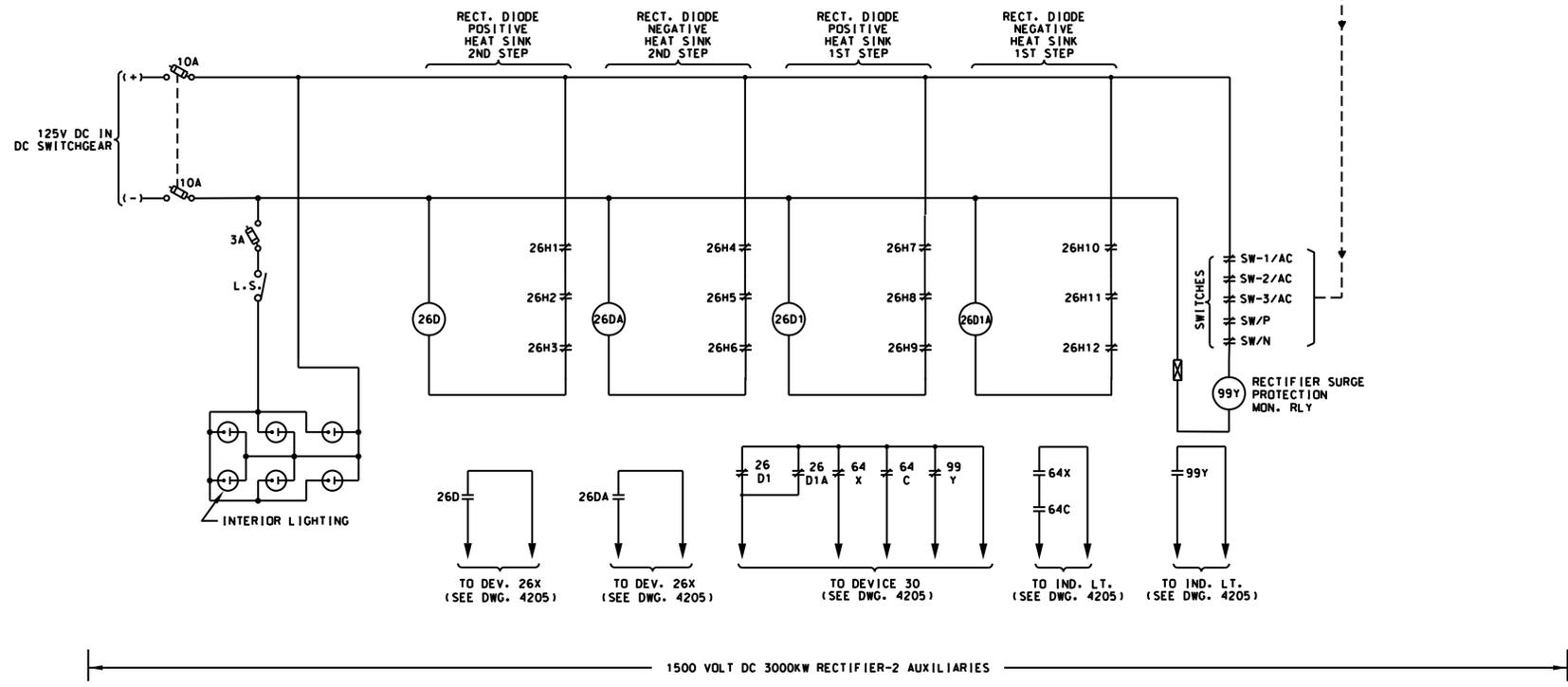
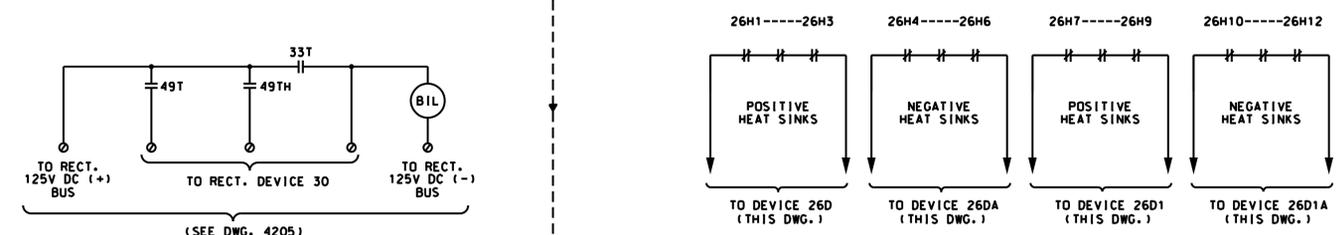
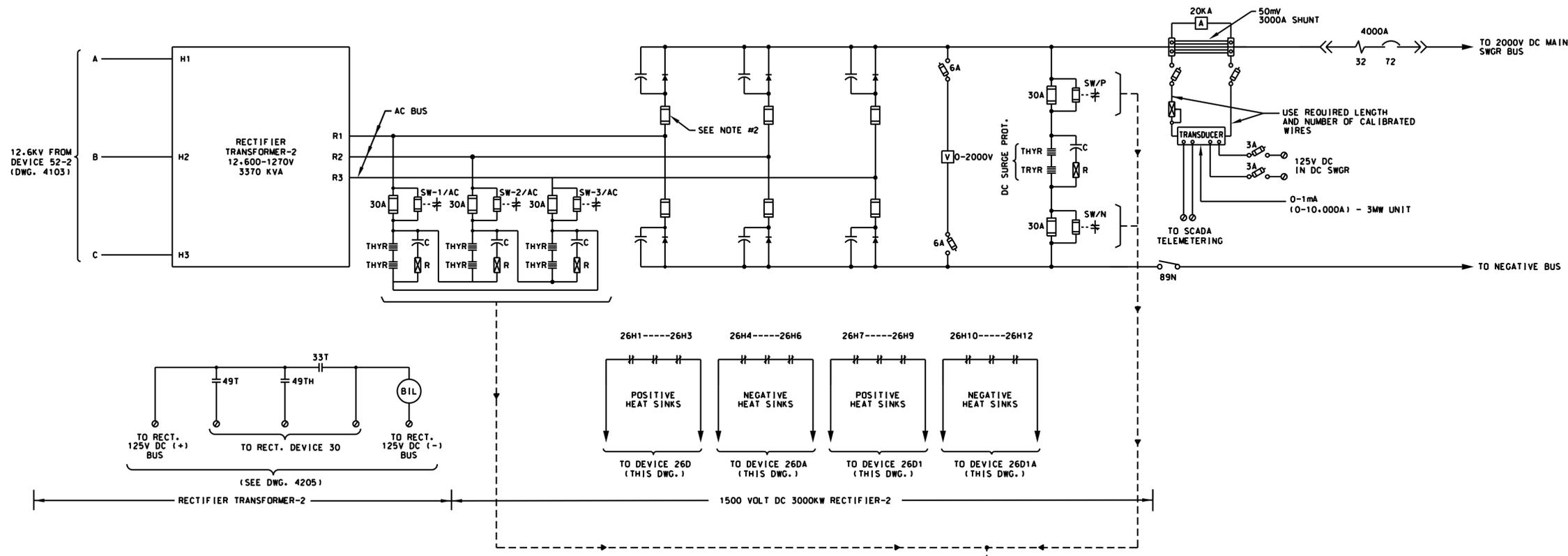


LOCATION NAME:  
**RIVERDALE SUBSTATION**

TITLE:  
**1500V DC SCHEMATIC DIAGRAM  
RECTIFIER-1 POWER & AUXILIARIES**

CAD FILE NUMBER: SS-17.5-4201.DGN	
SCALE: NTS	DISTRICT: MED
PROJECT NO. GW4254-57102002	SHEET NO. <b>SS-17.5-4201</b>
MILE POST NO. 17.5	





**NOTES:**

1. DIODE THERMAL DEVICES CONNECTED TOGETHER MUST BE ON HEAT SINKS OF THE SAME POLARITY UNDER ALL CONDITIONS.
2. PROVIDE TRIGGER TARGET TYPE DIODE FUSES.
3. CONTACT WILL CLOSE IN NORMAL CONDITION & WILL OPEN IN FAULT CONDITION.

**SYMBOLS:**

- ⊙ TERMINAL BLOCK

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0	07-28-2017	HS	HS	ISSUED FOR BID

REV	DATE	BY	APP	DESCRIPTION

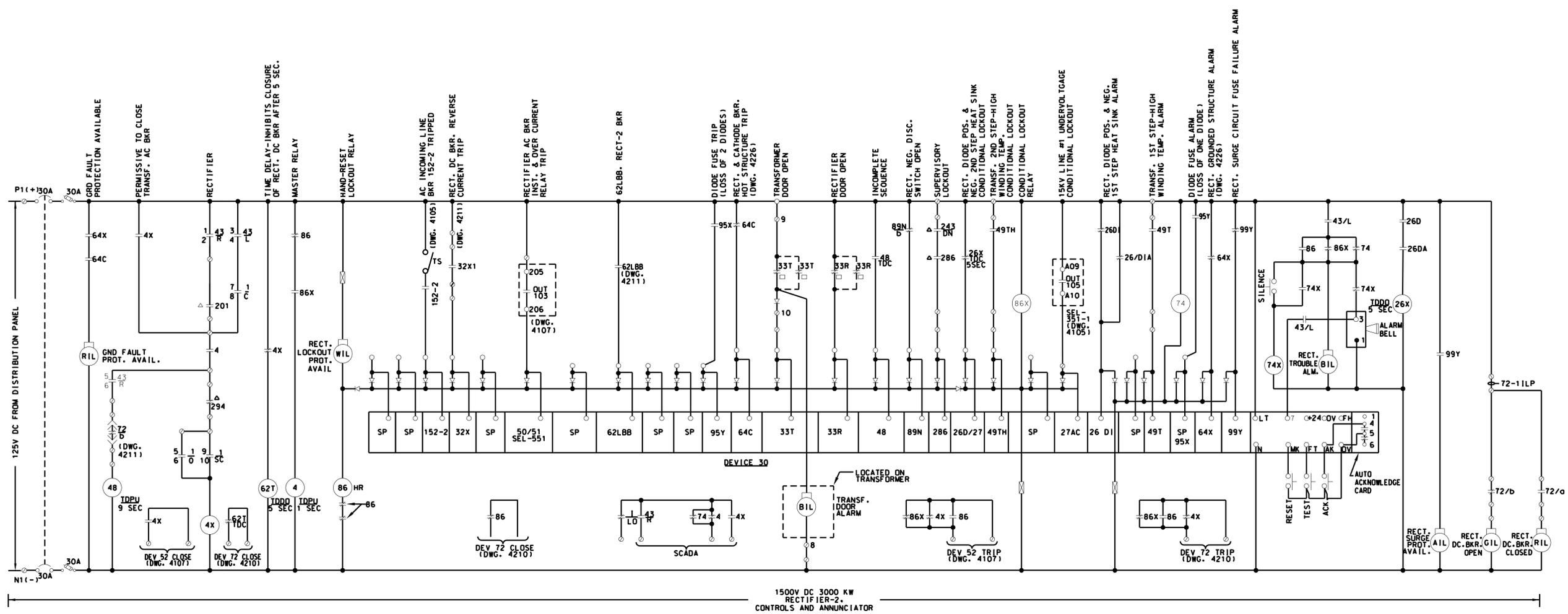
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CONSULTANT

DESIGNED: HS
DRAWN: JMC
CHECKED: FM
METRA P.M.: R. CERANT
DATE: JUNE 12, 2017

LOCATION NAME: <b>RIVERDALE SUBSTATION</b>
TITLE: <b>1500V DC SCHEMATIC DIAGRAM RECTIFIER-2 POWER &amp; AUXILIARIES</b>

CAD FILE NUMBER: SS-17.5-4204.DGN	DISTRICT: MED
SCALE: NTS	SHEET NO. SS-17.5-4204
PROJECT NO. GW4254-57102002	MILE POST NO. 17.5



**SYMBOLS:**

- △ LOCATED IN SCADA RTU CABINET
- CLOSED ONLY WITH BREAKER IN CONNECTED POS.
- ▲ OPEN ONLY WITH BREAKER IN CONNECTED POS.
- ⊙ TERMINAL BLOCK
- RTU-INDICATES SCADA REMOTE TERMINAL UNIT.

**MASTER CONTROL SWITCH  
DEVICE-1**

CONTACTS	POSITION			
	PULL OUT	TRIP	OFF AFTER TRIP	CLOSE
1-2	LO	X	X	X
3-4	T	X		X
5-6	O		X	X
7-8	C			X
9-10	SC		X	X

SPRING RETURN TO "OFF"

**SELECTOR SWITCH  
DEVICE-43**

CONTACTS	POSITION	
	REMOTE	LOCAL
1-2	R	X
3-4	L	X
5-6	R	X
7-8	L	X
9-10	R	X
11-12	L	X

NON-SPRING RETURN:  
REMOTE POSITION AT 12 O' CLOCK.  
LOCAL POSITION CLOCKWISE WHEN FACING FRONT OF SWITCH.

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Consulting Engineers  
20 N. Wacker Dr. Ste. 1500 Chicago Il. 60606

DESIGNED: HS  
DRAWN: JMC  
CHECKED: FM  
METRA P.M.: R. CERANT  
DATE: JUNE 12, 2017

**Metra**

ENGINEERING DEPARTMENT  
547 W. JACKSON BOULEVARD  
CHICAGO, ILLINOIS 60661

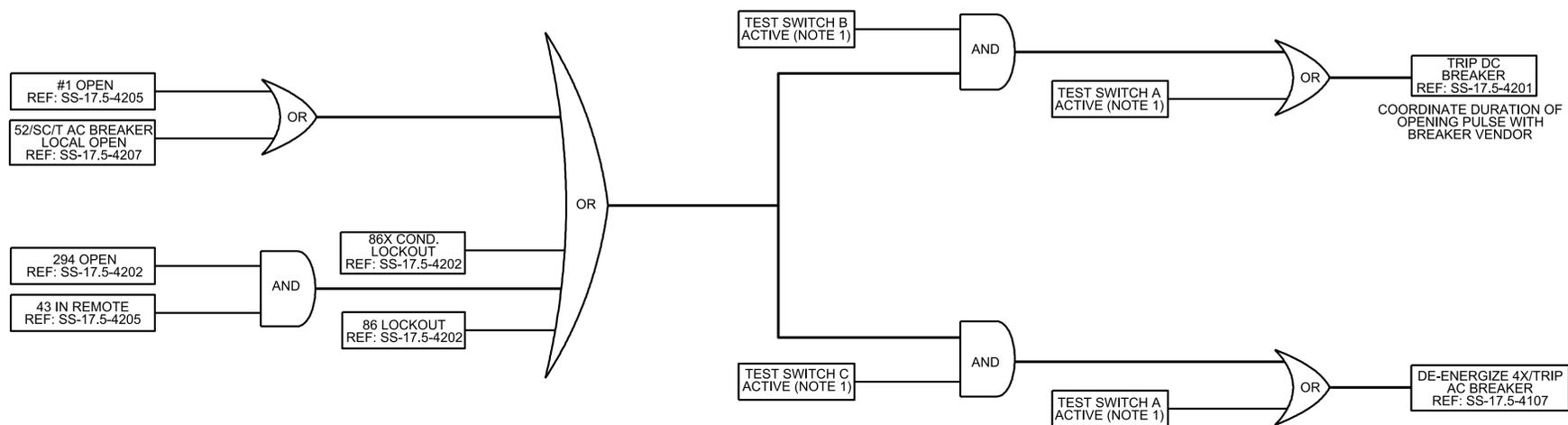
LOCATION NAME:  
**RIVERDALE SUBSTATION**

TITLE:  
**1500V DC SCHEMATIC DIAGRAM  
RECTIFIER-2 CONTROLS & ANNUNCIATOR**

CAD FILE NUMBER: SS-17.5-4205.DGN

SCALE: NTS	DISTRICT: MED
PROJECT NO. GW4254-57102002	SHEET NO. <b>SS-17.5-4205</b>
MILE POST NO. 17.5	

AC BREAKER/CATHODE TRIP



COORDINATE DURATION OF OPENING PULSE WITH BREAKER VENDOR

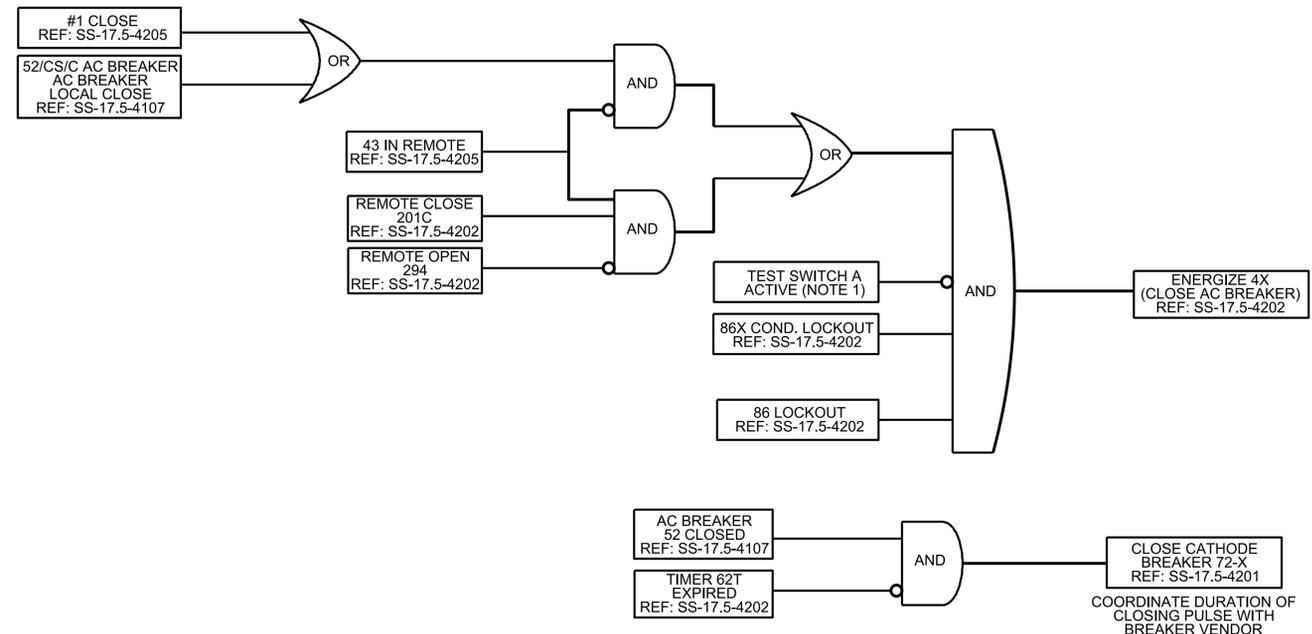
NOTES:

- TEST SWITCHES SHOWN IN THE LOGIC DIAGRAM SHALL BE SOFT KEYS PROGRAMMED ON THE HMI USED FOR THE ANNUNCIATOR. THE FOLLOWING KEYS SHALL BE AVAILABLE:
  - A TRIP AND BLOCK 52R AND 172R
  - B ENABLE TRIP TO 172R
  - C ENABLE TRIP TO 52R
  - D RESET 48 INCOMPLETE SEQUENCE
  - E ENABLE 48 INCOMPLETE SEQUENCE
  - F ENABLE 86 LOCKOUT
- ALL LOGIC DIAGRAMS ARE FOR INFORMATION ONLY. THE SUPPLIER SHALL ENSURE THAT THE PLC CODE MATCHES ALL CONTRACTUAL REQUIREMENTS BASED ON THE EQUIPMENT PROVIDED.

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				SUB CONSULTANT				PRIMARY CONSULTANT SEAL/ SIGNATURE 				PRIMARY CONSULTANT <b>LTK Engineering Services</b>				DESIGNED: A. ACHHAMMER DRAWN: N. DIAZ CHECKED: E. ROWE METRA P.M. R. CERANT DATE: JUNE 12, 2017				 ENGINEERING DEPARTMENT 547 W. JACKSON BOULEVARD CHICAGO, ILLINOIS 60661				LOCATION NAME: <b>RIVERDALE SUBSTATION</b>				CAD FILE NUMBER: \$FILES\$			
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																MILE POST NO. 17.5															
0	7/28/2017	AA	ER	ISSUED FOR BID				REV	DATE	BY	APP	DESCRIPTION																			

AC BREAKER/CATHODE CLOSE



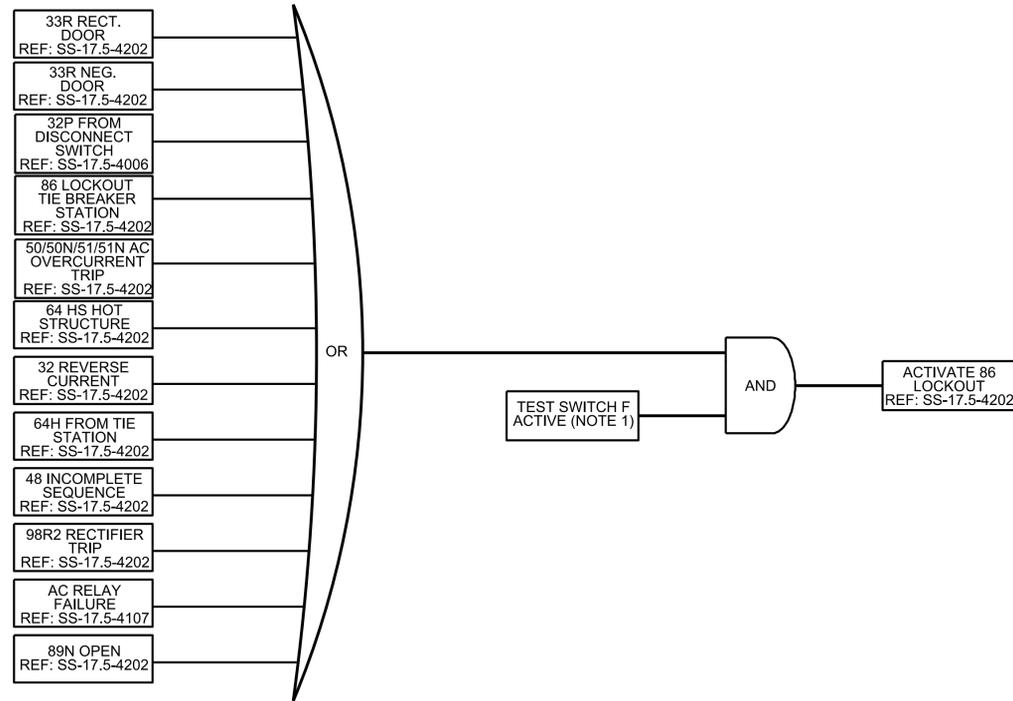
NOTES:

- TEST SWITCHES SHOWN IN THE LOGIC DIAGRAM SHALL BE SOFT KEYS PROGRAMMED ON THE HMI USED FOR THE ANNUNCIATOR. THE FOLLOWING KEYS SHALL BE AVAILABLE:
  - A TRIP AND BLOCK 52R AND 172R
  - B ENABLE TRIP TO 172R
  - C ENABLE TRIP TO 52R
  - D RESET 48 INCOMPLETE SEQUENCE
  - E ENABLE 48 INCOMPLETE SEQUENCE
  - F ENABLE 86 LOCKOUT
- ALL LOGIC DIAGRAMS ARE FOR INFORMATION ONLY. THE SUPPLIER SHALL ENSURE THAT THE PLC CODE MATCHES ALL CONTRACTUAL REQUIREMENTS BASED ON THE EQUIPMENT PROVIDED.

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																DRAWN: N. DIAZ								SCALE: NTS				DISTRICT: MED			
																								CHECKED: E. ROWE				PROJECT NO. GW4254-57102002			
																ENGINEERING DEPARTMENT				TITLE: RECTIFIER PLC LOGIC DIAGRAMS AC BREAKER/CATHODE CLOSE SHEET 2 OF 4				MILE POST NO. 17.5							
																547 W. JACKSON BOULEVARD															
																CHICAGO, ILLINOIS 60661															
																DATE: JUNE 12, 2017															
0	7/28/2017	AA	ER	ISSUED FOR BID				REV	DATE	BY	APP	DESCRIPTION																			

LOCKOUT LOGIC



NOTES:

- TEST SWITCHES SHOWN IN THE LOGIC DIAGRAM SHALL BE SOFT KEYS PROGRAMMED ON THE HMI USED FOR THE ANNUNCIATOR. THE FOLLOWING KEYS SHALL BE AVAILABLE:
  - A TRIP AND BLOCK 52R AND 172R
  - B ENABLE TRIP TO 172R
  - C ENABLE TRIP TO 52R
  - D RESET 48 INCOMPLETE SEQUENCE
  - E ENABLE 48 INCOMPLETE SEQUENCE
  - F ENABLE 86 LOCKOUT
- ALL LOGIC DIAGRAMS ARE FOR INFORMATION ONLY. THE SUPPLIER SHALL ENSURE THAT THE PLC CODE MATCHES ALL CONTRACTUAL REQUIREMENTS BASED ON THE EQUIPMENT PROVIDED.

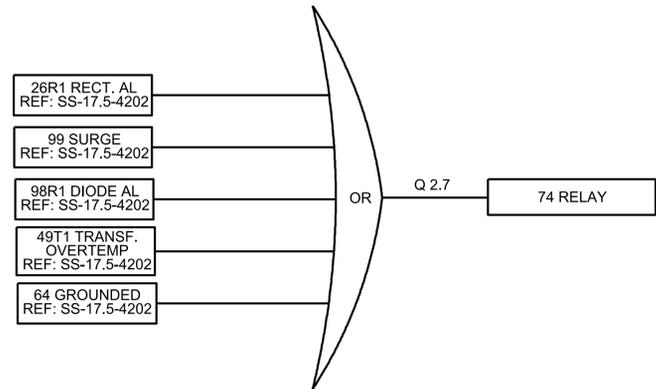
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0 7/28/2017 AA ER ISSUED FOR BID																												MILE POST NO. 17.5							
REV	DATE	BY	APP	DESCRIPTION	REV	DATE	BY	APP	DESCRIPTION																										

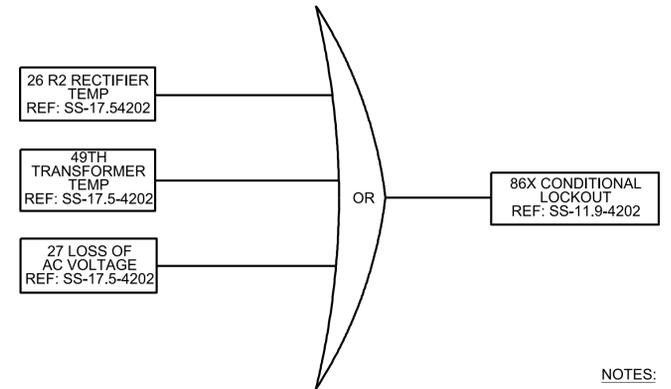
INCOMPLETE SEQUENCE



74 RELAY TROUBLE



CONDITIONAL LOCKOUT



NOTES:

- TEST SWITCHES SHOWN IN THE LOGIC DIAGRAM SHALL BE SOFT KEYS PROGRAMMED ON THE HMI USED FOR THE ANNUNCIATOR. THE FOLLOWING KEYS SHALL BE AVAILABLE:
  - A TRIP AND BLOCK 52R AND 172R
  - B ENABLE TRIP TO 172R
  - C ENABLE TRIP TO 52R
  - D RESET 48 INCOMPLETE SEQUENCE
  - E ENABLE 48 INCOMPLETE SEQUENCE
  - F ENABLE 86 LOCKOUT
- ALL LOGIC DIAGRAMS ARE FOR INFORMATION ONLY. THE SUPPLIER SHALL ENSURE THAT THE PLC CODE MATCHES ALL CONTRACTUAL REQUIREMENTS BASED ON THE EQUIPMENT PROVIDED.

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SUB CONSULTANT

PRIMARY CONSULTANT  
SEAL/ SIGNATURE

PRIMARY CONSULTANT

DESIGNED: A. ACHHAMMER  
DRAWN: N. DIAZ  
CHECKED: E. ROWE  
METRA P.M. R. CERANT  
DATE: JUNE 12, 2017

ENGINEERING DEPARTMENT  
547 W. JACKSON BOULEVARD  
CHICAGO, ILLINOIS 60661

LOCATION NAME:  
**RIVERDALE SUBSTATION**

TITLE:  
**RECTIFIER PLC LOGIC DIAGRAM  
LOCKOUT AND ALARM LOGIC  
SHEET 4 OF 4**

CAD FILE NUMBER:  
\$FILES\$

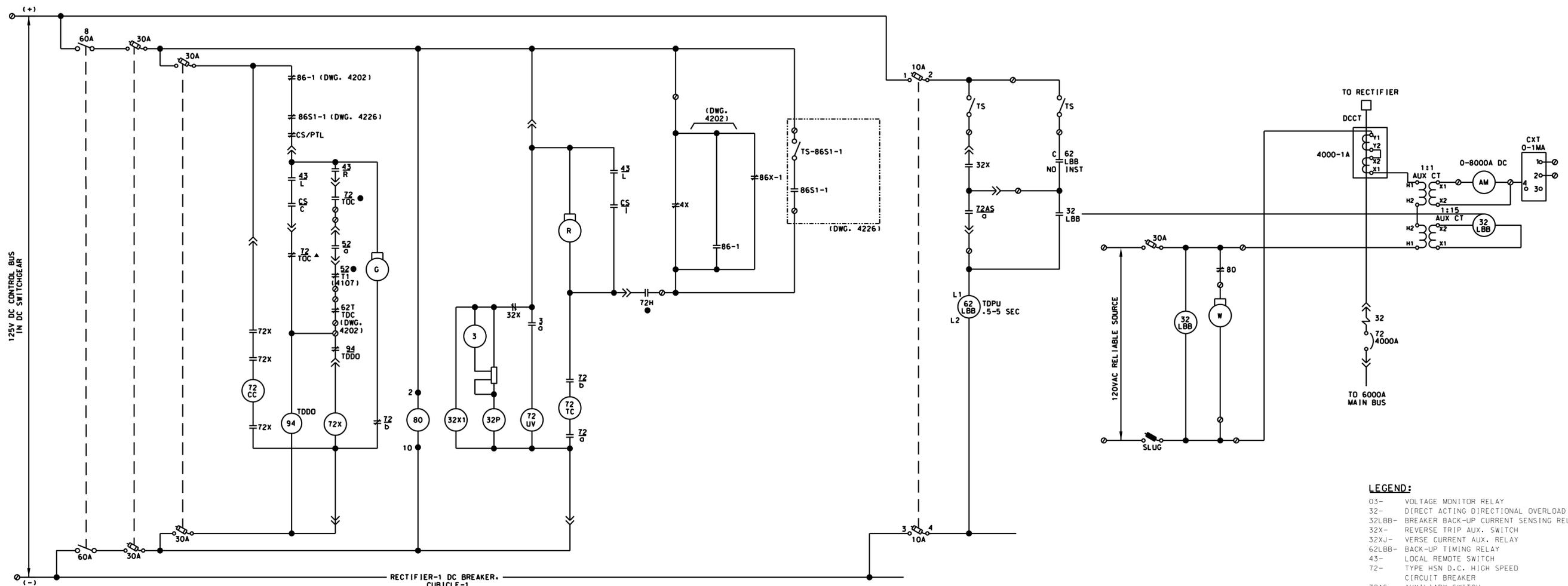
SCALE:  
NTS

PROJECT NO.  
GW4254-57102002

MILE POST NO.  
17.5

DISTRICT:  
MED

SHEET NO.  
**SS-17.5-4209**



- LEGEND:**
- 03- VOLTAGE MONITOR RELAY
  - 32- DIRECT ACTING DIRECTIONAL OVERLOAD
  - 32LBB- BREAKER BACK-UP CURRENT SENSING RELAY
  - 32X- REVERSE TRIP AUX. SWITCH
  - 32XJ- VERSE CURRENT AUX. RELAY
  - 62LBB- BACK-UP TIMING RELAY
  - 43- LOCAL REMOTE SWITCH
  - 72- TYPE HSN D.C. HIGH SPEED CIRCUIT BREAKER
  - 72AS- AUXILIARY SWITCH
  - 72CC- CLOSING SOLENOID
  - CS- CONTROL SWITCH
  - 72TC- SHUNT TRIP
  - 72UV- UNDER VOLTAGE COIL
  - 72X- CLOSING CONTACTOR
  - 76- DIRECT ACTING OVERLOAD
  - INST- INSTANTANEOUS
  - T00- TIME DELAY OPEN
  - A- AMBER INDICATING LIGHT
  - G- GREEN INDICATING LIGHT
  - R- RED INDICATING LIGHT

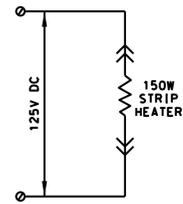
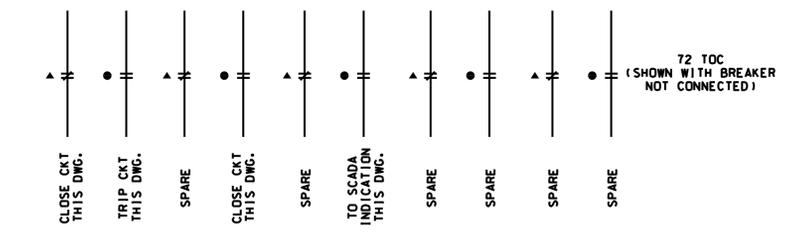
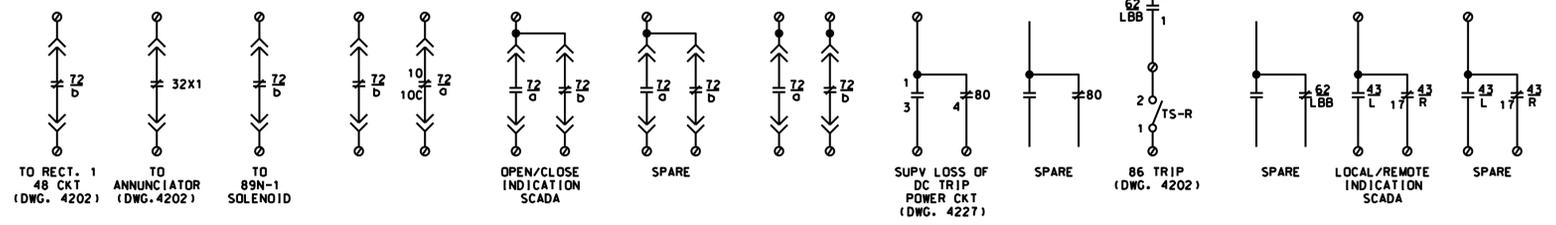
**CONTROL SWITCH DEVICE-CS**

CONTACTS	POSITION				
	PULL OUT	TRIP	OFF TRIP	AFTER CLOSE	CLOSE
1-2	L0	X	X	X	X
3-4	T	X			X
5-6	O		X	X	
7-8	C				X
9-10	SC			X	X

**SELECTOR SWITCH DEVICE-43**

CONTACTS	POSITION	
	REMOTE	LOCAL
1-2	R	X
3-4	L	X
5-6	R	X
7-8	L	X
9-10	R	X
11-12	L	X

NON-SPRING RETURN.  
REMOTE POSITION AT 12 O' CLOCK.  
LOCAL POSITION CLOCKWISE WHEN FACING FRONT OF SWITCH.



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0	07-28-2017	HS	HS	ISSUED FOR BID

REV	DATE	BY	APP	DESCRIPTION

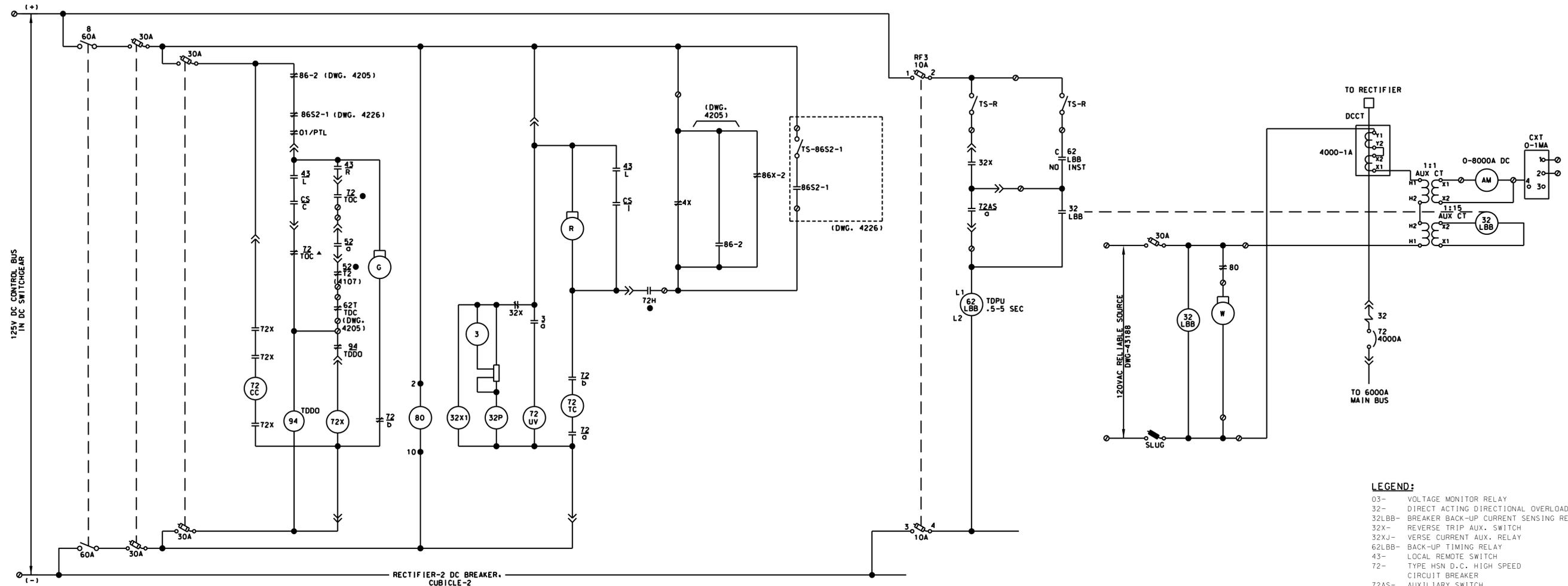


DESIGNED: HS
DRAWN: JMC
CHECKED: FM
METRA P.M.: R. CERANT
DATE: JUNE 12, 2017



LOCATION NAME: RIVERDALE SUBSTATION	TITLE: 1500V DC SCHEMATIC DIAGRAM RECTIFIER-1 BREAKER 72-1
--	--

CAD FILE NUMBER: SS-17.5-4210.DGN	DISTRICT: MED
SCALE: NTS	SHEET NO. SS-17.5-4210
PROJECT NO. GW4254-57102002	MILE POST NO. 17.5



- LEGEND:**
- 03- VOLTAGE MONITOR RELAY
  - 32- DIRECT ACTING DIRECTIONAL OVERLOAD
  - 32LBB- BREAKER BACK-UP CURRENT SENSING RELAY
  - 32X- REVERSE TRIP AUX. SWITCH
  - 32XJ- VERSE CURRENT AUX. RELAY
  - 62LBB- BACK-UP TIMING RELAY
  - 43- LOCAL REMOTE SWITCH
  - 72- TYPE HSN D.C. HIGH SPEED CIRCUIT BREAKER
  - 72AS- AUXILIARY SWITCH
  - 72CC- CLOSING SOLENOID
  - CS- CONTROL SWITCH
  - 72TC- SHUNT TRIP
  - 72UV- UNDER VOLTAGE COIL
  - 72X- CLOSING CONTACTOR
  - 76- DIRECT ACTING OVERLOAD
  - INST- INSTANTANEOUS
  - TDO- TIME DELAY OPEN
  - A- AMBER INDICATING LIGHT
  - G- GREEN INDICATING LIGHT
  - R- RED INDICATING LIGHT

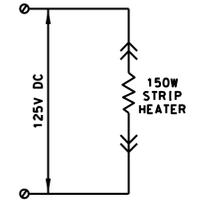
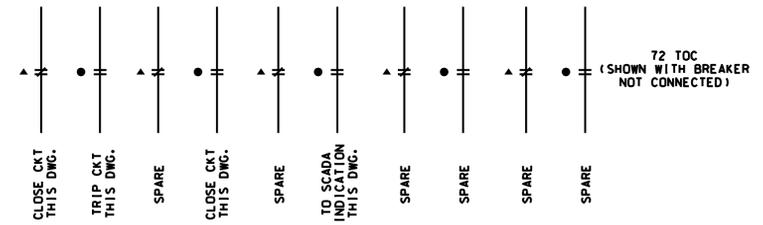
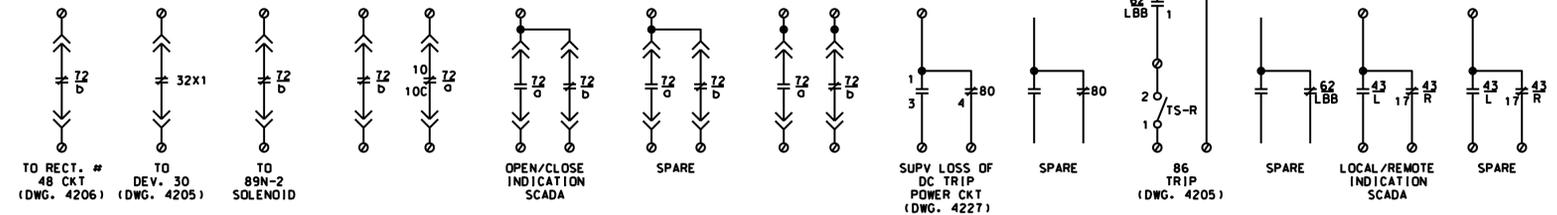
**CONTROL SWITCH DEVICE-CS**

CONTACTS	POSITION			
	PULL OUT	TRIP	OFF TRIP	AFTER CLOSE
1-2	X	X	X	X
3-4	X			X
5-6			X	X
7-8				X
9-10	SC		X	X

**SELECTOR SWITCH DEVICE-43**

CONTACTS	POSITION	
	REMOTE	LOCAL
1-2	X	
3-4	L	X
5-6	R	X
7-8	L	X
9-10	R	X
11-12	L	X

NON-SPRING RETURN.  
REMOTE POSITION AT 12 O' CLOCK.  
LOCAL POSITION CLOCKWISE WHEN FACING FRONT OF SWITCH.



PRINTED ON: SDATES

REV	DATE	BY	APP	DESCRIPTION
0	07-28-2017	HS	HS	ISSUED FOR BID

CONSULTANT SEAL & SIGNATURE



CONSULTANT



DESIGNED: HS

DRAWN: JMC

CHECKED: FM

METRA P.M.: R. CERANT

DATE: JUNE 12, 2017



LOCATION NAME:  
RIVERDALE SUBSTATION

TITLE:

**1500V DC SCHEMATIC DIAGRAM  
RECTIFIER-2 BREAKER 72-2**

CAD FILE NUMBER: SS-17.5-4211.DGN

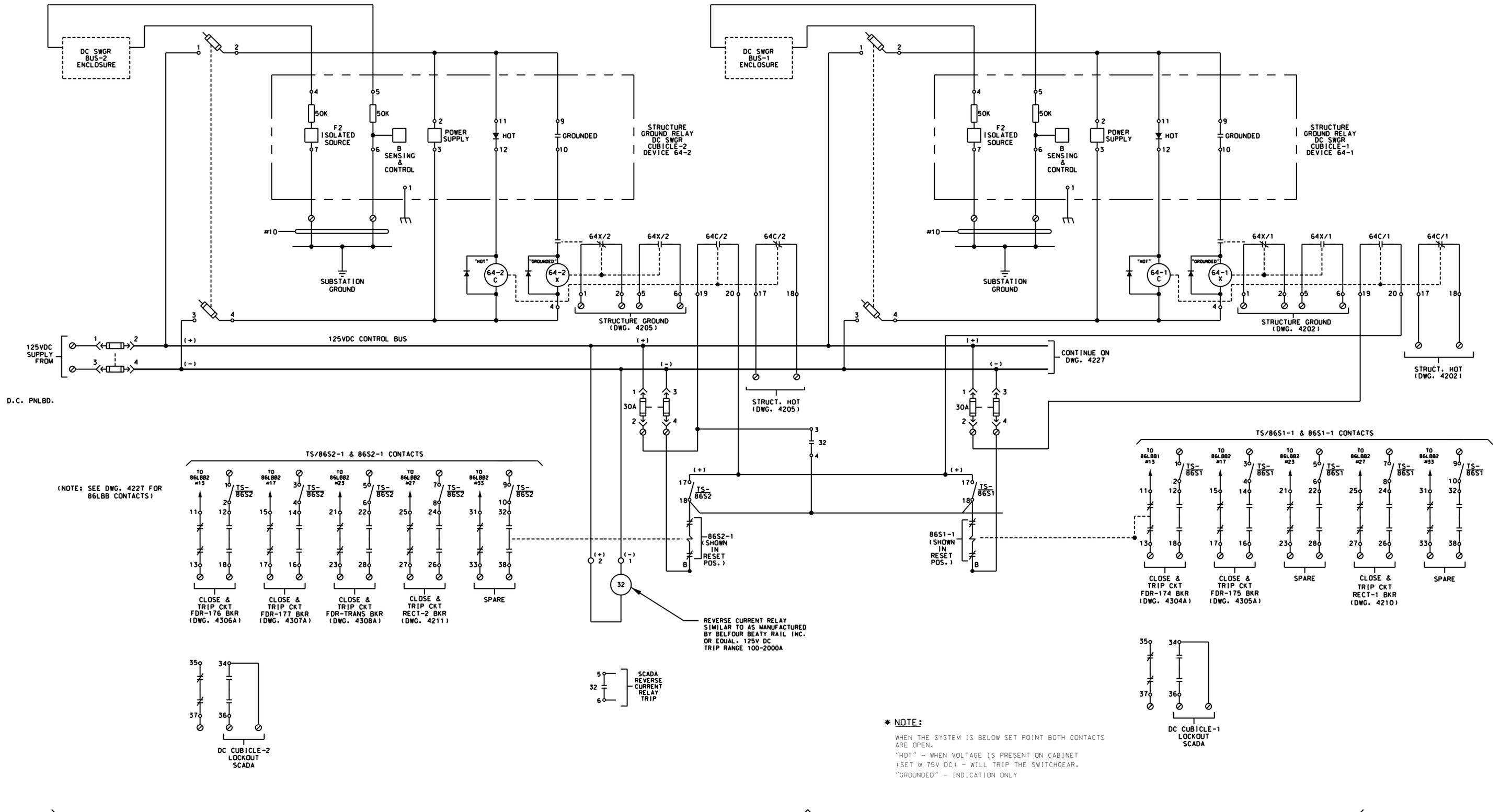
SCALE:  
NTS

DISTRICT:  
MED

PROJECT NO.  
GW4254-57102002

MILE POST NO.  
17.5

**SS-17.5-4211**



DC SWGR-STRUCTURE GRD RELAY, CUBICLE-2

DC SWGR-STRUCTURE GRD RELAY, CUBICLE-1

PRINTED ON: SDATES

REV	DATE	BY	APP	DESCRIPTION
0	07-28-2017	HS	HS	ISSUED FOR BID

CONSULTANT SEAL & SIGNATURE

CONSULTANT



**IDP** A Company of **Gannett Fleming**

Consulting Engineers  
20 N. Wacker Dr. Ste. 1500 Chicago IL 60606

DESIGNED: HS  
DRAWN: JMC  
CHECKED: FM  
METRA P.M.: R. CERANT  
DATE: JUNE 12, 2017



LOCATION NAME: **RIVERDALE SUBSTATION**

TITLE: **1500V DC SCHEMATIC DIAGRAM DC SWITCHGEAR GROUND RELAY**

CAD FILE NUMBER: SS-17.5-4226.DGN

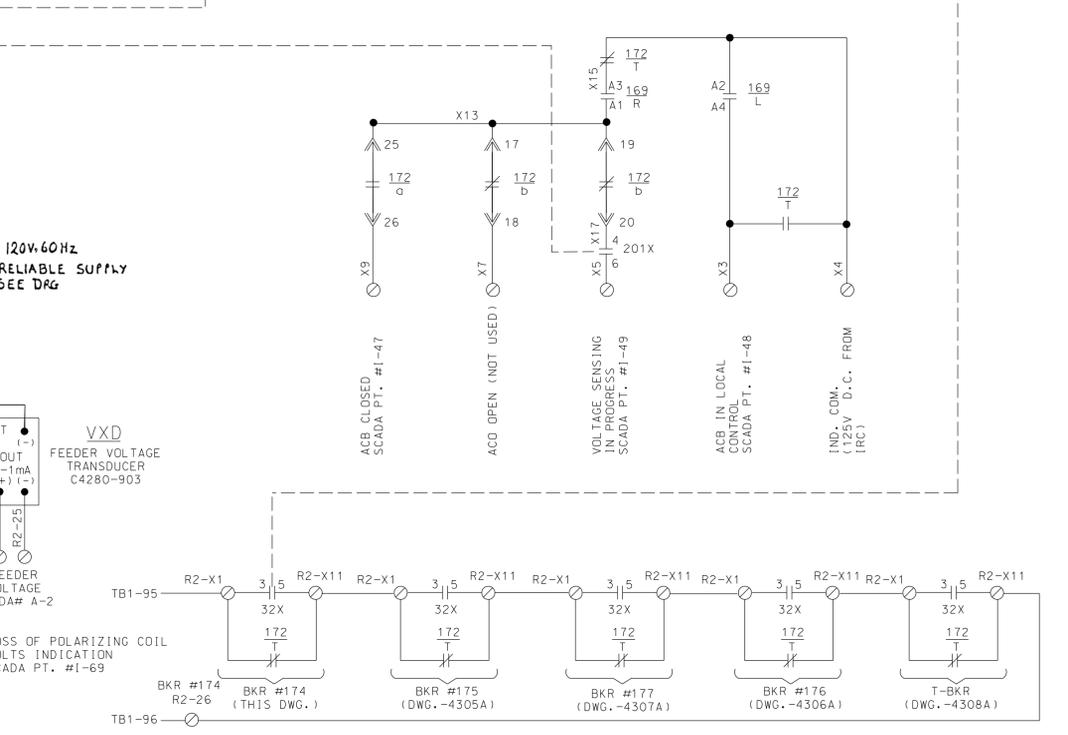
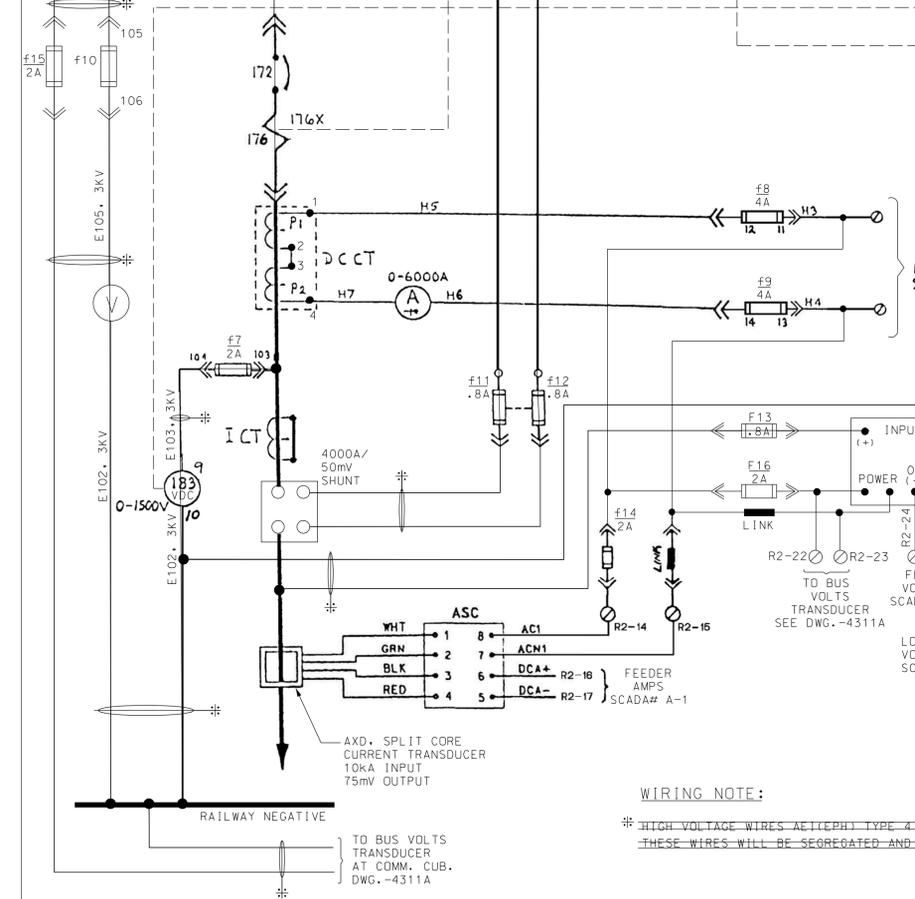
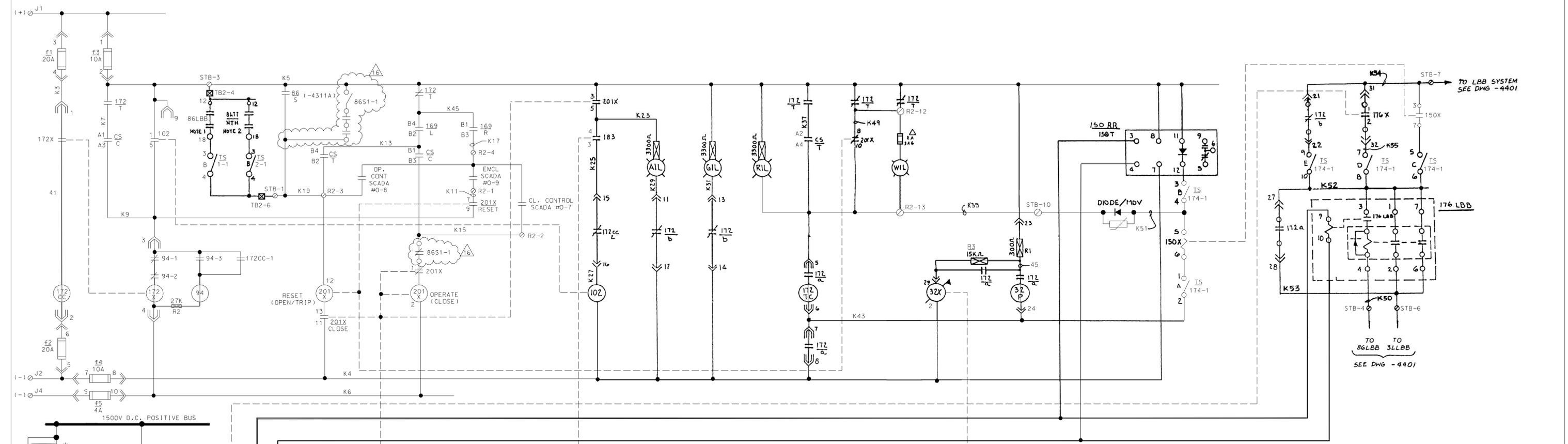
SCALE: NTS

DISTRICT: MED

PROJECT NO. GW4254-57102002

SHEET NO. **SS-17.5-4226**

MPLE POST NO. 17.5



- DEVICE LEGEND**
- 30LBB LBB ANNUNCIATOR TARGET RELAY
  - 32P POLARISING COIL FOR 176 TRIPPING 125VDC 2x50 OHM COILS
  - 32X FLAG INDICATION RELAY FOR LOSS OF 32P VOLTAGE
  - 62LBB TIMING RELAY 0.1 - 6.0 SEC.
  - 62TT TT TIMING RELAY 0.1 - 6.0 SEC.
  - 64D GROUND FAULT SENSING RELAY
  - 64XX AUX. RELAY FOR GROUND FAULT TRANSFER TRIP
  - 86/S LOCKOUT RELAY
  - 86LBB BREAKER BACKUP LOCKOUT RELAY (MANUAL RESET)
  - 86TT TRANSFER TRIP LOCKOUT RELAY (ELECT. RESET)
  - 94 CLOSING COIL CUT OFF (ANTI-PUMP) RELAY 125VDC
  - 94TT TRANSFER TRIP OUTPUT RELAY
  - 102 RECLOSING TIMER (SET AT 3.5 SECS.)
  - 127 AC SUPPLY CHANGE OVER RELAY
  - 150RR RATE OF RISE OVERCURRENT RELAY
  - 150T TIME OVERCURRENT RELAY
  - 150X AUXILIARY RELAY FOR LBB ON 150RR/150T
  - 169 LOCAL - REMOTE SWITCH
  - 172 D.C. FEEDER BREAKER
  - 172a-b BREAKER OPEN-CLOSE STATUS SWITCH
  - 1720C BREAKER CLOSING COIL 125VDC 1.8 OHM
  - 172T BREAKER CARRIAGE POSITION SWITCH
  - 172TC SHUNT TRIP COIL 125VDC 20 OHM
  - 172X CLOSING COIL CONTACTOR 125VDC 650 OHM
  - 176 MAGNETIC SERIES TRIP D/C DEVICE CAL. 3.5-4.5-6-7-8KA
  - 176F D/C RELAY (0-6000A SCALE) 120V, 60HZ. HIGH SAT. POINT
  - 176LBB LBB D.C. CURRENT SENSING RELAY
  - 176TD D/C RELAY, TIMER 125VDC (SAT. AT 20SEC) IN CASE W/ 176F
  - 176X AUXILIARY RELAY FOR MAGNETIC SERIES TRIP
  - 183 VOLTAGE MEASURING TRANSFER RELAY
  - 201 SUPERVISORY CLOSE RELAY (REMOTE CONTACT)
  - 201D EMERGENCY CLOSE RELAY (REMOTE CONTACT)
  - 201X BREAKER MASTER CONTROL RELAY (LATCHING TYPE)
  - 294 SUPERVISORY TRIP RELAY (REMOTE CONTACT)
  - 301TT CONTROL SWITCH FOR TRANSFER TRIP BY-PASS

- DEVICE ABBREVIATIONS**
- A AMMETER 0-6000A (0-2AFSD) RECT. MOVING COIL LONG SCALE
  - AIL AMBER INDICATION LAMP- AUTO CLOSE IN OPERATION 125V
  - C CLOSE
  - CC CLOSING COIL
  - CS CONTROL SWITCH TRIP- NEUTRAL- CLOSE
  - DCCT D.C. CURRENT TRANSDUCER 3000/1A 120V, 60HZ
  - DIODE/MOV DIRECTIONAL BLOCKING DIODE/METAL OXIDE VARISTOR
  - GIL GREEN INDICATION LAMP- C.B. OPEN. 125V
  - LBB LOCAL BREAKER MODE
  - LBK LOCAL BREAKER BACKUP
  - OP OPERATE
  - R REMOTE CONTROL MODE
  - RE RESET
  - REI RED INDICATION LAMP- C.B. CLOSED. 125V
  - RIL SWITCHBOARD D.C. SHUNT
  - T TRIP
  - T.S. TEST SWITCH
  - TT TRANSFER TRIP
  - V VOLTMETER (0-2000V) MOVING COIL, LONGSCALE DIRECT READING
  - VR1 ATTENUATOR 200 OHM VARIABLE
  - TEST LINK TEST LINK
  - ASC D.C. CURRENT SIGNAL CONDITIONER
  - AXD SPLIT CORE D.C. CURRENT TRANSDUCER
  - XCA D.C. VOLTS TRANSDUCER CALIBRATOR
  - VXD D.C. VOLTS TRANSDUCER
  - WIL WHITE INDICATING LIGHT

CIRCUIT WITHIN THE CLOUD INDICATES NEW WORK UNDER THIS CONTRACT

**NOTE:**  
SCHEMATIC DIAGRAM IS PRESENTED IN BREAKER OPEN AND IN SERVICE POSITION. ALL RELAYS DE-ENERGIZED.

**REFERENCE DRAWINGS**  
LBB SYSTEM SCHEMATIC DIAGRAM SS-175-4401  
TRANSFER TRIP SCHEMATIC DIAGRAM SS-175-4402

**WIRING NOTE:**  
\* HIGH VOLTAGE WIRES (ELECTRIF) TYPE 4 (1900/3300V). THESE WIRES WILL BE SEGREGATED AND RUN SEPARATELY FROM OTHER WIRES.

- BREAKER CONTACTS LEGEND:**
- ⊗ MULTICORE TERMINATION
  - BUS WIRING TB
  - △ LOCATED IN SEPARATE ENCLOSURE
  - ⊕ CARRIAGE SWITCH OPEN IN SERVICE
  - ⊖ CARRIAGE SWITCH CLOSED IN SERVICE POSITION
  - ⊕ AUX. SWITCH OPEN IN CB OPEN POSITION
  - ⊖ AUX. SWITCH CLOSED IN CB CLOSED POSITION
  - ⊕ AUX. SWITCH CLOSED IN CB OPEN POSITION
  - ⊖ AUX. SWITCH OPEN IN CB CLOSED POSITION
  - ⊕ MINOR DISCONNECT CONTACT CLOSED ONLY WHEN CIRCUIT BREAKER IS IN 'SERVICE' POSITION
  - ⊖ MINOR DISCONNECT CONTACT CLOSED WHEN CIRCUIT BREAKER IS IN 'TEST' POSITION AND 'SERVICE' POSITION
- LEGEND:**
- ⊗ TERMINAL POINT AT 1500 V D.C. SWITCHGEAR
  - ⊕ TERMINAL POINT AT 12.4 KV A.C. SWITCHGEAR
  - ⊖ TERMINAL POINT AT 4 KV A.C. SWITCHGEAR
  - ⊕ TERMINAL POINT AT RECTIFIER CONTROL PANEL
  - ⊖ TERMINAL POINT AT TRANSFORMER CONTROL PANEL
  - ⊕ TERMINAL POINT AT TRANSFER TRIP & LBB SWITCHBOARD
  - TERMINAL POINT AT SUPERVISORY CONTROL CABINET
  - ⊖ TERMINAL POINT AT BUS FAULT RELAY PANEL OR CONTROL SWITCHBOARD OR OTHER MISC. PANELS.
- LAST WIRE NO. K60

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
CHARGE															
11/05	11/05	11/05	11/05	11/05	11/05	11/05	11/05	11/05	11/05	11/05	11/05	11/05	11/05	11/05	11/05
WPS															

**Metra**  
Metropolitan Rail

**ENGINEERING DEPARTMENT**  
**CHICAGO, ILLINOIS**

D.C. FEEDER BREAKER  
SECTION NO. 174  
SCHEMATIC DIAGRAM

**RIVERDALE TIE STATION**

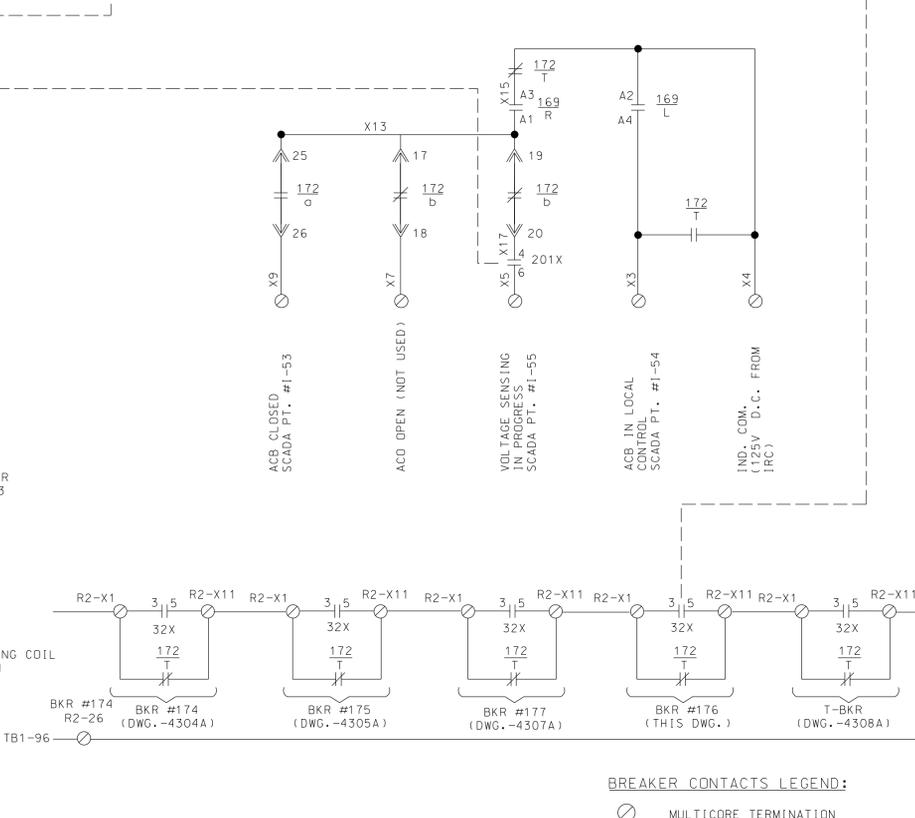
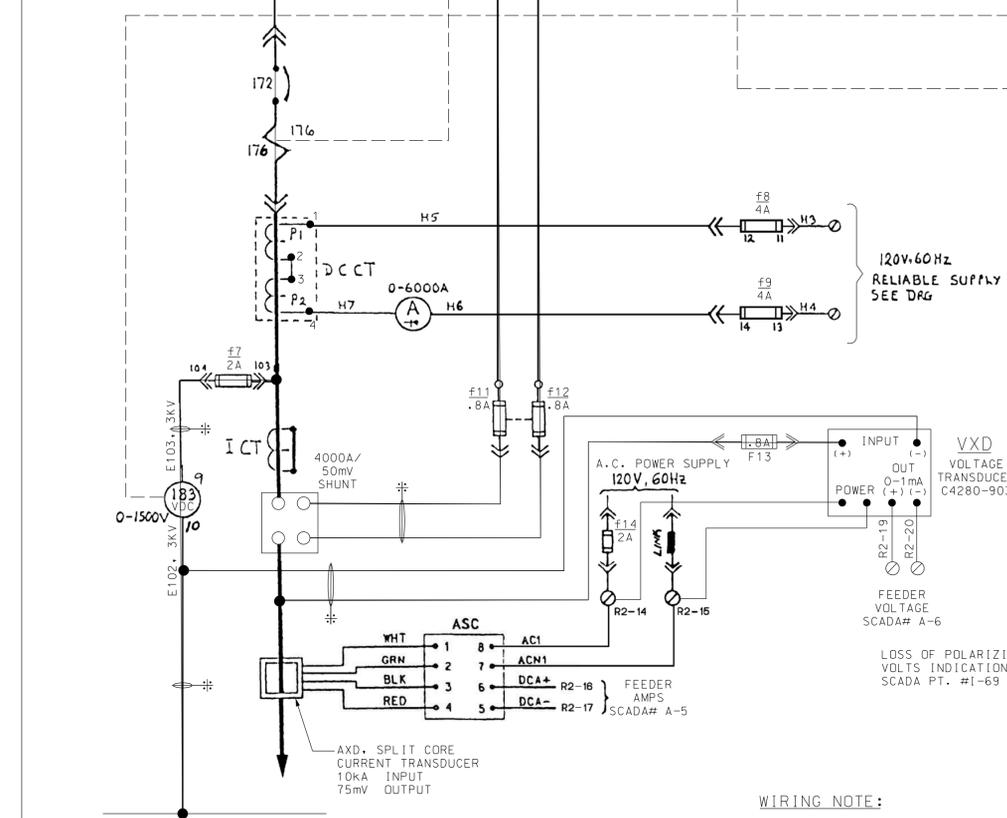
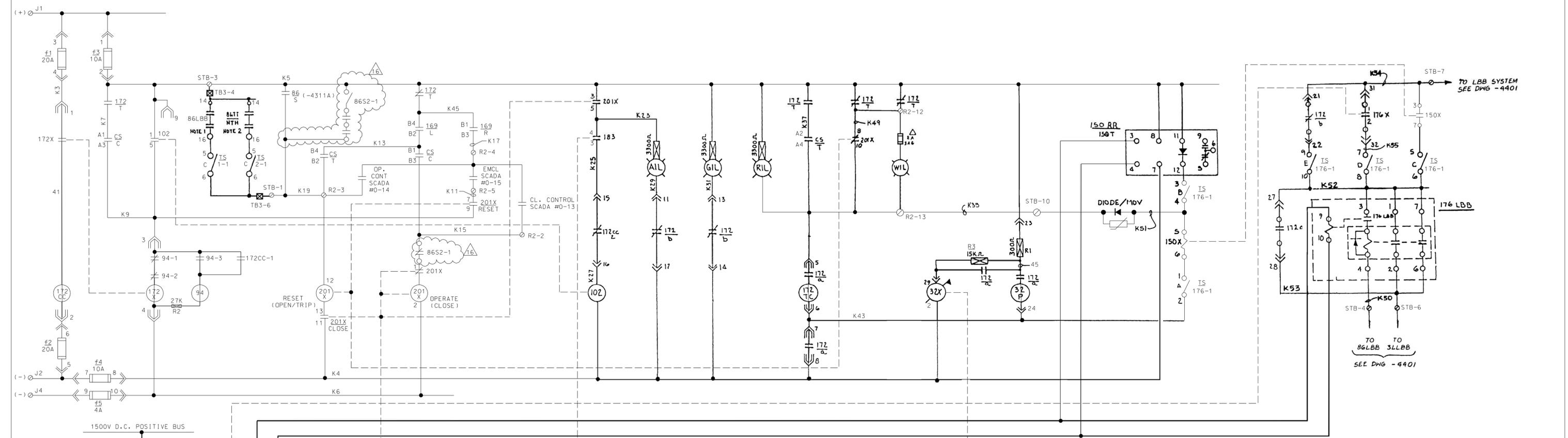
MFG BY WHIPP & BOURNE LTD W & B DWG. NO 418766

CAD FILE NO f/electrical/eml/rivdale/hyb/4304g.rvg

DESIGNED	DRAWN	CHECKED	APPROVED
-	AZ/CM	WPS	WPS

DISTRICT	DATE	SCALE	PRINT NUMBER
METRA ELECTRIC	5/27/18	NONE	SS-17.5-4304A





- DEVICE LEGEND**
- 30LBB 32P LBB ANNUNCIATOR TARGET RELAY
  - 62LBB 62TT TIMING RELAY 0.1 - 6.0 SEC.
  - 64D GROUND FAULT SENSING RELAY
  - 64XX 64X/AUX. RELAY FOR GROUND FAULT TRANSFER TRIP LOCKOUT RELAY
  - 86LBB 86/S BREAKER BACKUP LOCKOUT RELAY (MANUAL RESET)
  - 86TT 86TT TRANSFER TRIP LOCKOUT RELAY (ELECT. RESET)
  - 94 94TT CLOSING COIL CUT OFF (ANTI-PUMP) RELAY 125VDC
  - 94TT 94TT TRANSFER TRIP OUTPUT RELAY
  - 102 102 RECLOSING TIMER (SET AT 3.5 SECS.)
  - 127 127 AC SUPPLY CHANGE OVER RELAY
  - 150RR 150RR RATE OF RISE OVERCURRENT RELAY
  - 150T 150T TIME OVERCURRENT RELAY
  - 150X 150X AUXILIARY RELAY FOR LBB ON 150RR/150T LOCAL - REMOTE SWITCH
  - 172 172 D.C. FEEDER BREAKER
  - 172a-b 172a-b BREAKER OPEN-CLOSE STATUS SWITCH
  - 172CC 172CC BREAKER CLOSING COIL 125VDC 1.8 OHM
  - 172T 172T BREAKER CARRIAGE POSITION SWITCH
  - 172TC 172TC SHUNT TRIP COIL 125VDC 20 OHM
  - 172X 172X CLOSING COIL CONTACTOR 125VDC 650 OHM
  - 176 176 MAGNETIC SERIES TRIP O/C DEVICE CAL. 3.5-4.5-5.6-7-8KA
  - 176F 176F O/C RELAY (0-6000A SCALE) 120V., 60HZ. HIGH SAT. POINT
  - 176LBB 176LBB LBB D.C. CURRENT SENSING RELAY
  - 176TD 176TD O/C RELAY, TIMER 125VDC (SAT. AT 20SEC) IN CASE W/ 176F
  - 176X 176X AUXILIARY RELAY FOR MAGNETIC SERIES TRIP
  - 183 183 VOLTAGE MEASURING TRANSFER RELAY
  - 201 201 SUPERVISORY CLOSE RELAY (REMOTE CONTACT)
  - 201D 201D EMERGENCY CLOSE RELAY (REMOTE CONTACT)
  - 201X 201X BREAKER MASTER CONTROL RELAY (LATCHING TYPE)
  - 294 294 SUPERVISORY TRIP RELAY (REMOTE CONTACT)
  - 301TT 301TT CONTROL SWITCH FOR TRANSFER TRIP BY-PASS
- DEVICE ABBREVIATIONS**
- A AMMETER 0-6000A (0-2AFSD) RECT. MOVING COIL LONG SCALE
  - AIL AMBER INDICATION LAMP- AUTO CLOSE IN OPERATION 125V
  - C CLOSE
  - CC CLOSING COIL
  - CS CONTROL SWITCH TRIP- NEUTRAL- CLOSE
  - DCCT D.C. CURRENT TRANSDUCER 3000/1A 120V, 60HZ
  - DIODE/MOV DIRECTIONAL BLOCKING DIODE/METAL OXIDE VARISTOR
  - GIL GREEN INDICATION LAMP- C.B. OPEN, 125V
  - L LOCAL CONTROL MODE
  - LBB LOCAL BREAKER BACKUP
  - OP OPERATE
  - R REMOTE CONTROL MODE
  - RE RESET
  - RIL RED INDICATION LAMP- C.B. CLOSED, 125V
  - SHUNT SWITCHBOARD D.C. SHUNT
  - T TRIP
  - T.S. TEST SWITCH
  - TT TRANSFER TRIP
  - V VOLTMETER (0-2000V) MOVING COIL, LONGSCALE DIRECT READING
  - VR1 ATTENUATOR 200 OHM VARIABLE
  - T-L. TEST LINK
  - ASC D.C. CURRENT SIGNAL CONDITIONER
  - AXD SPLIT CORE D.C. CURRENT TRANSDUCER
  - XCA D.C. VOLTS TRANSDUCER CALIBRATOR
  - VXD D.C. VOLTS TRANSDUCER
  - WIL WHITE INDICATING LIGHT

CIRCUIT WITHIN THE CLOUD INDICATES NEW WORK UNDER THIS CONTRACT

**WIRING NOTE:**  
 \* HIGH VOLTAGE WIRES ARE (EPH) TYPE 4 (1900/3300V).  
 THESE WIRES WILL BE SEGREGATED AND RUN SEPARATELY FROM OTHER WIRES.

- BREAKER CONTACTS LEGEND:**
- ⊗ MULTICORE TERMINATION
  - BUS WIRING TB
  - △ LOCATED IN SEPARATE ENCLOSURE
  - ⊕ CARRIAGE SWITCH OPEN IN SERVICE
  - ⊖ CARRIAGE SWITCH CLOSED IN SERVICE POSITION
  - ⊕ AUX. SWITCH OPEN IN CB OPEN POSITION
  - ⊖ AUX. SWITCH CLOSED IN CB OPEN POSITION
  - ⊕ AUX. SWITCH OPEN IN CB CLOSED POSITION
  - ⊖ AUX. SWITCH CLOSED IN CB CLOSED POSITION
  - ⊕ MINOR DISCONNECT CONTACT CLOSED ONLY WHEN CIRCUIT BREAKER IS IN 'SERVICE' POSITION
  - ⊖ MINOR DISCONNECT CONTACT CLOSED WHEN CIRCUIT BREAKER IS IN 'TEST' POSITION AND 'SERVICE' POSITION
- LEGEND:**
- ⊗ TERMINAL POINT AT 1500 V D.C. SWITCHGEAR
  - ⊕ TERMINAL POINT AT 12.4 KV A.C. SWITCHGEAR
  - ⊖ TERMINAL POINT AT 4 KV A.C. SWITCHGEAR
  - ⊕ TERMINAL POINT AT RECTIFIER CONTROL PANEL
  - ⊖ TERMINAL POINT AT TRANSFORMER CONTROL PANEL
  - ⊕ TERMINAL POINT AT TRANSFER TRIP & LBB SWITCHBOARD
  - ⊖ TERMINAL POINT AT SUPERVISORY CONTROL CABINET
  - ⊕ TERMINAL POINT AT BUS FAULT RELAY PANEL OR CONTROL SWITCHBOARD OR OTHER MISC. PANELS.
- LAST WIRE NO. K60

REFERENCE DRAWINGS  
 LBB SYSTEM SCHEMATIC DIAGRAM 55-175-4401  
 TRANSFER TRIP SCHEMATIC DIAGRAM 55-175-4402

**Metra** ENGINEERING DEPARTMENT  
 CHICAGO, ILLINOIS

D.C. FEEDER BREAKER  
 SECTION NO. 176  
 SCHEMATIC DIAGRAM

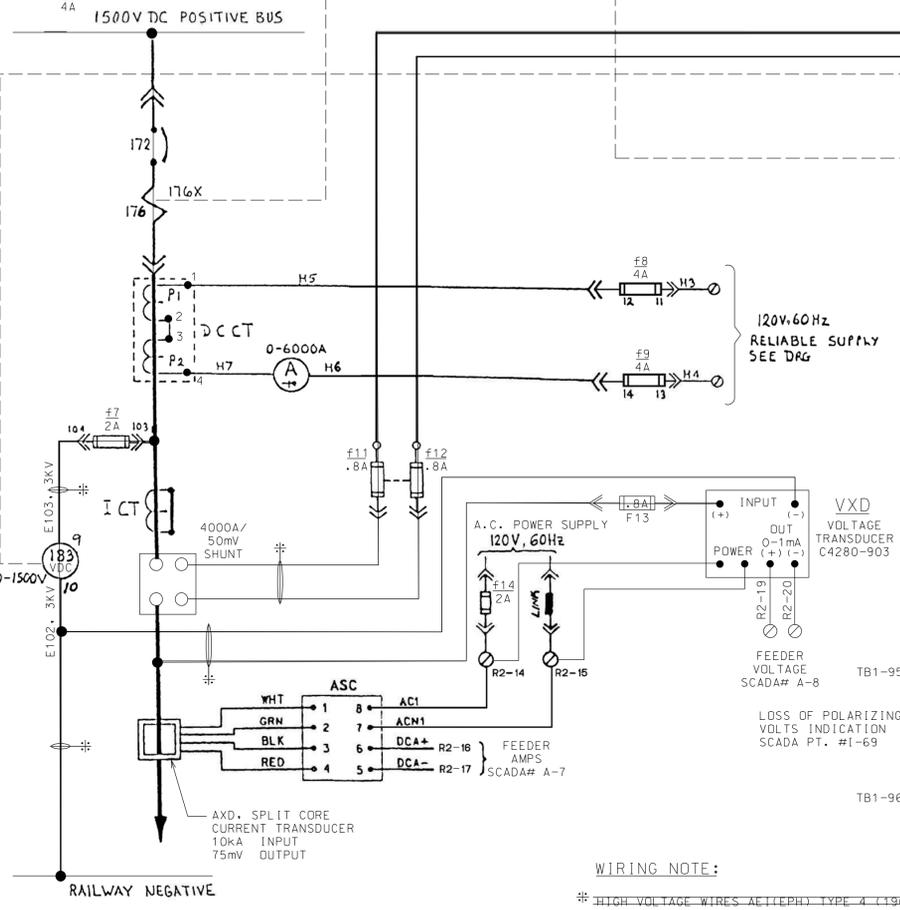
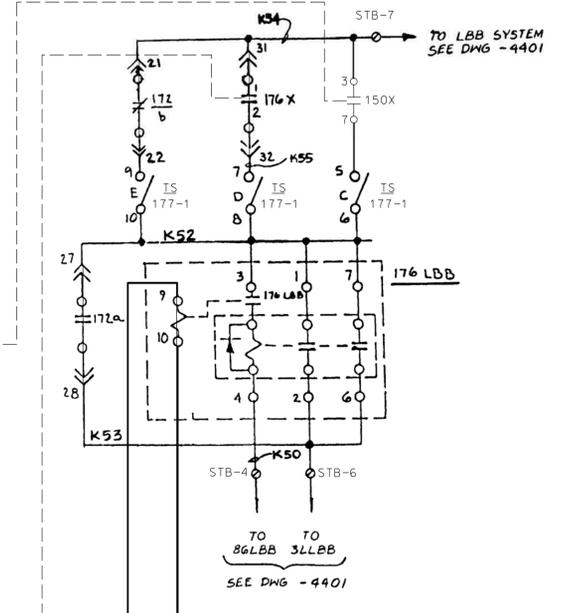
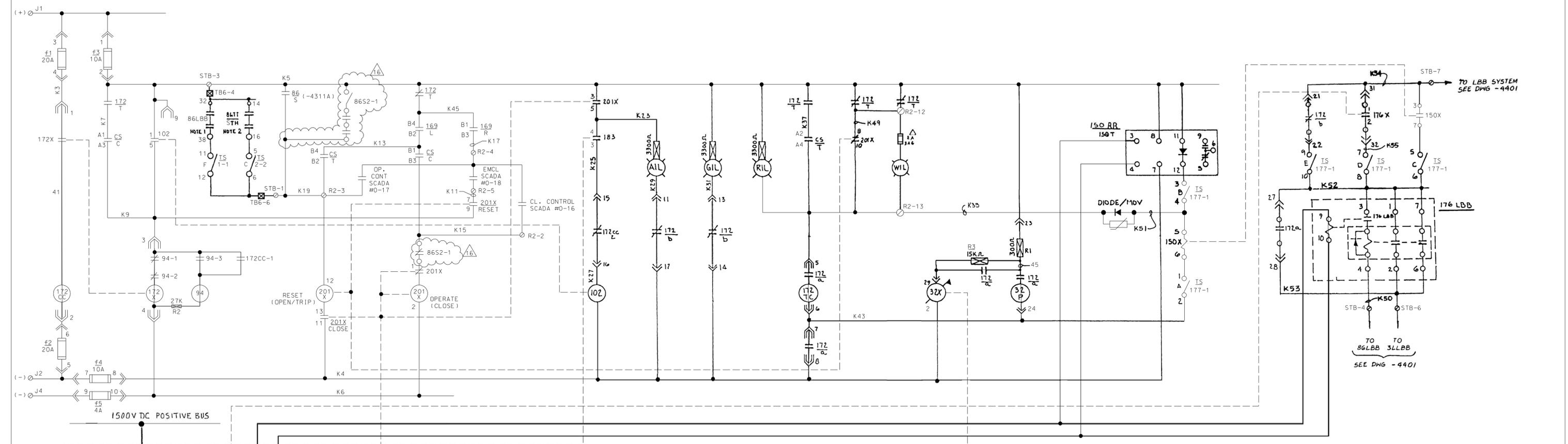
RIVERDALE TIE STATION  
 MFG BY WHIPP & BOURNE LTD W & B DWG. NO 418766  
 CAD FILE NO f/electrical/enl/riverdale/hyb/1306a.rxd

DESIGNED	DRAWN	CHECKED	APPROVED
-	AZ/CM	WPS	WPS

DISTRICT: METRA ELECTRIC DATE: 5/27/88 SCALE: NONE PRINT NUMBER: SS-17.5-4306A

BY LDP

1	CHANGE	2	10-15-81	3	RH	4	2 N/O BKS AUX S1/S5 AND R3 ADDED TO POLARISING CIRCUIT	5	CT	6	WIRE #139 RE-MED CORNING OF 150Y NOW SHOWN	7	3-9-83	8	5-14-84	9	LAMP ADDED	10	ADD LBB AND TRANSFER TRIP	11	CP/WPS	12	WPS	13	GENERAL REVISION	14	11/05 WPS	15	9/09 WPS/RM	16	07/28/17 HS
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DEVICE LEGEND

- 30LBB LBB ANNUNCIATOR TARGET RELAY
- 32P POLARISING COIL FOR 176 TRIPPING 125VDC 2X50 OHM COILS
- 32X FLAG INDICATION RELAY FOR LOSS OF VOLTAGE
- 62LBB TT TIMING RELAY 0.1 - 6.0 SEC.
- 62TT TT TIMING RELAY 0.1 - 6.0 SEC.
- 64D GROUND FAULT SENSING RELAY
- 64XX AUX. RELAY FOR GROUND FAULT TRANSFER TRIP
- 86/S LOCKOUT RELAY
- 86LBB BREAKER BACKUP LOCKOUT RELAY (MANUAL RESET)
- 86TT TRANSFER TRIP LOCKOUT RELAY (ELECT. RESET)
- 94 CLOSING COIL CUT OFF (ANTI-PUMP) RELAY 125VDC
- 94TT TRANSFER TRIP OUTPUT RELAY
- 102 RECLOSING TIMER (SET AT 3.5 SECS.)
- 127 AC SUPPLY CHANGE OVER RELAY
- 150RR RATE OF RISE OVERCURRENT RELAY
- 150T TIME OVERCURRENT RELAY
- 150X AUXILIARY RELAY FOR LBB ON 150RR/150T
- 169 LOCAL - REMOTE SWITCH
- 172 D.C. FEEDER BREAKER
- 172a-b BREAKER OPEN-CLOSE STATUS SWITCH
- 172CC BREAKER CLOSING COIL 125VDC 1.8 OHM
- 172T BREAKER CARRIAGE POSITION SWITCH
- 172TC SHUNT TRIP COIL 125VDC 20 OHM
- 172X CLOSING COIL CONTACTOR 125VDC 650 OHM
- 176 MAGNETIC SERIES TRIP O/C DEVICE CAL. 3.5-4.5-6-7-8KA
- 176F O/C RELAY (0-6000A SCALE) 120V., 60HZ., HIGH SAT. POINT
- 176LBB LBB D.C. CURRENT SENSING RELAY
- 176TD O/C RELAY, TIMER 125VDC (SAT. AT 20SEC) IN CASE W/ 176F
- 176X AUXILIARY RELAY FOR MAGNETIC SERIES TRIP
- 183 VOLTAGE MEASURING TRANSFER RELAY
- 94TT TRANSFER TRIP OUTPUT RELAY
- 201 EMERGENCY CLOSE RELAY (REMOTE CONTACT)
- 201X BREAKER MASTER CONTROL RELAY (LATCHING TYPE) SUPERVISORY TRIP RELAY (REMOTE CONTACT)
- 294 SUPERVISORY TRIP RELAY (REMOTE CONTACT)
- 301TT CONTROL SWITCH FOR TRANSFER TRIP BY-PASS

DEVICE ABBREVIATIONS

- A AMMETER 0-6000A (0-2AFSD) RECT. MOVING COIL LONG SCALE
- AIL AMBER INDICATION LAMP- AUTO CLOSE IN OPERATION 125V
- C CLOSE
- CC CLOSING COIL
- CS CONTROL SWITCH TRIP- NEUTRAL- CLOSE
- DCCT D.C. CURRENT TRANSDUCER 3000/1A 120V, 60HZ
- DIRECTIONAL BLOCKING DIODE/METAL OXIDE VARISTOR
- GIL GREEN INDICATION LAMP- C.B. OPEN. 125V
- L LOCAL CONTROL MODE
- LBB LOCAL BREAKER BACKUP
- OP OPERATE
- R REMOTE CONTROL MODE
- RE RESET
- RE INDICATION LAMP- C.B. CLOSED. 125V
- RIL RED INDICATION LAMP
- SHUNT SWITCHBOARD D.C. SHUNT
- T TRIP
- T.S. TEST SWITCH
- TT TRANSFER TRIP
- V VOLTMETER (0-2000V) MOVING COIL, LONGSCALE DIRECT READING
- VR1 ATTENUATOR 200 OHM VARIABLE
- TEST LINK
- ASC D.C. CURRENT SIGNAL CONDITIONER
- AXD SPLIT CORE D.C. CURRENT TRANSDUCER
- XCA D.C. VOLTS TRANSDUCER CALIBRATOR
- VXD D.C. VOLTS TRANSDUCER
- WIL WHITE INDICATING LIGHT

CIRCUIT WITHIN THE CLOUD INDICATES NEW WORK UNDER THIS CONTRACT

REFERENCE DRAWINGS  
 LBB SYSTEM SCHEMATIC DIAGRAM SS-175-4401  
 TRANSFER TRIP SCHEMATIC DIAGRAM SS-175-4402

NOTES:  
 SCHEMATIC DIAGRAM IS PRESENTED IN BREAKER OPEN AND IN SERVICE POSITION. ALL RELAYS DE-ENERGIZED.

BREAKER CONTACTS LEGEND:

- ⊙ MULTICORE TERMINATION
- BUS WIRING TB
- △ LOCATED IN SEPARATE ENCLOSURE
- ⊕ CARRIAGE SWITCH OPEN IN SERVICE
- ⊖ CARRIAGE SWITCH CLOSED IN SERVICE POSITION
- ⊕ AUX. SWITCH OPEN IN CB OPEN POSITION
- ⊖ AUX. SWITCH CLOSED IN CB OPEN POSITION
- ⊕ AUX. SWITCH OPEN IN CB CLOSED POSITION
- ⊖ AUX. SWITCH CLOSED IN CB CLOSED POSITION
- ⊕ MINOR DISCONNECT CONTACT CLOSED ONLY WHEN CIRCUIT BREAKER IS IN 'SERVICE' POSITION
- ⊖ MINOR DISCONNECT CONTACT CLOSED WHEN CIRCUIT BREAKER IS IN 'TEST' POSITION AND 'SERVICE' POSITION

LEGEND:

- ⊙ TERMINAL POINT AT 1500 V D.C. SWITCHGEAR
  - ⊙ TERMINAL POINT AT 12.4 KV A.C. SWITCHGEAR
  - ⊕ TERMINAL POINT AT 4 KV A.C. SWITCHGEAR
  - ⊖ TERMINAL POINT AT RECTIFIER CONTROL PANEL
  - △ TERMINAL POINT AT TRANSFORMER CONTROL PANEL
  - ⊕ TERMINAL POINT AT TRANSFER TRIP & LBB SWITCHBOARD
  - TERMINAL POINT AT SUPERVISORY CONTROL CABINET
  - ⊕ TERMINAL POINT AT BUS FAULT RELAY PANEL OR CONTROL SWITCHBOARD OR OTHER MISC. PANELS.
- LAST WIRE NO. K60

WIRING NOTE:

\* HIGH VOLTAGE WIRES ALLEPH TYPE 4 (1900/3300V). THESE WIRES WILL BE SEGREGATED AND RUN SEPARATELY FROM OTHER WIRES.

BY LDP

1	CHARGE
2	2 N/O BKR AUX S1/S5
3	2 N/O BKR AUX S1/S5
4	2 N/O BKR AUX S1/S5
5	2 N/O BKR AUX S1/S5
6	2 N/O BKR AUX S1/S5
7	2 N/O BKR AUX S1/S5
8	2 N/O BKR AUX S1/S5
9	2 N/O BKR AUX S1/S5
10	2 N/O BKR AUX S1/S5
11	2 N/O BKR AUX S1/S5
12	2 N/O BKR AUX S1/S5
13	2 N/O BKR AUX S1/S5
14	2 N/O BKR AUX S1/S5
15	2 N/O BKR AUX S1/S5
16	2 N/O BKR AUX S1/S5

**Metra** ENGINEERING DEPARTMENT  
CHICAGO, ILLINOIS

D.C. FEEDER BREAKER  
SECTION NO. 177  
SCHEMATIC DIAGRAM

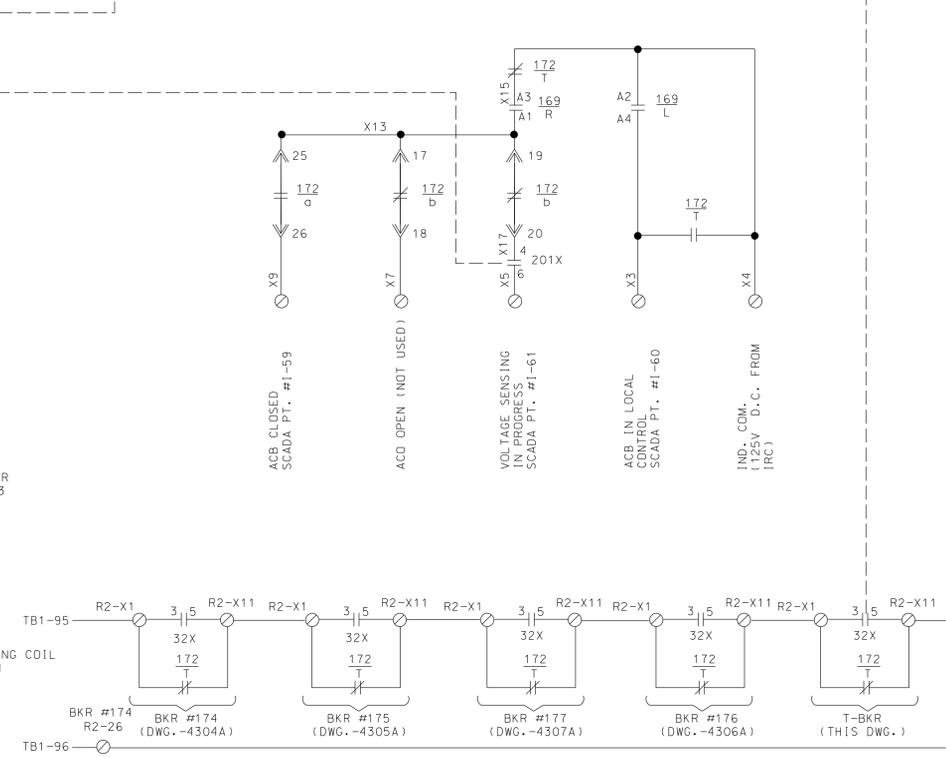
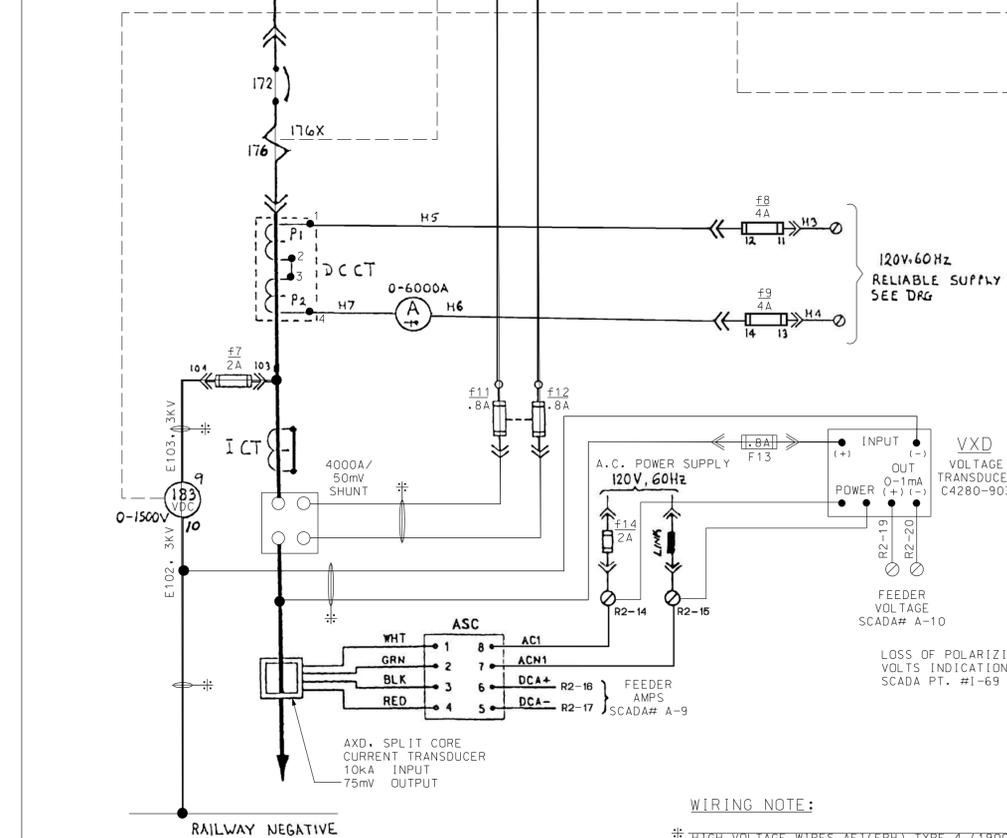
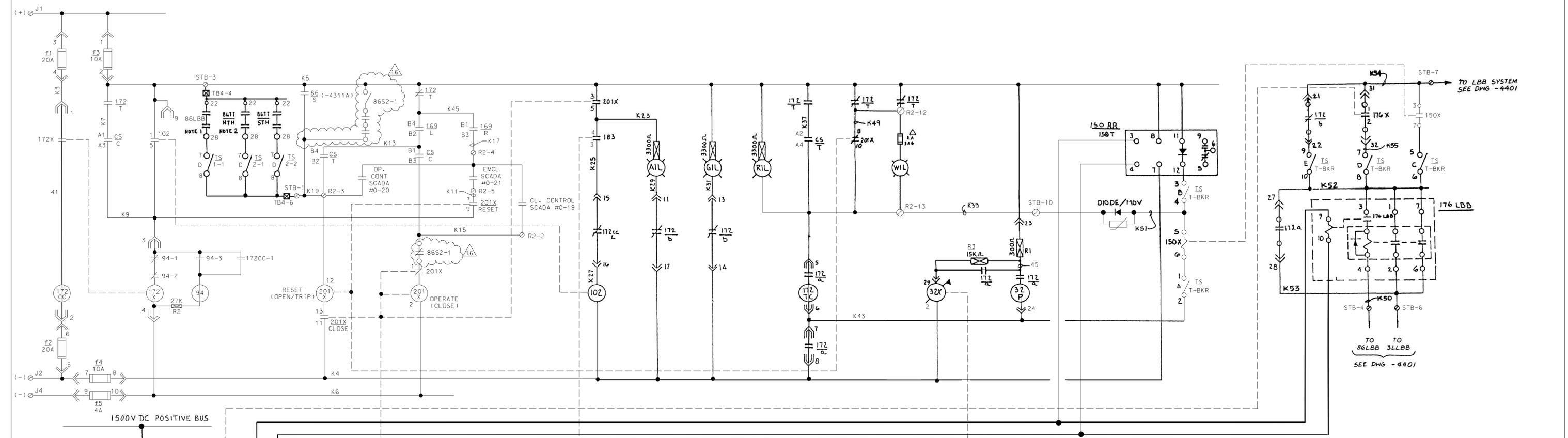
RIVERDALE TIE STATION

MFG BY WHIPP & BOURNE LTD W & B DWG. NO 418766

CAD FILE NO f/electrical/eal/riverdale/hyb/4307a.rwd

DESIGNED	DRAWN	CHECKED	APPROVED
-	AZ/CM	WPS	WPS

DIST NO	DATE	PRINT NUMBER
METRA ELECTRIC	5/27/88	SS-17.5-4307A



- DEVICE LEGEND**
- 30LBB LBB ANNUNCIATOR TARGET RELAY
  - 32P POLARISING COIL FOR 176 TRIPPING 125VDC 2X50 OHM COILS
  - 32X FLAG INDICATION RELAY FOR LOSS OF 32P VOLTAGE
  - 62TT TIMING RELAY 0.1 - 6.0 SEC.
  - 62TT TIMING RELAY 0.1 - 6.0 SEC.
  - 64D GROUND FAULT SENSING RELAY
  - 64XX AUX. RELAY FOR GROUND FAULT TRANSFER TRIP
  - 86/S LOCKOUT RELAY
  - 86LBB BREAKER BACKUP LOCKOUT RELAY (MANUAL RESET)
  - 86TT TRANSFER TRIP LOCKOUT RELAY (ELECT. RESET)
  - 94 CLOSING COIL CUT OFF (ANTI-PUMP) RELAY 125VDC
  - 94TT TRANSFER TRIP OUTPUT RELAY
  - 102 RECLOSING TIMER (SET AT 3.5 SECS.)
  - 127 AC SUPPLY CHANGE OVER RELAY
  - 150RR RATE OF RISE OVERCURRENT RELAY
  - 150T TIME OVERCURRENT RELAY
  - 150X AUXILIARY RELAY FOR LBB ON 150RR/150T
  - 169 LOCAL - REMOTE SWITCH
  - 172 D.C. FEEDER BREAKER
  - 172a-b BREAKER OPEN-CLOSE STATUS SWITCH
  - 172C BREAKER CLOSING COIL 125VDC 1.8 OHM
  - 172T BREAKER CARRIAGE POSITION SWITCH
  - 172TC SHUNT TRIP COIL 125VDC 20 OHM
  - 172X CLOSING COIL CONTACTOR 125VDC 650 OHM
  - 176 MAGNETIC SERIES TRIP O/C DEVICE CAL. 3.5-4-5-6-7-8KA
  - 176F O/C RELAY (0-6000A SCALE) 120V, 60HZ. HIGH SAT. POINT
  - 176LBB LBB D.C. CURRENT SENSING RELAY
  - 176TD O/C RELAY, TIMER 125VDC (SAT. AT 20SEC) IN CASE W/ 176F
  - 176X AUXILIARY RELAY FOR MAGNETIC SERIES TRIP
  - 183 VOLTAGE MEASURING TRANSFER RELAY
  - 201 SUPERVISORY CLOSE RELAY (REMOTE CONTACT)
  - 201D EMERGENCY CLOSE RELAY (REMOTE CONTACT)
  - 201X BREAKER MASTER CONTROL RELAY (LATCHING TYPE)
  - 294 SUPERVISORY TRIP RELAY (REMOTE CONTACT)
  - 301TT CONTROL SWITCH FOR TRANSFER TRIP BY-PASS
- DEVICE ABBREVIATIONS**
- A AMMETER 0-6000A (0-2AFSD) RECT. MOVING COIL LONG SCALE
  - AIL AMBER INDICATION LAMP- AUTO CLOSE IN OPERATION 125V
  - C CLOSE
  - CC CLOSING COIL
  - CS CONTROL SWITCH TRIP- NEUTRAL- CLOSE
  - DCCT D.C. CURRENT TRANSducer 3000/1A 120V, 60HZ
  - DIODE/MOV DIRECTIONAL BLOCKING DIODE/METAL OXIDE VARISTOR
  - GIL GREEN INDICATION LAMP- C.B. OPEN, 125V
  - L LOCAL CONTROL MODE
  - LBB LOCAL BREAKER BACKUP
  - OP OPERATE
  - R REMOTE CONTROL MODE
  - RE RESET
  - REI RED INDICATION LAMP- C.B. CLOSED, 125V
  - RIL SWITCHBOARD D.C. SHUNT
  - T TRIP
  - T.S. TEST SWITCH
  - TT TRANSFER TRIP
  - V VOLTMETER (0-2000V) MOVING COIL, LONGSCALE DIRECT READING
  - VR1 ATTENUATOR 200 OHM VARIABLE
  - T-L TEST LINK
  - ASC D.C. CURRENT SIGNAL CONDITIONER
  - AXD SPLIT CORE D.C. CURRENT TRANSducer
  - XCA D.C. VOLTS TRANSducer CALIBRATOR
  - VXD D.C. VOLTS TRANSducer
  - WIL WHITE INDICATING LIGHT

CIRCUIT WITHIN THE CLOUD INDICATES NEW WORK UNDER THIS CONTRACT

**NOTE:**  
SCHEMATIC DIAGRAM IS PRESENTED IN BREAKER OPEN AND IN SERVICE POSITION. ALL RELAYS DE-ENERGIZED.

**REFERENCE DRAWINGS**  
LBB SYSTEM SCHEMATIC DIAGRAM 55-175-4401  
TRANSFER TRIP SCHEMATIC DIAGRAM 55-175-4402

**WIRING NOTE:**  
\* HIGH VOLTAGE WIRES ARE (EPH) TYPE 4 (1900/3300V). THESE WIRES WILL BE SEGREGATED AND RUN SEPARATELY FROM OTHER WIRES.

**BREAKER CONTACTS LEGEND:**

- ⊗ MULTICORE TERMINATION
- BUS WIRING TB
- △ LOCATED IN SEPARATE ENCLOSURE
- ⊕ CARRIAGE SWITCH OPEN IN SERVICE
- ⊖ CARRIAGE SWITCH CLOSED IN SERVICE POSITION
- ⊕ AUX. SWITCH OPEN IN CB OPEN POSITION
- ⊖ AUX. SWITCH CLOSED IN CB CLOSED POSITION
- ⊕ AUX. SWITCH OPEN IN CB OPEN POSITION
- ⊖ AUX. SWITCH CLOSED IN CB CLOSED POSITION
- ⊕ MINOR DISCONNECT CONTACT CLOSED ONLY WHEN CIRCUIT BREAKER IS IN 'SERVICE' POSITION
- ⊖ MINOR DISCONNECT CONTACT CLOSED WHEN CIRCUIT BREAKER IS IN 'TEST' POSITION AND 'SERVICE' POSITION

**LEGEND:**

- ⊗ TERMINAL POINT AT 1500 V D.C. SWITCHGEAR
  - ⊗ TERMINAL POINT AT 12.4 KV A.C. SWITCHGEAR
  - ⊕ TERMINAL POINT AT 4 KV A.C. SWITCHGEAR
  - ⊖ TERMINAL POINT AT RECTIFIER CONTROL PANEL
  - △ TERMINAL POINT AT TRANSFORMER CONTROL PANEL
  - ⊗ TERMINAL POINT AT TRANSFER TRIP & LBB SWITCHBOARD
  - TERMINAL POINT AT SUPERVISORY CONTROL CABINET
  - ⊕ TERMINAL POINT AT BUS FAULT RELAY PANEL OR CONTROL SWITCHBOARD OR OTHER MISC. PANELS.
- LAST WIRE NO. K60

BY LDP

1	CHANGE	2	10-15-15	3	RH	4	2 N/O BKS AUX S1/S2 AND R3 ADDED TO POLARISING CIRCUIT	5	CT	6	WIRE #139 RE-USED CORNING (RATED 150V NOW SHOWN)	7	AS BUILT	8	5-14-84	9	LAMP ADDED	10	ADD LBB ANNUNCIATOR TRANSFER TRIP	11	CP/WPS	12	6/03	13	WPS	14	11/05	15	9/09	16	07/28/17	17	HS	18	ISSUED FOR BID
---	--------	---	----------	---	----	---	--	---	----	---	--	---	----------	---	---------	---	------------	----	-----------------------------------	----	--------	----	------	----	-----	----	-------	----	------	----	----------	----	----	----	----------------

**Metra** ENGINEERING DEPARTMENT  
CHICAGO, ILLINOIS

D.C. FEEDER BREAKER  
SECTION NO. T-BKR  
SCHEMATIC DIAGRAM

**RIVERDALE TIE STATION**

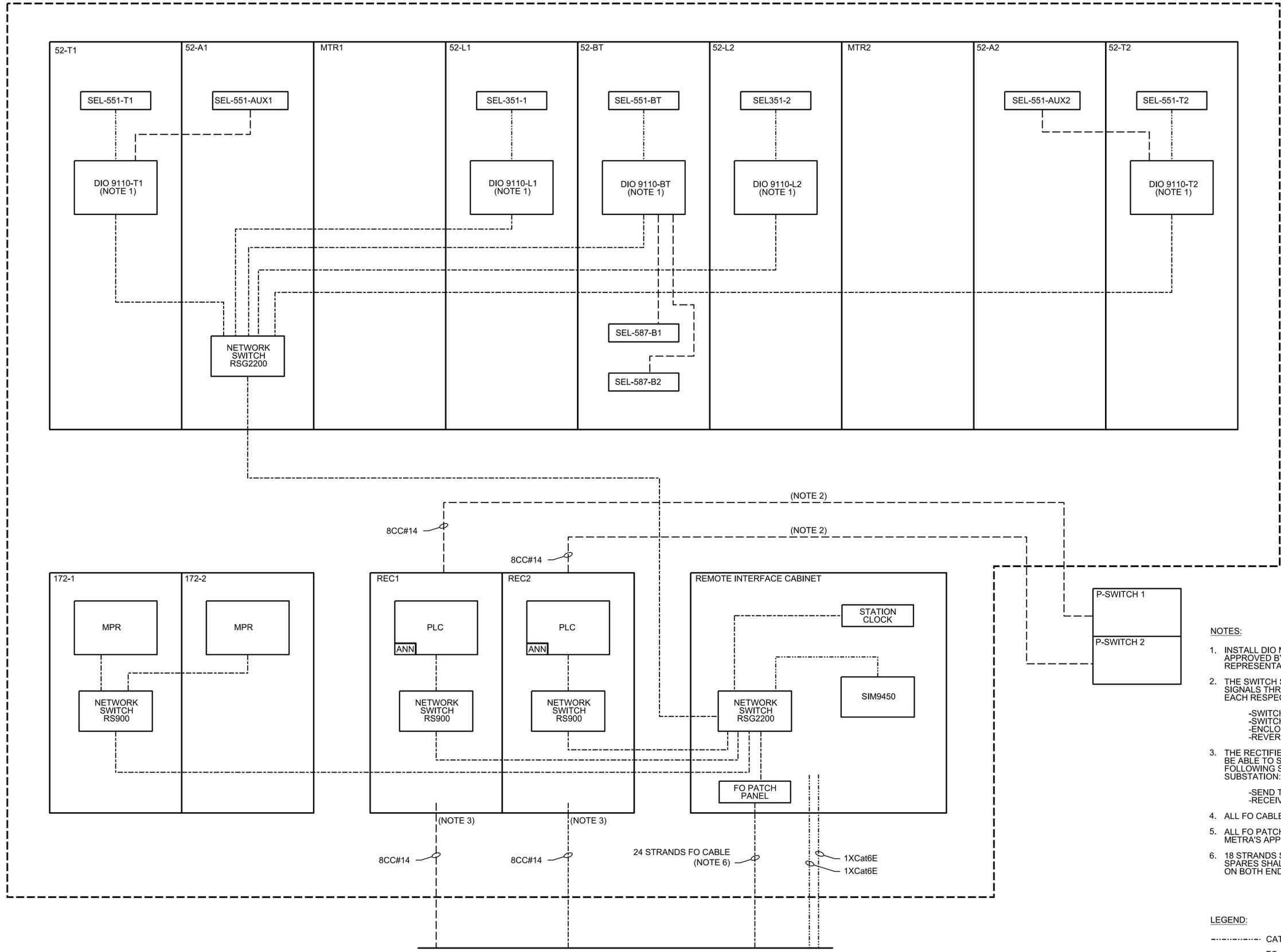
MFG BY WHIPP & BOURNE LTD W & B DWG. NO 418766

CAD FILE NO f/electrical/eam/riverdale/hyb/1308a.rxd

DESIGNED	DRAWN	CHECKED	APPROVED
-	AZ/CM	WPS	WPS

DISTRICT	DATE	PRINT NUMBER
METRA ELECTRIC	5/17/18	SS-17.5-4308A

NEW PREFABRICATED SUBSTATION



- NOTES:**
- INSTALL DIO MODULES AS NEEDED AND AS APPROVED BY METRA'S AUTHORIZED REPRESENTATIVE.
  - THE SWITCH SHALL SEND THE FOLLOWING SIGNALS THROUGH DRY CONTACTS TO EACH RESPECTIVE CONTROL CABINET:
    - SWITCH OPENED
    - SWITCH CLOSED
    - ENCLOSURE DOOR OPEN
    - REVERSE CURRENT
  - THE RECTIFIER CONTROL CABINET SHALL BE ABLE TO SEND/RECEIVE THE FOLLOWING SIGNALS TO THE EXISTING SUBSTATION:
    - SEND TRIP DC LOCKOUT
    - RECEIVE TRIP FROM 64HS
  - ALL FO CABLES USED SHALL BE MULTIMODE.
  - ALL FO PATCH PANELS SHALL BE SUBJECT TO METRA'S APPROVAL.
  - 18 STRANDS SHALL BE KEPT AS SPARES. ALL SPARES SHALL BE PROPERLY TERMINATED ON BOTH ENDS FOR FUTURE USE.

- LEGEND:**
- CAT 6E
  - FO CABLE
  - HARDWIRED

CONTINUED ON SHEET 2

PRINTED ON: SDATES

0	7/28/2017	AA	ER	ISSUED FOR BID
REV	DATE	BY	APP	DESCRIPTION

SUB CONSULTANT

PRIMARY CONSULTANT  
SEAL/ SIGNATURE

PRIMARY CONSULTANT

DESIGNED: A. ACHHAMMER  
DRAWN: N. DIAZ  
CHECKED: E. ROWE  
METRA P.M. R. CERANT  
DATE: JUNE 12, 2017

ENGINEERING DEPARTMENT  
547 W. JACKSON BOULEVARD  
CHICAGO, ILLINOIS 60661

LOCATION NAME:  
**RIVERDALE SUBSTATION**

TITLE:  
**STATION CONTROL ARCHITECTURE  
EXISTING BUILDING AND INTERFACES  
SHEET 1 OF 2**

CAD FILE NUMBER:  
SFILES5

SCALE:  
NTS

PROJECT NO.  
GW4254-57102002

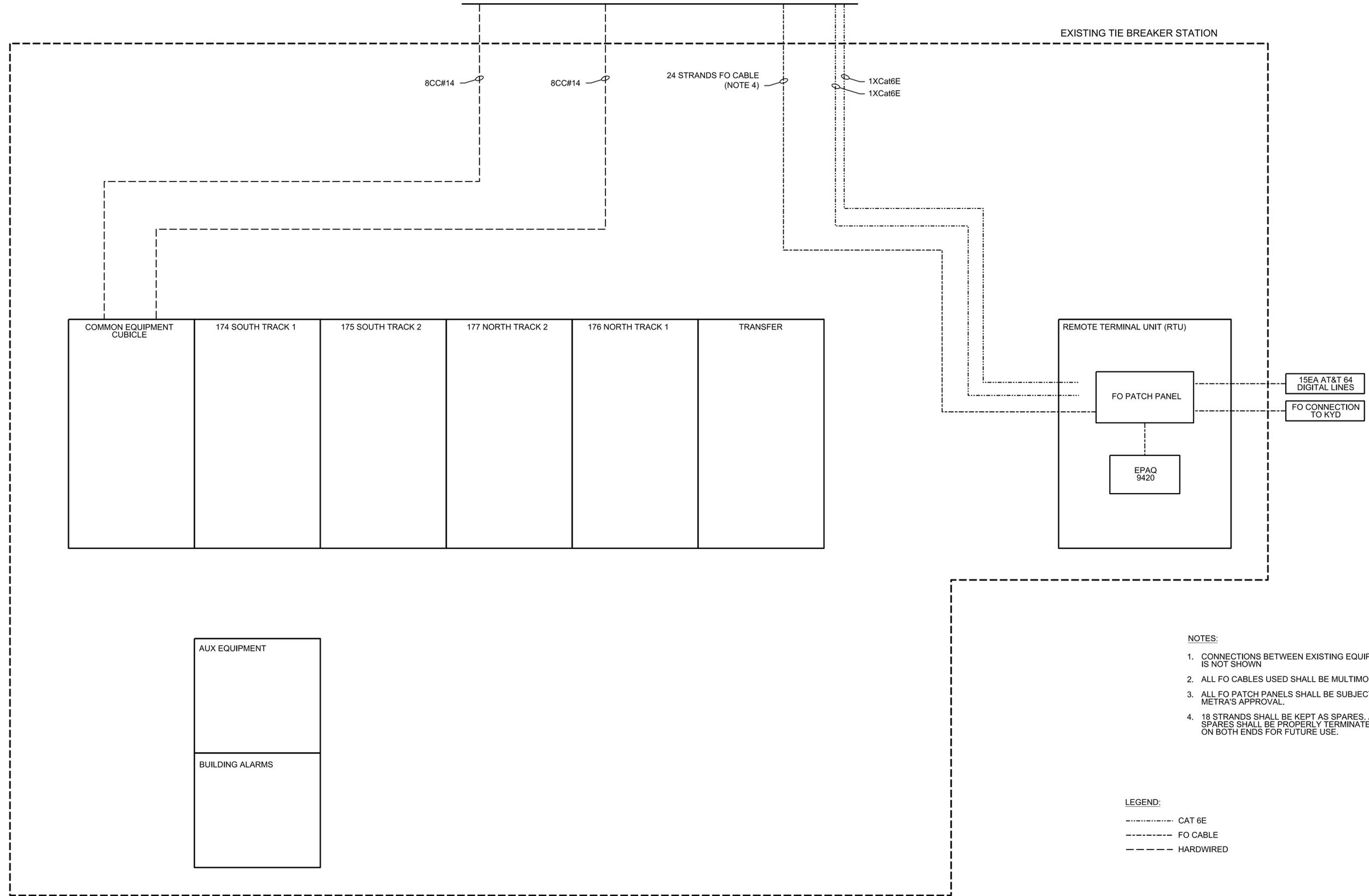
MILE POST NO.  
17.5

DISTRICT:  
MED

SHEET NO.  
**SS-17.5-5000**

CONTINUED ON SHEET 1

EXISTING TIE BREAKER STATION



- NOTES:**
1. CONNECTIONS BETWEEN EXISTING EQUIPMENT IS NOT SHOWN
  2. ALL FO CABLES USED SHALL BE MULTIMODE.
  3. ALL FO PATCH PANELS SHALL BE SUBJECT TO METRA'S APPROVAL.
  4. 18 STRANDS SHALL BE KEPT AS SPARES. ALL SPARES SHALL BE PROPERLY TERMINATED ON BOTH ENDS FOR FUTURE USE.

**LEGEND:**  
 ..... CAT 6E  
 - - - - - FO CABLE  
 - - - - - HARDWIRED

PRINTED ON: SDATES

				SUB CONSULTANT				PRIMARY CONSULTANT SEAL/ SIGNATURE				PRIMARY CONSULTANT				DESIGNED: A. ACHHAMMER				LOCATION NAME: RIVERDALE SUBSTATION				CAD FILE NUMBER: \$FILES\$							
																				TITLE: STATION CONTROL ARCHITECTURE EXISTING BUILDING AND INTERFACES SHEET 2 OF 2				SCALE: NTS				DISTRICT: MED			
																												PROJECT NO. GW4254-57102002			
0 7/28/2017 AA ER ISSUED FOR BID																								MILE POST NO. 17.5							
REV	DATE	BY	APP	DESCRIPTION	REV	DATE	BY	APP	DESCRIPTION	REV	DATE	BY	APP	DESCRIPTION	REV	DATE	BY	APP	DESCRIPTION	REV	DATE	BY	APP	DESCRIPTION	REV	DATE	BY	APP	DESCRIPTION		



ENGINEERING DEPARTMENT  
 547 W. JACKSON BOULEVARD  
 CHICAGO, ILLINOIS 60661

DATE: JUNE 12, 2017

**METRA RAILROAD CONTRACTOR AND SUBCONTRACTOR  
SAFETY REQUIREMENTS**

Before entering Metra property or property owned by other railroads that are part of this contract, contractor and its subcontractors at any tier who meets the definition of a roadway worker shall cause its employees to comply with Metra's Safety Rules and General Procedures (or the applicable safety rules of the railroad where business is being conducted). If the contractor and its subcontractors will perform work on Metra trackage or trackage on another railroad conducting business for or on behalf of Metra (with 25 feet of Union Pacific & BNSF trackage), the contractor, its employees and subcontractors at any tier must complete Metra's Contractors Orientation Safety Program located at [www.contractororientation.com](http://www.contractororientation.com) or the safety orientation of the railroad where business is being conducted. The web-master will charge an \$20.00 fee for each of the contractor's and subcontractors' employees and will furnish a contractor orientation course completion card which must be carried at all times while on Metra's trackage or that of another railroad conducting business for or on behalf of Metra.

Additionally, Metra's employees in charge will conduct an extended job briefing that will include all relevant information concerning on-track safety procedures in connection with the task at hand and will repeat the job briefing when conditions, authority, or protection changes.

**Notice**

No contractor or subcontractor is permitted to work on or near Metra trackage until the Metra employee is present at the job site and the extended job briefing has been conducted.

A fence separation of work activities and trackage may, when approved by Metra, allow the contractor to perform work outside of the fence without a Metra employee present.

Each contractor and subcontractor shall be responsible to comply with their safety action plan for all non-Federal Railroad Administration regulated issues such as, but not limited to, fall protection, welding procedures, fire safety, power line clearances, gas, phone electrical cables, etc.

Any excavation or other hazards created by the contractors or subcontractor work must be left in a condition that assures Metra's Workers, passengers and the general public are protected from said hazards.

Machines or other vehicles must not be left running when not attended. Further said equipment must be secured, locked and chained, if necessary to prevent unauthorized movement onto or in the foul of trackage.

**Definition: Roadway Worker**

Any employee of the railroad, or of a contractor to the railroad, whose duties include and who is engaged in the inspection, construction, maintenance, or repair of railroad track, bridges, roadway, signal and communication systems, roadway facilities, or electric traction systems, or in the operation of roadway maintenance machinery on or near track, with the potential of fouling a track.

**IN EMERGENCY  
CALL METRA POLICE (312) 322-2800**

## Quality Management Plans

Metra has developed Third-Party Contractor Quality Management Plans, namely Contractor Construction Quality Management Plan (CCQMP), Consultant Design Quality Management Plan (CDQMP), and Construction/Project Management Plan (CCQMP). These Quality Management Plans are consistent with the Metra Corporate Quality Management Plan and the current version of the Federal Transit Administration (FTA) Quality Assurance and Quality Control Guidelines, FTA-IT-90-5001-02.1, and incorporates the applicable elements of a quality program as listed in the FTA document.

The Quality Management Plans address what documentation Metra expects from its Third-Party Contractors and their sub-contractors to ensure that the Third-Party Quality Management Plan meets FTS such documentation meets Quality Assurance and Quality Control Guidelines.

It is the responsibility of the Third-Party Contractors and their subcontractors to implement the applicable elements of the Quality Management Plans. Additional documentation may be required for some projects. The Third-Party Contractors and their subcontractors shall provide such documentation when requested.

The Third-Party Contractor work activities associated with the project are subject to quality assurance audits by Metra. Metra quality assurance audits are performed to verify the implementation and to assess the overall effectiveness of the Quality Management Plan. If a deficiency or nonconforming activity is identified and noted during a Metra quality assurance audit, the Third-Party Contractor must take suitable action, at no expense to Metra, to implement the appropriate corrective action within the scheduled time allotted. Noncompliance of the quality requirements and/or non-completion of the corrective action within the scheduled time may be considered a breach of contract.

The current versions of the following Metra Third Party Contractor Quality Management Plans are available at <ftp://ftp.metarr.com> (File Transfer Protocol Site).

1. Contractor Construction Quality Management Plan (CCQMP)
2. Consultant Design Quality Management Plan (CDQMP)
3. Construction/Project Management Plan (CCQMP)

- Open your Web Browser, type-in <ftp://ftp.metarr.com> in the address line and hit 'Enter'
- Type the following for the 'User Name' and 'Password' and click 'logon'

**User Name:** metragrants **Password:** M3tr@u9r3

Click on the applicable Quality Management Plan to access its contents and the 'ReadMeFirst.pdf' file which provides the appropriate instructions to copy and save its contents.

**U.S. Department of Labor Wage Determinations**

General Decision Number: IL180009 06/01/2018 IL9

Superseded General Decision Number: IL20170009

State: Illinois

Construction Types: Building, Heavy, Highway and Residential

County: Cook County in Illinois.

BUILDING, RESIDENTIAL, HEAVY, AND HIGHWAY PROJECTS (does not include landscape projects).

Note: Under Executive Order (EO) 13658, an hourly minimum wage of \$10.35 for calendar year 2018 applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least \$10.35 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2018. The EO minimum wage rate will be adjusted annually. Please note that this EO applies to the above-mentioned types of contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but it does not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60). Additional information on contractor requirements and worker protections under the EO is available at [www.dol.gov/whd/govcontracts](http://www.dol.gov/whd/govcontracts).

Modification Number	Publication Date
0	01/05/2018
1	01/12/2018
2	02/16/2018
3	06/01/2018

ASBE0017-001 06/01/2017

	Rates	Fringes
ASBESTOS WORKER/INSULATOR		
Includes the application of all insulating materials, protective coverings, coatings, and finishes to all types of mechanical systems.....	\$ 50.50	25.80
Fire Stop Technician.....	\$ 40.40	24.54
HAZARDOUS MATERIAL HANDLER		

includes preparation, wetting, stripping removal scrapping, vacuuming, bagging and disposal of all insulation materials, whether they contain asbestos or not, from mechanical systems.....	\$ 37.80	24.54
-----		
BOIL0001-001 05/01/2017		
	Rates	Fringes
BOILERMAKER.....	\$ 46.18	29.58
-----		
BRIL0021-001 06/01/2016		
	Rates	Fringes
BRICKLAYER.....	\$ 44.88	26.62
-----		
BRIL0021-004 06/01/2017		
	Rates	Fringes
Marble Mason.....	\$ 44.63	26.83
-----		
BRIL0021-006 06/01/2017		
	Rates	Fringes
TERRAZZO WORKER/SETTER.....	\$ 44.38	25.84
TILE FINISHER.....	\$ 38.56	22.10
TILE SETTER.....	\$ 45.49	25.72
-----		
BRIL0021-009 06/01/2017		
	Rates	Fringes
MARBLE FINISHER.....	\$ 33.95	26.03
-----		
BRIL0021-012 06/01/2017		
	Rates	Fringes
Pointer, cleaner and caulker.....	\$ 45.42	24.06
-----		
CARP0555-001 06/01/2017		
BUILDING, HEAVY, AND HIGHWAY		
	Rates	Fringes
CARPENTER Carpenter, Lather, Millwright, Piledriver, and Soft Floor Layer		

Building.....	\$ 46.35	31.29
Heavy & Highway.....	\$ 46.35	31.31

-----  
 CARP0555-002 10/01/2017

RESIDENTIAL CONSTRUCTION

	Rates	Fringes
CARPENTER.....	\$ 37.11	31.29

-----  
 ELEC0009-003 06/04/2017

	Rates	Fringes
Line Construction		
Groundman.....	\$ 39.39	61.37%
Lineman and Equipment		
Operator.....	\$ 50.50	61.37%

-----  
 ELEC0134-001 06/05/2017

	Rates	Fringes
ELECTRICIAN.....	\$ 47.40	32.21

-----  
 ELEC0134-003 06/05/2017

	Rates	Fringes
ELECTRICIAN		
ELECTRICAL TECHNICIAN.....	\$ 43.10	23.95

The work shall consist of the installation, operation, inspection, maintenance, repair and service of radio, television, recording, voice sound vision production and reproduction, telephone and telephone interconnect, facsimile, data apparatus, coaxial, fibre optic and wireless equipment, appliances and systems used for the transmission and reception of signals of any nature, business, domestic, commercial, education, entertainment and residential purposes, including but not limited to communication and telephone, electronic and sound equipment, fibre optic and data communication systems, and the performance of any task directly related to such installation or service whether at new or existing sites, such tasks to include the placing of wire and cable and electrical power conduit or other raceway work within the equipment room and pulling wire and/or cable through conduit and the installation of any incidental conduit.

-----  
 ELEV0002-001 01/01/2018

	Rates	Fringes
ELEVATOR MECHANIC.....	\$ 54.85	32.645+a+b

FOOTNOTES:

a) PAID HOLIDAYS: New Year's Day; Memorial Day; Independence Day; Labor Day; Thanksgiving Day; Day after Thanksgiving Day; Veterans' Day and Christmas Day.

b) Employer contributes 8% of regular hourly rate as vacation pay credit for employee with more than 5 years of service, and 6% for employee with less than 5 years service

-----  
 \* ENGI0150-006 06/01/2017

Building and Residential Construction

	Rates	Fringes
OPERATOR: Power Equipment		
GROUP 1.....	\$ 50.10	36.45
GROUP 2.....	\$ 48.80	36.45
GROUP 3.....	\$ 46.25	36.45
GROUP 4.....	\$ 44.50	36.45

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1: Mechanic; Asphalt Plant\*; Asphalt Spreader; Autograde\*; Backhoes with Caisson attachment\*; Batch Plant\*; Benoto(Requires two Engineers); Boiler and Throttle Valve; Caisson Rigs\*; Central Redi-Mix Plant\*; Combination Backhoe Front Endloader Machine; Compressor and Throttle Valve; Concrete Breaker (Truck Mounted)\*; Concrete Conveyor; Concrete Conveyor, Truck Mounted; Concrete Paver over 27E cu. ft.\*; Concrete Paver 27E cu ft and Under\*; Concrete Placer\*; Concrete Placing Boom; Concrete Pump (Truck Mounted); Concrete Tower; Cranes\*; Cranes, Hammerhead\*; Cranes, (GCI and similar type Requires two operators only); Creter Crane; Crusher, Stone, etc; Derricks; Derricks, Traveling\*; Formless Curb and Gutter Machine\*; Grader, Elevating; Grouting Machines; Highlift Shovels or Front Endloader 2 1/4 yd. and over; Hoists, Elevators, Outside Type Rack and pinion and similar Machines; Hoists, One, Two, and Three Drum; Hoists, Two Tugger One Floor; Hydraulic Backhoes\*; Hydraulic Boom Trucks; Hydraulic Vac (and similar equipment); Locomotives; Motor Patrol\*; Pile Drivers and Skid Rig\*; Post Hole Digger; Pre- Stress Machine; Pump Cretes Dual Ram(Requiring frequent Lubrication and Water); Pump Cretes; Squeeze Cretes-Screw Type Pumps Gypsum Bulker and Pump; Raised and Blind Hole Drill\*; Roto Mill Grinder (36" and Over)\*; Roto Mill Grinder (Less Than 36")\*; Scoops-Tractor Drawn; Slip-Form Paver\*; Straddle Buggies; Tournapull; Tractor with Boom, and Side Boom; and Trenching Machines\*.

GROUP 2: Bobcat (over 3/4 cu yd); Boilers; Broom, Power Propelled; Bulldozers; Concrete Mixer (Two Bag and over); Conveyor, Portable; Forklift Trucks; Greaser Engineer;

Highlift Shovels or Front End loaders under 2 1/4 cu yd;  
 Automatic Hoists, Hoists, Inside Elevators; Hoists, Sewer  
 Dragging Machine; Hoists, Tugger Single Drum; Laser Screed;  
 Rock Drill (Self-Propelled); Rock Drill (Truck Mounted)\*;  
 Rollers; Steam Generators; Tractors; Tractor Drawn  
 Vibratory Roller (Receives an additional \$.50 per hour);  
 Winch Trucks with "A" Frame.

GROUP 3: Air Compressor-Small 250 and Under (1 to 5 not to  
 exceed a total of 300 ft); Air Compressor-Large over 250;  
 Combination-Small Equipment Operator; Generator- Small 50  
 kw and under; Generator-Large over 50 kw; Heaters,  
 Mechanical; Hoists, Inside Elevators (Remodeling or  
 Renovatin work); Hydrualic Power Units (Pile Driving,  
 Extracting, and Drilling); Low Boys; Pumps Over 3" (1 To 3  
 not to exceed a total of 300 ft); Pumps, Well Points;  
 Welding Machines (2 through 5); Winches, 4 Small Electric  
 Drill Winches; Bobcat (up to and including 3/4 cu yd)

GROUP 4 - Bobcats and/or other Skid Steer Loaders; Brick  
 Forklifts; Oilers

\*-Requires Oiler

-----  
 \* ENGI0150-025 06/01/2017

Heavy and Highway Construction

	Rates	Fringes
OPERATOR: Power Equipment		
GROUP 1.....	\$ 48.30	36.45
GROUP 2.....	\$ 47.75	36.45
GROUP 3.....	\$ 45.70	36.45
GROUP 4.....	\$ 44.30	36.45
GROUP 5.....	\$ 43.10	36.45

POWER EQUIPMENT OPERATOR CLASSIFICATIONS

GROUP 1: Asphalt Plant\*; Asphalt Heater and Planer  
 combination; Asphalt Heater Scarfire\*, Asphalt Spreader;  
 Autograder/ GOMACO or similar; ABG Paver\*, Backhoes with  
 Caisson attachment\*, Ballast Regulator, Belt Loader\*;  
 Caisson Rigs\*Car Dumper, Central Redi-Mix Plant\*,  
 Combination Backhoe; Front End Loader Machine (1 cu yd or  
 over Backhoe bucket or with attachments); Concrete Breaker  
 (truck mounted); Concrete Conveyor; Concrete Paver over 27E  
 cu ft\*; Concrete Placer\*; Concrete Tube Float; Cranes, all  
 attachments\*; Cranes, Hammerhead, Linden, Peco and machines  
 of a like nature\*; Creter Crane; Crusher, stone; All  
 Derricks; Derrick Boats; Derricks, traveling\*; Dowell  
 Machine with Air Compressor (\$1.00 above Class 1);  
 Dredges\*; Field Mechanic Welder; Formless Curb and Gutter  
 Machine\*; Gradall and machines of a like nature\*; Grader,  
 Elevating; Grader, Motor Grader, Motor Patrol, Auto Patrol,  
 Form Grader, Pull Grader, Subgrader; Guard Rail Post Driver

mounted\*; Hoists, one, two, and three Drum; Hydraulic Backhoes\*; Backhoes with Shear attachments\*; Mucking Machine; Pile Drivers and Skid Rig\*; Pre-Stress Machine; Pump Cretes Dual Ram (requires frequent lubrication and water)\*; Rock Drill- Crawler or Skid Rig\*; Rock Drill truck mounted\*; Rock/ Track Tamper; Roto Mill Grinder, (36" and over)\*; Slip-Form Paver\*; Soil Test Drill Rig, truck mounted\*; Straddle Buggies; Hydraulic Telescoping Form (tunnel); Tractor Drawn Belt Loader\*; Tractor Drawn Belt Loader with attached Pusher (two engineers); Tractor with boom; Tractaire with attachment; Traffic Barrier Transfer Machine\*; Trenching Machine; Truck Mounted Concrete Pump with boom\*; Underground Boring and/or Mining Machines 5 ft in diameter and over tunnel, etc.\*; Wheel Excavator\* & Widener (Apsco); Raised or Blind Hoe Drill, Tunnel & Shaft\*

GROUP 2: Batch Plant\*; Bituminous Mixer; Boiler and Throttle Valve; Bulldozer; Car Loader Trailing Conveyors; Combination Backhoe Front End Loader Machine, (less than 1 cu yd Backhoe Bucket with attachments); Compressor and Throttle Valve; Compressor, common receiver (3); Concrete Breaker or Hydro Hammer; Concrete Grinding Machine; Concrete Mixer or Paver 7S series to and including 27 cu ft; Concrete Spreader; Concrete Curing Machine; Burlap Machine; Belting Machine and Sealing Machine; Concrete Wheel Saw; Conveyor Muck Cars (Haglund or similar type); Drills (all); Finishing Machine-Concrete; Greaser Engineer; Highlift Shovels or Front End Loader; Hoist- Sewer Dragging Machine; Hydraulic Boom Trucks, all attachments; Hydro-Blaster (requires two operators); Laser Screed\*; Locomotives, Dinky; Off-Road Hauling Units (including articulating); Pump Cretes; Squeeze Cretes-Screw Type pumps, Gypsum Bulker and Pump; Roller Asphalt; Rotary Snow Plows; Rototiller, Seaman, self-Propelled; Scoops-Tractor Drawn; Self-propelled Compactor; Spreader-Chip-Stone; Scraper; Scraper-Prime Mover in Tandem regardless of size (add \$1.00 to Group 2 hourly rate for each hour and for each machine attached thereto add \$1.00 to Group 2 hourly rate for each hour); Tank Car Heater; Tractors, Push, pulling Sheeps Foot, Disc, or Compactor, etc; Tug Boats

GROUP 3: Boilers; Brooms, all power propelled; Cement Supply Tender; Compressor, Common Receiver (2); Concrete Mixer, two bag and over; Conveyor, Portable; Farm type Tractors used for mowing, seeding, etc; Fireman on Boilers; Forklift Trucks; Grouting Machines; Hoists, Automatic; Hoists, all Elevators; Hoists, Tugger single Drum; Jeep Diggers; Low Boys; Pipe Jacking Machines; Post-hole Digger; Power Saw, Concrete, Power Driven; Pug Mills; Rollers, other than asphalt; Seed and Straw Blower; Steam Generators; Stump Machine; Winch Trucks with A-Frame; Work Boats; Tamper-Form motor driven

GROUP 4: Air compressor - Small 250 and under (1 to 5 not to exceed a total of 300 ft); Air Compressor - Large over 250; Combination - Small Equipment Operator; Directional Boring Machine; Generators - Small 50 kw and under; Generators -

Large , over 50 kw; Heaters, Mechanical; Hydraulic power unit (Pile Driving, Extracting or Drilling); Light Plants (1 to 5); Pumps, over 3" (1 to 3, not to exceed a total of 300 ft); Pumps, Well Points; Tractaire; Welding Machines (2 through 5); Winches, 4 small electric drill winches;

GROUP 5: Bobcats (All); Brick Forklifts; Oilers; Directional Boring

\*Requires Oiler

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IRON0001-026 06/01/2017		
	Rates	Fringes
IRONWORKER		
Sheeter.....	\$ 47.58	37.34
Structural and Reinforcing..	\$ 47.33	37.34
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IRON0063-001 06/01/2017		
	Rates	Fringes
IRONWORKER, ORNAMENTAL.....	\$ 46.75	34.44
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IRON0063-002 06/01/2017		
	Rates	Fringes
IRONWORKER		
Fence Erector.....	\$ 39.58	27.70
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IRON0136-001 07/01/2017		
	Rates	Fringes
IRONWORKER		
Machinery Movers; Riggers;		
Macinery Erectors.....	\$ 40.17	33.04
Master Riggers.....	\$ 42.67	33.04
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LABO0002-006 06/01/2017		
	Rates	Fringes
LABORER (BUILDING & RESIDENTIAL)		
GROUP 1.....	\$ 41.20	27.47
GROUP 2.....	\$ 41.20	27.47
GROUP 3.....	\$ 41.28	27.47
GROUP 4.....	\$ 41.30	27.47
GROUP 5.....	\$ 41.40	27.47
GROUP 6.....	\$ 41.40	27.47
GROUP 7.....	\$ 41.43	27.47
GROUP 8.....	\$ 41.53	27.47
GROUP 9.....	\$ 41.55	27.47

GROUP 10.....	\$ 41.75	27.47
GROUP 11.....	\$ 41.78	27.47
GROUP 12.....	\$ 41.40	27.47

LABORER CLASSIFICATIONS

GROUP 1: Building Laborers; Plasterer Tenders; Pumps for Dewatering; and other unclassified laborers.

GROUP 2: Fireproofing and Fire Shop laborers.

GROUP 3: Cement Gun.

GROUP 4: Chimney over 40 ft.; Scaffold Laborers.

GROUP 5: Cement Gun Nozzle Laborers (Gunitite); Windlass and capstan person.

GROUP 6: Stone Derrickmen & Handlers.

GROUP 7: Jackhammermen; Power driven concrete saws; and other power tools.

GROUP 8: Firebrick & Boiler Laborers.

GROUP 9: Chimney on fire brick; Caisson diggers; & Well Point System men.

GROUP 10: Boiler Setter Plastic Laborers.

GROUP 11: Jackhammermen on fire brick work only.

GROUP 12: Dosimeter use (any device) monitoring nuclear exposure); Asbestos Abatement Laborer; Toxic and Hazardous Waste Removal Laborers.

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LABO0002-007 06/01/2017

	Rates	Fringes
LABORER (HEAVY & HIGHWAY)		
GROUP 1.....	\$ 41.20	27.47
GROUP 2.....	\$ 41.28	27.47
GROUP 3.....	\$ 41.40	27.47
GROUP 4.....	\$ 41.43	27.47
GROUP 5.....	\$ 41.40	27.47

LABORER CLASSIFICATIONS

GROUP 1: Common laborer; Tenders; Material expeditor (asphalt plant); Street paving, Grade separation, sidewalk, curb & gutter, strippers & All laborers not otherwise mentioned

GROUP 2: Asphalt tampers & smoothers; Cement gun laborers

GROUP 3: Cement Gun Nozzle (laborers), Gunitite

GROUP 4: Rakers, Lutemen; Machine-Screwmen; Kettlemen; Mixer-men; Drun-men; Jackhammermen (asphalt); Paintmen; Mitre box spreaders; Laborers on birch, overman and similar spreader equipment; Laborers on APSCO; Laborers on air compressor; Paving Form Setter; Jackhammermen (concrete); Power drive concrete saws; other power tools.

GROUP 5: Asbestos Abatement Laborers; Toxic and Hazardous Waste Removal Laborers, Dosimeter (any device) monitoring nuclear exposure

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LABO0002-008 06/01/2017

	Rates	Fringes
LABORER (Compressed Air)		
0 - 15 POUNDS.....	\$ 42.20	27.47
16 - 20 POUNDS.....	\$ 42.70	27.47
21 - 26 POUNDS.....	\$ 43.20	27.47
27 - 33 POUNDS.....	\$ 44.20	27.47
34 - AND OVER.....	\$ 45.20	27.47
LABORER (Tunnel and Sewer)		
GROUP 1.....	\$ 41.20	27.47
GROUP 2.....	\$ 41.33	27.47
GROUP 3.....	\$ 41.43	27.47
GROUP 4.....	\$ 41.55	27.47
GROUP 5.....	\$ 41.20	27.47

LABORER CLASSIFICATIONS (TUNNEL)

GROUP 1: Cage tenders; Dumpmen; Flagmen; Signalmen; Top laborers

GROUP 2: Air hoist operator; Key board operator; concrete laborer; Grout; Lock tenders (Free Air Side); Steel setters; Tuggers; Switchmen; Car pusher

GROUP 3: Concrete repairmen; Lock tenders (pressure side); Mortar men; Muckers; Grout machine operators; Track layers

GROUP 4: Air trac drill operator; Miner; Bricklayer tenders; Concrete blower operator; Drillers; Dynamiters; Erector operator; Form men; Jackhammermen; Powerpac; Mining machine operators; Mucking machine operator; Laser beam operator; Liner plate and ring setters; Shield drivers; Power knife operator; Welder- burners; Pipe jacking machine operator; skimmers; Maintenance technician

GROUP 5: Asbestos abatement laborer; Toxic and hazardous waste removal laborer; Dosimeter (any device) monitoring nuclear exposure

LABORER CLASSIFICATIONS (SEWER)

GROUP 1: Signalmen; Top laborers and All other laborers

GROUP 2: Concrete laborers and Steel setters

GROUP 3: Cement carriers; Cement mixers; Concrete repairmen; Mortar men; Scaffold men; Second Bottom men

GROUP 4: Air trac drill operator; Bottom men; Bracers-bracing; Bricklayer tenders; Catch basin diggers; Drainlayers; dynamiters; Form men; Jackhammermen; Powerpac; Pipelayers; Rodders; Welder-burners; Well point systems men

GROUP 5: Asbestos abatement laborer, Toxic and hazardous waste removal laborer; Dosimeter (any device) monitoring nuclear exposure

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LABO0225-001 06/01/2017

	Rates	Fringes
LABORER (DEMOLITION/WRECKING)		
GROUP 1.....	\$ 36.00	27.47
GROUP 2.....	\$ 41.40	27.47
GROUP 3.....	\$ 41.40	27.47

LABORER CLASSIFICATIONS

GROUP 1 - Complete Demolition

GROUP 2 - Interior Wrecking and Strip Out Work

GROUP 3 - Asbestos Work with Complete Demolition/Wrecking or Strip Out Work

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PAIN0014-001 06/01/2017

	Rates	Fringes
PAINTER (including taper).....	\$ 44.55	26.49

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PAIN0027-001 06/01/2017

	Rates	Fringes
GLAZIER.....	\$ 42.45	34.18

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PLAS0005-002 07/01/2015

	Rates	Fringes
PLASTERER.....	\$ 42.25	26.65

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PLAS0502-001 06/01/2017

	Rates	Fringes
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CEMENT MASON/CONCRETE FINISHER...	\$ 44.25	32.18
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* PLUM0130-001 06/01/2018		
	Rates	Fringes
PLUMBER.....	\$ 50.25	30.07
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* PLUM0597-002 06/01/2018		
	Rates	Fringes
PIPEFITTER.....	\$ 48.50	31.44
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ROOF0011-001 12/01/2017		
	Rates	Fringes
ROOFER.....	\$ 42.30	22.75
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SFIL0281-001 01/01/2018		
	Rates	Fringes
SPRINKLER FITTER.....	\$ 48.10	27.05
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SHEE0073-001 07/01/2017		
	Rates	Fringes
Sheet Metal Worker.....	\$ 43.50	35.42
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SHEE0073-002 07/01/2017		
	Rates	Fringes
Sheet Metal Worker ALUMINUM GUTTER WORK.....	\$ 30.57	35.42
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TEAM0731-001 06/01/2017		
COOK COUNTY - HEAVY AND HIGHWAY		
	Rates	Fringes
TRUCK DRIVER		
2 or 3 Axles.....	\$ 35.60	22.10
4 Axles.....	\$ 35.85	22.10
5 Axles.....	\$ 36.05	22.10
6 Axles.....	\$ 36.25	22.10

FOOTNOTES:

A. Paid Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, and Christmas Day.

B. 900 straight time hours or more in 1 calendar year for the same employer shall receive 1 week paid vacation; 3 years - 2 weeks paid vacation; 10 years - 3 weeks paid vacation; 20 years - 4 weeks paid vacation.

C. An additional \$.20 per axle shall be paid for all vehicles with more than six (6) axles.

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TEAM0731-002 03/01/2012

	Rates	Fringes
Traffic Control Device Monitor		
TRAFFIC SAFETY WORKER:		
Primary duties include but are not limited to the delivery, maintenance and pick-up of traffic control devices, the set-up and installation of traffic signs, pavement markings, barricades, crash barrels and glare screens, traffic control surveillance, the repair and maintenance trucks, cars, arrow boards, message signs, barricade and sign fabrication equipment.....	\$ 28.25	9.08

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TEAM0786-001 06/01/2017

COOK COUNTY - BUILDING AND RESIDENTIAL

	Rates	Fringes
TRUCK DRIVER		
2 & 3 Axles.....	\$ 39.942	0.25+a
4 Axles.....	\$ 39.75	0.25+a
5 Axles.....	\$ 39.967	0.25+a
6 Axles.....	\$ 40.184	0.25+a

FOOTNOTES:

a. \$719.00 per week.

An additional \$.20 per axle shall be paid for all vehicles with more than six (6) axles.

Paid Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, and Christmas Day.

900 straight time hours or more in 1 calendar year for the same employer shall receive 1 week paid vacation; 3 years - 2 weeks paid vacation; 10 years - 3 weeks paid vacation; 20

years - 4 weeks paid vacation.

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WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at [www.dol.gov/whd/govcontracts](http://www.dol.gov/whd/govcontracts).

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

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The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of "identifiers" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than "SU" or "UAVG" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing

the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

#### Survey Rate Identifiers

Classifications listed under the "SU" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

#### Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

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#### WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

- \* an existing published wage determination
- \* a survey underlying a wage determination
- \* a Wage and Hour Division letter setting forth a position on

- a wage determination matter
- \* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations  
 Wage and Hour Division  
 U.S. Department of Labor  
 200 Constitution Avenue, N.W.  
 Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator  
 U.S. Department of Labor  
 200 Constitution Avenue, N.W.  
 Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board  
 U.S. Department of Labor  
 200 Constitution Avenue, N.W.  
 Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION

**U.S DEPARTMENT OF TRANSPORTATION  
FEDERAL TRANSIT ADMINISTRATION REQUIREMENTS**

**CONTRACT CLAUSES**

If applicable, FTA Circular 4220.1F Contract Clauses will apply to any purchase order/contract resulting from this Invitation for Bid or Request for Proposal. See the attached listing of the Applicability of Third Party Clauses for the respective type of procurement. For further information, visit the FTA website: <http://www.fta.dot.gov>

**APPLICABILITY OF FTA THIRD PARTY CONTRACT PROVISIONS**

(Excluding micro-purchases, except Davis-Bacon requirements apply to contracts exceeding \$2,000)

<b>TYPE OF PROCUREMENT</b>					
<b>PROVISION</b>	<b>Professional Services/A&amp;E</b>	<b>Operations/ Management</b>	<b>Rolling Stock Purchase</b>	<b>Construction</b>	<b>Materials &amp; Supplies</b>
No Federal Government Obligations to Third Parties (by Use of a Disclaimer)	All	All	All	All	All
False Statements or Claims Civil and Criminal Fraud	All	All	All	All	All
Access to Third Party Contract Records	All	All	All	All	All
Changes to Federal Requirements	All	All	All	All	All
Termination	>\$10,000 if 49 CFR Part 18 applies.	>\$10,000 if 49 CFR Part 18 applies.	>\$10,000 if 49 CFR Part 18 applies.	>\$10,000 if 49 CFR Part 18 applies.	>\$10,000 if 49 CFR Part 18 applies.
Civil Rights (Title VI, ADA, EEO except Special DOL EEO clause for construction projects)	All	All	All>\$10,000	All	All
Special DOL EEO clause for construction projects				>\$10,000	
Disadvantaged Business Enterprises (DBEs)	All	All	All	All	All
Incorporation of FTA Terms	All	All	All	All	All
Debarment and Suspension	>\$25,000	>\$25,000	>\$25,000	>\$25,000	>\$25,000
Buy America			>\$100,000 As of Feb. 2011, FTA has not adopted the FAR 2.101 \$150,000 standard.	>\$100,000 As of Feb. 2011, FTA has not adopted the FAR 2.101 \$150,000 standard.	>\$100,000 As of Feb. 2011, FTA has not adopted the FAR 2.101 \$150,000 standard.
Resolution of Disputes, Breaches, or Other Litigation	>\$100,000	>\$100,000	>\$100,000	>\$100,000	>\$100,000
Lobbying	>\$100,000	>\$100,000	>\$100,000	>\$100,000	>\$100,000
Clean Air	>\$100,000	>\$100,000	>\$100,000	>\$100,000	>\$100,000
Clean Water	>\$100,000	>\$100,000	>\$100,000	>\$100,000	>\$100,000
Cargo Preference			Transport by ocean vessel.	Transport by ocean vessel.	Transport by ocean vessel.
Fly America	Foreign air transp./travel	Foreign air transp./travel	Foreign air transp./travel	Foreign air transp./travel	Foreign air transp./travel

**APPLICABILITY OF FTA THIRD PARTY CONTRACT PROVISIONS (Continued)**

(Excluding micro-purchases, except Davis-Bacon requirements apply to construction contracts exceeding \$2,000)

TYPE OF PROCUREMENT					
Professional Services/A&E	Professional Services/A&E	Operations/ Management	Rolling Stock Purchase	Construction	Materials & Supplies
Davis-Bacon Act				>\$2,000 (also ferries).	
Contract Work Hours and Safety Standards Act		>\$100,000 (transportation services excepted).	>\$100,000	>\$100,000 (also ferries).	
Copeland Anti-Kickback Act Section 1 Section 2				All > \$2,000 (also ferries).	
Bonding				\$100,000	
Seismic Safety	A&E for new buildings & additions.			New buildings & additions.	
Transit Employee Protective Arrangements		Transit operations.			
Charter Service Operations		All			
School Bus Operations		All			
Drug Use and Testing		Transit operations.			
Alcohol Misuse and Testing		Transit operations.			
Patent Rights	R & D				
Rights in Data and Copyrights	R & D				
Energy Conservation	All	All	All	All	All
Recycled Products		EPA-selected items \$10,000 or more annually.		EPA-selected items \$10,000 or more annually.	EPA-selected items \$10,000 or more annually.
Conformance with ITS National Architecture	ITS projects.	ITS projects.	ITS projects.	ITS projects.	ITS projects.
ADA Access	A&E	All	All	All	All
Notification of Federal Participation for States	Limited to States.	Limited to States.	Limited to States.	Limited to States.	Limited to States.
Pre-Award & Post-Delivery Audit			All Above \$100,000		

## THIRD PARTY CONTRACTING GUIDANCE APPLICABILITY

### No Government Obligations to Third Parties

- A. Contractor acknowledges and agrees that, notwithstanding any concurrence by the federal government in or approval of the solicitation or award of the underlying contract, absent the express written consent by the federal government, the federal government is not a party to this Contract and shall not be subject to any obligations or liabilities to the Customer, Contractor, or any other party (whether or not a party to that Contract) pertaining to any matter resulting from the underlying Contract.
- B. The Contractor agrees to include the above clause in each subcontract financed in whole or in part with federal assistance provided by FTA. It is further agreed that the clause shall not be modified, except to identify the subcontractor who will be subject to its provisions.

### False or Fraudulent Statements or Claims

The Contractor recognized that the requirements of the Program Fraud Civil Remedies Act of 1986, as amended, 49 U.S.C. part 3801 et seq. and US DOT regulation 49 C.F.R Part 31 apply to its action pertaining to this Contract. Accordingly, the Contractor certifies or affirms the truthfulness and accuracy of any statement it has made, it makes, or it may make pertaining to the Contract. In addition to other penalties that may be applicable, the Contractor also acknowledges that if it makes a false, fictitious, or fraudulent claim, statement, submission, or certification, the federal government reserves the right to impose the penalties of the Program Fraud Civil Remedies Act of 1986, as amended, on the Contractor to the extent the federal government deems appropriate. If applicable, the federal government reserves the right to impose on the Contractor the penalties of 18 U.S.C. Part 1001 and 49 U.S.C. Part No. 5307 (n) (1), to the extent the federal government deems appropriate.

### Environmental Requirements

The Contractor recognizes that many federal and state laws imposing environmental and resource conservation requirements may apply to the project. Some, but not all, of the major federal laws that may affect the project include: the National Environmental Policy Act of 1969, as amended, 42 U.S.C. § 4321 et seq.; the Clean Air Act, as amended., 42 U.S.C. § 7401 et seq.; and scattered sections of 29 U.S.C.; the Clean Water Act, as amended, scattered sections of 33 U.S.C. and 12 U.S.C.; the Resource Conservation and Recovery Act, as amended, 42 U.S.C. §§ 6901 et seq.; and the Comprehensive Environmental Response, Compensation, and Liability Act, as amended, 42 U.S.C. §§ 9601 et seq. The Contractor also recognizes that U.S. EPA, FHWA and other agencies of the federal government have issued and are expected in the future to issue regulations, guidelines, standards, orders, directives, or other requirements that may affect the project. Thus, the Contractor agrees to adhere to, and impose on its subcontractors and any other parties at any tier, any such federal requirements as the federal government may now or in the future promulgate that is applicable to this project. Listed below are requirements of particular concern to FTA, Metra and the Contractor. The Contractor acknowledges that this list does not constitute the Contractor's entire obligation to meet all federal environmental and resource conservation requirements.

#### A. Environmental Protection

The Contractor agrees to comply with the applicable requirements of the National Environmental Policy Act of 1969, as amended, 42 U.S.C. §§ 4321 et seq. in accordance with Executive Order No. 12898, "Federal' Actions to Address Environmental Justice in Minority Populations and Low-income Populations," 59 Fed. Reg. 7629, Feb. 16, 1994; FTA statutory requirements on environmental matters at 49 U.S.C. § 5324(b); Council on Environmental Quality regulations on compliance with the National Environmental Policy Act of 1969, as amended, 40 C.F.R. Part 1500 et seq.; and joint FHWA/FTA regulations, "Environmental Impact and Related Procedures," 23 C.F.R. Part 771 and 49 C.F.R. Part 622.

#### B. Air Quality

The Contractor agrees as follows:

1. The Contractor agrees to comply with all applicable standards, orders, or regulations issued pursuant to the Clean Air Act, as amended, 42 U.S.C. §§ 7401 et seq.

## EXHIBIT W

Specifically:

The Contractor agrees to comply with all applicable requirements of U.S. EPA regulations, "Conformity to State or Federal Implementation Plans of Transportation Plans, Programs, and Project Developed, Funded or Approved Under Title 23 U.S.C. or the Federal Transit Act," 40 C.F.R. Part 51, Subpart T; and "Determining Conformity of Federal Actions to State or Federal implementation Plans." 40 C.F.R. Part 93. To support the requisite air quality conformity finding for the project, the Contractor agrees to implement each air quality mitigation and control measure incorporated in the project. The Contractor agrees that any project identified in an applicable State Implementation Plan (SIP) as a Transportation Control Measure, will be wholly consistent with the description of the design concept and scope of the project described in the SIP.

2. The Contractor agrees to comply with, and assures compliance by its subcontractors at any tier, with these requirements resulting from the project. The Contractor will report any violation by its own employees and subcontractors at any tier that may result in any violation of these requirements to Metra, the FTA, and to the appropriate U.S. EPA Regional Office.

### C. Clean Water

1. The Contractor agrees to comply with all standards, order, or regulations issued pursuant to the Federal Water Pollution Control Act, as amended, 33 U.S.C. §§ 1251 et seq.
2. The Contractor agrees to comply with, and assures compliance by its subcontractors at any tier, with these requirements resulting from the project. The Contractor will report any violation by its own employees and subcontractors at any tier, that may result in any violation of these requirements to the Metra, FTA, and to the appropriate U.S. EPA Regional Office.

### Audit

Contractor shall permit the authorized representatives of Metra, RTA, IDOT, U.S. Department of Transportation, and the Comptroller General of the United States to inspect and audit all data and records of Contractor relating to its performance under the Contract.

### Disadvantage Business Enterprise ("DBE")

- A. Contractor must take all such action as may be necessary and reasonable to assure that disadvantaged business enterprises have an equitable opportunity to compete in all subcontracting activities and shall cooperate with Metra in its program for the participation of disadvantaged enterprises in Metra procurements.
- B. U.S. Department of Transportation Regulations. Each Contractor shall agree to abide by the following statements:

It is the policy of the Department of Transportation that disadvantaged business enterprises as defined in 49 CFR Part 26 shall have the maximum opportunity to participate in the performance of Contracts financed in whole or in part with federal funds under this Contract. Consequently, the DBE requirements of 49 CFR Part 26 applies to this Contract.

The Contractor agrees to ensure that disadvantaged business enterprises as defined in 49 CFR Part 26 have the maximum opportunity to participate in the performance of Contracts and subcontracts financed in whole or in part with federal funds provided under this Contract. In this regard all Contractors shall take all necessary and reasonable steps in accordance with 49 CFR Part 23 to ensure that disadvantaged business enterprises have the maximum opportunity to compete for and perform Contracts. Contractors shall not discriminate on the basis of race, religion, color, sex, national origin, age, or disability in the award and performance of DOT-assigned Contracts.

### Employment

- A. Equal Employment Opportunity and Fair Employment Practices

In connection with the execution and performance of this Contract, Contractor shall not discriminate against any employee or applicant for employment because of race, religion, color, sex, national origin, age or disability. Such action shall include,

but not be limited to, the following: employment, upgrading, demotion, transfer, recruitment, recruitment advertising, layoff, termination, rates of pay or other forms of compensation, and selection for training, including apprenticeship.

**B. FTA Regulations**

Contractor for itself, its assignees and successors in interests, agrees that it will comply with the following regulation:

1. Compliance with Regulations

Contractor shall comply with the Regulations relative to nondiscrimination in federally-assisted programs of the Department of Transportation (hereinafter, "DOT") Title 49, Code of federal regulations, Part 21, as they may be amended from time to time (hereinafter referred to as the Regulations), which are incorporated herein by reference and made a part of this Contract.

2. Nondiscrimination

Contractor, with regard to the work performed by it during this Contract, shall not discriminate on the grounds of race, religion, color, sex, national origin, age, or disability in the selection and retention subcontractors, including procurements of materials and leases of equipment. Contractor shall not participate either directly or indirectly in the discrimination prohibited by Section 21.5 of the Regulations, including employment practices when this Contract covers a program set forth in Appendix B of the Regulations.

3. Solicitations for Subcontracts (including Procurements of Materials and Equipment)

In all solicitations either by competitive bidding or negotiation made by Contractor for work to be performed under a subcontract, including procurements of materials or leases of equipment, each potential subcontractor or supplier shall be notified by Contractor of Contractor's obligations under the Contract and the regulations relative to nondiscrimination on the grounds of race, religion, color, sex, national origin, age, or disability.

4. Information and Reports

Contractor shall provide all information and reports required by the regulations or directives issued pursuant thereto, and shall permit access to its books, records, accounts other sources of information, and its facilities as may be determined by Metra or FTA to be pertinent to ascertain compliance with such regulations, orders, and instructions. Where any information required of Contractor is in the exclusive possession of another who fails or refuses to furnish said information, Contractor shall so certify to Metra or FTA, as appropriate, and shall set forth what efforts it has made to obtain said information.

5. Sanctions for Noncompliance

In the event Contractor's noncompliance with the nondiscrimination provisions of this Contract, Metra shall impose such Contract sanctions as it or FTA may determine to be appropriate including, but not limited to:

- a) Withholding of payments to Contractor under this Contract until Contractor complies, and/or
- b) Cancellation, termination or suspension of this Contract, in whole or in part.

6. Incorporation of Provisions

Contractor shall include these paragraphs (1) through (6) of this Section in every subcontract, including procurements of materials and leases of equipment, unless exempt by the regulations, or directives issued pursuant hereto. Contractor shall take such action with respect to any subcontract or procurement as Metra or FTA may direct as a means of enforcing such provisions including sanctions for noncompliance; provided, however, that in the event Contractor becomes involved in, or is threatened with, litigation with a subcontractor or supplier as a result of such direction, Contractor may request Metra to enter into such litigation to protect the interest of Metra, and in addition, Contractor may request the United States to enter into such litigation to protect the interests of the United States.

C. Equal Employment Opportunity – FEPC

Contractor shall comply with, and assure that each subcontractor complies with the following regulations of the Illinois Human Rights Commission:

1. In the event of the Contractor's noncompliance with any provision of this Equal Opportunity Clause, the Illinois Human Rights Act or the Illinois Human Rights Commission's Rules and Regulations, the Contractor may be declared non-responsible and therefore ineligible for future Contracts or subcontracts with the State of Illinois or any of its political subdivisions or municipal corporations, and the Contract may be canceled or avoided in whole or in part, and such other sanctions or penalties may be imposed or remedies invoked as provided by statute or regulation. During the performance of this Contract, the Contractor agrees as follows:
  - a. That it will not discriminate against any employee or applicant for employment because of race, religion, color, sex, national origin, age, disability, ancestry, physical or mental handicap unrelated to ability, or an unfavorable discharge from military service; and further that it will examine all job classifications to determine if minority persons or women are, underutilized and will take appropriate affirmative action to rectify any such underutilization.
  - b. That, if it hires additional employees in order to perform this Contract or any portion hereof, it will determine the availability (in accordance with the Commission's Rules and Regulations) of minorities and women in the area(s) from which it may reasonably recruit and will hire for each job classification for which employees are hired in such a way that minorities and women are not underutilized.
  - c. That, in all solicitations or advertisements for employees placed by it or on its behalf, it will state that all applicants will be afforded equal opportunity without discrimination because of race, religion, color, sex, national origin, age, disability or ancestry, physical or mental handicap unrelated to ability, or an unfavorable discharge from military service.
  - d. That it will send to each labor organization or representative of workers with which it has or is bound by a collective bargaining or other agreement or understanding, a notice advising such labor organization or representative of the Contractor's obligations under the Illinois Human Rights Act and the Commission's Rules and Regulations. If any such labor organization or representative fails or refuses to cooperate with the Contractor in its efforts to comply with such Act and Rules and Regulations, the Contractor will promptly so notify the Illinois Human Rights Commission and the Contracting Agency and will recruit employees from other sources when necessary to fulfill its obligations thereunder.
  - e. That it will submit reports as required by the Illinois Human Rights Commission's Rules and Regulations, furnish all relevant information as may from time to time be requested by the Commission or the Contracting Agency, and in all respects comply with the Illinois Human Rights Act and the Commission's Rules and Regulations.
  - f. That it will permit access to all relevant books, records, accounts, and work sites by personnel of the Contracting Agency and the Illinois Human Rights Act and the Commission's Rules and Regulations.
  - g. That will include verbatim or by reference the provisions of paragraphs (a) through (g) of this clause in every performance subcontract as defined in Section 1.1 (17) (a) of the Commission's Rules and Regulations so that such provisions will be binding upon every such subcontractor, and that it will also include the provisions of paragraphs (a), (e), (f), and (g) in every supply subcontract as defined in Section 1.1 (17) (a) of the Commission's Rules and Regulations so that such provisions will be binding upon every such subcontractor. In the same manner as with other provisions of this Contract, the Contractor will be liable for compliance with applicable provisions of this clause by all its subcontractors and further it will promptly notify the contracting agency and the Illinois Human Rights Commission in the event any subcontractor fails or refuses to comply therewith. In addition, no Contractor will utilize any subcontractor declared by the Commission to be non-responsible and therefore ineligible for Contracts or subcontracts with the State of Illinois or any of its political subdivisions or municipal corporations.
2. Each Contractor and subcontractor shall in turn include the Equal Employment Opportunity Clause set forth in Section 6.1 of these Rules and Regulations in each of its subcontracts verbatim or by reference so that provisions of Paragraphs (a) through (g) of said clause will be binding upon subcontractors of every tier, provided, however, that only paragraphs

(a), (e), (f) and (g) need be included in every subcontract as defined in Section 1.1 (17) (a) of these Rules and Regulations.

**Copyright and Rights in Data**

To the extent applicable and pursuant to Section 18 of the October 1, 2001 Master Agreement ("MA (8)") entered into between Customer and the Federal Transit Administration, Vendor agrees to provide to the federal government a royalty-free, non-exclusive and irrevocable license to reproduce, publish, or otherwise use, and to authorize others to use, for federal government purposes the "subject data" as set forth in Master Agreement. As set forth in the Master Agreement, "for federal government purposes," means use only for the direct purposes of the federal government. In addition, the federal government may not provide or otherwise extend to other parties, without the copyright owner's consent, the federal government's license to: (1) Any subject data developed under a grant agreement, or under a third party contract or sub-agreement financed by a grant agreement or cooperative agreement, whether or not a copyright has been obtained; and (2) Any rights of copyright to which Metra or a third party contractor purchases ownership with federal assistance.

**Energy Conservation**

The Contractor agrees to comply with the mandatory energy efficiency standards and policies within applicable state energy conservation plans issued in compliance with the Energy Policy and Conservation Act (42 U.S.C., Section 6321 et seq.).

**Changing Requirements**

To achieve compliance with changing federal, state, and local requirements, Contractor is to recognize that the requirements may change and the changed requirements will apply to this project as required, unless the federal, state, and/or local government determines otherwise.

**Patent Rights**

If any invention, improvement, or discovery of the Contractor is conceived or first actually reduced to practice in the course of or under the Contract, and that invention, improvement, or discovery is patentable under the laws of the United States of America or any foreign country, the Contractor will notify Metra immediately and provide a detailed written report of same.

In addition, unless the federal government makes a contrary determination in writing; the rights and responsibilities of the Contractor, Metra and the federal government pertaining to that invention, improvement, or discovery will be determined in accordance with applicable federal laws, regulation, including any waivers thereof. Unless specified otherwise, the Contractor agrees it will transit to the FTA those rights due the federal government in any invention resulting from the Contracts described in the U.S. Dept. of Commerce's Regulation, No. 37 C.F.R Part 401.

**Contract Hours and Safety Standards Act**

The Contractor agrees to comply and assure compliance with Sections 102 and 107 of the Contract Work Hours and Safety Standards Act, as amended 40 U.S.C. Parts 327 through 333; and implements and complies with U.S. Department of Labor Regulation 29 C.F.R. Part 1926.

**Substance Abuse**

To the extent the Contractor, subcontractor, or any party contracted for work as a result of this Contract performs a safety sensitive function, it agrees to comply with, and assures its employees comply with the requirements of 49 U.S.C. Part 5331 and 49 C.F.R. Part 653 for Drug Abuse. To the extent the Contractor, subcontractor, or any party contracted for work as a result of this Contract performs a safety sensitive function, it agrees to comply with, and assures its employees comply with the requirements of 49 U.S.C. Part 5331, 49 C.F.R. Part 654 for Alcohol Abuse.

**Preference for Recycled Products**

If specified by Metra in the IFB or RFP and to the extent practicable and economically feasible, Metra agrees to accept by competitive preference, products and services that conserve natural resources, protect the environment and that are energy

efficient. Examples of such products may include, but are not limited to products described in the U.S. Environmental Protection Agency guidelines at 40 C.F.R. parts 247-253, which implement section 6002 of the Resource Conservation and Recovery Act, as amended, 42 U.S.C. §6962.

**Employee Protections**

The Contractor agrees to comply with and assures compliance by its sub-contractors at any tier, with applicable employee protection requirements for employees of section 102 of the Contract Work Hours and Safety Standards Act, as amended, 40 U.S.C. §327 through 332, and implementing U.S. DOL regulations, "Labor Standards Provisions Applicable Federally Financed and Assisted Contracts (also Labor Standard Provisions Applicable to Non-construction Contracts Subject to the Contract Work Hours and Safety Standards Act)", 29 C.F.R. Part 5.

**Termination**

Termination for cause and termination for convenience provisions must be included in contracts exceeding \$10,000. The Common Grant Rule for non-governmental recipients requires administrative, contractual, or legal contract remedies in instances in which a contractor violates or breaches terms of a contract that exceeds the small purchase threshold, which FTA recognizes as the simplified acquisition threshold. *See*, Chapter II, Subsection 3.b. The Common Grant Rule for non-governmental recipients also requires termination clauses for non-governmental recipients when procurements exceed the small purchase threshold, which FTA recognizes as the simplified acquisition threshold *See*, Chapter II. Subsection 3.b. FTA strongly encourages care in developing appropriate performance remedies in all third party contracts.

**Debarment and Suspension**

Debarment and suspension regulations and guidance include the following:

- A. Department of Transportation (DOT) Debarment and Suspension Regulations, "Non-procurement Suspension and Debarment," 2 CFR Part 1200 apply to each third party contract at any tier of \$25,000 or more, to each third party contract at any tier for a federally required audit (irrespective of the contract amount), and to each third party contract at any tier that must be approved by an FTA official irrespective of the contract amount (*See*, 2 CFR Part 1200). Thus, the recipient must apply DOT's debarment and suspension requirements to itself and each third party contractor at every tier to the extent required by DOT's regulations that incorporate the requirements of Office of Management and Budget (OMB), "Guidelines to Agencies on Government wide Debarment and Suspension (Non-procurement)", "2 CFR Part 180.
- B. Even though the recipient may collect a debarment and suspension certification from the prospective third party contractor, or include a clause in the third party contract requiring disclosure, FTA strongly recommends that the recipient check the System for Award Management (SAM) at <https://www.sam.gov/portal/SAM> before awarding a third party contract.
- C. State Debarment and Suspension Lists.

A recipient may also treat any prospective contractor or subcontractor listed on a centralized state government debarment and suspension list as non-responsible and ineligible for contract award.

**Preference for U.S. Property - Buy America**

FTA's "Buy America" law and regulations apply to projects that involve the purchase of more than \$100,000 of iron, steel, manufactured goods, or rolling stock to be delivered to the recipient to be used in the FTA assisted project. If FTA funds are used for the project, Buy America requirements apply to all procurement contracts under the project irrespective of whether a recipient decides to fund a discrete part of the project without FTA funds. Only if an activity is outside the FTA project and is financed entirely without funds to which FTA's Buy America regulations would apply may the recipient disregard FTA's Buy America requirements. Property that the contractor acquires to fabricate a deliverable for the recipient, such as tools, machinery, and other equipment or facilities, is not subject to FTA's Buy America requirements unless the recipient intends to take possession of that property upon completion of the project. Thus, if a third party contractor is acquiring property for its general inventory of equipment or facilities to conduct its overall business affairs, the recipient may enter the cost of that acquisition into its calculations of overhead amounts applicable to the FTA assisted project irrespective of whether the property acquired would comply with FTA's Buy America regulations. FTA's Buy America statute does not pre-empt State laws with stricter requirements on the use of foreign articles, materials, and supplies.

FTA cautions that its Buy America regulations that apply to FTA assisted third party procurements, published at 49 CFR Part 661, differ from Federal "Buy American Act" regulations that apply to direct Federal procurements, published in the FAR at 48 CFR Chapter 1, Subparts 25.1 and 25.2. FTA strongly recommends that the recipient review FTA's Buy America regulations before undertaking any FTA assisted procurement.

For any FTA assisted project having third party construction contracts exceeding \$100,000, FTA's Buy America law and regulations require the third party contractor to provide property produced or manufactured in the United States for use in the construction project that the recipient acquires, unless FTA has granted a waiver authorized by those regulations. If FTA funds are used for the project, Buy America requirements apply to all third party procurement contracts under the project irrespective of whether a recipient decides to fund a discrete part of the project without FTA funds. Only if an activity is outside the FTA project and is financed entirely without funds to which FTA's Buy America regulations would apply may the recipient disregard FTA's Buy America requirements. FTA cautions that its Buy America regulations are complex and different from the Federal "Buy American Act" regulations in the Federal Acquisition Regulation (FAR) at 48 CFR Chapter 1, Subchapter D, Part 25, Subparts 25.1 and 25.2.

Property that the contractor acquires to perform its construction activities for the recipient, such as tools, machinery, and other equipment or facilities, is not covered by FTA's Buy America requirements unless the recipient intends to take possession of that property upon completion of the project. Thus, if a third party contractor is acquiring property for its general inventory of equipment or facilities to conduct its overall business affairs, the recipient may enter the cost of that acquisition into its calculations of overhead amounts applicable to the FTA assisted project irrespective of whether that property would comply with FTA's Buy America regulations.

### **Disputes**

The Common Grant Rules charge the recipient with responsibility for evaluating and resolving third party contract disputes. If the recipient intends to request FTA's permission to use Federal assistance to support payments to a third party contractor to settle a dispute, or intends to request increased Federal assistance for that purpose.

### **Claims and Litigation**

The Common Grant Rules charge the recipient with responsibility for evaluating and resolving third party contract claims and litigation resulting from a contractor's violation, default, or breach of its third party contracts with recipients of Federal assistance. The recipient is also responsible for resolving any claims and litigation the contractor may present against it due to FTA's financial interest in the settlement of third party contract claims and litigation, and concerns about matters with significant policy consequences to the Federal Government.

### **Shipments of Property - U.S. Flag Requirements**

#### Shipments by Ocean Vessel

The Common Grant Rules require third party contract provisions to ensure compliance with 46 U.S.C. Section 55303 and Maritime Administration regulations, "Cargo Preference - U.S. Flag Vessels," 46 CFR Part 381, implementing the codified Cargo Preference Act. With few exceptions, the regulations require that U.S. Flag vessels be used to transport at least 50 percent of any federally assisted property.

#### Shipments by Air Carrier

Third party contracts involving shipments of federally assisted property by air carrier will require provisions to ensure compliance with Section 5 of the International Air Transportation Fair Competitive Practices Act of 1974, as amended ("Fly America" Act), 49 U.S.C. Section 40118, and GSA regulations, "Use of United States Flag Air Carriers," 41 CFR Sections 301-10.131 through 301-10.143. The regulations require shipment by U.S. flag air carriers unless such carriers are not reasonably available within the standards of GSA's implementing regulations.

Project Travel - Use of U.S. Flag Air Carriers

Third party contracts to acquire transportation by air carrier needed by people participating in a federally assisted project require provisions to ensure compliance with Section 5 of the International Air Transportation Fair Competitive Practices Act of 1974, as amended ("Fly America" Act), 49 U.S.C. Section 40118, and GSA regulations, "Use of United States Flag Air Carriers," 41 CFR Sections 301-10.131 through 301-10.143. The regulations require transportation by U.S. flag air carriers unless U.S. flag air carriers are not reasonably available within the standards of the GSA's implementing regulations.

**Prevailing Wages**

Under 49 U.S.C. Section 5333(a), Davis-Bacon Act prevailing wage protections apply to laborers and mechanics employed on FTA assisted construction, alteration, or repair projects. The Common Grant Rules require third party contracts for construction, alteration, or repair at any contract tier exceeding \$2,000 to include provisions requiring compliance with the Davis-Bacon Act, 40 U.S.C. Sections 3141 et seq., and implementing DOL regulations "Labor Standards Provisions Applicable to Contracts Governing Federally Financed and Assisted Construction," 29 CFR Part 5. The Davis-Bacon Act requires that contractors pay wages to laborers and mechanics at a rate not less than the minimum wages specified in the wage determination made by the Secretary of Labor. The Davis-Bacon Act also requires contractors to pay wages not less than once a week. The recipient must include a copy of the current prevailing wage determination issued by DOL in each contract solicitation and must condition contract award upon the acceptance of that wage determination. These requirements are in addition to the separate Wage and Hour Requirements addressed in paragraph 2.c (l) of this Chapter IV.

**Anti-Kickback**

Section 1 of the Copeland "Anti-Kickback" Act, at 18 U.S.C. Section 874, prohibits anyone from inducing, by any means, any person employed on construction, prosecution., completion, or repair of a federally assisted building or work, to give up any part of his or her compensation to which he or she is otherwise entitled. Section 2 of that Act, at 40 U.S.C. Section 3145, as amended, and implementing DOL regulations, "Contractors and Subcontractors on Public Building or Public Work Financed in Whole or in part by Loans or Grants from the United States," 29 CFR Part 3, impose record keeping requirement on all third party contracts for construction, alteration, or repair exceeding \$2,000. The Common Grant Rules also require provisions for compliance with the Copeland "Anti-Kickback" Act, as amended and implementing DOL regulations.

**Bonding**

The Common Grant Rules require bonds for all construction contracts exceeding the simplified acquisition threshold (*See*, Chapter II, Subsection 3.b) unless FTA determines that other arrangements adequately protect the Federal interest.

**Protections for Public Transportation Employees**

When the recipient acquires public transportation services from a third party contractor, the terms of the recipient's DOL certification of public transportation employee protective arrangements will apply to work under the contract provided by those employees covered by the certification. That certification is required by 49 U.S.C. Section 5333(b) (often referred to as "13(c)") and implementing DOL guidelines, "Section 5333(b), Federal Transit Law," 29 CFR Part 215. Consequently, the third party contractor must comply with the terms of that DOL certification.

The Fair Labor Standards Act, 29 U.S.C. Sections 201 et seq., also applies to public transportation employees performing work involving commerce.

**Accessibility – American Disabilities Act**

A third party contractor providing public transportation services must operate its services in compliance with 42 U.S.C. Sections 12101 et seq.; DOT regulations, "Transportation Services for Individuals with Disabilities)" using facilities and equipment that comply with 49 CFR Part 37; and Joint ATBCB/DOT regulations, "Americans with Disabilities Accessibility Specifications for Transportation Vehicles," 36 CFR Part 1192 and 49 CFR Part 38. Private entities must comply with the requirements of 49 CFR Part 37 applicable to public entities with which they contract to provide public transportation services. The recipient should advise its third party contractors operating public transportation services to review the requirements for public entities in this context.

**Charter Service Restrictions**

A third party contractor performing services using FTA assisted facilities or equipment may not use those facilities or that equipment to support any charter service operations except as permitted by 49 U.S.C. Section 5323(d) and FTA regulations, "Charter Service," 49 CFR Part 604.

**School Bus Restrictions**

A third party contractor performing services using FTA assisted facilities or equipment may not use those facilities or that equipment to support exclusive school bus operations except as permitted by 49 U.S.C. Sections 5323(f) or (g) and FTA regulations, "School Bus Operations," 49 CFR Part 605, to the extent consistent with 49 U.S.C. Sections 5323(f) or (g).

**Seismic Safety**

The recipient must include seismic safety provisions in its third party contracts for the construction of new buildings or additions to existing buildings as required by 42 U.S.C. Sections 7701 *et seq.*, and DOT regulations, "Seismic Safety," 49 CFR Part 41 at Sections 41.117 and 41.120, implementing the Earthquake Hazards Reduction Act of 1977, as amended, 42 U.S.C. Sections 7701 *et seq.*

**Special Notification Requirements for States**

For many years, various Federal appropriations laws imposed notification requirements on all recipients of Federal assistance awards exceeding \$500,000. Currently, notification requirements have been limited to States, but the \$500,000 threshold has been removed. Therefore, each State must include provisions in all its requests for proposals, solicitations, Federal assistance applications, forms, notifications, press releases, or other publications involving FTA assistance, stating that FTA is or will be providing Federal assistance for the project, the amount of Federal assistance FTA has provided or expects to provide, and the Catalog of Federal Domestic Assistance (CFDA) Number of the program that authorizes the Federal assistance. FTA interprets the statute to require that sub recipients, lessees, or third party contractors of the State at any tier also comply with those notification requirements. Because appropriations laws expire annually and these provisions have not been enacted as permanent legislation or even appear consistently in the same appropriations acts, it is necessary to review the various Federal appropriations acts for the applicable fiscal year to determine the required level of notification. FTA's Master Agreement incorporates the notification requirements in effect when that Master Agreement is issued.

**Intelligent Transportation Systems**

Intelligent transportation system (ITS) property and services must comply with the National ITS Architecture and Standards to the extent required by Section 5307(c) of SAFETEA-LU, FTA Notice, "FTA National ITS Architecture Policy on Transit Projects," 66 FR 1455 *et seq.*, January 8, 2001, and later published policies or implementing directives FTA may issue. Consequently, third party contracts, involving ITS, are likely to require provisions to ensure compliance with Federal requirements.

**Lobbying Certification and Disclosure**

If the third party contract will exceed \$100,000, the recipient must obtain a lobbying certification before awarding the contract, and if applicable, a lobbying disclosure from a prospective third party contractor. See, DOT regulations, "New Restrictions on Lobbying" 49 CFR Part 20, modified as necessary by 31 U.S.C. Section 1352, which implement the Byrd "Anti-Lobbying" Amendment, 31 U.S.C. Section 1352.

**Incorporation of FTA Terms**

The provisions in this section includes, in part, certain standard terms and conditions required by USDOT/FTA, whether or not expressly set forth in these provisions. All contractual provisions required by USDOT/FTA, as set forth in FTA Circular 4220.1F are hereby incorporated by reference. Anything to the contrary herein notwithstanding, all USDOT/FTA mandated terms shall be deemed to control in the event of a conflict with other provisions contained in this Contract. The Contractor shall not perform any act, fail to perform any act, or refuse to comply with any Metra requests, which would cause Metra to be in violation of the USDOT/FTA terms and conditions.

## Veterans Preference

The Contractor must ensure that the following provisions are inserted in all subcontracts entered into with any Subcontractors and labor organizations that furnish skilled, unskilled, and craft union skilled labor, or which may provide any material, labor, or services in connection with this Contract.

1. **Federal Requirements.** The Contractor must give preference to veterans, as defined in 5 U.S.C. § 2108, who have the skills and abilities required to perform construction work required under the Contract; however, this does not require a Contractor to give a preference to any veteran over any equally qualified applicant who is a member of any racial or ethnic minority, female, an individual with a disability, or a former employee.
2. **State Requirements.** The Contractor must comply with the provisions of 330 I.L.C.S. 55/0.01 *et seq.*, which requires that a preference be given to veterans in the employment and appointment to fill positions in the construction, addition, or alteration of all public works. However, this preference will apply only where the individuals are available and qualified to perform the Work to which the employment relates.