Middle Tennessee Electric

Barfield Substation Engineering, Procurement, and Construction Specifications RFP

May 2025

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Section 100

Request for Proposal Letter

May 1, 2025

Dear Bidder:

This letter is a request for a proposal to engineer, procure, and construct the Barfield Substation for Middle Tennessee Electric (MTE) in accordance with the attached specifications and drawings. The proposal will be evaluated by MTE.

The proposal is to include at a minimum, but not limited to, a general arrangement drawing, a proposed site plan drawing (if different than provided design), transformer foundation design details, and any other necessary drawings required to support your proposed design to MTE for our evaluation. Also required is a list of the major suppliers of materials and proposed subcontractors. At a minimum, this list of suppliers and subcontractors shall include **all** consulting engineers including geotechnical engineers, excavation Contractors, concrete Contractors, steel suppliers, and steel/bus erectors. MTE reserves the right to request the Contractor to change subcontractors or suppliers before the contract is signed. Refusal to change subcontractors or suppliers may cause the proposal to be rejected. In addition, the proposal is to include a schedule including starting date, design target dates, approval drawing dates, excavation start dates, steel erection start date, completion dates of each stage of construction, etc. **Failure to provide any of the above design details, schedules, and lists with your proposal may result in a rejection of your proposal during evaluation.**

The proposal is to build the substation to MTE design specifications, applicable industry standard codes, and use the manufacturers and subcontractors specified and any specific material detailed in the specifications. There is to be one section of the proposal that is labeled "Exceptions". The "Exceptions" section of the proposal is to include any items that the bidder is proposing not to follow in the specifications. MTE will evaluate each "Exception" on its own merit. If the "Exception" is not specifically approved in writing, then the Contractor **must** follow the MTE specification at no additional cost to MTE.

The enclosed site plans, land survey, and geotechnical study were prepared by qualified parties, and believed by MTE to be valid. MTE assumes no liability with initial site conditions submitted or design drawings provided for bidding purposes. MTE's intent is to provide a design guideline. MTE recommends that the bidder procure the services of a Licensed Surveyor, Civil Engineer, Excavator, and Geotechnical Engineer to evaluate the site and site conditions in preparing a proposal for the construction of the substation.

MTE expects firm price proposals for the construction of the substation. Change orders due to the Contractor’s failure to understand the scope of work and standard MTE practices will not be approved. Contractor, at their expense, must provide work and material according to applicable codes and MTE standards. However, given the volatile nature of the industry, change orders

deemed by MTE to be appropriate will be accepted. Proposals and designs with adders, loopholes, exceptions, limitations, clauses, or other such criteria will be subject to rejection at MTE's sole discretion without explanation.

The Contractor will be responsible for designing and building the substation. The Contractor will be financially responsible for any defects in material and workmanship (reference Guarantee and Warranty section of Engineering Specification for details). The Contractor will design and build the site, steel structures, bus work, foundations, and concrete. The Contractor will be responsible for designing and installing oil containment for the transformers, providing SPCC plan, and designing the ground grid. The Contractor will also be responsible for the procurement of the control house. MTE will design the protective relaying and control scheme, conduit system, cable schedule, and field connections. The Contractor will be responsible for the installation of the conduit system, field cabling, 120/240 VAC system, and terminations for the protective relaying and controls including fiber optic cables. MTE will provide a drop-in concrete control building complete with the protective relaying and controls and auxiliary equipment. MTE will provide the power transformer and dress-out of the transformer. The Contractor will connect the transformer to the bus. MTE will provide the two station service transformers and Contractor will install. MTE will provide the 27 kV breakers and the Contractor will install.

The Contractor completion date for this substation is **December 2026**. There will be a $1,000 per day-liquidated damages from that date. There will not be any extensions on the deadline date unless the holdup is due to the fault of MTE or extreme acts of nature such as a tornado touching down on the site, extensive flooding or other extreme unforeseen site conditions as determined by MTE. Maximum liquidated damages will be five (5) percent of the project cost.

This project has already been approved by MTE to be completed. However, the cost to MTE for this project is not to exceed $2,000,000 for the 2025 budget year. The rest of the work will be completed and paid for during the 2026 budget year.

The site shall be ready for the delivery of the two power transformers. The first transformer will be arriving **August 2026**. The second transformer will arrive **September 2026.** It is the responsibility of the Contractor to have the site ready to accept delivery. Failure of the Contractor to meet this date will cause any delay or storage fees charged by the transformer manufacturer to be passed on to the Contractor.

The substation shall be complete and ready for the 161kV TVA line by **October 2026**. Failure to meet this date will result in a $500 per day-liquidated damages.

The Contractor shall be responsible for the removal of all existing debris from the substation site.

The Contractor will be responsible for posting a performance bond equal to the contract amount within 10 days of the awarding of the contract by MTE.

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Proposal Information

By submitting a proposal, the bidder acknowledges that he/she has made a careful examination of the site of the Project and of the Plans, Specifications and Construction Drawings, and has become informed as to the location and nature of the proposed construction, the transportation facilities, the kind and character of soil and terrain to be encountered, the kind of equipment, tools, and other facilities required before and during the construction of the Project and has become acquainted with the availability status of materials to be furnished and with the labor conditions which would affect work on the Project. The bidder also acknowledges that details provided in this RFP document are for general bidding purposes only and the bidder takes full responsibility for verifying the validity of such information before submitting a proposal. In addition, the bidder accepts full liability for any failure in evaluating the scope of work required. If any conflict or problem exists, the bidder shall notify MTE for resolution before submitting a proposal.

MTE substation construction projects require Construction Site Managers. The proposals are to include the proposed Construction Site Manager and their experience resume. MTE reserves the right to request the Contractor to change their proposed Construction Site Manager before the contract is signed. Refusal to change the proposed Construction Site Manager might cause the proposal to be rejected (see Construction Site Manager Section of Engineering Specification for details).

The site is the property on the corner of Barfield Rd and Hwy 99 in Murfreesboro, right behind Thornton's gas station.

This request for proposal is made with the specific understanding that MTE reserves the right to reject any and all proposals without explanation. This will be a private bid opening. The bids will need to be submitted to MTE no later than **1:30pm on June 25, 2025**.

Also note, there will be a pre-bid meeting at **9:30am on May 21, 2025,** at MTE. The address is 1010 Haley Rd, Murfreesboro, TN 37129. The meeting will conclude with a site visit.

Included in this proposal package are the following documents and drawings:

- Approved Contractors List
- Contract
- Engineering and Construction Specifications
- Circuit Switcher Specification
- 1200 Amp Substation 161 kV Disconnect Switch Specification
- 2000 Amp Substation 161 kV Disconnect Switch Specification
- 25 kV Substation Switch Specification
- Substation Nuts, Bolts, and Washer Standards

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- Typical Switch Grounding Details
- Concrete Control House Specifications
- Control Panel Specifications
- General Bill of Materials for Control House
- General Control House Layout & Details
- General Relay/Control Panel Layout & Details
- Nameplate Schedule
- Point-to-point wiring diagrams
- Communication cables diagram
- AC & DC Panelboard details
- Control switch specification sheets
- Wall Specifications
- One-line Diagram
- General Arrangement and Details
- Typical Distribution Bay Detail Drawings, LAK-100
- Typical Cable/Conduit Details and Conduit Layout, SAN-070
- TVA CT's and PT's
- Preliminary Site Design Build Plans
- Erosion Plan, Driveway, and Mobile Drive Details
- Geotechnical Investigation Report

If you have any questions, don't hesitate to get in touch with me at (615)580-9133 or autumnferree@mte.com .

Sincerely,

Autumn Ferree
Electrical Engineer
Middle Tennessee Electric
1010 Haley Road
Murfreesboro, TN 37129

Initial_____No Bid

Section 200

Approved Bidders and Contractors

Barfield Substation Approved Bidders/Contractors List

Approved Substation Packagers

Dis-Tran Packaged Substations, LLC
4725 Hwy 28 East
Pineville, LA 71360

MD Henry Company, Inc.
120 Clark Street
Pelham, AL 35124

Approved Site-work Contractors

Thorne's Excavating Co.
624 Old Horn Springs Road
Lebanon, TN 37087

Baker Construction
3895 Betty Ford Road
Murfreesboro, TN 37130

Approved Geotechnical Engineers

Geosciences Design Group, LLC
2212B Dunn Ave.
Nashville, TN 37211

Geo Services, LLC
163 Business Park Dr. #15
Lebanon, TN 37090

Geotek Engineering Co., Inc.
2909 Elizabeth Street
Nashville, TN 37211

TTL, Inc.
5010 Linbar Drive, Ste. 153
Nashville, TN 3721

If you wish to use someone not on the approved list, please submit the following for the new company to Autumn Ferree for approval five (5) working days prior to the proposal due date: five (5) references, a list of similar projects completed, and contact information.

Section 300

Contract and Forms

SUBSTATION PROJECT CONSTRUCTION CONTRACT

NOTICE AND INSTRUCTIONS TO BIDDER

1. **Owner Furnished Materials.** The lump sum price(s) submitted in the Bidder's Proposal shall not include provisions for the materials that shall be furnished by the Owner (or "Owner Furnished Materials"). The Owner Furnished Materials shall be specified in the Plans, Specifications and Construction Drawings (collectively, the "Plans").

2. **Obtaining Documents.** The Plans, together with all necessary forms and other documents for bidders shall be obtained from the Owner in PDF format.

3. **Due Diligence.** Prior to the submission of the Proposal, the Bidder shall make and shall be deemed to have made a careful examination of the site of the project and of the Plans, and forms of Contractor's Proposal and Contractor's Bond, and shall review the location and nature of the proposed construction, the transportation facilities, the kind and character of soil and terrain to be encountered, the kind of facilities required before and during the construction of the project, general local conditions, environmental and historic preservation considerations, and all other matters that may affect the cost and time of completion of the project. Bidder will be required to comply with all federal, state, and local laws, rules, and regulations applicable to its performance, including those pertaining to the licensing of contractors, and the Anti Kick-Back Act of 1986 (41 U.S.C. 51 et seq).

4. **The Time for Completion of Construction** of the project is of the essence of the Contract and shall be as specified by the Owner in the Plans.

5. **Contractor's Bond.** For a Contract in excess of $500,000, the Bidder agrees to furnish a Contractor's Bond with sureties listed by the United States Treasury Department as Acceptable Sureties, in a penal sum not less than the contract price.

6. **Debarment Certification.** The Bidder must provide to the Owner a suspension and debarment certificate in the form attached hereto.

7. **Contract is Entire Agreement.** The Contract to be effected by the acceptance of the Proposal shall be deemed to include the entire agreement between the parties thereto, and the Bidder shall not claim any modifications thereof resulting from any representation or promise made at any time by any officer, agent or employee of the Owner or by any other person.

8. **Minor Irregularities.** The Owner reserves the right to waive minor irregularities or minor errors in any Proposal, if it appears to the Owner that such irregularities or errors were made through inadvertence. Any such irregularities or errors so waived must be corrected on the Proposal in which they occur prior to the acceptance thereof by the Owner.

9. **The Owner Represents:**

   a. Owner Furnished Materials will be provided on hand at locations specified per the Plans, or if such materials are not on hand, they will be made available by the Owner to the successful Bidder at the locations specified before the time such materials are required for construction.

b. All titles, easements and rights-of-way, except as shown on maps included in the Plans, have been obtained from the owners of the properties on which the project is to be constructed (including tenants who may reasonably be expected to object to such construction). The remaining easements and rights-of-way, if any, will be obtained as required to avoid delay in construction.

c. Contractor shall be responsible for the staking and layout of project per the Plans, except for those areas indicated in the Plans to be completed by Owner.

d. Where underground distribution construction is required, permission has been obtained from state and local highway and road authorities to install underground distribution power facilities and set pedestals, if any, on the highway and road right-of-way in the project area. Notwithstanding such permission granted to the Owner, each Bidder is responsible for ascertaining that the equipment, methods of construction, and repair proposed to be used on the project will meet all requirements of public authorities having jurisdiction over highway and road right-of-way. The successful Bidder will be required to furnish proof satisfactory to the Owner of compliance with this requirement. If required by highway or road authorities, the successful Bidder will furnish to such authorities a bond or meet other guaranty requirements to assure the prompt repair of all damages to highways and roads and their associated rights-of-way caused by the Bidder during construction of the project. This requirement is in addition to and independent of the Contractor's Bond required under this Contract. The acceptance of a bid from any Bidder is not to be construed as approval of the Bidder's equipment or proposed construction methods by or on behalf of the highway and road authorities. Bidders may obtain information concerning the requirements of highway and road authorities by communicating with the following:

_____

e. All funds necessary for prompt payment for the construction of the project will be available.

If the Owner shall fail to comply with any of the undertakings contained in the foregoing representation or if any of such representations shall be incorrect, the Bidder will be entitled to an extension of time of completion for a period equal to the delay, if any, caused by the failure of the Owner to comply with such undertakings or by any such incorrect representation; provided the Bidder shall have promptly notified the Owner in writing of its desire to extend the time of completion in accordance with the foregoing; provided, however, that such extension, if any, of the time of completion shall be the sole remedy of the Bidder for the Owner's failure, because of conditions beyond the control and without the fault of the Owner, to furnish materials in accordance with subparagraph a. above.

THE MIDDLE TENNESSE
ELECTRIC MEMBERSHIP CORPORATION
Owner

*By*_____

_____
Title

_____, *20*___
Date

PROPOSAL

(hereinafter referred to as “Proposal” or “Contract”)

TO:

THE MIDDLE TENNESSEE ELECTRIC MEMBERSHIP CORPORATION (MTEMC), 555 New Salem Road, Murfreesboro, TN 37129 (hereinafter called the "Owner").

ARTICLE I--
GENERAL

Section 1. Offer to Construct. The undersigned (hereinafter called the "Bidder') hereby proposes to receive and install such materials and equipment as may hereinafter be specified to be furnished by the Owner, and to furnish all other materials and equipment, all machinery, tools, labor, transportation and other means required to construct the project in strict accordance with the Plans, Specifications and Construction Drawings (collectively, the “Plans”), which are incorporated by reference as if fully set forth herein, for the lump sum price hereinafter stated.

Section 2. Materials and Equipment. The Bidder agrees to furnish and use in the construction of the project under this Proposal, in the event the Proposal is accepted, only such approved material in the Plans. The use of non-listed materials requires prior consent by the Owner.

The Bidder will purchase all materials and equipment (other than Owner Furnished Materials) outright and not subject to any conditional sales agreements, bailment, lease or other agreement reserving unto the seller any right, title or interest therein. All such materials and equipment shall be new and shall become the property of the Owner when erected in place.

Section 3. Owner Furnished Materials. The Bidder understands and agrees that, if this Proposal is accepted, the Owner will furnish to the Bidder the material set forth in the attached Plans as Owner Furnished Materials. For those items not yet delivered, the Bidder will, on behalf of the Owner, accept delivery of such of the materials as may be subsequently delivered and will promptly forward to the Owner for payment the supplier's invoice. The Bidder will acknowledge in writing the receipt of all materials received as indicated in the Plans. The materials referred to are on hand at, or will be delivered to, the substation site and the Bidder will use such materials in constructing the project.

Materials, if any, not required for the project, which have been furnished to the Bidder by the Owner or delivery of which has been accepted by the Bidder on behalf of the Owner, shall be returned to the Owner by the Bidder upon completion of construction of the project. The value of all materials not installed in the project nor returned to the Owner shall be deducted from the final payment to the Bidder.

The Owner shall not be obligated to furnish materials in excess of the quantities, size, kind and type set forth in the Plans. If the Owner furnishes, and the Bidder accepts, materials in excess thereof the values of such excess materials shall be their actual cost as stated by the Owner.

Information on the shipping schedules of materials in the Plans will be furnished to the Bidder as necessary during progress of the work.

Upon delivery, the Bidder shall promptly receive, unload, transport and handle all materials and equipment in the Plans at its expense and shall be responsible for demurrage, if any.

Section 5. Description of Contract. The Notice and Instructions to Bidders, Plans, Specifications, and Construction Drawings, which by this reference are incorporated herein, together with the Proposal and Acceptance constitute the Contract. The Plans, Specifications, and Construction Drawings, including maps, special drawings, and approved modifications in standard specifications are attached
hereto and identified as follows:

Section 6. Due Diligence. The Bidder has made a careful examination of the site of the project to be constructed and of the Plans, Specifications, Construction Drawings, and form of Contractor's Bond attached hereto, and has become informed as to the location and nature of the proposed construction, the transportation facilities, the kind and character of soil and terrain to be encountered, and the kind of facilities required before and during the construction of the project, and has become acquainted with the labor conditions, federal, state, and local laws, rules, and regulations applicable to its performance.

Section 7. License. The Bidder warrants that a Contractor's License is required and it possesses Contractor's License No. _____ for the State of Tennessee and said license expires on _____, 20____.

Section 8. Warranty of Good Faith. The Bidder warrants that this Proposal is made in good faith and without collusion or connection with any person or persons bidding or the same work.

Section 9. Financial Resources.

a. The Bidder warrants that it has or will obtain the financial resources necessary to ensure completion of the project.

b. The Bidder agrees that in the event this Proposal is accepted and a Contractor's Bond is required, it will furnish a Contractor's Bond in the form attached hereto, in a penal sum not less than the maximum Contract price, with a surety or sureties listed by the United States Department of Treasury as Acceptable Sureties.

Section 10. Taxes. The lump sum price in this Proposal includes provisions for the payment of all monies which will be payable by the Bidder or the Owner in connection with the construction of the project on account of taxes imposed by any taxing authority upon the sale, purchase or use of materials, supplies and equipment, or services or labor of installation thereof to be incorporated in the project as part this project. The Bidder agrees to pay all such taxes, except taxes upon the sale, purchase or use of Owner Furnished Materials. The Bidder will furnish to the appropriate taxing authorities all required information and reports pertaining to the project, except as to the Owner Furnished Materials.

Section 11. Changes in Quantities. The Bidder understands and agrees that the quantities, as specified in the Plans and called for in this Proposal are approximate. If the Owner changes the quantity of any material specified in this Proposal by more than fifteen percent (15%), the change shall be regarded as a change in the construction within the meaning of Article II, Section 1(d) of this proposal.

ARTICLE II-CONSTRUCTION

Section 1. Time and Manner of Construction.

a. The Bidder agrees to commence construction of the project on a date (hereinafter called the "Commencement Date") which shall be determined by the agreement of the Bidder and Owner after the proposed Bidder's schedule is approved by the Owner. In no event will the Commencement Date be later than ____ calendar days after date of approved by the Owner. The Bidder further agrees to prosecute diligently and to complete construction in strict accordance with the Plans no later than _____, 20____ . Since time is of the essence for the substation project, Liquidated Damages may be required to be paid by the Bidder if the Bidder does not complete the substation project by the above completion date. Liquidated Damages will be defined in the Plans.

b. The time for Completion of Construction shall be extended for the period of any reasonable delay which is due exclusively to causes beyond the control and without the fault of the Bidder, including Acts of God, fires, floods, inability to obtain materials and acts or omissions of the Owner with respect to matters for which the Owner is solely responsible: Provided, however that no such extension of time for completion shall be granted the Bidder unless within ten (10) days after the happening of any event relied upon by the Bidder for such an extension of time the Bidder shall have made a request therefore in writing to the Owner, and provided further that no delay in such time of completion or in the progress of the work which results from any of the above causes, except acts or omissions of the Owner, shall result in any liability on the part of the Owner.

c. The sequence of construction shall be as set forth in the Plans. Or if no sequences are set forth, the sequence of construction shall be as determined by the Bidder, subject to the approval of the Owner.

d. The Owner may from time to time during the progress of the construction of the project may make such changes, additions, or subtractions from the Plans, List of Materials and sequence of construction provided for in the previous paragraphs which are part of the Contractor's Proposal as conditions may warrant. Provided, however, that if any change in the construction to be done shall require an extension of time, a reasonable extension will be granted if the Bidder shall make a written request therefore to the Owner within ten (10) days after any such change is made. And provided further, that if the cost to the Bidder of construction of the project shall be materially increased by any such change or addition, the Owner shall pay the Bidder for the reasonable cost thereof in accordance with a Construction Contract Amendment signed by the Owner and the Bidder, but no claim for additional compensation for any such change or addition will be considered unless the Bidder shall have made a written request therefore to the Owner prior to the commencement of work in connection with such change or addition.

Section 2. Environmental Protection. The Bidder shall perform the work in compliance with all applicable Federal, State, and local Environmental Laws. For purposes of this Agreement, the term "Environmental Laws" shall mean all Federal, state, and local laws including statutes, regulations ordinances, codes, rules, and other governmental restriction and requirements relating to the environment or solid waste, hazardous substances, hazardous waste, toxic or hazardous material, pollutants or contaminants including, but not limited to the Comprehensive Environmental Response, Compensation, and Liability Act, as amended, 42 U.S.C. §§ 9601, et seq., the

Federal Water Pollution Control Act, as amended, 33 U.S.C. §§ 1251, et seq., and the Solid Waste Disposal Act, as amended, 42 U.S.C. §§ 6901, et seq., now or at any time hereafter in effect.

Section 3. Tools, Equipment, and Qualified Personnel. The Bidder agrees that in the event this Proposal is accepted it will make available for use in connection with the proposed construction all necessary tools and equipment and qualified supervisors and workers.

Section 4. Changes in Construction. The Bidder agrees to make such changes in construction previously installed in the project by the Bidder as required by the Owner for prices arrived at as follows:

a. For substations where only a portion of the substation is affected by the change, the compensation for such change shall be as agreed upon in writing by the Bidder and the Owner prior to the commencement of work in connection with such change.

b. For all other changes, the compensation for such change shall be the reasonable cost thereof as agreed upon by the Bidder and the Owner.

No payment shall be made to the Bidder for materials or labor involved in correcting errors or omissions on the part of the Bidder which result in construction not in accordance with the Plans.

Section 5. Construction Not in Proposal. The Bidder also agrees that when it is necessary to construct items not shown in the Proposal, in absence of other mutual agreement, it will construct such items for a price arrived at as follows:

a. The cost of materials shall be determined by the invoices.

b. The cost of labor shall be the reasonable cost thereof, but in no event shall it exceed an amount determined by calculating the ratio of the total labor costs to the total material costs in the section of the Proposal involved, and multiplying the cost of materials for the items in question by this ratio.

Section 6. Supervision and Inspection.

a. The Bidder shall give sufficient supervision to the work, using its best skill and attention. The Bidder will carefully study and compare all drawings, specifications and other instructions and will at once report to the Owner any error, inconsistency or omission which it may discover. The Bidder shall cause the construction work on the project to receive constant supervision by a competent superintendent (hereinafter called the "Superintendent") who shall be present at all times during working hours where construction is being carried on. The Bidder shall also employ, in connection with the construction of the project, capable, experienced and reliable supervisors and such skilled workers as may be required for the various classes of work to be performed. The Bidder shall be solely responsible for the means and methods of construction and for the supervision of the Bidder's employees.

b. The Owner reserves the right to require the removal from the project of any employee of the Bidder if in the judgment of the Owner such removal shall be necessary in order to protect the interest of the Owner. The Owner shall have the right to require the Bidder to increase the number of its employees and to increase or change the amount or kind of tools and equipment if at any time the progress of the work shall be unsatisfactory to the Owner; but the failure of the Owner to give any such directions shall not relieve the Bidder of its obligations to complete the work within the time and in the manner specified in this Proposal.

c. The construction of the project and all materials and equipment used therein, shall be subject to the inspection, tests, and acceptance by the Owner and the Bidder shall furnish all information required by the Owner concerning the nature or source of any materials incorporated or to be incorporated in the project. All Bidder procedures and records pertaining to the work shall be made available to the Owner-for review prior to such inspections and tests. The Bidder shall provide all reasonable facilities necessary for such inspection and tests and shall maintain an office at the site of the project, with telephone service where obtainable and at least one office employee to whom communications from the Owner may be delivered. Delivery of such communications in writing to the employee of the Bidder at such office shall constitute delivery to the Bidder. The Bidder shall have an authorized agent accompany the Owner when final inspection is made and, if requested by the Owner, when any other inspection is made. The performance of such inspections or tests by the Owner shall not relieve the Bidder of its obligations to perform the work in accordance with the requirements of this Contract.

d. In the event that the Owner shall determine that the construction contains or may contain numerous defects, it shall be the duty of the Bidder and the Bidder's Surety or Sureties, if any, to have an inspection made by an engineer approved by the Owner for the purpose of determining the exact nature, extent and location of such defects.

e. The Owner may require that the Bidder suspend the work wholly or in part for such period or periods as the Owner may deem necessary due to unsuitable weather or such other conditions as are considered unfavorable for satisfactory prosecution of the work or because of the failure of the Bidder to comply with any of the provisions of the Contract: Provided, however, that the Bidder shall not suspend work pursuant to this provision without written authority from the Owner so to do. The time of completion hereinabove set forth shall be increased by the number of days of any such suspension, except when such suspension is due to the failure of the Bidder to comply with any of the provisions of this Contract. In the event that work is suspended by the Bidder with the consent of the Owner, the Bidder before resuming work shall give the Owner at least twenty-four (24) hours' notice thereof in writing.

Section 7. Defective Materials and Workmanship.

a. The acceptance of any materials, equipment (except Owner Furnished Materials) or any workmanship by the Owner shall not preclude the subsequent rejection thereof if such materials, equipment, or workmanship shall be found to be defective after delivery or installation, and any such materials, equipment or workmanship found defective before final acceptance of the construction shall be replaced or remedied, as the case may be, by and at the expense of the Bidder. Any such condemned material or equipment shall be immediately removed from the site of the project by the Bidder at the Bidder's expense. The Bidder shall not be entitled to any payment hereunder so long as any defective materials, equipment or workmanship in respect to the project, of which the Bidder shall have had notice, shall not have been replaced or remedied, as the case may be.

b. Notwithstanding any certificate which may have been given by the Owner, if any materials, equipment (except Owner Furnished Materials) or any workmanship which does not comply with the requirements of this Contract shall be discovered within one (1) year after Completion of Construction of the project, the Bidder shall replace such defective materials or equipment or remedy any such defective workmanship within thirty (30) days after notice in writing of the existence thereof shall have been given by the Owner. If any such defective materials, equipment, or workmanship so replaced or repaired is found to be defective within one year after the completion of the replacement or repair, the Bidder shall replace or remedy such defective materials, equipment, or workmanship. If the Bidder shall be called upon to replace any defective materials or equipment or to remedy defective workmanship as

herein provided, the Owner, if so requested by the Bidder shall de-energize that section of the project involved in such work. In the event of failure by the Bidder so to do, the Owner may replace such defective materials or equipment or remedy such defective workmanship, as the case may be, and in such event the Bidder shall pay to the Owner the cost and expense thereof.

ARTICLE III--PAYMENTS AND RELEASE OF LIENS

Section 1. Payments to Bidder.

a. On or before the fifth (5) day of each calendar month, the Bidder will make application for payment, and the Owner, on or before the fifteenth (15) day of such month, shall make partial payment to the Bidder for construction accomplished during the preceding calendar month on the basis of completed construction furnished and certified to by the Bidder and approved by the Owner solely for the purposes of payment: Provided, however, that such approval shall not be deemed approval of the workmanship or materials. Only ninety percent (90%) of each such estimate approved during the construction of the project shall be paid by the Owner to the Bidder prior to Completion of the project. Upon completion by the Bidder of the construction of the project, the Owner will review, inspect, and test the substation for completeness, accuracy of construction with the Plans, and quality of the workmanship and materials. Upon the approval and acceptance by the Owner, the Owner shall make payment to the Bidder of all amounts to which the Bidder shall be entitled thereunder which shall not have been paid. Final payment should be made not later than ninety (90) days after the date of completion of construction of the project unless withheld because of the fault of the Bidder.

b. No payment shall be due while the Bidder is in default in respect of any of the provisions of this Contract and the Owner may withhold from the Bidder the amount of any claim by a third party against either the Bidder or the Owner based upon an alleged failure of the Bidder to perform the work hereunder in accordance with the provisions of this Contract.

c. The Owner and the Administrator shall have the right to inspect all payrolls, invoices of materials, and other data and records of the Bidder and of any subcontractor, relevant to the construction of the project.

Section 2. Release of Liens and Certificate of Contractor. Upon the completion by the Bidder of the construction of the project but prior to final payment to the Bidder, the Bidder shall deliver to the Owner releases of all liens and of rights to claim any lien, in the form attached hereto from all manufacturers, material suppliers, and subcontractors furnishing services or materials for the project and a certificate in the form attached hereto to the effect that all labor used on or for the project has been paid and that all such releases have been submitted to the Owner.

Section 3. Payments to Material Suppliers and Subcontractors. The Bidder shall pay each material supplier, if any, within five (5) days after receipt of any payment from the Owner, the amount thereof allowed the Bidder for and on account of materials furnished or construction performed by each material supplier or each subcontractor.

ARTICLE IV--PARTICULAR UNDERTAKINGS OF THE BIDDER

Section l. Protection to Persons and Property. The Bidder shall at all times take all reasonable precautions for the safety of employees on the work and of the public, and shall comply with all applicable provisions of federal, state, and local laws, rules, and regulations and building and construction codes, in addition to the safety rules and procedures of the Owner.

The following provisions shall not limit the generality of the above requirements:

a. The Bidder shall at no time and under no circumstances cause or permit any employee of the Bidder to perform any work upon energized lines, or upon structures carrying energized conductors, unless otherwise specified in the Plans.

b. The Bidder shall transport and store all material in facilities and vehicles which are designed to protect the material from damage. The Bidder shall ensure that all vehicles, trailers, and other equipment used comply with all applicable licensing, traffic, and highway requirements.

c. The Bidder shall so conduct the construction of the project as to cause the least possible obstruction of public highways.

d. The Bidder shall provide and maintain all such guard lights and other protection for the public as may be required by applicable statutes, ordinances and regulations or by local conditions.

e. The Bidder shall do all things necessary or expedient to properly protect any and all parallel, converging and intersecting lines, joint line poles, highways, and any and all property of others from damage, and in the event that any such parallel, converging and intersecting lines, joint line poles, highways or other property are damaged in the course of the construction of the project the Bidder shall at its own expense restore any or all of such damaged property immediately to as good a state as before such damage occurred.

f. Where the right-of-way of the project traverses cultivated or grazing lands, the Bidder shall limit the movement of its crews and equipment so as to cause as little damage as possible to crops, orchards or property and shall endeavor to avoid marring the lands. All fences which are necessarily opened or moved during the construction of the project shall be replaced in as good condition as they were originally found prior to construction and precautions shall be taken to prevent the escape of livestock. Except as otherwise provided in the descriptions of underground plowing and trenching assembly units, the Bidder shall not be responsible for loss of or damage to crops, orchards or property (other than livestock) on the right-of-way necessarily incident to the construction of the project and not caused by negligence or inefficient operation of the Bidder. The Bidder shall be responsible for all other loss of or damage to crops, orchards, or property, whether on or off the right-of-way, and for all loss of or damage to livestock caused by the construction of the project.

The right-of-way for purposes of this said section shall be indicated on the attached Plans.

g. The project, from the commencement of work to completion, or to such earlier date or dates when the Owner may take possession and control in whole or in part as hereinafter provided shall be under the charge and control of the Bidder and during such period of control by the Bidder all risks in connection with the construction of the project and the materials to be used therein shall be borne by the Bidder. The Bidder shall make good and fully repair all injuries and damages to the project or any portion thereof under the control of the Bidder by reason of any act of God or other casualty or cause whether or not the same shall have occurred by reason of the Bidder's negligence.

(1) To the maximum extent permitted by law, Bidder shall defend, indemnify, and hold harmless Owner and Owner's directors, officers, and employees from all claims, causes of action, losses, liabilities, and expenses (including reasonable attorney's fees) for personal loss, injury, or death to persons (including but not

limited to Bidder's employees) and loss, damage to or destruction of Owner's property or the property of any other person or entity (including but not limited to Bidder's property) in any manner arising out of or connected with the Contract, or the materials or equipment supplied or services performed by Bidder, its subcontractors and suppliers of any tier. But nothing herein shall be construed as making Bidder liable for any injury, death, loss, damage, or destruction caused by the sole negligence of Owner.

(2) To the maximum extent permitted by law, Bidder shall defend, indemnify, and hold harmless Owner and Owner's directors, officers, and employees from all liens and claims filed or asserted against Owner, its directors, officers, and employees, or Owner's property or facilities, for services performed or materials or equipment furnished by Bidder, its subcontractors and suppliers of any tier, and from all losses, demands, and causes of action arising out of any such lien or claim. Bidder shall promptly discharge or remove any such lien or claim by bonding, payment, or otherwise and shall notify Owner promptly when it has done so. If Bidder does not cause such lien or claim to be discharged or released by payment, bonding, or otherwise, Owner shall have the right (but shall not be obligated) to pay all sums necessary to obtain any such discharge or release and to deduct all amounts so paid from the amount due Bidder.

(3) Bidder shall provide to Owner's satisfaction evidence of Bidder's ability to comply with the indemnification provisions of subparagraphs i and ii above, which evidence may include but may not be limited to a bond or liability insurance policy obtained for this purpose through a licensed surety or insurance company.

h. Any and all excess earth, rock, debris, underbrush and other useless materials shall be removed by the Bidder from the site of the project as rapidly as practicable as the work progresses.

i. Upon violation by the Bidder of any of the provisions of this section, after written notice of such violation given to the Bidder by the Owner, the Bidder shall immediately correct such violation. Upon failure of the Bidder so to do the Owner may correct such violation at the Bidder's expense: Provided, however, that the Owner may, if it deems it necessary or advisable, correct such violation at the Bidder's expense without such prior notice to the Bidder.

j. The Bidder shall report any and all accidents immediately upon occurrence to the Owner, giving such data as may be prescribed by the Owner.

k. The Bidder shall not proceed with the cutting of trees or clearing of right-of-way without written notification from the Owner that proper authorization has been received from the owner of the property, and the Bidder shall promptly notify the Owner whenever any landowner objects to the trimming or felling of any trees or the performance of any other work on its land in connection with the project and shall obtain the consent in writing of the Owner before proceeding in any such case.

l. The Bidder will furnish, prior to the commencement of underground distribution construction, proof satisfactory to the Owner, of compliance with requirements of highway and road authorities having jurisdiction, including without limitation, the furnishing of a bond or other guaranty, and approval by such authorities of the equipment and methods of construction and repair to be used by the Bidder.

Section 2. Insurance. The Bidder shall take out and maintain throughout the period of this Agreement the following types and minimum amounts of insurance:

a. Workers' compensation and employers' liability insurance, as required by law, covering all its employees who perform any of the obligations of the Bidder under the contract. If any employer or employee is not subject to the workers' compensation laws of the governing state, then insurance shall be obtained voluntarily to extend to the employer and employee coverage to the same extent as though the employer or employee were subject to the workers' compensation laws.

b. Public liability insurance covering all operations under the contract shall have limits for bodily injury or death of not less than $5 million each occurrence, limits for property damage of not less than $5 million each occurrence, and $10 million aggregate for accidents during the policy period. A single limit of $5 million of bodily injury and property damage is acceptable. This required insurance may be in a policy or policies of insurance, primary and excess including the umbrella or catastrophe form.

c. Automobile liability insurance on all motor vehicles used in connection with the contract, whether owned, nonowned, or hired, shall have limits for bodily injury or death of not less than $2 million per person and $2 million each occurrence, and property damage limits of $2 million for each occurrence. A single limit of $2 million of bodily injury and property damage is acceptable. This required insurance may be in a policy or policies of insurance, primary and excess including the umbrella or catastrophe form.

The Owner shall have the right at any time to require public liability insurance and property damage liability insurance greater than those required in subsection "b" and "c" of this Section.

The Owner shall be named as Additional Insured on all policies of insurance required in subsections "b" and "c" of this Section.

The policies of insurance shall be in such form and issued by such insurer as shall be satisfactory to the Owner. The Bidder shall furnish the Owner a certificate evidencing compliance with the foregoing requirements which shall provide not less than (30) days prior written notice to the Owner of any cancellation or material change in the insurance.

Section 3. Delivery of Possession and Control to Owner.

Upon written request of the Owner the Bidder shall deliver to the Owner full possession and control of any portion of the project provided the Bidder shall have been paid at least ninety percent (90%) of the cost of construction of such portion. Upon such delivery of the possession and control of any portion of the project to the Owner, the risk and obligations of the Bidder as set forth in Article IV Section 1.g hereof with respect to such portion of the project so delivered to the Owner shall be terminated; Provided, however, that nothing herein contained shall relieve the Bidder of any liability with respect to defective materials and workmanship as contained in Article II, Section 7 hereof.

Section 4. Energizing the Project.

a. Prior to Completion of the project the Owner, upon written notice to the Bidder, may test the construction thereof by temporarily energizing any portion or portions thereof. During the period of such test the portion or portions of the project so energized shall be considered as within the possession and control of the Owner and governed by the provisions of Section 3 of this Article. Upon written notice to the Bidder by the Owner of the completion of such test and upon de-

energizing the lines involved therein said portion or portions of the project shall be considered as returned to the possession and control of the Bidder unless the Owner shall elect to continue possession and control in the manner provided in Section 3 of this Article.

b. The Owner shall have the right to energize permanently any portion or portions of the project delivered to its possession and control pursuant to the provisions of Section 3 of this Article.

Section 5. Assignment of Guarantees. All guarantees of materials and workmanship running in favor of the Bidder shall be transferred and assigned to the Owner prior to the time the Bidder receives final payment.

ARTICLE V--REMEDIES

Section 1. Completion on Bidder's Default. If default shall be made by the Bidder or by any subcontractor in the performance of any of the terms of this Proposal, the Owner, without in any manner limiting its legal and equitable remedies in the circumstances, may serve upon the Bidder and the Surety or Sureties, if any, upon the Contractor's Bond or Bonds a written notice requiring the Bidder to cause such default to be corrected forthwith. Unless within twenty (20) days after the service of such notice upon the Bidder such default shall be corrected or arrangements for the correction thereof satisfactory to both the Owner shall be made by the Bidder or its Surety or Sureties, if any, the Owner may take over the construction of the project and prosecute the same to completion by Contract or otherwise for the account and at the expense of the Bidder, and the Bidder and its Surety or Sureties, if any, shall be liable to the Owner for any cost or expense in excess of the Contract price occasioned thereby. In such event the Owner may take possession of and utilize, in completing the construction of the project, any materials, tools, supplies, equipment, appliances, and plant belonging to the Bidder or any of its subcontractors, which may be situated at the site of the project. The Owner in such contingency may exercise any rights, claims or demands which the Bidder may have against third persons in connection with this Contract and for such purpose the Bidder does hereby assign, transfer and set over unto the Owner all such rights, claims and demands.

Section 2. Liquidated Damages. The time of the Completion of Construction of the project is of the essence of the Contract. Should the Bidder neglect, refuse or fail to complete the construction within the time herein agreed upon, after giving effect to extensions of time, if any, herein provided, then, in that event and in view of the difficulty of estimating with exactness damages caused by such delay, the Owner shall have the right to deduct from and retain out of such moneys which may be then due, or which may become due and payable to the Bidder, amounts as specified in the Plans as liquidated damages and not as a penalty. If the amount due and to become due from the Owner to the Bidder is insufficient to pay in full any such liquidated damages, the Bidder shall pay to the Owner the amount necessary to effect such payment in full: Provided, however, that the Owner shall promptly notify the Bidder in writing of the manner in which the amount retained, deducted or claimed as liquidated damages was computed.

Section 3. Cumulative Remedies. Every right or remedy herein conferred upon or reserved to the Owner shall he cumulative, shall be in addition to every right and remedy now or hereafter existing at law or in equity or by statute and the pursuit of any right or remedy shall not be construed as an election: Provided, however, that the provisions of Section 2 of this Article shall be the exclusive measure of damages for failure by the Bidder to complete the construction of the Project within the time herein agreed upon.

ARTICLE VI-MISCELLANEOUS

Section 1. Patent Infringement. The Bidder shall hold harmless and indemnify the Owner from any and all claims, suits and proceedings for the infringement of any patent or patents covering any materials or

equipment used in construction of the project.

Section 2. Permits for Explosives. All permits necessary for the handling or use of dynamite or other explosives in connection with the construction of the project shall be obtained by and at the expense of the Bidder.

Section 3. Compliance with Laws. The Bidder shall comply with all federal, state, and local laws, rules, and regulations applicable to its performance under the contract and the construction of the project.

Section 6. Equal Opportunity Provisions.

a. Bidder's Representations.

The Bidder represents that:

It has____, does not have____,100 or more employees, and if it has, that it has____, has not_____, furnished the Equal Employment Opportunity-Employers Information Report EEO-1, Standard Form 100, required of employers with 100 or more employees pursuant to Executive Order 11246 of September 24, 1965, and Title VII of the Civil Rights Act of 1964.

The Bidder agrees that it will obtain, prior to the award of any subcontract for more than $10,000 hereunder to a subcontractor with 100 or more employees, a statement, signed by the proposed subcontractor, that the proposed subcontractor has filed a current report on Standard Form 100.

The Bidder agrees that if it has 100 or more employees and has not submitted a report on Standard Form 100 for the current reporting year and that if this Contract will amount to more than $10,000, the Bidder will file such report, as required by law, and notify the owner in writing of such filing prior to the Owner's acceptance of this Proposal.

b. Equal Opportunity Clause. During the performance of this Contract, the Bidder agrees as follows:

(1) The Bidder will not discriminate against any employee or applicant for employment because of race, color, religion, sex, sexual orientation, gender identity, or national origin. The Bidder will take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, color, religion, sex, sexual orientation, gender identity, or national origin. Such action shall include, but not be limited to, the following: Employment, upgrading, demotions or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection of training, including apprenticeship. The Bidder agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this Equal Opportunity Clause.

(2) The Bidder will, in all solicitations or advertisements for employees placed by or on behalf of the Bidder, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, or national origin.

(3) The Bidder 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 said labor union or workers' representative of the Bidder's commitments under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

(4) The Bidder will comply with all provisions of Executive Order 11246 of September 24, 1965, and the rules, regulations and relevant orders of the Secretary of Labor.

(5) The Bidder will furnish all information and reports required by Executive Order 11246 of September 24, 1965, and by rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to its books, records, and accounts by the administering agency and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

(6) In the event of the Bidder's noncompliance with the Equal Opportunity Clause of this Contract or with any of the said rules, regulations, or orders, this Contract may be canceled, terminated, or suspended in whole or in part, and the Bidder may be declared ineligible for further Government contracts or federally assisted construction 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 provided by law.

(7) The Bidder will include this Equal Opportunity Clause in every subcontractor purchase order unless exempted by the rules, regulations, or order of the Secretary of Labor issued pursuant to Section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The Bidder will take such action with respect to any subcontract or purchase order as the administering agency may direct as a means of enforcing such provisions, including sanctions for noncompliance; Provided, however, that in the event Bidder becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the administering agency, the Bidder may request the United States to enter into such litigation to protect the interests of the United States.

c. Certificate of Nonsegregated Facilities. The Bidder certifies that it does not maintain or provide for its employees any segregated facilities at any of its establishments, and that it does not permit its employees to perform their services at any location, under its control, where segregated facilities are maintained. The Bidder certifies further that it will not maintain or provide for its employees any segregated facilities at any of its establishments, and that it will not permit its employees to perform their services at any location, under its control, where segregated facilities are maintained. The Bidder agrees that a breach of this certification is a violation of the Equal Opportunity Clause in this Contract. As used in this certification, the term "segregated facilities" means any waiting rooms, work areas, restrooms and washrooms, restaurants and other eating areas, timeclocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees which are segregated by explicit directive or are in fact segregated on the basis of race, color, religion, or national origin, because of habit, local custom, or otherwise. The Bidder agrees that (except where it has obtained identical certifications from proposed subcontractors for specific time periods) it will obtain identical certifications from proposed subcontractors prior to the award of subcontracts exceeding $10,000 which are not exempt from the provisions of the Equal Opportunity Clause, and that it will retain such certifications in its files.

Section 7. Franchises and Rights-of-Way. The Bidder shall be under no obligation to obtain or assist in obtaining: Any franchises, authorizations, permits or approvals required to be obtained by the Owner from Federal, State, County, Municipal or other authorities; any rights-of-way over private lands; or any agreements between the Owner and third parties with respect to the joint use of poles, crossings, or other matter incident to the construction and operation of the project.

Section 8. Nonassignment of Contract. The Bidder shall perform directly and without subcontracting not less than twenty-five percent (25%) of the construction of the project, to be calculated on the basis of the total Contract price. The Bidder shall not assign the Contract effected by an acceptance of this Proposal or any interest in any funds that may be due or become due hereunder or enter into any contract with any person, firm or corporation for the performance of the Bidder's obligations hereunder or any part thereof without the approval in writing of the Owner and of the Surety or Sureties, if any, on any bond furnished by the Bidder for the faithful performance of the Bidder's obligations hereunder. If the Bidder, with the consent of the Owner and any Surety or Sureties on the Contractor's Bond or Bonds, shall enter into a subcontract with any subcontractor for the performance of any part of this Contract, the Bidder shall be as fully responsible to the Owner for the acts and omissions of such subcontractor and of persons employed by such subcontractor as the Bidder would be for its own acts and omissions and those of persons directly employed by it.

Section 9. Successors and Assigns. Each and all of the covenants and agreements herein contained shall extend to and be binding upon the successors and assigns of the parties hereto.

Section 10. Independent Contractor. The Bidder shall perform the work as an independent contractor, not as a subcontractor, agent, or employee of the Owner. Upon acceptance of this Proposal, the successful Bidder shall be the Contractor and all references in the Proposal to the Bidder shall apply to the Contractor.

Section 11. Counterparts. This Contract may be executed in multiple counterparts, each of which shall be deemed an original and all of which shall constitute one and the same instrument.

ATTEST

_____
Witness

Dated _____

_____
Bidder

_____
Title

_____
Address

The Proposal must be signed with the full name of the Bidder. If the Bidder is a partnership, the Proposal must be signed in the partnership name by a partner. If the Bidder is a corporation, the Proposal must be signed in the corporate name by a duly authorized officer and the corporate seal affixed and attested by the Secretary of the Corporation.

ACCEPTANCE

The Owner hereby accepts the fore going Proposal of the Bidder, _____

_____, *for the construction of the following:*

_____

_____

_____

_____

_____

_____

_____

*for a total contract price of $*_____*(*_____*dollars.)*

The Middle Tennessee Electric
Membership Corporation
Owner

By _____
COO

_____
Witness

_____, *20* _____
Date of Contract

CERTIFICATION REGARDING DEBARMENT, SUSPENSION, INELIGIBILITY AND VOLUNTARY EXCLUSION – LOWER TIER COVERED TRANSACTIONS

INSTRUCTIONS FOR CERTIFICATION

1. By signing and submitting this proposal, the prospective lower tier participant is providing the certification set out below.

2. The certification in this clause is a material representation of fact upon which reliance was placed when this transaction was entered into. If it is later determined that the prospective lower tier participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government, the department or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.

3. The prospective lower tier participant shall provide immediate written notice to the person to which this proposal is submitted if at any time the prospective lower tier participant learns that its certification was erroneous when submitted or had become erroneous by reason of changed circumstances.

4. The terms *covered transaction, debarred, suspended, ineligible, lower tier covered transaction, participant, person, primary covered transaction, principal, proposal, and voluntarily excluded*, as used in this clause, have the meaning set out in the Definitions and Coverage sections of the rules implementing Executive Order 12549. You may contact the person to which this proposal is submitted for assistance in obtaining a copy of those regulations.

5. The prospective lower tier participant agrees by submitting this proposal that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transactions with a person who is proposed for debarment under 48 CFR part 9, subpart 9.4, debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency with which this transaction originated.

6. The prospective lower tier participant further agrees by submitting this proposal that it will include the clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion - Lower Tier Covered Transaction," without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions.

7. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that it is not proposed for debarment under 48 CFR part 9, subpart 9.4, debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows that the certification is erroneous. A participant may decide the method and frequency by which it determines the eligibility of its principals. Each participant may, but is not required to, check the List of Parties Excluded from Federal Procurement and Nonprocurement Programs.

8. Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of a participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

9. Except for transactions authorized under paragraph 5 of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is proposed for debarment under 48 CFR part 9, subpart 9.4, suspended, debarred, ineligible, or

voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the department or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.

CERTIFICATION

(1) The prospective lower tier participant certifies, by submission of this proposal, that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any Federal department or agency.

(2) Where the prospective lower tier participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

Organization Name PR/Award or Project Name

Name and Title

Signature Date

U.S. Department of Agriculture
Rural Utilities Service

WAIVER AND RELEASE OF LIEN

WHEREAS the undersigned, _____
NAME OF MANUFACTURER, MATERIAL SUPPLIER OR SUBCONTRACTOR

has furnished to _____ *the following:*
NAME OF CONTRACTOR

_____ *for*
KIND OF MATERIAL AND SERVICES FURNISHED

use in the construction of a project belonging to _____
NAME OF BORROWER

and designated the Rural Utilities Service as _____
RUS DESIGNATION

NOW, THEREFORE, the undersigned, _____
NAME OF MANUFACTURER, MATERIAL SUPPLIER, OR SUBCONTRACTOR

for and in consideration of $ _____ *and other good and valuable consideration, the receipt whereof is hereby acknowledged, do(es) hereby waive and release any and all liens, or right to or claim of lien, on the above described project and premises, under any law, common or statutory, on account of labor or materials, or both, heretofore or hereafter furnished by the undersigned to or for the account of*

said _____ *for said project .*
NAME OF CONTRACTOR

Given under my (our) hand(s) and seal(s) this _____ *day of* _____ *,20* _____ .

_____
Name of Manufacturer, Material Supplier, or Subcontractor

By _____
President

This Waiver and Release of Lien must be signed with the full name of the Manufacturer, Material Supplier, or Subcontractor. If the Manufacturer, Material Supplier, or Subcontractor is a partnership, this Waiver and Release of Lien must be signed in the partnership name by a partner. If the Manufacturer, Material Supplier, or Subcontractor is a corporation, this Waiver and Release of Lien must be signed in the corporate name by a duly authorized officer and the corporate seal affixed and attested by the Secretary of the Corporation.

Section 400

Engineering and Construction Specification

Barfield Substation
Engineering and Construction Specifications
MIDDLE TENNESSEE ELECTRIC

GENERAL INFORMATION

The following specifications are submitted in addition to the drawings and reports in order to provide the information necessary to build the substation to MTE standards.

The drawings contain notes and directions that are not included in this narrative.

Job site **safety** is the responsibility of the Contractor.

All design work shall be done under appropriate Tennessee licensed Professional Engineers. All drawings and calculations submitted to MTE shall bear their Tennessee engineering seals and signatures. The engineering company shall also be authorized to practice engineering in the State of Tennessee, in accordance with Tennessee Code Annotated Sections 62-2-601 and 62-2-602.

All Contractors shall be licensed in the state of Tennessee. The Contractor's license should have a total limit of no less than the bid amount. Failure to meet these criteria will result in a rejection of the bid due to Rules for Tennessee Board for License Contractors 0680-1-.18.

In the event that a conflict arises between the site construction drawings, the specifications, or the site conditions, the Contractor shall immediately cease work and contact MTE personnel and the design engineer.

All work shown shall be performed in accordance with the plans and site work specifications for this project and shall conform to all codes, ordinances, restrictions, and standards for all governing agencies having jurisdiction over the site. The Contractor will only perform construction activities based on plans and specifications that have been issued for construction purposes.

All applicable codes and standards shall be followed in the design and building of this substation including but not limited to the following:

Rural Electric Service (RUS)
Institute of Electrical and Electronic Engineers (IEEE)
National Electric Safety Code (NESC)
Nation Electrical Manufacturers Association (NEMA)
American National Standards Institute (ANSI)
American Concrete Institute (ACI)
American Society of Testing Materials (ASTM)
American Institute of Steel Construction (AISC)
American Society of Civil Engineers (ASCE)

In the event the Contractor feels that conflict exists between documents containing specifications for this substation, the Contractor shall immediately bring it to the attention of MTE so that the conflict may be resolved before it causes problems with the project. If the Contractor finds that it is not possible to meet the specifications in this document, then work is to be stopped and MTE is to be notified immediately so that the problem may be resolved.

If the Contractor finds that something is extraordinary and/or unconventional in these specifications, notify MTE so the issue can be resolved.

APPROVAL DRAWINGS and APPROVAL LIST

Approval drawings are to be submitted for the site work plan, site drainage plan, general arrangement, steel design, foundation layouts and design details, ground grid design details, oil containment, lightning study, all bills of material, and any other pertinent design details. Two (2) copies of these drawings and lists are to be submitted. MTE will return one set with corrections or approve them as submitted. Approval by MTE shall not relieve the Contractor of the responsibility for the correctness of the drawings furnished by the Contractor nor the compliance with the specifications or any applicable codes, ordinances, restrictions, and standards for all governing agencies having jurisdiction over the site.

DRAWINGS

The Contractor shall supply MTE copies of construction drawings. Copies of the electronic versions of the final drawings in the latest AutoCAD format are required. Electronic files may be provided on a CD-R with a professional label detailing the Project Name, EPC, and Date of As-builts at a minimum. These drawings shall include, but are not limited to, site work plan, site drainage plan, the general arrangement, structure erection diagrams, steel details, foundation layouts, foundation construction details, oil containment details, lightning study, grounding layout, apparatuses furnished by the Contractor, and the bill of materials. The bill of materials electronic format shall be in an Excel or Word format.

TENNESSEE ONE CALL

It is the Contractor’s responsibility to have all underground utilities located.

PERMITS

MTE will obtain any local building permits and attend any planning committee should it be required. Additionally, any other permits such as burn permit, blasting permits, TDOT driveway permit, communications tower permits, etc. will be the sole responsibility of the Contractor.

The Contractor shall be required to post a 4’ x 6’ sign near the construction entrance. The sign shall bear the Contractor’s name, “MTE”, and the site address. The right of way setback and sign dimensions shall follow local requirements for temporary signs.

CONSTRUCTION MEETINGS

There will be a regular weekly meeting during the construction phase that will be attended by a minimum of one of the following: Project Manager, Project Engineer, or senior level management from MTE. The Contractor shall also have appropriately responsible personnel at the meetings.

The meeting is to be scheduled at the same time and day for each week. If conflicts occur, the meeting can be rescheduled or skipped by agreement of both the Contractor and MTE. This is not to be a normal occurrence. There should be a minimum of one-day notice for meetings to be changed. Failure to attend a scheduled meeting will result in a $100 fine for the Contractor.

CONSTRUCTION SITE MANAGER

A full-time Construction Site Manager, (aka “CSM”) is required. It is required that the same CSM remain with the substation construction project from start to finish.

The CSM shall be a direct employee of the EPC Contractor and shall be at the site anytime work is being performed. The CSM shall be easily accessible and available at all times (i.e. not in a bucket truck or running a stinger truck). This person shall also be at the regular weekly construction meetings and provide the interface between MTE, construction personnel, and the Contractor. The CSM shall be aware of all construction tasks taking place at all times and shall be responsible for keeping the project on schedule and resolving any construction issues as they arise. Substation Construction Foremen shall report directly to the CSM. The CSM shall consult with MTE Substation Electrical Engineer on any construction issues or conflicts as they arise and report them during the weekly construction meeting. (Note: The CSM is not a Substation Construction Foreman. See Construction Site Foreman Section for details.)

It is required that the CSM have a minimum of fifteen (15) years experience with substation construction and a minimum of four (4) years experience with substation construction management. It is strongly recommended, but not required, that the CSM be an Engineer. The Contractor shall submit an experience resume for the proposed CSM for MTE approval during the bid process. MTE reserves the right to reject the Contractors proposed CSM for any reason.

CONSTRUCTION SITE FOREMAN

There shall be a separate Construction Site Foreman (aka “CSF”) for each major discipline of work that will be performed (i.e. earthwork, concrete placement, steel and bus erection, etc…) on site. Resumes of all proposed CSF shall be submitted and are subject to approval by MTE.

It is required that the same CSF remains with the substation construction project from start to finish for their portion of the project.

The CSF shall be a direct employee of the sub-Contractor or Contractor performing the work and shall be at the site anytime work is being performed for their portion of the project. The CSF shall be easily accessible and available at all times. This person shall also be at the regular weekly construction meetings and report their progress and any construction issues encountered. The CSF shall be aware of all construction tasks taking place for their portion of the work. The CSF shall report directly to the CSM. (Note: The Construction Site Foremen are not the Substation Construction Site Manager. See Construction Site Manager Section for details.)

It is required that the CSF has a minimum of four (4) years experience in their chosen discipline. The Contractor shall submit an experience resume for each proposed CSF for MTE approval during the bid process. MTE reserves the right to reject the Contractors proposed CSF for any reason.

SITE WORK

Clearing and grubbing limits shall include all areas disturbed by grading operations.

All structures inside the fence shall be located a minimum of 12’ from the fence.

The disturbed site not covered with gravel or concrete shall be surfaced with a minimum of 4” of topsoil unless otherwise stated. A complete 15-15-15 slow release commercial fertilizer shall be applied at a rate of 16 pounds per 1000 square feet. The area shall then be raked perpendicular to the slope to a smooth and uniform texture with no rocks greater than 3 inches in diameter visible. The area is then to be sodded or seeded as applicable. If necessary, concrete retainage walls shall be used.

Slopes should not be greater than 2 to 1 without approval of MTE. If the site plan requires steeper slopes, then North American Green C350 Permanent Stabilization Mat will be required. Other solutions may also be required. Preference will be given to proposals with retainage walls when steeper slopes are unavoidable. The site should not have areas with grass that is not mowable.

The Contractor is responsible for sowing or sodding the disturbed site. If the Contractor chooses to sow seed then they shall:

- apply 5 pounds of Kentucky 31 Fescue and 1 pound of Perennial Rye per 1000 square feet for grass sown during the months of September through April
- apply 5 pounds of common Bermuda seed and 1 pound of Perennial Rye per 1000 square feet for grass sown during the months of May through August
- apply mulch at the rate of one bale per 1,000 square feet.
- within 24 hours of sewing grass seed, the ground is to be watered so that the ground is saturated to a level of 4 inches deep

If the Contractor places sod, then:

- install Kentucky 31 Fescue sod if installed during the months of September through April
- install Bermuda sod if installed during the months of May through August
- the sod is to be staked in place
- the sod is to be watered immediately after installation
- the Contractor is required to keep the sod watered till it is established

The Contractor is responsible for providing a smooth, rut free, obstruction free mowable surface. Mowable areas shall not have a slope for more than 2:1 without approval by MTE. See the Payment Section for grass requirements.

The landscaping, trees and shrubs, will be provided and installed by MTE after the station is energized.

MTE has contracted with a civil engineering firm and provided a preliminary site design. However, the Contractor shall obtain a civil engineering firm to evaluate this site for the final design and layout. MTE is agreeable to the Contractor using the civil engineering firm that provided the preliminary design. The final site design shall be a collaborative effort between the Contractor, Civil Engineering firm, Geotechnical Engineering firm, and MTE. The Contractor shall follow recommendations of the civil engineering firm and geotechnical engineering firm for the required site drainage, elevations, earthwork, and site design details. Site elevations and site drainage plans shall be based from a 100-year flood plain study, site conditions, and surrounding area site conditions. The Contractor shall adhere to all Federal, State, and Local codes and regulations in the design and construction of the site. All design and construction modifications the deviate from the preliminary design shall be approved by MTE.

MTE has provided a geotechnical engineering report for this site, but assumes no liability for the information contained therein. The Contractor shall obtain the services of a geotechnical engineer and shall confirm the correctness of the geotechnical engineering report provided by MTE for this site before construction begins. The Contractor shall follow the recommendations of the geotechnical engineer for the earthwork activities including, but not limited to: excavation, fill placement, fill compaction, and temporary and permanent slope excavations. All earthwork is to be monitored by a qualified geotechnical engineer provided by the Contractor. Copies of all reports are to be sent directly from the geotechnical engineer to MTE. See the Geotechnical Engineering section of this specification.

The Contractor shall coordinate the installation of all underground utilities. All underground utilities (storm sewer, electrical conduit, irrigation sleeves, ground grid, and any other miscellaneous items) shall be placed before the placement of base course of gravel. Any ditches or trenches opened up for placement of underground utilities shall be placed back with proper compaction.

Property pins are marked. The Contractor will be responsible for locating and maintaining the baselines. The Contractor is also responsible for protection of all property corners and benchmarks. All property corners and benchmarks eliminated or damaged during construction shall be replaced by the Contractor. The Contractor is also responsible for silt fence removal.

Before placing engineered fill material, the Contractor is responsible for providing samples of the material to be used to the geotechnical engineering firm to ensure that it is suitable material. An approval report for this material is to be sent directly from the geotechnical engineer to MTE before proceeding. MTE must approve the site fill. MTE retains the right to reject the proposed site fill.

Any ditches dug, areas around foundations, or other disturbance to the substation pad shall be back filled and compacted a minimum of 95% compaction or greater if required by the Geotechnical engineer.

All areas inside the fence that are not part of the mobile drive are to have 6" of compacted crusher run gravel with 2" of clean rock chips (1/4”) top dressing. The gravel portion of the mobile drive is to have 1' of surge rock as a base, and then have 6" of compacted crusher run gravel with 2" of rock chips (1/4") top dressing. A detail drawing is shown on the site specifications drawing. The concrete area of the mobile drive is to have 10" of surge rock, 2" of compacted crusher run, and 8" of 4,000-pound concrete with 1.5 pounds of polypropylene fiber reinforcement per cubic yard. A detail drawing is shown on the site specifications drawing.

The Contractor shall install 1/4” clean rock chips 4’ around the perimeter of the fence. The first two feet shall be 8” in depth to match the grade inside the substation fence. The rock shall taper to 1” above the external grade. There shall be no gap between the bottom of the fence and the gravel.

Below the gravel of the substation pad is a required 36” of dirt. There is 18” of dirt required above and below the ground grid. Under no circumstances shall these requirements not be met, including after the final grading of the site. If dirt removal is expected during final grading, then include this amount in addition to the requirements. If the geotechnical test shows rock in the 36” space, then the rock must be removed before the pad is built. **Include this 36” of dirt in your bid**.

The construction of the mobile drive is critical because it will support a mobile substation transformer weighing approximately 70 tons. No bedrock is to be removed for the placement of the mobile drive outside the pad area or in the concrete area. If bedrock is hit before the required fill stone, then place the stone directly on the bedrock. If bedrock is encountered in the concrete area of the mobile drive, there will need to be a minimum of 4 inches of gravel placed between the 8" of concrete and the bedrock. The mobile drive shall be designed without any rapid grade changes so that the MTE mobile transformer shall enter and exit the substation. This mobile drive area is not exempt from the required 36” of dirt. The substation pad slope must be designed such that water does not accumulate in this area.

GEOTECHNICAL ENGINEERING

The Contractor shall obtain a geotechnical engineering firm. The firm will need to be approved by MTE before submitting a proposal. The geotechnical firm shall provide the Contractor and MTE a report or confirm the report provided by MTE to aid the Contractor in the design and construction of the site and foundations. The Contractor is to follow the geotechnical engineer’s recommendations during construction of the substation.

Once stripping activities have been completed, and before fill placement, a representative of the geotechnical engineering firm should be present to observe proof-rolling activities and locate any unstable zones. Once unstable areas have been undercut to a stable sub grade, fill should be placed to attain construction grades. All lifts should be placed and compacted in accordance with the geotechnical report. A qualified technician from the geotechnical firm, on a full time basis, shall observe all shot rock fill placement. Each lift of soil fill should be tested (density and moisture) for compliance with project specifications. Field reports detailing daily observations and field tests shall be prepared and submitted to MTE.

Concrete shall be sampled in accordance with ASTM C-172 and C-31. Each batch of concrete shall be tested. Each sample shall consist of at least 6- 6" X 12" cylindrical specimens to be tested in compression at the following interval: 7-day break - 1; 14-day break – 2, 28-day break - 2; spare - 1. Two samples should be from before pouring, two samples from mid-pour, and two samples from the end of pour. Any foundations or concrete work formed with a concrete batch that did not meet the minimum design requirements shall be removed and re-formed at the Contractor’s expense.

Any footing excavations in question by MTE, Geotechnical Engineer, or Contractor should be observed by qualified field personnel from the geotechnical firm before concrete placement. All footing excavations for the 161 kV dead-end structure, the 13 kV pull off bays, static poles, and the transformer pads shall be observed by qualified field personnel from the geotechnical firm and reports filed with MTE.

OIL CONTAINMENT SYSTEM

The oil containment system for this substation will consist of a pit encompassing each transformer foundation. The two transformer pits are to be connected by piping. These pits shall be shall able to hold a minimum of 14,000 gallons of oil or water total after any rock fill has been placed. The Contractor shall be responsible for the design of the pits and this design shall meet the EPA's requirements for a SPCC plan. The Contractor shall submit the plans for the oil containment as approval drawings and provide the appropriate SPCC plan.

The following is an example of a typical pit design (excluding mobile transformer containment) by MTE: Install a concrete catch basin around the transformer with galvanized steel grating to provide containment all around the transformer. The steel grating is to have a small area of grating above the water pickup location to provide man access for clean out. An approved drain assembly is Zurn, Catalog #Z125-4NL. Other drain assemblies will be considered if alternatives are submitted. Concrete catch basins should extend eight feet past the transformer foundation. In areas outside the concrete catch basins, the drainpipe shall be fully embedded in a minimum of 4" of crusher run gravel. The fall of the pipe shall be a minimum of 1.5 feet in 100 feet. There shall be an American Resilient Wedge Gate Valve #2504 with operating handle installed three to five feet inside the fence to control the flow of water/oil. An operating "tee" handle shall also be provided. The "tee" of the handle shall be between 2.0' and 3.5' above finished grade. Conduit and ground grid entering the concrete catch basin shall be constructed and sealed to protect against the leaking of water or oil through the concrete penetrations.

ROCK & SITE

It is recommended that the Contractor procure the services of a Licensed Surveyor, Civil Engineer, and Geotechnical Engineer to evaluate the site and site conditions in preparing a proposal for the construction of the substation. MTE assumes no liability with initial site conditions submitted or design drawings provided for bidding purposes, as it is not our intent to provide such information. MTE's intent is to provide property lines, and MTE design guidelines only.

MTE expects rock to be encountered in this project. MTE will not accept any rock clause or site fill clause associated with this project. The Contractor is responsible for any rock removal and site fill needed. Site fill must be approved by Geotechnical Engineer and MTE before use. If site fill is rejected by Geotechnical Engineer or MTE, then Contractor must locate and provide an approved site fill at their expense.

Any damage resulting from rock removal activities will be the responsibility of the Contractor.

TEMPORARY SERVICE, STATION SERVICE, AC, and LIGHTING

MTE will provide a 100 Amp 120/240 V temporary service and the electricity at no charge to the Contractor. If the Contractor wants the temporary service relocated during the project, then that will be at the Contractor's expense. The Contractor shall notify the MTE Project Engineer at least one week before the temporary service is needed.

MTE will furnish two 13 kVA distribution type transformers to be installed by the Contractor. MTE will also furnish a bracket and fused double cutout for each transformer to be installed by the Contractor. The Contractor shall provide for the mounting of the transformers and brackets on their steel design. Mounting bolt patterns consist of two holes for the bracket and two holes for the transformer. The dimensions are to be determined before steel fabrication.

The Contractor shall furnish and install 120/240V, 225 Amp NEMA 3R panel boxes for each station service transformer. The panel boxes and breakers shall be rated for 10kAIC. MTE will provide design at later date, however, in general:

- 240V, 225A MAIN breaker is to be supplied
- 120V, 20A breaker is to be supplied for each distribution breaker bay
- 120V, 20A breaker for the lighting supplied by that panel box
- 120V, 20A breaker for outside outlets
- 240V, 20A breaker for the 240V outlet located near the transformers
- 240V, 100A breakers for the power transformer
- 240V, 100A breaker to the station service throw over switch

Each panel box is to feed a 100A throw over switch. The switch is to be three position, Source 1, Neutral, and Source 2. The control handle is to be pad-lockable in any of the three positions. Each source shall be identified with permanent labels indicating “BANK #1” source or “BANK #2” source. The throw over switch is to be located in a NEMA 3R cabinet. The output of this

throw over switch is to feed the Control building. The wire size between the panel boxes, throw over switch, and control building shall be #1/0 AWG ALTP or equivalent copper.

The Contractor is responsible for providing and installing the triplex from the throw over switch to the panel box mounted inside the control building.

The Contractor is responsible for providing and pulling triplex into the transformer control boxes. The Contractor will also terminate the triplex in the transformer control panel. It is to be #4 Cu with #6 Cu neutral.

The Contractor shall provide and install 8 luminaires in the substation located in the areas shown on the drawings. The luminaires are to be for substation lighting complete with bracket and 120 V ballast, Holophane # PXLW. There are to be two photo control relays, single pole, 30A, 125V 60Hz, Trinetics # MR-XG spec 6356. Four of the luminaires are to be fed off the BANK #1 station service with one photo control. The remaining four luminaires are to feed off the BANK #2 station service and the other photo control relay. The lights are to be mounted approximately 8 feet above final grade.

A 120V 15A receptacle is required at each light location. At the location of the two nearest lights to the transformers, a 240V, 20A outlet is required in addition to the 120V outlets. The Contractor is responsible for providing all necessary material and the installation of the outlets.

In summary, the Contractor is responsible for providing and installing all of the AC system.

WALL

The wall is to be installed as shown in the general layout and described in the attached concrete wall specifications. A twenty-foot swing gate (i.e. two 10 foot gates) shall be installed on the front of the pad at the drive entrance. The swing gates shall have MTE approved hand holes for looping a gate chain. The wall shall encompass the entire substation “pad”. Any defects in the wall found during final inspection shall be fixed or replaced to MTE’s satisfaction.

CONDUIT AND CABLING

MTE will design the conduit system for the substation. The Contractor will provide and install the conduit systems and junction boxes. The Contractor will provide and install the pull strings in the relaying and protection conduit. Since the conduit for the protection scheme cannot be designed before the steel layout is complete, there will be a "typical conduit system design" provided in the RFP for bidding purposes.

The below grade duct system is to be schedule 40 PVC conduit with long hubs. Typically, 1-1/4” and 2-1/2” conduit shall be installed. See the "typical conduit system design" bill of material for details. The above grade conduit and turn up elbows shall be schedule 80 PVC. The radius shall be 24” for turn up elbows and 36” elbows for turns in the ground. There should be no more than three sweeps per conduit run. Cable trench is acceptable, but shall be drive rated.

The Contractor shall furnish and install all junction boxes required by MTE. The breaker junction boxes (~6) are to be NEMA 3R, 30" X 24" X 8” aluminum, .125 thick, with continuous welds, not just spot welds. The RC3 transformer box (1) is to be NEMA 3R, 30" X 30" X 12” aluminum, .125 thick, with continuous welds, not just spot-welds. The PT boxes shall be NEMA 3R, 10” x 10” x 4”. MTE has approved Hoffman, and Wiegman. The boxes are to have continuous swing hinges with a ¼ turn semi-flush oil-tight padlockable latch. NO SCREW LATCHING BOXES. Contractor shall submit proposed box for use and MTE must approve the boxes before purchase.

There will be one metering cabinet and two junction boxes furnished by TVA and installed by the Contractor. The Contractor will furnish and install conduit between these boxes and between the CT’s and PT’s. The Contractor will also pull the TVA furnished wires between the metering cabinet and the junction boxes and the CT’s and PT’s.

MTE will design and specify the cabling system. The Contractor will provide and install the field cables per the MTE cable schedule and field connection drawings. This includes the termination of the field cables in the appropriate equipment. Note, fiber optic cabling is included in this requirement. Since the cabling system for the protection scheme is not complete at this time, a "typical cable schedule design" has been provided in the RFP for bidding purposes. **Also, bid as an option, a discount if MTE provides the cabling and performs the installation.**

INSTRUMENT TRANSFORMERS

TVA will furnish and the Contractor will install a set of current transformers and a set of potential transformers. The Contractor will install all associated conduit, wiring, and junction boxes/metering cabinets as specified in the Conduit section. The TVA metering potential transformers shall be installed on the side of the TVA metering current transformers closest to the power transformer.

The Contractor will supply and install two sets of potential transformers for the use of MTE. The 13 kV PTs shall be Ritz VEF15-20 catalogue number 122031010.60305, 110 kV BIL, 60:1 ratio, 1500 VA thermal rating, and accuracy class 0.3 WXYZ. MTE potential transformers shall be installed on the opposite side of the TVA metering potential transformers.

LIGHTNING ARRESTERS

The Contractor is to provide and install (3) arresters for the 161 kV bus and (3) for the 13 kV bus. The arresters should be placed close to the mobile transformer location. The arresters shall be Ohio Brass EVP0106003001 and EVP0009003001. The arrestors located on the distribution bays will be provided by MTE and installed by the Contractor.

LIGHTNING PROTECTION

The Contractor is responsible for conducting a lightning study, designing a lightning protection system, and installing the required lightning protection system. A copy of the study and proposed protection system shall be submitted with the approval package. The static wire shall be 3/8" HSS Grade B.

POWER TRANSFORMERS

MTE will provide two (2) power transformers. MTE will purchase new 161/13 kV transformers for the Bank No. 1 & Bank No. 2 transformer pads. Typically, MTE's transformers weigh ~100 tons. The transformer foundations shall be adequately designed to handle 150 tons.

The Contractor will connect the transformer(s) to the substation bus and ground grid. MTE will supply NEMA 4 hole spades on the bushings of the transformers. See the Grounding Section for details about the grounding. The Contractor will connect the conduit to the transformers and pull the cables and terminate the control, fiber, and CT wiring.

CIRCUIT BREAKERS

MTE will furnish and the Contractor will install eight (8) 25 kV circuit breakers. The Contractor will be responsible for setting the breakers on the pads, making all conduit attachments, ground grid connections, and 25 kV bus connections. NEMA 4 hole pad connectors will be furnished with the breaker. The Contractor will also off load the breakers upon delivery. If the Contractor is unable to take receipt of the breakers upon delivery, then the breakers will be sent to the nearest MTE local office. The Contractor will be responsible for retrieving the breakers at their own expense. A total of eight (8) concrete foundations including all conduit attachments, ground grid connections, and 25 kV bus connections shall be provided for the circuit breakers regardless if shown as future.

CIRCUIT SWITCHER

The Contractor shall supply and install the circuit switchers as described in the attached specifications. The circuit switchers are numbered 912, 914, 922, and 924. The Contractor is responsible for making the circuit switchers ready for testing and service. Damage resulting from improper installation or not making ready shall be the responsibility of the Contractor.

SWITCHES

The Contractor shall install and adjust all switches before turning over station. MTE shall verify and approve switch adjustments before any piercing bolts are set. Contractor shall provide a lift for MTE personnel at site to verify proper operation and timing of the switches.

GROUP OPERATED SWITCHES

The Contractor shall supply and install the group-operated switches as described in the attached specifications. The 161 kV disconnect switches 911, 913, 921, 923, 919, and 929 are specified by "Substation 161 kV Disconnect Switch Specifications". The 161 kV disconnect switch (none) is specified by "2000 Amp Substation Disconnect Switch Specifications". The 25 kV disconnect switches specifications are contained in the "25 kV Substation Switch Specifications" and they shall be numbered 317, 319, 327, 329, 339, and 349.

HOOK STICK OPERATED SWITCHES

The Contractor shall supply and install the hook stick operated switches for the distribution bays as described in the attached specifications. They shall be numbered as indicated on the Single Line Diagram. Any device (25 kV breaker, etc…) showing future still requires all hook stick operated switches. The Hook stick operated switches shall be Southern States PBO-1,1200A rated.

The Contractor shall also supply two (2) hooksticks, and supply and install two (2) hookstick containers. The hooksticks shall be Hastings 3119 and the hookstick containers shall be Hastings 01-3252 with fence mounting kit 01-3200-41.

STATION GROUNDING

The ground grid shall be designed to meet all the safety requirements for a power substation. The Contractor is responsible for designing and installing the grounding system. The Contractor should use IEEE 80 and IEEE 142 as guides in their design. Design shall include a 10% contingency factor for any future fault current increases, and be designed on the basis of a 50kg person and 0.5s fault clearing time. An insulating surface layer resistivity of 2000 ohm-meters shall be used for the gravel. A resistivity of 100 ohm-meters shall be used along the line. The Contractor shall furnish substation step and touch potential calculations and a graph showing the various ground potential voltages throughout the entire ground grid during a fault with the grounding approval drawings. Contractor shall include the maximum fault earth return current ground potential rise calculation.

The buried ground grid shall be a minimum of 18" below the earth, 26" below final grade. The buried ground conductor shall be either #4/0 AWG BCu or 500 MCM BCu. All below grade connections are to be made using DMC Power compression grounding connectors. MTE personnel will randomly test the DMC Power connections during installation.

A minimum of four 20' long 2" diameter ground rods with SAE Conducrete backfill, or an approved equivalent, shall be installed. They are to be located near the four sets of lightning arresters that are not for the mobile transformer.

All above grade conductor shall be #4/0 AWG BCu. The conductor is to be supported with bronze clamps at a maximum distance of every 8 feet when the conductor goes up a structure. The conductor is to be connected to the equipment and/or structures with a tin-plated bronze connector. The connectors are to be Burndy # YA-28 for one hole applications and Burndy #YA-28-2 for two hole applications.

Columns, stands, and towers must have a minimum of one ground grid connection. If the base exceeds 10 square feet, a minimum of two ground grid connections must be placed on diagonally opposite corners. All switch operator platforms must be connected as shown in the attached diagrams including a minimum of two connections and two copper conductors back to the steel structure ground wire.

On group operated switches and other hand operated equipment, a flexible tinned copper braid, a #4/0 Cu cable equivalent, shall be clamped to the vertical shaft and have a ferrule on the free end connected to the grounded steel structure ground wire. If the vertical shaft makes more than one rotation, the braid shall be connected to the shaft through a slip-ring connection.

The neutral bushing of the power transformers shall be connected to the ground grid by a minimum of two separate grounding conductors that follow a different path from the bushing to the ground grid. All three grounding pads on the transformer shall be connected to the ground grid.

There will be two station service transformers. Each station service transformer shall have a loop ground of #2 AWG Cu. The loop should start at the #4/0 column ground and pass through the low voltage neutral bushing, both case ground lugs, and return to the #4/0 column ground.

Circuit breakers, fault initiating switches, and circuit switchers shall have at least two connections placed on diagonally opposite corners. The bolted frame extensions shall be grounded.

The ground terminal of the lightning arresters shall have a single connection to a common ground bus having a minimum of two connections to the ground grid. Again, the conductor size is to be #4/0 AWG BCu.

Cabinets and junction boxes shall have a minimum of one #2 AWG BCu connection to the ground grid.

The fence is to be grounded with a minimum #4/0 AWG BCu ground loop located outside the fence from 3 to 4 feet. This fence loop is to be connected to the substation ground grid at multiple locations. The fence is to be grounded as indicated in the attached drawings. The fence is to be grounded at each corner post, each gate post, and at each location where a circuit will cross the fence. Additional grounds are to be added so that the maximum distance between fence grounds is 50 feet. Connections to the fence fabric are to be made by using a #2 BCu SD tinned conductor and split bolt or parallel groove clamp suitable for bi-metallic connections. There are to be a minimum of four connections to the mesh and each strand of barbwire is to be connected to the #2 BCu SD.

One run of #4/0 AWG BCu from the ground grid shall be provided and installed to the first pole of each circuit for a total of six runs. These poles are normally located 15' to 45' outside the substation fence. These pole locations will be staked for the Contractor when they are ready to install the ground grid. A minimum of 5 feet of copper must be coiled up at the pole locations for MTE to make connections.

CONCRETE / FOUNDATIONS

The foundations and the anchor bolts are to be designed such that the bottoms of the steel base plate sit on leveling nuts. The bottom of the base plate should be a consistent distance above the finished concrete and that distance should be about 2 inches. A grout cap will not be required. The top of the concrete shall be poured such that water will not sit on top of the foundation. The concrete is to be smooth and consistent in appearance above grade.

All foundations shall have an ultimate strength of 4,000 PSI and consist of air-entrained concrete and reinforcing steel in accordance with ASTM A615-Grade 60. All foundations on top of concrete shall be at least 3 inches above grade and no more than 18 inches above grade. The foundations may be spread type footings and/or augured-type foundations. The distribution breakers shall be installed on slab foundations. The concrete is to be tested as indicated in the Geotechnical Engineering section.

In the concrete pouring, the following precautions should be noted:

1) No concrete should be poured if the atmospheric temperature is below 35 degrees Fahrenheit or over 90 degrees Fahrenheit without taking special heating or cooling precautions as recommended.

2) The concrete shall be allowed to cure a minimum of five days before the equipment base is installed and leveled. At this time, the leveling nuts shall be torqued no more than 10 pounds so that the anchor bolt bonding will remain undisturbed.

3) In the event of over-excavation of any footing, the void shall be filled with soil free of rocks and whose plasticity index is no greater than 20. The fill material shall be placed in 6 to 9 inch layers and each lift shall be compacted to 98% or better of the standard maximum density in accordance with ASTM-01618 (or AASHOT-99). The geotechnical engineering firm must test this and provide copies of the test reports to MTE. As an alternative, the voids may be filled with concrete.

4) Special moist-curing procedures should be used when necessary. The sealing of concrete shall be performed when necessary for proper curing.

5) Excessive spading and internal vibration of the concrete mixture should be avoided.

The Contractor is responsible for selecting the concrete supplier and if concrete is found to be bad at any time, the Contractor will be responsible to MTE for the bad concrete.

If a foundation is poured with the anchor bolt pattern incorrect, epoxy anchors may be used for correction. MTE should be contacted after the epoxy anchors are installed, then an independent licensed structural engineer will be hired by the Contractor to perform "pull tests" to determine that the anchors are fully bonded in the foundation. The Engineer's signed and sealed report will be required by MTE. Note: Epoxy anchors shall not be used on foundations that support tension bearing structures such as feeder bays or transmission line structures.

The Contractor is responsible for pouring two (2) transformer foundations. The transformer foundations shall be poured a minimum of 12' X 18'. Transformer foundations shall be designed and constructed to support a minimum transformer weight of 150 tons.

The Contractor is responsible for pouring the fence perimeter security post foundations.

The following concrete compression strength requirements must be met before material installation and/or placement on foundations, slabs, or piers:

1) Equipment foundations shall be cured a minimum of 14 days and shall have a minimum concrete compression strength of 85% of the specified minimum 28 day strength.

2) Structure foundations shall be cured a minimum of 7 days and shall have a minimum concrete compression strength of 70% of the specified minimum 28 day strength. Before attaching wires, structure foundations shall be cured a minimum of 28 days and shall have a minimum concrete compression strength of 100% of the specified minimum 28 day strength.

STRUCTURES

Structural steel shall conform to all the latest ASTM standards. The structural steel shall be fabricated and erected in accordance with the latest recommendations of the AISC specifications for the design, fabrication, and erection of structural steel for buildings. Care is to be taken in shipping, on and off loading, storage, and erection not to damage the galvanizing or to not lay the steel directly on the ground. Any damage to the galvanizing shall be repaired as soon as possible. All steel structures on bolts are to be hot dipped galvanized. **Steel is to remain clean and free of dirt or mud. Contractor will be required to clean the steel if it is dirty.**

This station is to be designed to have three transformer bays: two power transformer bays and one mobile transformer bay. The station is to have eight distribution bays arranged in a split bus arrangement with four bays on each side of the station. See the general arrangement diagram.

The incoming 161kV TVA TL will terminate on the TVA provided switch structures. TVA will attach to this structure and furnish materials required for termination. The Contractor shall furnish eyebolts or other approved means for TVA to connect their static wires to the Contractor provided static pole structure.

The distribution bays must operate and replicate our existing distribution bay design. The Contractor may modify the steel design/fabrication methods from the tapered cut and welded wide flange design shown, but the main bus, transfer bus, and all switches must be located in the same arrangement. Variance in operating from the existing MTE design will not be allowed. See the enclosed distribution bay drawings. The Contractor shall supply brackets or other accessories for MTE to attach our distribution circuits to the distribution bays. This includes

provisions for mounting our insulators to the steel structures, our NEMA 4-hole pads to the bus work and our intermediate class lightning arresters to the steel at the point of attachment of the insulators to the steel.

BUSWORK

The 161 kV bus shall be aluminum tubing with DMC Power swedge connectors. The bus size must be 4" and/or 2", Sch 40 and/or Sch 80.

The 25 kV bus shall be constructed from the following bus sizes: 4", 3" and/or 2", Sch 40 or Sch 80 aluminum tube bus, 4" X 4" X 3/8" UABC, and ¼" X 4" aluminum flat bar. All tube bus connectors shall be DMC Power swedge connectors.

The transformer bus shall have a minimum 3,000 Amp capacity at 30 degrees Centigrade rise rating.

Wire bus for jumpers for both 161 kV and 25 kV bus shall be 795 KCMIL AAC (Arbutus). This is a standard wire size for MTE and we will sell the Contractor wire for this station at our cost plus 15% plus tax if the Contractor desires. The only approved cable terminal lugs for use on the 795 AAC are Burndy #YCAK391A-4N, Anderson #ACF-795-C, Homac #SAL800-4N, and DMC Power swedge connectors.

Excluding the 795 AAC, all bus work shall be supported such that deflection is less than 1/150th of the span length for a two-support span and less than 1/200th for a three-support, or more, span. Tube bus shall be provided with vibration-damping cable and end caps. The bus and bus support supplied shall have a short-time current capability of 40,000 Amps fault current. The bus and bus support system shall be designed such that the bus system suffers no mechanical or electrical damage at this fault current level. The bus level shall be designed to allow for expansion and contraction by providing for both slip and fixed supports. All switches shall have less than 120 pounds longitudinally, 40 pounds transversely, and 110 pounds vertical load at the terminal or as per the latest version of the ANSI standards.

The bottom of any insulator or surge arrester shall maintain a minimum height of 8’-6” from the top of the concrete foundation. The following minimum height clearances from the top of the concrete foundations or foot holds on steel structures such as base plates to the lowest live part of any bus or equipment shall be meet:

1) 25kV equipment shall maintain a minimum top of foundation clearance of 10’-0”.

2) 161kV equipment shall maintain a minimum top of foundation clearance of 14’-0”.

INSULATORS

The high side of the station insulators shall be 161 kV, 750 kV BIL, gray, post type and porcelain. The low side of the station shall be 25 kV, 150 kV BIL, gray, post type, porcelain. The only approved manufacturers of acceptable insulators are Locke, Lapp, or Newell.

SWITCH, BREAKER, AND PHASE DESIGNATIONS

Numbers shall be provided for all switches and breakers shown on the single line diagram. The numbers shall be permanent, porcelain-enameled, black on white background, and 2 inches square. The number tags are to be mounted in three digit tag holders.

The numbers shall be mounted as follows:

Group operated switches:	Mount at the switch handle and switch location on the structure
Hookstick switches:	Mount on the structure in the proximity of the switch or switch base
Switchers and Breakers:	Mount on the mechanism door.

Phase Markings (A, B, C) shall be installed as shown on an attached drawing. Fourteen (14) sets will be required for the 25 kV bus and four (4) sets will be required for the 161 kV bus. Phase markers are to be 4" X 4", porcelain-enameled: red with white letter "A", white with blue letter "B", blue with white letter "C". They are to have mounting holes in each corner.

Switch numbers, phasing tags, and holders may be obtained from Cherokee Porcelain Enamel Company, 2717 Independence Lane, Knoxville, TN 37914, 423-637-7833, fax 423-637-0019.

TESTING

A walk-through of the station will be conducted by MTE personal before energizing the station. This will include torque testing of at least 20 randomly selected bolted bus connections. If any fail the test, the Contractor will be required to go back and re-torque all of the bolted bus connections in the station. MTE will then repeat the tests. Some structural bolted connections will also be checked.

The testing of all relays, circuit breakers, circuit switchers, transformers switchboards, metering and control wiring terminals will be done by MTE or other Contractors. The substation Contractor will not be responsible for this type of testing, however, will be responsible for correcting any Contractor errors found during testing.

CLEAN UP

The Contractor will be responsible for disposing of all rubbish resulting from the construction of this substation. The Contractor will be responsible for any damage done to adjacent property during this construction project.

All completed steel and buswork should be free of dirt, mud, and debris.

GUARANTEE AND WARRANTY

Contractor shall warranty their work against all defects in material and workmanship for a period of two years after station is put in service or 2.5 years after the project is completed by the Contractor, whichever expires first.

After the station has been in service for 90 days, MTE will contact the equipment manufacturer if the problem is with a device that carries a warranty independent of the Contractor's warranty. If MTE and the manufacturer cannot resolve the problem, then MTE will request assistance from the Contractor for the period of the Contractor's warranty.

A final $5,000 will be held until the grass has a suitable stand to MTE.

Written application for final payment of the 10% withholding may be made 60 days after the energization of the substation and MTE's receipt of final drawings.

Project Coordination

The Contractor **MUST** provide MTE and TVA with site elevations, substation baselines, dead-end detail drawings and location by ASAP. TVA needs the center of the pull-off to be located by the above date for the project to stay on schedule. The A-frame shall be ready for attachment of the 161kV TVA line on or before October 2026 or earlier.

SITE FACILITIES

Contractor shall provide a mobile office on the site upon work beginning. Mobile office shall be climate controlled, provide adequate meeting space, and provide phone and fax machine access, and adequate seating. Contractor shall connect all required service connections to mobile office, maintain the mobile office, and follow all requirements for bracing. Contractor shall provide and maintain restroom facilities on the site during the construction process.

COMMUNICATIONS TOWER

N/A

Section 500

Control House Engineering and Construction Specification

CONTROL BUILDING AND EQUIPMENT

I. GENERAL

A. Scope

1. This document specification covers the design and fabrication requirements of a single-story, single-module concrete equipment control house unit. The delivered unit, described in the subsections that follow, includes structural, electrical, and mechanical systems required to satisfy MTE's control house.

B. Classification

1. The control house unit, hereinafter referred to as "control house", shall be of nominal dimension shown on the MTE control house drawing in the Appendix section.

C. Submittals

1. Submit the information specified in this subsection to MTE and approved before start of control house fabrication. Include clear explanations where drawings and data deviate from MTE control house drawing or this specification.

2. Preliminary Drawings. Submit shop drawings that include the following details:

a) interior layout, including reflected ceiling plan

b) load path or whole control house section that describes frame and sheathing materials, and structural fasteners

c) one-line electrical diagram that describes service and feeder power wiring in the control house

d) circuit breaker panel schedule that identifies rating & location of circuits furnished with control house

3. Foundation Drawing. Submit foundation plan drawing showing slab plan dimensions and control house tie-down details. If soil-bearing data is provided with this order, also furnish foundation structural details, such as concrete strength and reinforcing steel.

II. APPROVED CONTROL HOUSE MANUFACTURERS

A. The approved control house manufactures are as follows:

1. Modular Connections LLC

II. APPLICABLE DOCUMENTS

A. The following documents, of issue in effect at time of invitation-for-bid or request-for-proposal, form a part of this specification to the extent specified herein. At time of publication, editions indicated were valid.

B. In event of conflict between the MTE control house drawing and this specification, the drawing shall take precedence. In event of conflict between this specification and other documents specified herein, this specification shall take precedence.

C. All standards are subject to revision. Manufacturer shall apply the most recent editions of standards indicated below:

D. Documents

MTE control house drawing
ACI 304: Guide for Measuring, Mixing, Transporting, and Placing Concrete
ACI 305: Hot Weather Concreting
ACI 306: Cold Weather Concreting
ACI 308: Standard Practice for Curing Concrete
ACI 309: Guide for Consolidation of Concrete
ACI 318: Building Code Requirements for Structural Concrete

ARI 210/240: Standard for Unitary Air Conditioning and Air Source Heat Pump Equipment
ASCE 7: Minimum Design Loads for Buildings and Other Structures
ASHRAE 90.1: Energy Efficient Design of New Buildings
ASTM A36: Standard Specification for Structural Steel
ASTM A185: Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A615: Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C31: Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33: Standard Specification for Concrete Aggregate
ASTM C39: Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C150: Standard Specification for Portland Cement
ASTM C172: Standard Method of Sampling Freshly Mixed Concrete
ASTM C260: Standard Specification for Air-Entraining Admixtures in Concrete
ASTM C330: Standard Specification for Lightweight Aggregate for Structural Concrete
ASTM C494: Standard Specification for Chemical Admixtures in Concrete
ASTM E84: Test Method for Surface Burning Characteristics of Building Materials [fire retardant]
ASTM E119: Test Methods for Fire Tests or Building Construction and Materials [fire resistance]
ASTM E136: Test Method for Behavior of Materials in a Vertical Tube Furnace [non-combustibility]
ASTM E152: Methods of Fire Tests of Door Assemblies
AWS D1.1: Structural Welding Code-Steel
AWS D1.4: Structural Welding Code-Reinforcing Steel
EIA 222: Structural Standards for Steel Antenna Towers and Antenna Supporting Structures
IBC: International Building Code, International Code Council (ICC)
NBC: National Building Code, Building Official Code Association (BOCA)
NFPA-70: National Electric Code, National Fire Protection Association
SBC: Standard Building Code, Southern Building Code Conference International (SBCCI)
UBC: Uniform Building Code, International Conference of Building Officials (ICBO)
UL 752: Bullet Resisting Equipment
UL 1449: 2nd Ed., Transient Voltage Surge Suppressor

IEEE 484, Recommended Practice for Installation of Large Storage Batteries

IEEE 450, Recommended Practice for Maintenance, Testing, and Replacement of Large Storage Batteries

IEEE 485-1997, Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications

ANSI A358.1, Emergency Eyewash and Shower Equipment

III. REQUIREMENTS

A. Engineer, design, and fabricate control house to conform to performance requirements specified, herein. Requirements are categorized by discipline as structural, electrical, mechanical, and architectural. Ancillary equipment and systems not classified as above are specified as a miscellaneous requirement.

B. Structural Requirements

1. Design Loads. Design control house to resist loads from wind, gravity, structural movement including thermally induced, and to withstand in-service use (e.g. weather) without failure.

2. Provide floor panel with integral and flush lifting provisions that permit crane lift without the use of separate bolt-on devices, but make use of readily available crane hardware, e.g., hooks, shackles, or D-rings. Design lifting provision for control house tie-down. Tie-down hardware in wall not permitted.

3. Unless otherwise indicated, design loads are:

   a) 200 psf uniform floor live load per ASCE 7 while on foundation

   b) 125 psf uniform floor live load per ASCE 7 during lifting and transport

   c) 100 psf uniform roof live load per ASCE 7

   d) 120-150 mph wind load per ASCE 7, exposure C

   e) Seismic: importance factor 1.0, use group I, spectral response coefficients – SDS = 0.47 & SD1 = 0.19, site class D

   f) 2-hour fire resistance per ASTM E119 on exterior walls

   g) Level 4 high rifle bullet resistance when tested in accordance with UL 752

   h) In addition, control house shall be capable of certification under the following model code influences and construction classifications when classed as **S2** occupancy:

   i) UBC [ICBO] …..…….. V_N

   j) SBC [SBCCI] ….……. IV_U

   k) NBC [BOCA] …..……. 5B

   l) IBC [ICC]……..… 5B

4. Materials. Furnish required materials and components in the process necessary for structural system.

5. Concrete. Use concrete formulation with no less than 4000-psi compressive strength at 28 days and a density less than 100 pcf.

   a) Cement: Type I or II Portland cement per ASTM C150

   b) Aggregate: lightweight sand per ASTM C33 and lightweight coarse per ASTM C330; use coarse aggregate no larger than ¾ inches nominal.

   c) Admixtures: air entraining admixtures per ASTM C260 and water reducing admixtures per ASTM C494.

   d) Water: clean and free of oils, acids, solids, salts, organic materials, or other substances harmful to concrete or reinforcing steel. Use no non-potable water.

6. Steel. Use embedded reinforcing and other structural steel components that conform to the following:

   a) Rebar: use grade 60 deformed reinforcing bar per ASTM A615

   b) Welded wire fabric: use f_y=60 ksi wire fabric reinforcement per ASTM A185

   c) Other steel: use ASTM A36 steel, or better, for other steel components, e.g. weld plates, lifting and tie-down hardware

7. Installation.

   a) Panel Fabrication. Construct floor, walls, and roof into pre-cast reinforced concrete panels in conformance with ACI 318 with a minimum thickness of 6" on floors and 4" on roof and wall panels. Cast reinforced steel plates in floor, walls, and roof panels to provide for welded panel-to-panel connections. Also:

      (1) Measure, mix, and transport concrete per ACI 304
      (2) Collect concrete samples for strength testing per ASTM C172, mold into cylinders per ASTM C31, and test for compressive strength per ASTM C39; see also Section 4, herein
      (3) Cure concrete in forms and protect from moisture loss, excessive heat, and freezing until removal from form; conform to ACI 305 and ACI 306 as required for hot and cold concreting
      (4) Consolidate concrete per ACI 309
      (5) Mold or screed minimum ¼" per foot slope on roof in two directions for proper water drainage
      (6) Mold steel door frames into cast panel walls where required by drawing [client drawing number]; see also §3.4.2(F), herein; include step-joint threshold to prevent water from entering control house
      (7) Mold keyed or step-joint edges into fabricated panels to enhance moisture protection and water runoff; mold roof/wall so that joint is not exposed
      (8) Treat wall panels with retarders as required to permit exposure of coarse aggregate for exterior finish; "seeding" of exterior surface with coarse aggregate is not permitted

   b) Control house Assembly. Install weatherproofing features as concrete panels are assembled. Weld finished panels together to form rigid concrete shell. Also:

      (1) Dust and waterproofing per §3.4.2, herein
      (2) Welding: use certified welders and conform to applicable provisions of AWS D1.1 and D1.4

C. Electrical Requirements

1. Electric Power & Lighting. Engineer, design, and furnish electrical system compatible with applicable electrical details on MTE control house drawing and NFPA 70, the National Electrical Code. Except as noted on MTE control house drawing also comply with the following:

   a) General interior lighting: minimum of 50 fc at the work plane, 30" above finished floor
   b) LED interior lighting is preferred.
   c) Emergency interior lighting: self-contained unit with battery back-up for 1½ hours of service when fully charged
   d) Service AIC rating: 10,000 amps minimum

e) Provide 15-amp duplex convenience receptacles around room perimeter

2. Electric Control Wiring. Engineer, design and furnish controls that will operate on-board systems without need for operator intervention. Also provide alarm wiring that will alert persons present and remote alarm systems of conditions that require attention.
3. Air Conditioner Unit Control. Provide thermostatic controls to operate primary air conditioner for ordinary loads and alternate air conditioner for periods of high load that cannot be sustained by primary unit. Configure system to alternate between redundant air conditioners to level running time.
4. Generator Control. On control houses equipped with generator, provide control to sense voltage or frequency fault, start generator, and switch control house load from the utility power grid to generator; see separate specification for complete generator controls.
5. Fire Suppression Control. On control houses equipped with fire suppression and detection, provide control to sense the following conditions and provide stated alarm, and provide wired control contacts for field connection to MTE monitor:
   a) First alarm: if any detector in any zone senses positive, sound horn or siren and close "first alarm" contacts
   b) Second alarm (pre-discharge): if any two (2) detectors from different zones sense positive, sound bell (or horn with different tone characteristic than first alarm), close "second alarm" contacts, shut-down air handling systems, and initiate discharge of suppression agent after 10-second countdown
   c) Trouble alarm: if power should fail, or supervised circuit be opened or shorted, close "trouble alarm" contact
   d) Manual release: if pull station located near door is engaged, begin immediate initiation of countdown to discharge and agent release
   e) Manual abort: while mushroom pushbutton is engaged, suspend countdown to discharge and agent release
   f) Wire detector, discharge, manual release, abort, and audible alarms as supervised circuits to detect inadvertent circuit damage or disruption.
6. Miscellaneous Alarms. Provide the following additional alarms by wiring form "C" alarm contacts to MTE monitor:
   a) High temperature alarm (HTA): engage contacts when temperature exceeds preset limit
   b) Low temperature alarm (LTA): engage contacts when temperature falls below preset limit
   c) High humidity alarm (HHA): engage contacts when relative humidity exceeds preset limit
   d) Low humidity alarm (LHA): engage contacts when relative humidity falls below preset limit
   e) Door (intrusion) alarm (DA): engage contacts when magnetic pick senses door opening
   f) Power fail alarm (PFA): engage contact when total system power or single phase is lost
   g) Smoke alarm (D_n): engage when smoke products are sensed in line smoke detector; not required as separate item when fire suppression and detection system is specified
   h) Hydrogen detection alarm (HDA): engage contact upon detection of hydrogen gas

i) Surge Arrester alarm (SUR): engage contact upon detection of status change

7. Materials. Furnish materials, components, and devices that are new and of highest quality, and standard products of manufacturers regularly engaged in their production. Ensure that, where applicable, electric materials are listed or recognized by Underwriters Laboratories, or another 3rd-party agency approved by MTE. See MTE's control house drawing for specific components and systems, as well as circuit ratings and sizes. Conform to the following:
   a) Power wiring: 600V THHN or THWN wire sized in accordance with NFPA-70; use size 12 awg minimum
   b) Control wiring: 250V TFFN solid wire sized in accordance with manufacturer or listing instructions for class 2 thermostat, generator, or fire detection systems; use #18 awg minimum
   c) Alarm wiring: 250V solid shielded, twisted cable assemblies; use #22 awg minimum
   d) Fixed raceway: EMT, rigid metal conduit, or metal wireway size per NFPA-70
   e) Flexible raceway; use liquidtite conduit on exterior and flexible metal conduit on interior of control house
   f) Branch circuit breakers: thermal magnetic circuit breakers; rate breakers that supply lighting circuits as "SWD" and motor loads as "HACR"
   g) Light fixtures: 2-tube, 4-foot surface-mounted fluorescent fixtures with CBM-rated ballast, prismatic wrap-around diffuser, and in-line RFI filters for noise suppression or LED
   h) Wiring devices: use UL listed quiet-type lighting toggle switches and grounded receptacles
   i) Service Disconnects: Fused disconnects or enclosed circuit breakers labeled as "suitable for use as service equipment"
8. Installation. Perform all wiring in accordance with best commercial practice in accordance with NFPA-70.
   a) Install wiring in surface mount EMT conduit; where flexible conduit is required by code between equipment and final junction box in circuit, use flexible metal conduit on interior and liquidtite conduit on control house exterior
   b) Where required, use properly sized and insulated wire nuts for conductor splices; locate no splices except in outlet or junction boxes.
   c) Install 75W incandescent exterior door light with vandal-resistant lens and, when required by drawing [client drawing number], a photocell and switched override
   d) Coordinate location of interior light fixtures to maximize illumination between rows of equipment
   e) Center duplex receptacles 18 inches above finished floor and locate so that no point along room perimeter is greater than six feet from a receptacle
   f) Insofar as practical, enclose class 2 signal circuits in raceway
9. AC Panelboard.
   a) 120/240V, 1 phase, 3-wire, 42 circuit bolt-on breakers, surface mount, 10-kAIC, 225A bus rating, 225A main breaker.
   b) As circuit breakers shall be clearly labeled with a panel schedule.
   c) Provide a minimum of (3) 3" conduits from panelboard to cable tray.
   d) Provide calculated amps per phase.

e) See MTE drawing for requirements.

10. DC Panelboard.
    a) 250V, 48 circuit plug-in breakers, surface mount, 10-kAIC, 225A bus rating, 150A main breaker.
    b) As circuit breakers shall be clearly labeled with a panel schedule.
    c) Provide a minimum of (3) 3" conduits from panelboard to cable tray.
    d) See MTE drawing for requirements.
11. Telecommunications Panel
    a) See MTE drawings for part numbers and requirements.
    b) Provide a minimum of (2) 3" conduits from the Telecommunications panel to cable tray.
    c) Two (2) 2" galvanized steel conduits must protrude through one exterior and interior wall below the Telecommunications Panel. Each conduit shall be plugged at the exterior end with a galvanized square head solid plug.
12. Provide conduit entrance boxes as shown on drawings. The conduit entrance boxes shall have removable bottom plates to allow field punching holes for conduits. The conduit entrance boxes shall have padlockable doors with a continuous hinge for permitting entry into the enclosures for work. Bolt-on covers are NOT allowed. A field installed skirt extension may be required from the bottom of the conduit entrance box to ground level.

D. Mechanical Requirements

1. Performance. Furnish and install mechanical systems as specified in this section when identified on MTE control house drawing.
2. HVAC System. Design and equip control house for heating, ventilation, and air conditioner system that will maintain interior temperature under specified operating conditions. Calculate heating and cooling based on heat load of control house manufacturer's installed equipment and control house conduction losses and solar loading; and when furnished, use sensible and latent losses from MTE-furnished equipment loads, ventilation and personnel losses. Control house manufacturer shall calculate the heat load of all installed equipment. Size system for 100% redundancy under the following operating conditions:
    a) Ambient temperature: -30°F (-35°C) thru 104°F (40°C)
    b) Interior temperature: 65°F (18°C) minimum at minimum ambient, and 84°F (30°C) maximum at maximum ambient temperature,
    c) Ambient humidity: 5-95%
3. Ventilation. Design and equip control house for complete air change every thirty minutes.
    a) Backup cooling unit: control vent fan with thermostat that engages ventilation fan when temperature exceeds air conditioner's normal cooling window
4. Fire Suppression System. If fire suppression and detection system is specified on MTE control house drawing, design system to stop air infiltration from air handling units. Fit vent fan discharge and intake with motorized dampers for containment of suppression agent. Provide electrical controls to shut down fans and air conditioners and close dampers before suppression agent discharge but not before commitment of system to discharge. See also separate specification for fire suppression and detection system.

5. Engine-Generator. If engine-generator is specified on MTE control house drawing, design and equip control house for alternate power service and size generator set to maintain control house complete operation through occasional power interruptions. MTE will furnish control house manufacturer with power requirements of MTE equipment and projected outage duration. See separate specification for selection of engine generator
6. Materials. Except where alternate approval is permitted, furnish only UL-listed equipment; also:
   a) air conditioners: wall-mounted units with SEER rating no less than 10.0 and capacity rated using ARI 210/240; equip each unit with low ambient control, anti-cycle relay, integral circuit breaker disconnect, and washable filter
   b) heater: built-in to wall mount air conditioner, smallest standard rating available for the air conditioner required
   c) engine-generator: see separate specification
   d) fire-suppression and detection system: see separate specification
   e) fire extinguisher: class ABC Halon 1211 or class BC CO_2; each extinguisher fully charged to capacity with 9lb minimum
   f) vent louvers: aluminum gravity shutters for fan intake and exhaust; add motor operator where fire suppression system is specified
   g) vent fan: ac powered, single-speed with built-in or separate overload
   h) thermostats: vent and air conditioner control over range of 50°-90°F; provide air conditioner control for integral heat and control to continuously run evaporator fan
7. Installation.
   a) Air Conditioner. Install air conditioners for transport as well as operation. Use stainless steel fastening hardware for mounting air conditioners. Seal exterior with UV-resistant caulk and install drip edge over top of each unit to prevent water entry. Install fixed return grille and supply grille with one-way adjustable slats. Locate units for maximum circulation and behind no equipment obstructions.
   b) Engine-Generator. Secure gensets in separate generator room with dedicated entrance door (similar to equipment room door, but large enough to accommodate eventual removal of generator). In addition, provide the following features for generator installation:
      (1) Design wall to separate generator and equipment rooms to provide one (1) hour minimum fire resistance
      (2) Equip generator room with wall-mounted fire extinguisher
      (3) Emergency light

E. Architectural Requirements

1. Construct control house with standard interior and exterior finish and weather resistance consistent with environment of the continental United States.
2. Performance. Provide necessary weatherproofing to prevent moisture and dust infiltration. Provide panel insulation to reduce heat loss from conduction. Add insulation to floor, wall, and roof construction to ensure that total control house U_0 factor is less than 0.09 btu/hr/ft^2/°F when calculated per ASHRAE 90.1.
3. Materials. Furnish components and materials that conform to architectural requirements of this specification. Also:
   a) Dust seal: pre-compressed, self-expanding polyurethane joint sealant
   b) Water seal: butyl tape or caulk
   c) Roof finish: white mastic coating made with elastomeric acrylic

d) Exterior wall coating: clear, non-yellowing and UV resistant acrylic sealer
e) Exterior trim (concrete surfaces): high-build, textured, water based, acrylic paint for masonry and concrete;
f) Exterior door: heavy duty steel, fully-welded with continuous aluminum tamperproof hinge
g) Insulation walls/roof: use polyisocyanurate or other insulation with equivalent K-factor
h) Insulation floor: use polystyrene or other insulation with equivalent K-factor
i) Control house entrance shall be a 48"x84" door with a panic bar style operating mechanism.
j) Desk shall be self-supporting and removable. Wall-mounted folding desk are NOT allowed.

4. Installation.
   a) Interior Finish. Finish interior walls and ceiling with white laminated sheathing board and vinyl trim. Finish floor with light colored commercial-grade vinyl.
   b) Exterior Finish. Finish exterior with medium colored exposed aggregate finish sealed with UV-resistant clear coat and painted trim. Finish roof with seamless UV-resistant elastomeric coating.
   c) Weatherproofing. Add dust and waterproofing to fabricated concrete panels before assembly:
      (1) Waterproofing: double-seal all wall-to-wall and roof-to-wall joints with butyl sealant; to permit water runoff, use no waterproofing on wall-to-floor joints
      (2) Dust proofing: seal exterior exposure of wall-to-wall and floor-to-wall joints with a dust seal

IV. SURGE PROTECTION

A. The surge protector shall be GE Catalog# TLE120S050WM.

B. Surge protection shall be mounted less than 6 inches from AC panel.

V. BATTERY SYSTEM

A. The battery system shall consist of batteries, battery rack, rubber mat, eyewash station, spill containment, and battery charger.

B. The battery spill containment system shall be made of a non-corrosive material and shall be capable of holding the entire volume of battery acid contained within the battery system.

C. The battery system nominal voltage shall be 125VDC.

D. The battery system shall be electrically isolated from ground.

E. The batteries shall be Alpha Catalog# 40PzS 6-200, 130VDC, 200Amp hour, Lead Selenium. Batteries to include safety and flip top flame arrester caps. Any accessories necessary for testing and maintaining batteries shall be provided.

F. Two (2) battery cell lifting straps shall be provided.

G. The battery rack shall be Alpha Catalog# 2G570/2900 SEB, Seismic zone 1, 2-step, 1-tier. The battery rack rails shall be covered with plastic insulators.

H. The battery charger shall be Alpha Catalog# ACS160252084061A0.

I. The eyewash station shall be Survival Air Systems Catalog #SAS 5135 or equivalent. It can be obtained at NAPA Auto. The drain pipe shall be routed to the outside of the building to prevent spillage inside the control building.

J. The Hydrogen Gas Detector shall be Arrgh!! Manufacturing Catalog #H2 HGD-DR.

VI. BATTERY CHARGER TRANSFER SWITCH AND BATTERY EMERGENCY SERVICE

A. The following requirements will allow MTE to feed a backup battery charger and/or accept DC power from a backup battery bank.

1. Two (2) 2" galvanized steel nipples must protrude through one exterior and interior wall near the battery charger. Each nipple shall be plugged at the exterior end with a galvanized square head solid plug.

2. Two (2) junction boxes shall be required as follows:

a. One (1) junction box shall contain two (2) two-pole power distribution blocks mounted horizontally. One set of power blocks shall be wired between the 125VDC output of the battery charger and DC battery charger breaker of the DC distribution panel. The top of the terminal blocks shall be considered the "source" side, where the battery charger output is considered the "source". A 2" opening at the bottom of the junction box shall contain a grommet. The junction box shall be labeled with black phenolic with white engraved lettering, "BATTERY CHARGER DC JUNCTION."

c. One (1) junction box shall contain two (2) two-pole power distribution blocks mounted horizontally. One set of power blocks shall be wired between the 240VAC output of the designated battery charger AC breaker of the AC distribution panel and "AC INPUT" of the battery charger. The power blocks shall be rated to carry a minimum 30A current. The top of the terminal blocks shall be considered the "source" side, where the AC breaker output is considered the "source". A 2" opening at the bottom of the junction box shall contain a grommet. The junction box shall be labeled with black phenolic with white engraved lettering, "BATTERY CHARGER AC JUNCTION."

VII. QUALITY ASSURANCE

A. At MTE, quality is a primary concern. Control house manufacturer must maintain an aggressive quality assurance program that ensures delivered units meet highest standards of workmanship and materials, and that these specifications are satisfied.

B. Organization

1. Provide for separate quality assurance organization where authority and responsibility are clearly defined in writing. This organization shall have:

a) Clear authority to withhold items that do not meet quality standards.
b) Direct access to top management at each facility so that quality problems can be efficiently resolved
c) Quality assurance manual with current approval by nationally recognized third party agency
d) Records on each deliverable unit relative to item acceptance and rejection, plus disposition of rejected items

C. Material Control

1. Provide for program to ensure materials and components meet requirements specified herein and manufacturer's own specifications, and that nonconforming materials will not be used. This program shall include:
   a) Receiving inspection program where receiving inspectors have ready access to appropriate drawings, engineering orders, specifications, vendor catalogs, purchase orders, etc.
   b) Area with controlled access for adequate storage and security of materials furnished by customers
   c) Material aging program to control use of materials with limited shelf life
   d) Documented system for handling nonconforming materials, including means of removing nonconforming materials from process

D. Test Equipment

1. Provide for controlled program that maintains calibration of measuring devices, gauges, and test equipment. This includes:
   a) Procedures that call for periodic inspection of tools used for inspection in production process and means of removing nonconforming tools and test equipment
   b) Written working standards of accuracy for test equipment and periodic calibration program to primary standards traceable to National Bureau of Standards
   c) Program to stamp test equipment with most recent calibration date and due date of next calibration

2. In-Process Inspection

a) Provide for program to ensure work-in-process and finished goods meet applicable codes & standards, manufacturer's standards, and requirements specified herein. This program shall provide for means to:
   (1) Prevent unauthorized use of nonconforming or uninspected materials
   (2) Inspect finished items to ensure that contract requirements are met using drawing and other documents that reflect latest changes
   (3) Compile and maintain inspection log of in-process and final inspections of deliverable units
   (4) Identify inspection status of in-process work
   (5) Track disposition of rejected items, including reworked items

VIII. DOCUMENTATION

A. Engineering Drawings

1. Submit three (3) complete set of engineering drawings with each delivered control house unit. Include the following in each set:

a) Final dimensioned interior layout, including wall orientation and ceiling plan showing all installed components and surface raceway
b) Exterior elevations on all four (4) main views
c) Electric feeder diagram, including electric service information panel schedules
d) Control wiring diagrams and schedule of manufacturer-installed control house alarms
e) Schedule of key allowable stresses, including wind, live floor, and live roof loads, and seismic shear coefficient; also list construction and occupancy classification
f) Schedule of fire resistance ratings
g) Shipping and foundation information, including approximate shipping weight
h) Total control house section that identifies all structural components and connections, sheathings and finishes; identify total load path from top of roof to foundation connection
i) Provide drawings on paper format no smaller than B-size, 11" x 17"; also make final engineering drawings available on AutoCAD .DWG format on CD.

B. Calculations

1. For certification, from a licensed PE in the state of Tennessee, submit one (1) set of complete engineering calculations as required:
   a) Structural: justify control house construction with structural design loads
   b) Electrical: justify service size using loads of all known equipment
   c) Lighting: justify furnished lighting with illumination level required using zonal cavity method
   d) Energy: justify control house construction and insulation with overall control house energy efficiency required using system performance method of ASHRAE 90.1; when required for state certification, also justify per code having jurisdiction
   e) Air conditioner; justify air conditioner size using actual air conditioner performance with control house conduction loss, solar loading, lighting loss, vent loss, and equipment load
   f) Fire-suppression: justify agent tank fill with control house internal area using appropriate specific volume

C. Service Manual

1. Provide three (3) operations and maintenance manual with each delivered control house unit. Assemble manual in bound format with table of contents to identify major divisions. Compile manual to include:
   a) Model and serial numbers for control house and major components (e.g. air conditioner, engine-generator, etc.)
   b) Building statement of warranty
   c) Warranty information on components with transferable warranty
   d) Manufacturer data on electrical and mechanical systems, and electrical components where available
   e) control house start-up information
   f) preventive maintenance procedures and schedule
   g) control house repair procedures

D. Warranty

1. Furnish, with each delivered unit, statement of warranty that includes all systems furnished and installed by manufacturer for period of not less than one (1) year

and to commence no sooner than manufacturer's final invoice date. Items to include in statement of warranty:

a) assignments of warranties of any systems, materials or components that exceed the one (1) year control house warranty period
b) clear instruction on activating warranty
c) clear instructions on submitting claims for service under warranty, including 24-hour phone contact

IX. SITEWORKS

A. Transportation to Site

1. Deliver prefabricated control house to disclosed site without damage or deformity. Encase delicate exterior components and cover openings for protection against transportation damage. Use tractor-trailer combination designed for proper over width, over height, and overweight load per DOT regulations. Use trailer with air-ride suspension.

B. Off Loading

1. Furnish crane to off load control house on MTE-furnished foundation. Provide detailed offloading drawings that describe recommended rigging requirements. Furnish and install tie-down hardware.

C. On-Site Services

1. Install all items removed for transportation; this includes, but is not limited to drip caps, hoods, and exterior lights. Work to be performed no later than seven (7) days after delivery to site.

D. Certifications

1. Furnish MTE up to four (4) sets of plans prepared and signed by a professional engineer legally authorized to practice in jurisdiction where control house will be delivered, verifying that structure meets indicated loading requirements and codes of authorities having jurisdiction. MTE will disclose site location at time of order. Also provide state certification (decal, insignia, letter, etc.) as required to legally deliver and place manufactured control house on disclosed site.

PROTECTIVE RELAYING AND CONTROL PANELS

I. DESCRIPTION

A. Relay/Control Panels including all relaying equipment, communication cables, misc. hardware, wiring, and testing requirements.

II. APPROVED PANEL MANUFACTURERS

A. The approved panel manufacturers are as follows:

1. EP^2
2. Keystone EMC
3. KVA
4. Panelmatic
5. Schweitzer Engineering Laboratories (SEL)

III. DESIGN DATA

A. Relay/Control Panels and equipment shall be designed, sized, manufactured, and tested in accordance with the following standards:

1. ANSI C37 Series, Protective Relays and Proposed Standard C37.21 for Switchboards
2. ANSI C39.1, Switchboard Instruments
3. ICEA, Specifications for Wire and Cable
4. NEC, Current Rating of Control Wiring
5. NEMA
6. IEEE
7. AISI

IV. RELAY/CONTROL PANEL CONSTRUCTION

A. Relay/Control Panel shall be a freestanding structure with provisions for securely fastening to a concrete floor.

B. Relay/Control Panel shall be constructed from 11 gauge cold-rolled steel.

C. Relay/Control Panel shall be painted ANSI 61 gray on the exterior and Gloss White on the interior.

D. Relay/Control Panel shall be 19” rack-mounted panel style. See MTE drawings for panel layouts.

E. Relay/Control Panel shall be 90”H x 24”W x 24”D.

F. Provide a 1” x ¼” copper ground bus at the bottom of each Relay/Control Panel.

1. The copper ground bus shall be connected to the Relay/Control Panel via two 5/8” gun studs.
2. The gun studs shall be free of paint to ensure a good connection to the copper ground bus.
3. The Relay/Control Panel’s ground buses shall be connected to each other and

provide a means for connection to the building ground (4/0 awg).

4. The ground bus shall run the full width of the Relay/Control Panels.
5. The ground bus shall be drilled and tapped to accommodate 10/32 screws. A minimum of 24 slots per Relay/Control Panel.

G. Relay/Control Panel shall provide a method for MTE to securely fasten incoming field cables (eg. wire way or cable tie-off tabs).

H. Nameplates shall be black laminated plastic composition, with permanent white engraved lettering, and beveled edges (white core w/ black front). The nameplates **MUST** be fastened to panel using small round head stainless steel screws.

I. All hardware shall be stainless steel (eg. screws, bolts, and nuts).

V. WIRING

A. Use No. 12 AWG stranded tinned copper conductor, 600 VAC class, type SIS cross-linked polyethylene insulation for all secondary and control circuits.

B. Use No. 10 AWG stranded tinned copper conductor, 600 VAC class, type SIS cross-linked polyethylene insulation for all current transformer secondary circuits.

C. All wiring shall be permanently labeled using a "Device Coordinate" method (e.g. 1AA-15). Panduit LJSL series or equivalent labels shall be used.

D. For Phoenix/Euro style terminal blocks see SEL application guide AN2014-08 for details. Connections for green Euro-style terminal blocks require an appropriate single or dual conductor bootlace ferrule or terminal lug. Conductors shall be sized accordingly.

E. Wiring inside of cable tray shall be rated for cable tray use.

F. All panel-to-panel wiring shall be connected through terminal block points from each panel. Direct device-to-device wiring between panels is unacceptable. Manufacturer is responsible for providing and connecting all panel-to-panel wiring.

G. Terminations shall be made using non-insulated ring-tongue connectors. Panduit, Thomas & Betts, Burndy, or Amp brand connectors shall be used. Use of any connector that is not UL listed is unacceptable.

H. A maximum of two (2) connections per terminal stud shall be followed.

I. Single conductor terminations shall be landed with the crimp out. Termination points with two conductors shall be landed as follows: first conductor shall be crimp in and second conductor shall be crimp out.

J. All terminations shall be made with the manufacturer's suggested crimp tool. All crimp tools shall be tested and certified to the manufacturer's specification. Wire terminations will be randomly tested upon receipt of the Relay/Control Panels. Failure of more than two (2) terminations may require the manufacturer to provide an on-site visit to re-check all terminations.

K. Panel wiring and terminations shall stay clear of terminal block side(s) designated for field connections.

L. Use of Panduit style wire way is permitted. If wire way is used, then a minimum of 15% spare volume shall be provided on the relay panel side and the field cable connection side

shall be empty.

M. Physical wiring diagrams shall utilize a device coordinate method. Tabular method is not acceptable.

VI. TESTING

A. All testing must be performed by qualified personnel with extensive knowledge of electric utility substation controls.

B. Test personnel shall possess the ability to discern between proper and improper circuit design and functionality and shall possess the ability to suggest corrective action. Any corrections shall be approved by MTE beforehand.

C. Relay/Control Panels shall pass an initial point-to point ringer test per the physical wiring diagram before functional testing may begin.

D. Relay/Control Panels shall be fully functionally tested. This includes, but is not limited to, applying current and voltage to all relaying and metering to check for proper operation. Currents must be injected to ensure proper connection of wiring through test switches to metering and relaying. Where possible, confirm currents and voltages via the relaying or metering displays.

E. All relaying conditions must be simulated via breaker simulators and other devices to ensure the desired outcome for the relaying. If manufacturer believes something to be un-conventional or not standard industry practice, then work shall be stopped immediately, and MTE made aware of the conflict. MTE will provide resolution for the conflict.

F. Re-block all electro-mechanical devices after testing.

G. All devices shall be powered up and verified to work properly.

H. All spare outputs, contacts, and input shall be tested for proper operation.

I. Misc. equipment shall be tested for proper operation.

J. Testing must be performed in accordance with all applicable NEC, IEEE, ANSI and NEMA standards.

K. Testing results shall be submitted to MTE via the Operation & Maintenance Manuals.

L. MTE shall be notified at least two (2) weeks prior to functional testing and retains the right to witness the functional testing stage should it be deemed necessary.

VII. RELAYS AND MISC. EQUIPMENT

A. Refer to MTE provided Bill of Material for specific part numbers and descriptions. All equipment shall be provided as listed. Any items deemed as equivalents must be approved before use.

B. Manufacturer shall provide all relaying and controls including misc. hardware.

C. Relays shall be SEL.

D. TVA shall supply the Underfrequency relaying insert and manufacturer shall install.

E. Terminal blocks shall be rated for 30A, 600Vac, and equipped with insulating barriers between poles. GE Type EB or Marathon equivalent shall be used. Terminal strips shall

be clearly marked as shown on drawings. CT circuits shall have "Shorting" Type terminal blocks with a shorting pin for each pole. All other circuits shall have "Straight Strap" Type terminal blocks.

F. Fuse blocks shall be rated for 30A, 250V. Fuses shall be sized as shown on drawings.

G. Indication lights shall be long-life LED type with removable cap and replaceable lamps. Ledtronics type RLPH, GE type ET-16, or equivalent shall be used.

H. Control switches and lockout relays shall be Electroswitch Series 24.

I. Test switches shall be ABB type FT-19R.

VIII. COATING SYSTEM – (HIGH PERFORMANCE / LOW MAINTENANCE)

A. All coatings shall be applied inside an environmentally controlled (air quality, temperature and humidity) paint booth with ventilation and filtration provisions in full EPA compliance and in accordance with the coating manufacturer's requirements. *Coating performed in outside, ambient air conditions shall NOT be acceptable.*

B. At least one (1) coat of primer is required with a minimum of two (2) finish coats. Relay/Control Panels shall have a glossy finish. One (1) can of touch-up paint shall be provided.

C. All coatings shall be applied using an ***electrostatic application process***.

D. All exterior and interior surfaces shall be thoroughly cleaned prior to coating application per the coating manufacturer's recommended practice.

E. The following minimum coating system test results shall be adhered to:

1. Corrosion Resistance (Salt spray): Passes 2000 hours per ASTM-B117
2. Color & Gloss Retention: Only slight change after 500 and 1000 hours in Q.U.V. test
3. Oil Resistance Immersion: Passes both 72 hours at 78 degrees F and 72 hours at 212 degrees to 220 degrees F
4. Hardness: Minimum H pencil hardness
5. Abrasion Resistance: 3000 cycles per ASTM D4060 using Teledyne Taber with CS-10 wheels
6. Chemical Resistance: Excellent
7. Washability & Stain Resistance: Excellent
8. Humidity Resistance: 1000 hours per ASTM-D2247 run at 113 degrees F

Exhibit A

Preliminary Site Design Build Plans

PRELIMINARY DESIGN BUILD PLANS

FOR

BARFIELD ROAD - SUBSTATION

MIDDLE TENNESSEE ELECTRIC

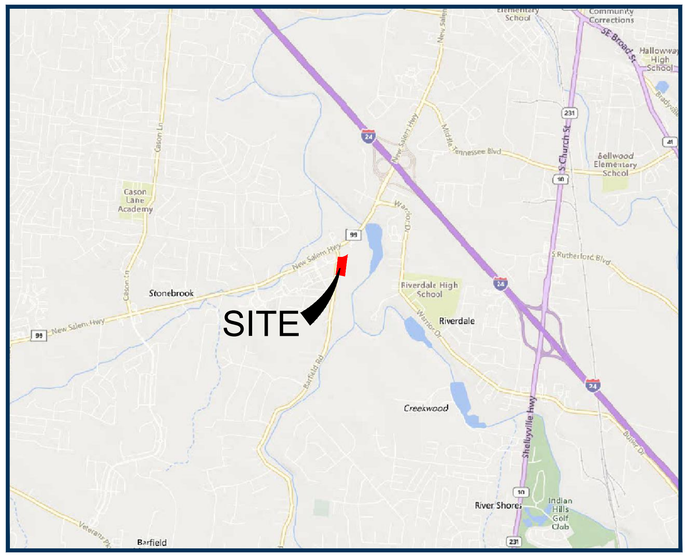
CONTACTS

OWNER/DEVELOPER

LARRY TAYLOR
MIDDLE TENNESSEE ELECTRIC
555 NEW SALEM HIGHWAY
MURFREESBORO, TN 37219
1-877-777-9020
larry.taylor@mtemc.com

CIVIL

ERIC PARL, PE
RAGAN SMITH
1500 MEDICAL CENTER PKWY SUITE 2J
MURFREESBORO, TN 37129
(615) 546-6050
eparl@ragansmith.com



LOCATION MAP
NOT TO SCALE

INDEX OF SHEETS

BARFIELD ROAD
CITY OF MURFREESBORO,
RUTHERFORD COUNTY,
TENNESSEE

811 Know what's below. Call before you dig.

RaganSmith

Nashville - Murfreesboro - Chattanooga
ragansmith.com

PRELIMINARY PLANS
CONCEPTUAL PURPOSE ONLY
NOT FOR CONSTRUCTION
SUBJECT TO CHANGE

BARFIELD ROAD - SUBSTATION
FOR
MIDDLE TENNESSEE ELECTRIC
CITY OF MURFREESBORO, RUTHERFORD COUNTY, TENNESSEE

Scale: NTS
Date: 04.24.2025
Approved By: E. PARL
Revisions:
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Drawing Title:
COVER SHEET

Drawing No.
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Project No.
23-0331

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SITE GENERAL NOTES:

1. Existing conditions taken from survey by:Ragan Smith & Associates, Inc., dated 2023.12.22.
2. The contractor shall verify the location of all existing utilities in the proximity of the construction area and report any discrepancies to the owner's representative prior to beginning work.
3. The contractor shall conform to all local, state and federal codes and obtain all permits prior to beginning work.
4. The contractor shall check all finished grades and dimensions and report any discrepancies to the owner's representative prior to beginning work.
5. Dimensions are to the face of curb, edge of concrete and face of building unless noted otherwise.
6. Proposed building footprint is for graphic purposes only. Contractor shall use the current architectural drawings for building stakeout and verify that there are no discrepancies with these plans.
7. All traffic markings shall conform to the manual of uniform traffic control device (MUTCD). All pavement marking shall be thermoplastic unless directed otherwise by the owner's representative.
8. All accessible ramps, parking spaces and accessible routes shall comply with the current ADA requirements.
9. Exterior door landings shall be provided per the local building code. Contractor shall coordinate door locations and adjacent sidewalk/landing grades with these plans and report any discrepancies to the owner's representative.
10. Maintain one set of as-built drawings on the job site for distribution to the architect/engineer upon completion: include detention pond topo, all utility locations, and all new sidewalk ramps. elevations for all sanitary and storm sewer structures shall be included, drawings shall include vertical and horizontal information on all new utilities as well as existing utilities discovered during construction. final drawings shall be produced and stamped by licensed surveyor.
11. Provide a smooth transition between existing pavement and new pavement. Field adjustment of final grades may be necessary. Install all utilities prior to installation of pavement.

SITE CONSTRUCTION NOTES:

1. The necessary permits for the work shown on these site development plans will be obtained by the contractor prior to commencement of any work on this project. The contractor shall give all necessary notices and obtain all permits and pay all fees involved in securing said permits. He shall also comply with all city, county and state building laws, ordinances or regulations relating to the construction of the project.
2. The contractor shall be responsible for and shall bear all expenses of field staking necessary for site and building layout. All layout shall be performed in accordance with the site layout plan.
3. The location of existing piping and underground utilities, such as water and gas lines, electrical and telephone conduits, etc., as shown on this portion of the plans have been determined from the best available information by actual surveys, or taken from the records and drawings of the existing utilities. However, the civil engineer does not assume responsibility that, during construction, the possibility of utilities other than those shown may be encountered or that actual location of those shown may vary somewhat from the location designated on this portion of the plans. In areas where it is necessary that the exact locations of underground lines be known, the contractor shall, at this own expense, furnish all labor and tools to either verify and substantiate or definitively establish the location of the lines.
4. The contractor must understand that the work is entirely at his risk until same is accepted and he will be held responsible for its safety by the owner. Therefore, the contractor shall furnish and install all necessary temporary works for the protection of the work, including barricades, warning signs, and lights.
5. The site development portion of this project will be subject to the inspection and final approval of the local planning, codes, water and sewer departments (and/or utility districts), engineering/public works departments and fire marshal's office.
6. If, during the construction of the site development portion of this project, a question of intent or clarity arises from either the plans or specifications, the contractor will immediately bring the matter to the attention of the civil engineer or owner's representative for resolution before the affected work items are initiated or pursued further.
7. The contractor will exercise extreme caution in the use of equipment in and around overhead and/or underground power lines. If at any time in the pursuit of this work the contractor must work in close proximity of the above-noted lines, the electric and/or telephone companies shall be contacted prior to such work and the proper safety measures taken. The contractor should make a thorough examination of the overhead lines in the project area prior to the initiation of construction.
8. The contractor shall be responsible for any damage done to the premises or adjacent premises, or injuries to the public during the construction of the work, caused by himself, his subcontractors, or the carelessness of any of his employees.

DEMOLITION NOTES:

1. The contractor will be required to remove all excavated materials and such items shall become the property of the contractor. All items shall be properly disposed of at an off-site location. The contractor shall outline any and all possible haul routes and shall be prepared to submit such to the local jurisdiction public works department, the civil engineer and other authorities for approval.
2. If, at any time, prior to or during the demolition work, hazardous material is encountered, the contractor shall notify the owner's representative and appropriate governmental agency.
3. The contractor shall notify adjacent owners of work that may affect their property, potential noise, utility outage or disruption. Such operations shall be conducted by the contractor with minimum interference to adjacent owners. Adjacent egress and access shall be properly maintained at all times. Do not close or obstruct any roadways, parking or sidewalks without permission from the adjacent owners or the local jurisdiction public works department.
4. Prior to the commencement of demolition/grading operations, all overhead and underground utilities shall be located. All removal and/or relocation of utilities shall be coordinated with the respective utility companies.
5. The contractor will provide all necessary protective measures to safeguard existing utilities from damage during construction of this project. In the event that special equipment is required to work over or around the utilities, the contractor will be required to furnish such equipment at no additional cost to owner.
6. The contractor will be solely responsible for contacting all affected utilities prior to submitting his bid to determine the extent to which utility disconnections and/or adjustments will have upon the schedule of the work for the project. Some utility facilities may need to be adjusted concurrently with the contractor's operations, while some work may be required 'around' utility facilities that will remain in place. It is understood and agreed that the contractor will receive no additional compensation for delays or inconvenience caused by the utility adjustment.

EROSION PREVENTION AND SEDIMENT CONTROLS:

1. All control measures must be properly installed and maintained in accordance with the manufacturer's specifications, TDEC and local standards.
2. Design, inspection, and maintenance of BMPs described and shown on these plans shall be consistent or exceed recommendations contained in the current edition of TDEC's Tennessee erosion control handbook.
3. BMP capacity [sediment traps, silt fences, sedimentation ponds, and other sediment control] shall not be reduced by more than 50% at any given time. if periodic inspections or other information indicates a control has been used inappropriately or incorrectly, the contractor must replace or modify the control for relevant site situations.
4. Where permanent or temporary vegetation cover is used as a control measure, the timing of the planting is critical. planning for planting of vegetation cover during winter or dry months should be avoided.
5. If sediment escapes the permitted area, off-site accumulations of sediment that have not reached a stream must be removed at a frequency sufficient to minimize offsite impacts. The contractor shall not initiate remediation/restoration of a stream without consulting the division first. The NOI general permit does not authorize access to private property. arrangements concerning removal of sediment on adjoining property must be settled by the contractor and adjoining landowner.
6. Litter, construction debris, and construction chemicals exposed to storm water shall be picked up prior to anticipated storm events or before being carried off of the site by wind or otherwise prevented from becoming a pollutant source for storm water discharges. After use, materials used for EPSC should be removed or otherwise prevented from becoming a pollutant source for storm water discharge.
7. Erodible material storage areas (including overburden and stockpiles of soil) and borrow pits are considered part of the site and should be addressed with appropriate bmp's accordingly.
8. Pre-construction vegetative ground cover shall not be destroyed, removed, or disturbed more than 15 days prior to grading or earth moving unless the area is stabilized. contractor shall sequence events to minimize the exposure time of graded or denuded areas. Clearing and grubbing shall be held to the minimum necessary for grading and equipment operation. Existing vegetation at the site should be preserved to the maximum extent practicable.
9. EPSC measures must be in place and functional before moving operations begin and must be constructed and maintained throughout the construction period. Temporary measures may be removed at the beginning of the workaday, but must be replaced at the end of the workday.
10. The following records shall be maintained on or near site: the dates when major grading activities occur; the dates when construction activities temporarily or permanently cease or a portion of the site; the dates when stabilization measures are initiated; inspection records and rainfall records. Contractor shall maintain a rain gauge and daily rainfall records at the site, or use a reference site for a record of daily amount of precipitation.
11. A copy of the SWPPP shall be retained on-site and should be accessible to the director and the public. Once site is inactive or does not have an onsite location adequate to store the SWPPP, the location of the SWPPP, along with a contact phone number, shall be posted on-site. If the SWPPP is located off-site, reasonable local access to the plan, during normal working hours, must be provided.
12. Off-site vehicle tracking of sediments and the generation of dust shall be minimized. A stabilized construction access (a point of entrance/exit to a construction site) shall be constructed as needed to reduce the tracking of mud and dirt onto public roads by construction vehicles.
13. Inspections must be performed at least twice every calendar week. Inspections shall be performed at least 72 hours apart. where sites or portions of construction sites have been temporarily stabilized, or runoff is unlikely due to winter conditions or due to extreme drought, such inspection has to be conducted once per month until thawing or precipitation results in runoff or construction activities resumes. Inspection requirement do not apply to definable areas that have been finally stabilized, as designed by the engineer. Written notification of the intent to change the inspection frequency and the justification for such request must be submitted to the local environmental field office, or the division's Nashville central office for projects of TDOT or TVA. Should the division discover that monthly inspection of the division discover that monthly inspections of the site are not appropriate due to insufficient stabilization measures or otherwise, twice weekly inspections shall resume. The division may inspect the site to confirm or deny the notification to conduct monthly inspections.
14. Inspectors performing the required twice weekly inspections must have an active certification and a record of certification must be kept on site. Based on the results of the inspection, any inadequate control measures or control measures in disrepair shall be replaced or modified, or repaired as necessary, before the next rain event, but in no case more than 7 days after the need identified.
15. Outfall points shall be inspected to determine whether EPSC measures are effective in preventing significant impacts to receiving waters. Where discharge locations are inaccessible, nearby downstream locations shall be inspected. Locations where vehicles enter or exit the site shall be inspected for evidence of offsite sediment tracking.
16. Construction is expected to begin 02/01/2026 and completed by 02/01/2028

TREE PROTECTION NOTES:

1. Any required excavation in or around the protection zone to accommodate underground services, footings, etc., shall be indicated on the plan, and shall be excavated by hand. In addition, related root pruning shall be accomplished by a certified arborist via ANSI A-300-95 standard so as to minimize impact of the general root system.
2. The storage of building materials or stockpiling shall not be permitted within the limits of or against the protection barriers.
3. Trees within the protection barriers must be adequately cared for throughout the construction process (i.e., they must be watered sufficiently, particularly if the tree's root system has been disturbed by excavation). Fill shall not be placed upon the root system in such a manner as to endanger the health or life of the affected tree.
4. Tree protection barrier shall be constructed prior to the issuance of any permits and shall remain intact throughout the entire period of construction.

FINAL STABILIZATION NOTES:

1. Upon completion the following methods shall be used as final stabilization for erosion control.
2. All temporary or "during construction" erosion control measures shall be removed. (i.e. silt fence, construction entrance, inlet protection, excessive riprap, etc.)
3. Sediment accumulation shall be removed from detention pond, swales, ditches, inlets, and outfalls.
4. Sediment and debris removed shall be disposed of properly. If contamination of materials suspected, contact TDEC or local waste management for proper disposal.
5. All areas of exposed soils shall receive seed/straw, sodding, erosion control matting, and/or mulch.
6. All swales and ditches shall have a healthy stand of grass.
7. All outfalls shall possess an appropriate amount of riprap or other approve means to prevent scouring.

SITE GRADING & STORM DRAINAGE NOTES:

1. Erosion control sediment barriers and tree protection barrier shall be installed prior beginning site work.
2. No heavy equipment shall cross or be stored outside the limits of construction, within tree protections zones, or under the drip line of existing trees to remain.
3. Topsoil stripped from areas to be graded shall be stockpiled on site in a location approved by the owner's representative.
4. Drainage shall be routed around stockpile locations for the duration of grading operations. Erosion control measures shall be installed to prevent loss of topsoil material.
5. Prior to beginning construction, contractor shall review geotechnical report.
6. All cut and fill shall be performed under the direction/observation of the geotechnical engineer.
7. The suitability of soils for fill material shall be determined by the geotechnical engineer.
8. Unless directed otherwise by geotechnical engineer, all fill areas shall be raised in lifts not exceeding 8" in thickness. the relative compaction of each layer shall not be less than 95% of the standard proctor maximum dry density (ASTM D-698) in all areas of fill within open areas and 98% of same specification for areas under roads, parking, sidewalks, building slabs, and foundations.
9. All grading shall be completed to the grades indicated within these plans. final grades shall provide proper drainage and prevent standing water.
10. All storm drainage castings to be John Bouchard & Sons Co. or approved equal, unless otherwise noted.
11. All storm drainage pipes to be RCP, Class III, unless otherwise noted.
12. Installation of pipe material shall be placed with a screen stone envelope and when under pavement entire trench to be backfilled with screen stone to subgrade. Size of stone, envelopes, and trenches to be specified by municipalities for public lines and private lines to adhere to common practices for installation requirements.
13. Existing structure castings to remain shall be adjusted to match new grade.

SITE UTILITY NOTES:

1. All materials and workmanship for utility lines and appurtenances shall be in strict compliance with the governing utility company and local codes. Prior to construction contractor shall notify utility company. (see utility contact information)
2. Contractor shall coordinate site electrical, gas, telephone, and cable with the respective utility company for service layout and design information. Any proposed layout of these utilities depicted on these drawings is graphical only and not intended to represent design of these utilities.
3. Prior to commencement of construction, contractor shall obtain all permits and pay any required tap and connection fees.
4. All trenching, pipe laying and backfilling shall be in accordance with federal OSHA regulations.
5. Site contractor shall construct all utility services to within 5' of building.
6. Contractor shall be responsible for coordinating the sequencing of construction for all utility lines to avoid conflicts.
7. Contractor shall coordinate size and location of water, sewer and stormwater connections to the building as depicted on the building mechanical plans and the site utility plan and notify the engineer or owner's representative of any discrepancies.
8. Water services lines ¾" - 3" shall be Type-K copper and 4" or larger shall be ductile iron pipe - Class 52 unless otherwise required by utility company.
9. Fire line installation and thrust blocking location and sizing shall be per N.F.P.A. and local fire department requirements.
10. Water meter manufacturer/model number and vault specifications shall be per the water utility company.
11. Backflow device (RPBP/DDCVA) manufacturer/model number shall be per the water utility company.
12. Contractor shall install hot box enclosure (pre-finished dark green) on all exterior above-ground backflow devices. Domestic and fire backflow devices shall be heated. Contractor shall coordinate providing appropriate electrical service to backflow device.
13. Contractor shall coordinate location of backflow device with the building mechanical drawings.
14. Sanitary sewer service lines shall be SDR 35 PVC unless specified otherwise.
15. Maintain a 10' horizontal and 18" vertical separation between sanitary sewer and water lines.
16. All fire line mains to be installed by licensed fire protection contractor.
17. Installation of pipe material shall be placed with a screen stone envelope and when under pavement entire trench to be backfilled with screen stone to subgrade. Size of stone, envelopes, and trenches to be specified by municipalities for public lines and private lines to adhere to common practices for installation requirements.
18. Contact local fire department before locating and installing fire department connection. Location and type subject to change to meet required codes.
19. Coordinate with local utility and/or fire department on approved meter, fire hydrant, reduced pressure backflow preventor, and double detector check valve assembly and vault manufacturers.
20. Detailed water and sanitary sewer plans and shop drawings to be approved by jurisdictional agencies prior to construction.
21. Any existing water or sewer service that will no longer remain active at the completion of construction must be removed and capped at the main. All trench work and paving repair shall comply with current metro public works standards.

FEMA FLOOD NOTE:

1. By scaled map location and graphic plotting only, this property lies within flood zone **"X"** (other areas), as designated on current Federal Emergency Management Agency Map No. **47149C0260J**, with an effective date of **May 9,2023**, which makes up a part of the National Flood Insurance Administration report; Community No.470168, Panel No.0260, Suffix **J**, which is the current Flood Insurance Rate Map for the community in which said premises is situated. Said map defines zone **"X"** with 0.2% annual chance flood hazard, areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile.

BLASTING NOTES:

1. Contractor shall provide all labor, materials, equipment, tools, superintendence, transportation, services and operations to complete the blasting operation.
   a. Prior to blasting on the project the Contractor will provide a plan for review which details the proposed blasting portion of the rock breaking and any mechanical rock breaking removal which are part of the planned excavation and the plans to complete all rock extraction on the project in an efficient and safe manner.
   b. The plan must be reviewed and approved by an engineering or geotechnical blasting expert, with a minimum of 20 years' experience in the field of explosive blasting, vibration measurements and the effects of blasting on nearby structures.
2. All blasting shall be done in accordance with the Tennessee Blasting Standards Act of 1975 as amended, and any other federal or local laws or regulations which govern blasting in the area where the project is located.
3. The blasting company shall have a company registration certificate and each employee engaged in the blasting activities which include the use and handling of explosive, shall carry the appropriate, current blasters license or handlers card as required and issued by the Department of Commerce and Insurance, Fire Prevention Division - TN State Fire Marshal's Office.
4. All transportation, record keeping, handling and storage of explosives shall be conducted in accordance with applicable State and Federal agencies requirements.
5. Appropriate authorities shall be notified of any loss, theft of explosives or unauthorized access into an explosives magazine.
6. All explosive on site, not being used for loading a blast, will be kept in an approved locked magazine.
7. No overnight storage of explosives is permitted on site.
8. Contractor shall use every reasonable precaution, including, but not limited to, visual and audible warning signals, signs, flags, barricades or Jersey barriers to ensure employee and pedestrian safety. Contractor will comply with all State and Federal requirements for public notification and blast site security.
9. Due precaution shall be taken to prevent accidental discharge of blasting caps from current induced by radar, radio transmitters, lightning, adjacent power lines, dust storms, or other sources of extraneous electricity. Precautions shall include the prominent display of adequate signs as required for compliance with Federal, State and any local laws.
10. Blasting operations in the proximity of overhead power lines, communication lines, utility services, or other services and structures shall not be carried on until the utility operators and/or owners have been notified and safe control measures have been taken.
11. All drill holes shall be sufficiently large to admit freely the insertion of the cartridges of explosives. Tamping shall be done only with wood rods or plastic tamping poles without exposed metal parts.
12. No holes shall be loaded, adjacent to a blast, except those to be fired in the next blast. After a blast is loaded, all remaining explosives and detonators shall be immediately returned to an authorized on site approved storage magazine. When blasts are separated by a safe distance two blasts may be loaded and detonated separately but at no time can drilling occur inside 50 feet of a loaded blast hole.
13. No loaded holes shall be left unattended or unprotected at any time.
14. All blasting operations shall take place between sun-up and sun-down (hours of daylight only) unless special exemptions is granted by the Local Fire Marshal's office.
15. Immediately after blasting, the firing line shall be disconnected from the blasting machine or initiation device. An inspection of the area shall be made by the blaster to determine if all charges have been exploded before an all clear signal is sounded which allows employees to return to the area to resume their work. If a misfire is found, no other work shall be done in the area with the exception of work that is necessary to remove the hazard of the misfire.
16. All blasting shall be designed to prevent flying rock or debris. The contractor shall use adequate, good quality stemming material and shall cover the blasts with blasting mats or adequate material as required to prevent flying rock.
17. The contractor, at his own expense, will be required to perform pre-blast in order to comply with State or Local performance and notification requirements or may opt to have pre-blast surveys performed on any adjacent structures not required by the State or Local governments. These surveys shall be performed by an experienced consultant who specializes in such inspections.
18. The contractor hereby assumes sole responsibility for all personal injury or damage to real or personal property, or interference with the use or enjoyment of any property by reason of blasting or the resulting ground displacement, ground vibration, or air concussion. The contractor assumes full responsibility for operating all equipment and performing all blasting in conformance with federal, state or local laws and regulations described by any other governmental authority limiting the amount of ground vibration or air concussion. Nothing presented in any of the preceding notes, in any way relieves the contractor of any responsibilities for any damage to the existing structures or utilities in the area of blasting.
19. No blasting to be done within 25' of finished water, sewer line or fiber optic cables.
20. Use all precautions to protect adjacent properties from danger associated with blasting operations.
21. When blasting is being conducted in close proximity to nearby structures as it typically the case in urban areas, close interval line drilling should be utilized to create effective vibration transmission barrier.

GEOTECHNICAL NOTE:

1. A geotechnical report has been prepared for this site by TTL dated 07/16/2024. The contractor shall be responsible for reviewing the geotechnical report and shall incorporate all geotechnical considerations, recommendations and special notes into the construction and stabilization of this project.

RaganSmith
Nashville - Murfreesboro - Chattanooga
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PRELIMINARY PLANS
CONCEPTUAL PURPOSE ONLY
NOT FOR CONSTRUCTION
SUBJECT TO CHANGE

BARFIELD ROAD - SUBSTATION

FOR

MIDDLE TENNESSEE ELECTRIC

CITY OF MURFREESBORO, RUTHERFORD COUNTY, TENNESSEE

Scale: NTS

Date: 04.24.2025

Approved By: E. PARL

Revisions:

- - -
- - -
- - -
- - -
- - -
- - -

Drawing Title:

CIVIL NOTES

Drawing No.

C0.1

Project No.

23-0331

LEGEND

IR(O)	IRON ROD (OLD)
●	IRON ROD (NEW) (1/2" X 18" W/CAP STAMPED "RAGAN SMITH & ASSOCIATES")
①	LOT NUMBER
R.O.W.C.T.	REGISTER'S OFFICE FOR WILLIAMSON COUNTY, TN
○	BOLLARD
▪	MAILBOX
♿	HANDICAPPED PARKING
⊸	SIGN
-X-X-	FENCE
INV	INVERT ELEVATION
ELEV	ELEVATION
-W-	WATER LINE
	FIRE HYDRANT
	WATER VALVE
W	WATER METER
	SIAMESE WATER CONNECTION
	IRRIGATION CONTROL VALVE
	UTILITY POLE
	UTILITY POLE W/ ANCHOR
	UTILITY POLE W/ LIGHT
E	ELECTRIC BOX
P	TRANSFORMER PAD
T	TELEPHONE RISER
	CABLE TV BOX
-P-	OVERHEAD ELECTRIC POWER LINE
-T-	OVERHEAD TELEPHONE LINE
-P&T-	OVERHEAD POWER AND TELEPHONE LINES
-CATV-	OVERHEAD CABLE TELEVISION LINE
-UGE-	UNDERGROUND ELECTRIC LINE
E	ELECTRIC STUBOUT
-ANC-	ANCHOR WIRE
RCP	REINFORCED CONCRETE PIPE
CMP	CORRUGATED METAL PIPE
	CATCH BASIN/CURB INLET
	AREA DRAIN
	HEADWALL
-SA-	SANITARY SEWER LINE
	SANITARY SEWER MANHOLE
	SEWER CLEAN-OUT
PVC	POLYVINYL CHLORIDE
	SEWER VALVE
-FM-	SEWER FORCE MAIN
	SEWER SEPTIC FIELDS
	CONCRETE SIDEWALK
	500 YEAR FEMA LINE
	100 YEAR FEMA LINE
	FEMA ZONE X (OTHER AREAS OF FLOOD HAZARD)
	FEMA ZONE AE
	DEMOLITION SHADING
-FO-	FIBER OPTIC LINE
FO	FIBER OPTIC BOX
	LIGHT STANDARD
-UGC-	
-G-	GAS LINE
G	UNDERGROUND CABLE TELEVISION
G	GAS STUBOUT
	GAS VALVE
	GAS METER

NOTE

UTILITY SYMBOLS SHOWN IN LEGEND AND DRAWING ARE NOT TO SCALE; FOR GRAPHIC REPRESENTATION ONLY.

DEMOLITION NOTES

1. SHADING DEPICTS AREAS WHERE ALL BUILDINGS, ASPHALT, CURBING, CONCRETE, STEPS, SIGNS, WALLS AND TREES ARE TO BE DEMOLISHED AND REMOVED.
2. NO DISTURBANCE OR DEMOLITION OF ANY UTILITY INFRASTRUCTURE SHALL TAKE PLACE WITHOUT PRIOR COORDINATION WITH UTILITY OWNER.

BENCHMARK
ELEV. = 601.60'
RAILROAD SPIKE IN
POWER POLE #132108

20' ACCESS AND UTILITY EASEMENT
RECORD BOOK (RB) 532, PAGE (PG) 3295;
RB 1152, PG 2490; RB 1152, PG 2586 & RB
1413, PG 1465, R.O.R.C.T.
(EXCEPTION 16)

PORTION OF CURB & GUTTER AND ASPHALT TO BE REMOVED AS NEEDED. CURB & GUTTER TO BE INSTALLED ALONG EDGE OF ROAD. SEE LAYOUT PLAN. TO BE COORDINATED WITH CITY OF MURFREESBORO PRIOR TO DEMO/CONSTRUCTION.

M.T.E.M.C. EASEMENT
OVERHEAD
PLAT BOOK 44, PAGE 293 &
RECORD BOOK 2018, PAGE 2469
R.O.R.C.T.
(EXCEPTIONS 10 &11)

CONTRACTOR TO FIELD VERIFY EXISTING ANCHORS PRIOR TO CONSTRUCTION AND COORDINATE ACCORDINGLY WITH UTILITY PROVIDER AND GRADING PLAN

BARFIELD ROAD
(RIGHT-OF-WAY WIDTH VARIES)

N07°22'16"E 585.33'

10' PUBLIC UTILITY EASEMENT
PLAT BOOK 36, PAGE 277 &
RECORD BOOK 1163, PAGE 1474
R.O.R.C.T.
(EXCEPTION 11)

30' CUD EASEMENT
PLAT BOOK 36, PAGE 277 &
RECORD BOOK 1163, PAGE 1474
R.O.R.C.T.
(EXCEPTION 11)

5' CONCRETE SIDEWALK

42' MSBL

THIS PORTION OF EXISTING GRAVEL IS TO BE REMOVED

EXISTING SIGN TO BE REMOVED

EXISTING GATE TO BE REMOVED

EXISTING FENCE TO BE REMOVED

S86°36'06"E 77.37'

LOT 1
SALEM SQUARE
SECTION-1 LOT-1
RESUB OF LOT-1
PLAT BOOK 44, PAGE 293
R.O.R.C.T.

MAP 113, PARCEL 005.12
GARRETT INVESTMENT GROUP, LLC
RECORD BOOK 2198, PAGE 2988
R.O.R.C.T.

PORTION OF SIDEWALK AND CURB & GUTTER TO BE REMOVED FOR NEW ENTRANCE. SEE LAYOUT PLAN

ACCESS & PUBLIC UTILITY EASEMENT
PLAT BOOK 44, PAGE 293 &
RECORD BOOK 2018, PAGE 2469
R.O.R.C.T.
(EXCEPTIONS 10 & 11)

30' SANITARY SEWER EASEMENT
PLAT BOOK 44, PAGE 293 &
RECORD BOOK 2018, PAGE 2469
R.O.R.C.T.
(EXCEPTIONS 10 & 11)

EX. SANITARY MH
RIM=593.36

EX. SANITARY MH
RIM=593.81

N60°57'22"E 99.52'

5' CONCRETE

EGRESS-INGRESS EASEMENT
RECORD BOOK 103, PAGE 1073
R.O.R.C.T.
(EXCEPTION 6)

30' SANITARY SEWER EASEMENT
RECORD BOOK 103, PAGE 1073
R.O.R.C.T.
(EXCEPTION 6)
(SHOWN PER RECORDED DESCRIPTION- SEE POSSIBLE INTENDED LOCATION AT THE SOUTHEAST CORNER OF THE OLD PUMP STATION PARCEL)

MAP 113, PARCEL 005.13
NEW SALEM LAND
DEVELOPMENT, LLC
(OLD PUMP STATION PARCEL)
RECORD BOOK 1763, PAGE 2416
R.O.R.C.T.

CONTRACTOR TO FIELD VERIFY EXISTING FOC LINE PRIOR TO CONSTRUCTION AND COORDINATE ACCORDINGLY WITH UTILITY PROVIDER AND GRADING PLAN

LOT 3
ROWLAND - BARFIELD ROAD
PLAT BOOK 11, PAGE 158
R.O.R.C.T.

N78°05'40"W 306.93'
20' MSBL

500 YR - FEMA LINE

100 YR - FEMA LINE

ROCK PILE (5± HIGH)

TO BE REMOVED PER GRADING PLAN

ROCK & DIRT PILE (20± HIGH)

TO BE REMOVED PER GRADING PLAN

40' SANITARY SEWER EASEMENT
RECORD BOOK 816, PAGE 2588
R.O.R.C.T.
(EXCEPTION 7)

100' TVA EASEMENT
DEED BOOK 658, PAGE 80
R.O.R.C.T.
(EXCEPTION 5)

LOT 3 OLD LOT LINE

MAP 113, PARCEL 005.04
WORLD OUTREACH CHURCH OF
MURFREESBORO TENNESSEE, INC.
RECORD BOOK 1971, PAGE 3158
R.O.R.C.T.

40' TEMPORARY CONSTRUCTION EASEMENT
RECORD BOOK 816, PAGE 2588
R.O.R.C.T.
(EXCEPTION 7)

30' SANITARY SEWER EASEMENT
RECORD BOOK 103, PAGE 1073
R.O.R.C.T.
(EXCEPTION 6)
(SURVEYOR'S OPINION: MAY HAVE BEEN INTENDED LOCATION PER EXHIBITS SHOWN IN RECORD BOOK 709, PAGE 3041 & RECORD BOOK 816, PAGE 2588, R.O.R.C.T.)

S07°22'16"W 212.82'

S53°11'50"E 100.00'

S36°48'10"W 100.00'

N53°11'50"W 43.58'

S07°22'16"W 412.50'

REMAINDER (16.4 ACRES±)
MAP 113, P/O PARCEL 005.00
NEW SALEM LAND DEVELOPMENT, LLC
RECORD BOOK 1763, PAGE 2416
R.O.R.C.T.

100'x100' LEASE PARCEL
RECORD BOOK (RB) 532, PAGE (PG) 3295; RB 1152, PG 2490; RB 1152, PG 2586 & RB 1413, PG 1465, R.O.R.C.T.
(EXCEPTION 16)

Know what's below. Call before you dig.

0 30 60

G:\23-0331\1-CIVIL ENGINEERING\2-PLAN SHEETS\PRELIMINARY PLANS\01 EXIST.DWG
PLOTTED BY LANA AUBARK ON 4/24/2025 5:19 PM LAST UPDATED BY LAUBARK ON 4/24/2025 1:42 PM

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ragansmith.com

PRELIMINARY PLANS
CONCEPTUAL PURPOSE ONLY
NOT FOR CONSTRUCTION
SUBJECT TO CHANGE

BARFIELD ROAD - SUBSTATION

FOR

MIDDLE TENNESSEE ELECTRIC

CITY OF MURFREESBORO, RUTHERFORD COUNTY, TENNESSEE

Scale: 1"=30'

Date: 04.24.2025

Approved By: E. PARL

Revisions:

Drawing Title:

EXISTING CONDITIONS & DEMOLITION PLAN

Drawing No.

C0.2

Project No.

23-0331

SITE DATA:

PROPERTY INFORMATION:

STREET ADDRESS:	BARFIELD ROAD
CITY:	MURFREESBORO, TENNESSEE
COUNTY:	RUTHERFORD
TAX MAP:	113
PARCEL:	005.00 & 005.13
LOT SIZE:	± 4.38 AC (190,804 S.F.)

OWNER / DEVELOPER:

MIDDLE TENNESSEE ELECTRIC
LARRY TAYLOR, PE
555 NEW SALEM HIGHWAY
MURFREESBORO, TN 37219
(615) 494-1593
larrytaylor@mte.com

CIVIL ENGINEER:

RAGAN SMITH ASSOCIATES, INC
ERIC PARL, PE
1500 MEDICAL CENTER PKWY SUITE 2J
MURFREESBORO, TN 37129
(615) 546-6050
eparl@ragansmith.com

ZONING INFORMATION:

ZONING CLASSIFICATION:	CH (HIGHWAY COMMERCIAL DISTRICT)
BUILDING SETBACKS:	
FRONT:	42'
SIDE:	10'
REAR:	20'

PROJECT INFORMATION:

EXISTING USE:	VACANT
PROPOSED USE:	ELECTRICAL SUBSTATION
PROPOSED IMPERVIOUS AREA:	±1.38 AC

HEIGHT OF SUBSTATION COMPONENTS:

ELECTRICAL MASTS:	85'
A-FRAME:	70.5'
OTHER:	27'

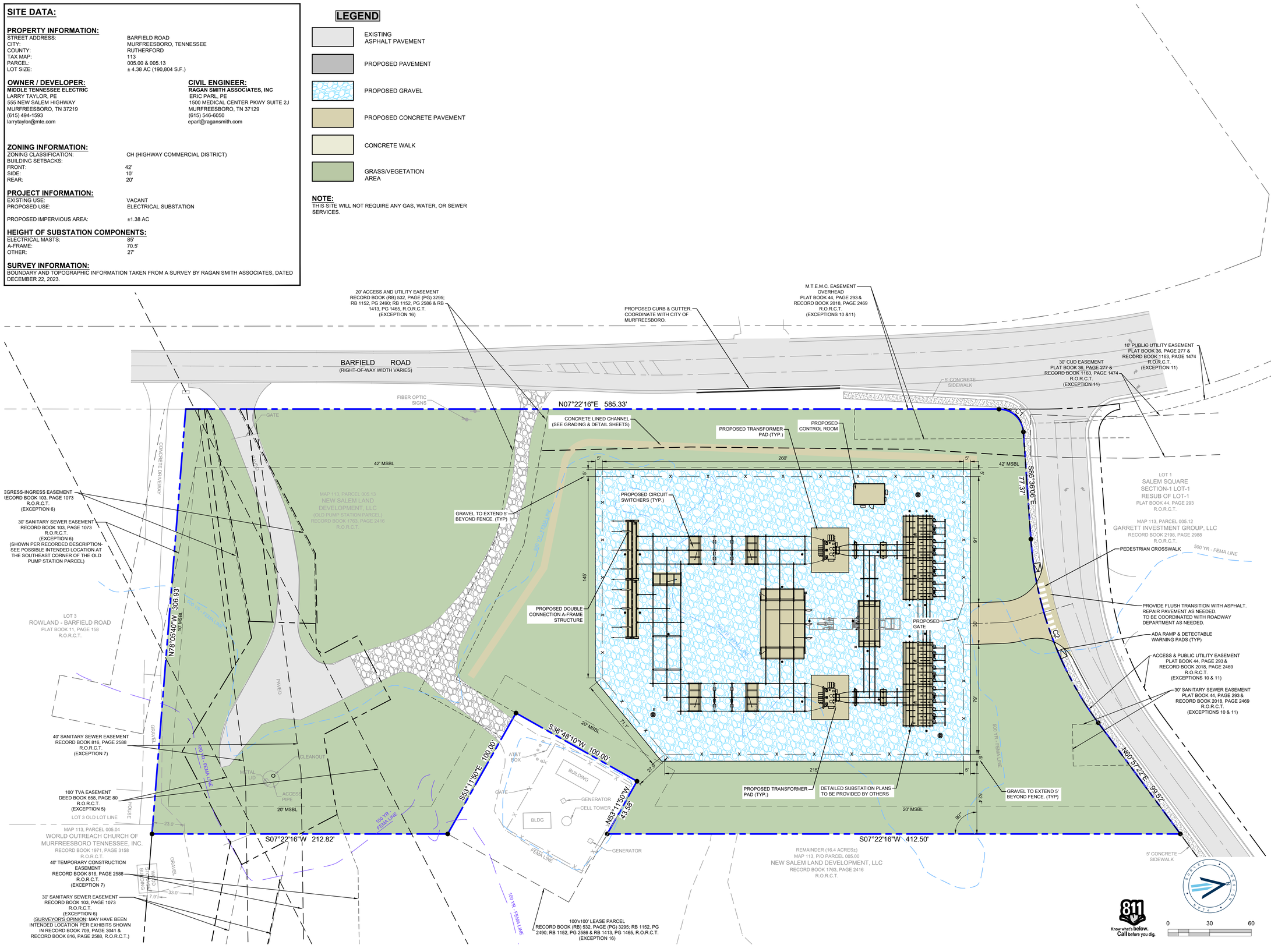
SURVEY INFORMATION:

BOUNDARY AND TOPOGRAPHIC INFORMATION TAKEN FROM A SURVEY BY RAGAN SMITH ASSOCIATES, DATED DECEMBER 22, 2023.

LEGEND

- EXISTING ASPHALT PAVEMENT
- PROPOSED PAVEMENT
- PROPOSED GRAVEL
- PROPOSED CONCRETE PAVEMENT
- CONCRETE WALK
- GRASS/VEGETATION AREA

NOTE:
THIS SITE WILL NOT REQUIRE ANY GAS, WATER, OR SEWER SERVICES.



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PRELIMINARY PLANS
CONCEPTUAL PURPOSE ONLY
NOT FOR CONSTRUCTION
SUBJECT TO CHANGE

BARFIELD ROAD - SUBSTATION

FOR

MIDDLE TENNESSEE ELECTRIC

CITY OF MURFREESBORO, RUTHERFORD COUNTY, TENNESSEE

Scale: 1"=30'

Date: 04.24.2025

Approved By: E. PARL

Revisions:

- - -
- - -
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- - -

Drawing Title:

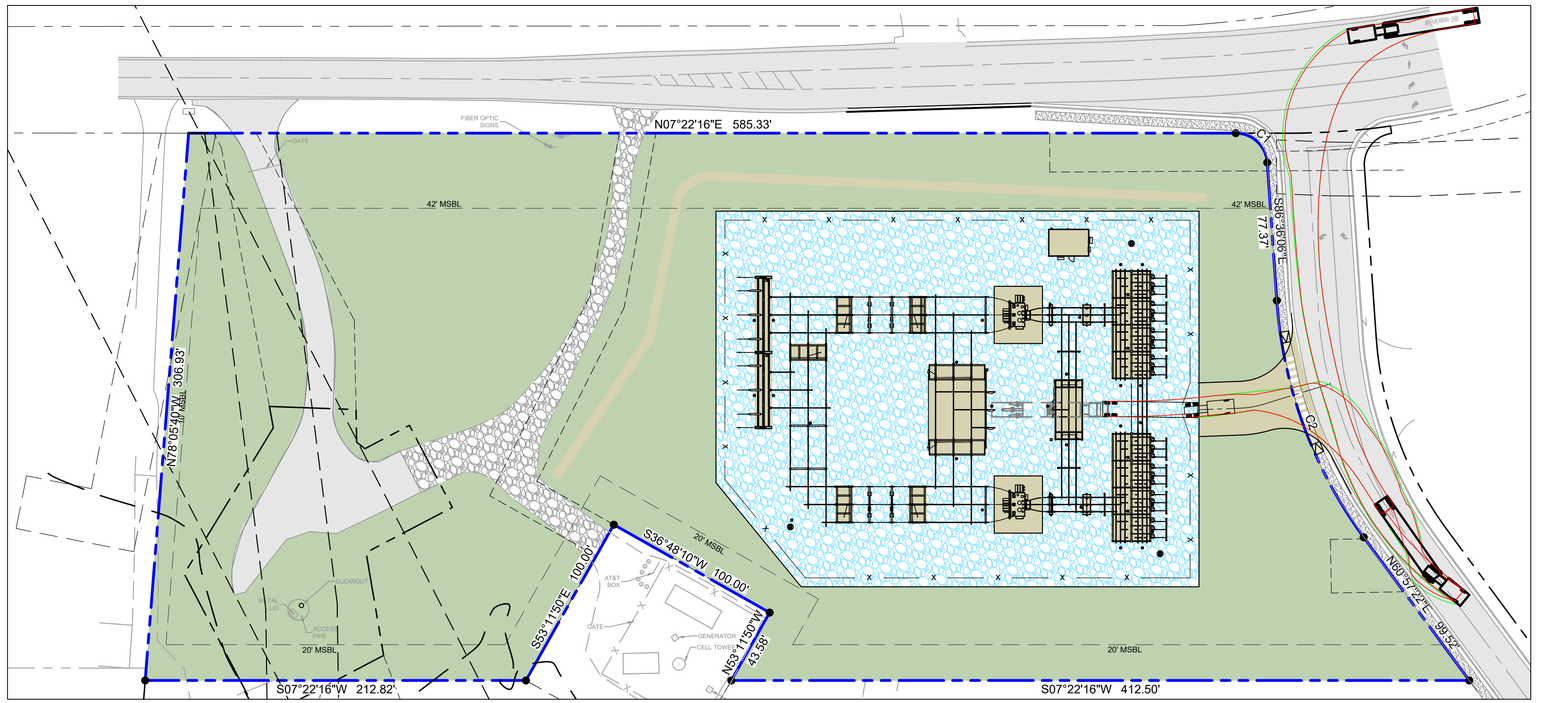
SITE LAYOUT PLAN

Drawing No.

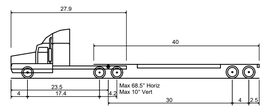
C1.1

Project No.

23-0331



TRUCK ENTRANCE REVERSE ROUTE



WB-67 - Interstate Semi-Trailer	
Overall Length	60.001ft
Overall Width	8.500ft
Overall Body Height	13.500ft
Min Body Ground Clearance	1.334ft
Max Track Width	8.500ft
Lock-to-lock time	6.00s
Max Steering Angle (Virtual)	28.40°

NOTE:
TRUCK DIMENSIONS PROVIDED BY MTEMC

LEGEND

BUMPER OVERHANG

TIRE ROUTE

0 40 80

Know what's below. Call before you dig.

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ragansmith.com

PRELIMINARY PLANS
CONCEPTUAL PURPOSE ONLY
NOT FOR CONSTRUCTION
SUBJECT TO CHANGE

BARFIELD ROAD - SUBSTATION

FOR

MIDDLE TENNESSEE ELECTRIC

CITY OF MURFREESBORO, RUTHERFORD COUNTY, TENNESSEE

Scale: 1"=40'

Date: 04.24.2025

Approved By: E. PARL

Revisions:

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Drawing Title:

TRUCK MOVEMENT PLAN

Drawing No.

C1.2

Project No.

23-0331

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PLOTTED BY: LANA ALBAHRI ON 4/4/2025 5:21 PM LAST UPDATED BY TEMP ON 4/2/2025 9:31 AM

BENCHMARK
ELEV. = 601.60'
RAILROAD SPIKE IN
POWER POLE #132108

BARFIELD ROAD
(RIGHT-OF-WAY WIDTH VARIES)

20' ACCESS AND UTILITY EASEMENT
RECORD BOOK (RB) 532, PAGE (PG) 3295;
RB 1152, PG 2490, RB 1157, PG 2586 & RB
1413, PG 1465, R.O.R.C.T.
(EXCEPTION 16)

OVERHEAD
PLAT BOOK 44, PAGE 293 &
RECORD BOOK 2018, PAGE 2469
R.O.R.C.T.
(EXCEPTIONS 10 &11)

CONTRACTOR TO FIELD VERIFY EXISTING ANCHORS PRIOR TO CONSTRUCTION AND COORDINATE ACCORDINGLY WITH UTILITY PROVIDER AND GRADING PLAN

CONCRETE CHANNEL (TYP.)
(SEE DETAIL SHEET AND
SECTION VIEW THIS SHEET)

10' PUBLIC UTILITY EASEMENT
PLAT BOOK 36, PAGE 277 &
RECORD BOOK 1163, PAGE 1474
R.O.R.C.T.
(EXCEPTION 11)

30' CUD EASEMENT
PLAT BOOK 36, PAGE 277 &
RECORD BOOK 1163, PAGE 1474
R.O.R.C.T.
(EXCEPTION 11)

5' CONCRETE
SIDEWALK

N07°22'16"E 585.33'

S86°36'06"E
77.37'

LOT 1
SALEM SQUARE
SECTION-1 LOT-1
RESUB OF LOT-1
PLAT BOOK 44, PAGE 293
R.O.R.C.T.

MAP 113, PARCEL 005.12
GARRETT INVESTMENT GROUP, LLC
RECORD BOOK 2198, PAGE 2988
R.O.R.C.T.

500 YR - FEMA LINE

ACCESS & PUBLIC UTILITY EASEMENT
PLAT BOOK 44, PAGE 293 &
RECORD BOOK 2018, PAGE 2469
R.O.R.C.T.
(EXCEPTIONS 10 & 11)

30' SANITARY SEWER EASEMENT
PLAT BOOK 44, PAGE 293 &
RECORD BOOK 2018, PAGE 2469
R.O.R.C.T.
(EXCEPTIONS 10 & 11)

EX. SANITARY MH
RIM=593.36

EX. SANITARY MH
RIM=593.81

N60°51'22"E 99.52'

EGRESS-INGRESS EASEMENT
RECORD BOOK 103, PAGE 1073
R.O.R.C.T.
(EXCEPTION 6)

30' SANITARY SEWER EASEMENT
RECORD BOOK 103, PAGE 1073
R.O.R.C.T.
(EXCEPTION 6)
(SHOWN PER RECORDED DESCRIPTION-
SEE POSSIBLE INTENDED LOCATION AT
THE SOUTHEAST CORNER OF THE OLD
PUMP STATION PARCEL)

CONTRACTOR TO FIELD VERIFY EXISTING FOC LINE PRIOR TO CONSTRUCTION AND COORDINATE ACCORDINGLY WITH UTILITY PROVIDER AND GRADING PLAN

MAP 113, PARCEL 005.13
NEW SALEM LAND
DEVELOPMENT, LLC
(OLD PUMP STATION PARCEL)
RECORD BOOK 1763, PAGE 2416
R.O.R.C.T.

42' MSBL

CONCRETE DRIVEWAY

PAVED

GATE

FIBER OPTIC
SIGNS

N78°05'40"W 306.93'

LOT 3
ROWLAND - BARFIELD ROAD
PLAT BOOK 11, PAGE 158
R.O.R.C.T.

PROPOSED CONCRETE CHANNEL TO DISCHARGE WATER AT THE EXISTING ELLIPTICAL DOUBLE 38"x24" RCP.

0.5% MIN. SLOPE

HIGH POINT CROWN

CE

CW

C2

-5.31%

CHECK DAM (TYP.)
EVERY 100 FT STARTING
FROM END OF CHANNEL

40' SANITARY SEWER EASEMENT
RECORD BOOK 816, PAGE 2588
R.O.R.C.T.
(EXCEPTION 7)

GRAVEL

CLEANOUT

RETAIL
LID

ACCESS
PIPE

20' MSBL

100' TVA EASEMENT
DEED BOOK 658, PAGE 80
R.O.R.C.T.
(EXCEPTION 5)

LOT 3 OLD LOT LINE

MAP 113, PARCEL 005.04
WORLD OUTREACH CHURCH OF
MURFREESBORO TENNESSEE, INC.
RECORD BOOK 1971, PAGE 3158
R.O.R.C.T.
40' TEMPORARY CONSTRUCTION
EASEMENT
RECORD BOOK 816, PAGE 2588
R.O.R.C.T.
(EXCEPTION 7)

30' SANITARY SEWER EASEMENT
RECORD BOOK 103, PAGE 1073
R.O.R.C.T.
(EXCEPTION 6)
(SURVEYOR'S OPINION: MAY HAVE BEEN
INTENDED LOCATION PER EXHIBITS SHOWN
IN RECORD BOOK 709, PAGE 3041 &
RECORD BOOK 816, PAGE 2588, R.O.R.C.T.)

S07°22'16"W 212.82'

S53°11'50"E 100.00'

N53°11'50"W 43.58'

S07°22'16"W 412.50'

PROPOSED GRASS CHANNEL TO DISCHARGE WATER INTO THE REGIONAL DETENTION POND

100 YR FEMA LINE

(REMAINDER OF 16 ACRES)
MAP 113, PARCEL 005.02
NEW SALEM LAND DEVELOPMENT, LLC
709, PAGE 2416
R.O.R.C.T.

GRASS CHANNEL (TYP.)
(SEE DETAIL SHEET AND
SECTION VIEW THIS SHEET)

CONTRACTOR TO ADJUST EARTHWORK HEIGHT AS NEEDED TO ENSURE NO GRADE OR EROSION ISSUE.

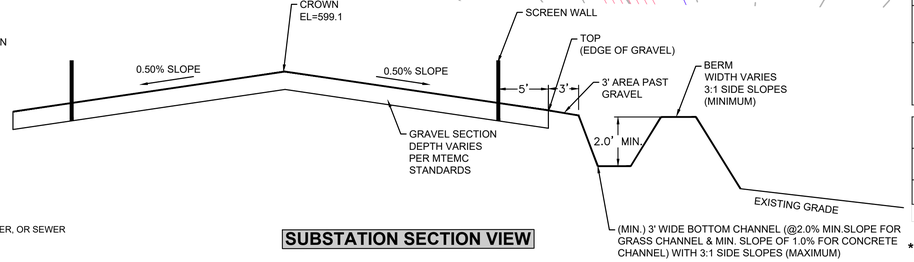
PROPOSED CONTOURS BY MASTER DEVELOPMENT ENGINEER. CONTRACTOR TO COORDINATE OFFSITE GRADING WITH MASTER DEVELOPER.

DETENTION POND DESIGN AND GRADING TO BE COORDINATED WITH MASTER PLAN DEVELOPMENT ENGINEER

PROPOSED GRASS CHANNEL TO DISCHARGE WATER INTO THE REGIONAL DETENTION POND

LEGEND

- EXISTING ASPHALT PAVEMENT
- PROPOSED PAVEMENT
- PROPOSED GRAVEL
- PROPOSED CONCRETE PAVEMENT
- CONCRETE WALK
- GRASS/VEGETATION AREA



SUBSTATION SECTION VIEW

NOTE:
THIS SITE WILL NOT REQUIRE ANY GAS, WATER, OR SEWER SERVICES.

Volume Summary							
Name	**Type**	**Cut Factor**	**Fill Factor**	**2d Area** (Sq. Ft.)	**Cut** (Cu. Yd.)	**Fill** (Cu. Yd.)	**Net** (Cu. Yd.)
23-0331 MTE BARFIELD VOLUMES	full	1.000	1.000	114174.30	4399.84	9370.54	4970.71<Fill>

Totals				
	2d Area (Sq. Ft.)	**Cut** (Cu. Yd.)	**Fill** (Cu. Yd.)	**Net** (Cu. Yd.)
Total	114174.30	4399.84	9370.54	4970.71<Fill>

* Value adjusted by cut or fill factor other than 1.0

***EARTH WORK SUMMARY:**

LIMIT OF DISTURBANCE=2.97 AC

SF SF SILT FENCE (SEE DETAIL, C3.1)

CW CONCRETE WASHOUT (SEE DETAIL, C3.1)

CE TEMPORARY CONSTRUCTION ENTRANCE (SEE DETAIL, C3.1)

CHECK DAM (SEE DETAIL, C3.1)

Know what's below. Call before you dig.

0 30 60

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PRELIMINARY PLANS
CONCEPTUAL PURPOSE ONLY
NOT FOR CONSTRUCTION
SUBJECT TO CHANGE

BARFIELD ROAD - SUBSTATION

FOR

MIDDLE TENNESSEE ELECTRIC

CITY OF MURFREESBORO, RUTHERFORD COUNTY, TENNESSEE

Scale: 1"=30'

Date: 04.24.2025

Approved By: E. PARL

Revisions:

Drawing Title:

SITE GRADING, DRAINAGE & EROSION CONTROL PLAN

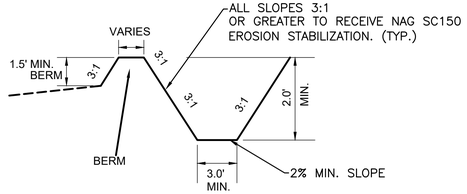
Drawing No.

C2.1

Project No.

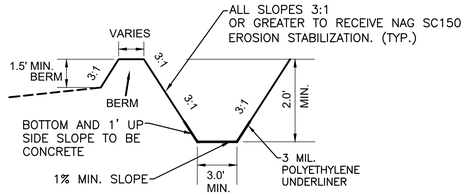
23-0331

G:\23-0331\C\CIVIL ENGINEERING\C2-PLAN SHEETS\PRELIMINARY PLANS\23-0331 GRADING.DWG
PLOTTED BY: LANA ALBASRI ON 4/24/2025 9:52 PM LAST UPDATED BY: LALBASRI ON 4/24/2025 6:58 PM



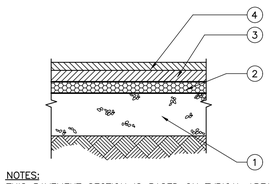
GRASS CHANNEL

NOT TO SCALE



CONCRETE LINED CHANNEL

NOT TO SCALE



NOTES:

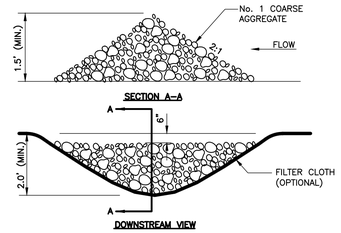
1. THIS PAVEMENT SECTION IS BASED ON TYPICAL AREA SOIL TYPES, SITE CONDITIONS AND LOADING. CONTRACTOR SHALL REFER TO GEOTECHNICAL STUDY FOR SITE SPECIFIC PAVEMENT RECOMMENDATIONS.
2. REFER TO "TDOT STANDARD SPECIFICATIONS AND BRIDGE CONSTRUCTION" FOR PAVING MATERIALS AND SPECIFICATIONS.
3. COORDINATE PAVEMENT WORK IN RIGHT OF WAY WITH CITY OF LAVERGNE.

HEAVY DUTY PAVEMENT

NOT TO SCALE

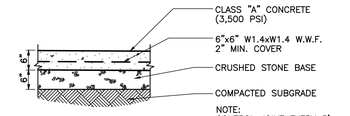
PROPOSED PAVEMENT SCHEDULE

	MATERIAL	THICKNESS (INCHES)	TDOT GRADING
1.	CRUSHED STONE BASE/ SURGE ROCK	12.0	C or D
2.	6" CRUSH AND RUN	3.0	C or D
3.	ASPHALTIC BINDER COURSE	3.0	B-Modified
4.	ASPHALTIC SURFACE COURSE	2.0	D or E



ROCK CHECK DAM

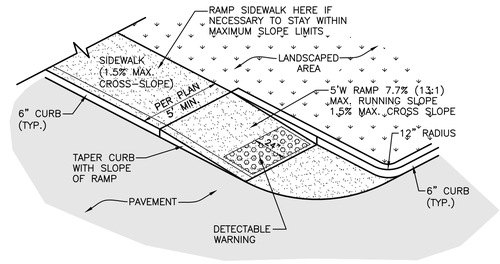
NOT TO SCALE



NOTE:
CONTROL JOINT EVERY 5',
EXPANSION JOINT EVERY 25',
UNLESS OTHERWISE NOTED.

CONCRETE PAVEMENT

NOT TO SCALE

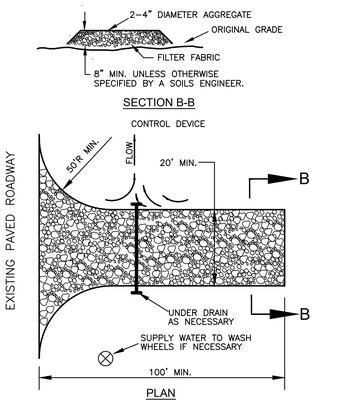


NOTES:

1. DETECTABLE WARNINGS SHALL BE WHITACRE-GREER 4"x8" ADA PAVING BRICK OR APPROVED EQUAL. COLOR SHALL CONSTRAST VISUALLY WITH ADJOINING SURFACES.
2. INSTALL DETECTABLE WARNINGS PER MANUFACTURER'S SPECIFICATIONS.
3. A VARIATION OF THE RAMP MAY BE USED IN CERTAIN CIRCUMSTANCES BUT MUST COMPLY WITH ADA SPECIFICATIONS.

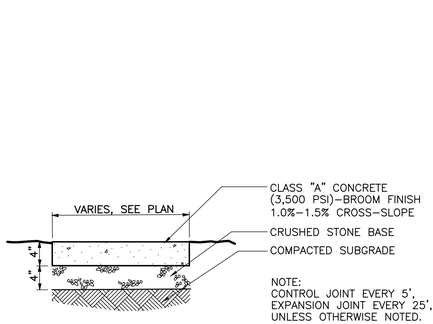
ACCESSIBLE RAMP CURBED RADIUS

NOT TO SCALE



STABILIZED CONSTRUCTION ENTRANCE

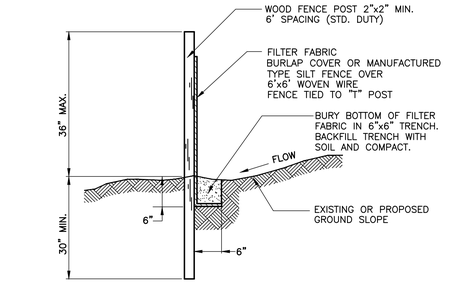
NOT TO SCALE
REFER TO TDEC BMP MANUAL, SECTION 7.28



NOTE:
CONTROL JOINT EVERY 5',
EXPANSION JOINT EVERY 25',
UNLESS OTHERWISE NOTED.

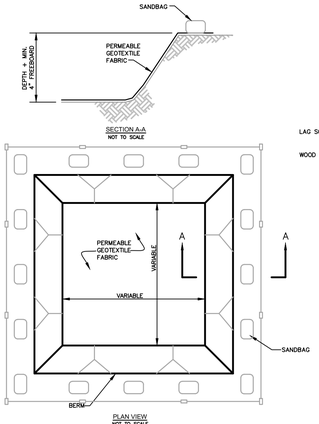
CONCRETE WALK

NOT TO SCALE

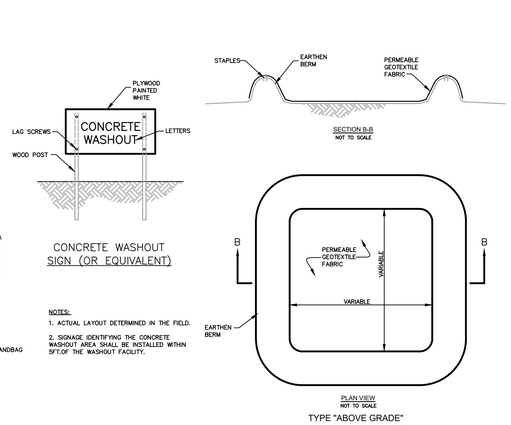


WIRE BACKED EROSION / SILTATION FENCE

NOT TO SCALE



TYPE "BELOW GRADE"



CONCRETE WASHOUT
SIGN (OR EQUIVALENT)

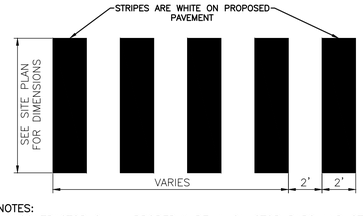
NOTES:

1. ACTUAL LAYOUT DETERMINED IN THE FIELD.
2. SIGNAGE IDENTIFYING THE CONCRETE WASHOUT AREA SHALL BE INSTALLED WITHIN 5FT. OF THE WASHOUT FACILITY.

TYPE "ABOVE GRADE"
WITH EATHERN BERMS

CONCRETE WASHOUT

NOT TO SCALE
REFER TO TDEC BMP MANUAL, SECTION 7.16

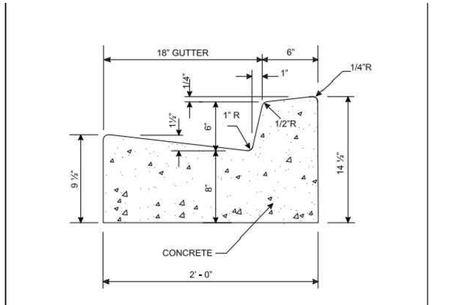


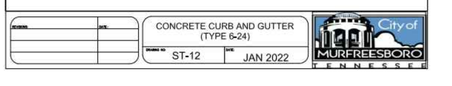
NOTES:

1. CONTRACTOR SHALL PROPERLY RE-ALIGN STOP BARS AND OTHER PAVEMENT MARKERS AS NECESSARY TO INSTALL CROSSWALK PER METRO STANDARDS.
2. CROSSWALK STRIPES SHALL BE APPLIED PER METRO STANDARDS.
3. CONTRACTOR SHALL APPLY LONG LIFE MARKING MATERIALS ONLY.

PEDESTRIAN CROSSWALK

NOT TO SCALE





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PRELIMINARY PLANS
CONCEPTUAL PURPOSE ONLY
NOT FOR CONSTRUCTION
SUBJECT TO CHANGE

BARFIELD ROAD - SUBSTATION

FOR

MIDDLE TENNESSEE ELECTRIC

CITY OF MURFREESBORO, RUTHERFORD COUNTY, TENNESSEE

Scale: NTS

Date: 04.24.2025

Approved By: E. PARL

Revisions:

- - -
- - -
- - -
- - -
- - -
- - -

Drawing Title:

CONSTRUCTION DETAILS

Drawing No.

C3.1

Project No.

23-0331

G:\23-0331\CIVIL ENGINEERING\3 PLAN SHEETS\PRELIMINARY PLANS\03 DETAILS.DWG
PLOTTED BY: LANA ALBARRON ON 4/24/2025 5:23 PM LAST UPDATED BY LALBARRON ON 4/24/2025 5:01 PM

Exhibit B

One-Line Diagram

BT FROM 254, 264, 274, & 284 ON FIBER

BT FROM 214, 224, 234, & 244 ON FIBER

MAIN BUS #2

MAIN BUS #1

TRANSFER BUS #2

TRANSFER BUS #1

TRANS. BUS

MOBILE

STATION SERVICE #2 25 KVA 7200-120/240V

STATION SERVICE #1 25 KVA 7200-120/240V

MTE CHECK METER

TVA METER CABINET

TVA TEST BOX #2

TVA TEST BOX #1

MTE (PT2) TEST BOX #2

MTE (PT1) TEST BOX #1

LOAD BREAK 3000 AMP

STATION CLASS ARRESTER 13KV

STATION CLASS ARRESTER 161KV

43BNK BANK 2 NORMAL PARALLEL

438NK BANK 1 NORMAL PARALLEL

ON FIBER BREAKERS

PARALLEL BANK 2 43BNK

PARALLEL BANK 1 438NK

PARALLEL OR BANK 2 BANK SWITCH 751-2H OCST ON.

PARALLEL OR BANK 1 751-1H OSCILLATION.

25/33.33/41.67/46.67 MVA 9% Z 161.7/13.09 kV GE PROLEC WAUKESHA

BANK 2

BANK 1

CIRCUIT SWITCHER 750 KV BIL 1200 AMP 20000 AIC

161 KV TO ??? ???

UF TRIP, LOCKOUT AND BLOCK CLOSE SELECTED BREAKERS 274, 274, AND 274

TVA UF SCHEME

LEGEND

- 161 kV
- 26 kV
- 13 kV
- CURRENT CIRCUIT
- FIBER RELAYING SCHEME
- COMMAND/TRIP CIRCUIT
- IEEE ELEMENT
- SEL VARIABLE (IF APPLICABLE)
- PHYSICAL DEVICE #

BT	BLOCK TRIP
TT	TRANSFER TRIP

IEEE LEGEND

- 26 APPARATUS THERMAL DEVICE
- 27DC BATTERY LOW DC VOLTAGE
- 29 ISOLATING SWITCH
- 49 TRANSFORMER THERMAL RELAY
- 50 INSTANTANEOUS OVERCURRENT
- 51 INVERSE TIME OVERCURRENT
- 62 TIME DELAYED RELAYING
- 63 PRESSURE SWITCH
- 63LO LOW N2 PRESSURE RELAY
- 63PR PRESSURE RELIEF DEVICE
- 71 LOW OIL RELAY
- 87 DIFFERENTIAL RELAY

REVISED	DATE:	BY:
REVISED	DATE:	BY:
REVISED	DATE:	BY:
REVISED	DATE:	BY:

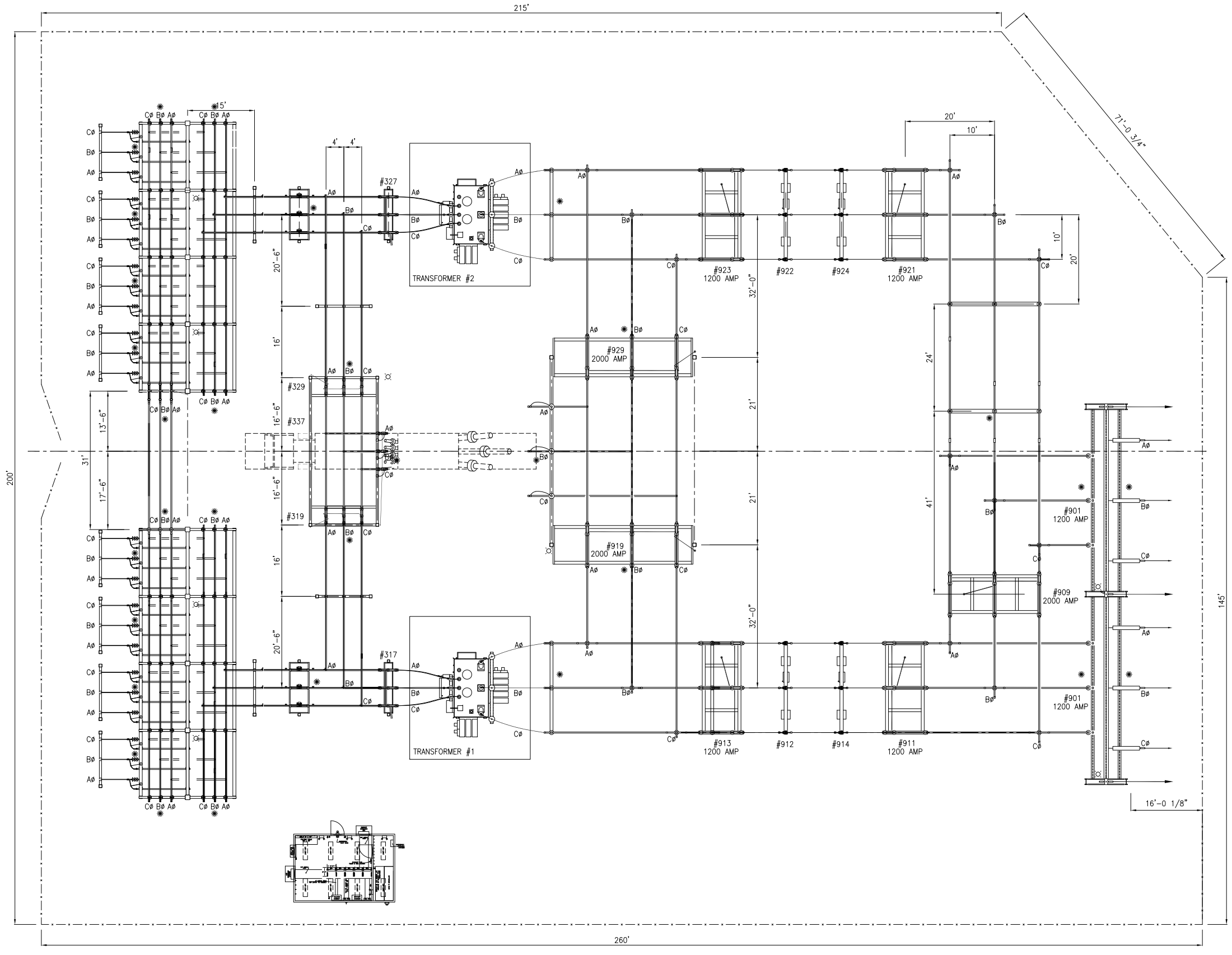
EXHIBIT "C" BARFIELD SUBSTATION

DATE: 1/13/2025 DRAWN BY: A. FERREE

SCALE: NONE CHECKED BY: L. TAYLOR

Exhibit C

General Arrangement and Details



NOTE:
1. DIMENSIONS ARE GENERAL APPROXIMATIONS ONLY.
✸ PHASING TAG LOCATIONS
☼ STATION LIGHT LOCATIONS

DATE	REVISION	BY

MTEMC

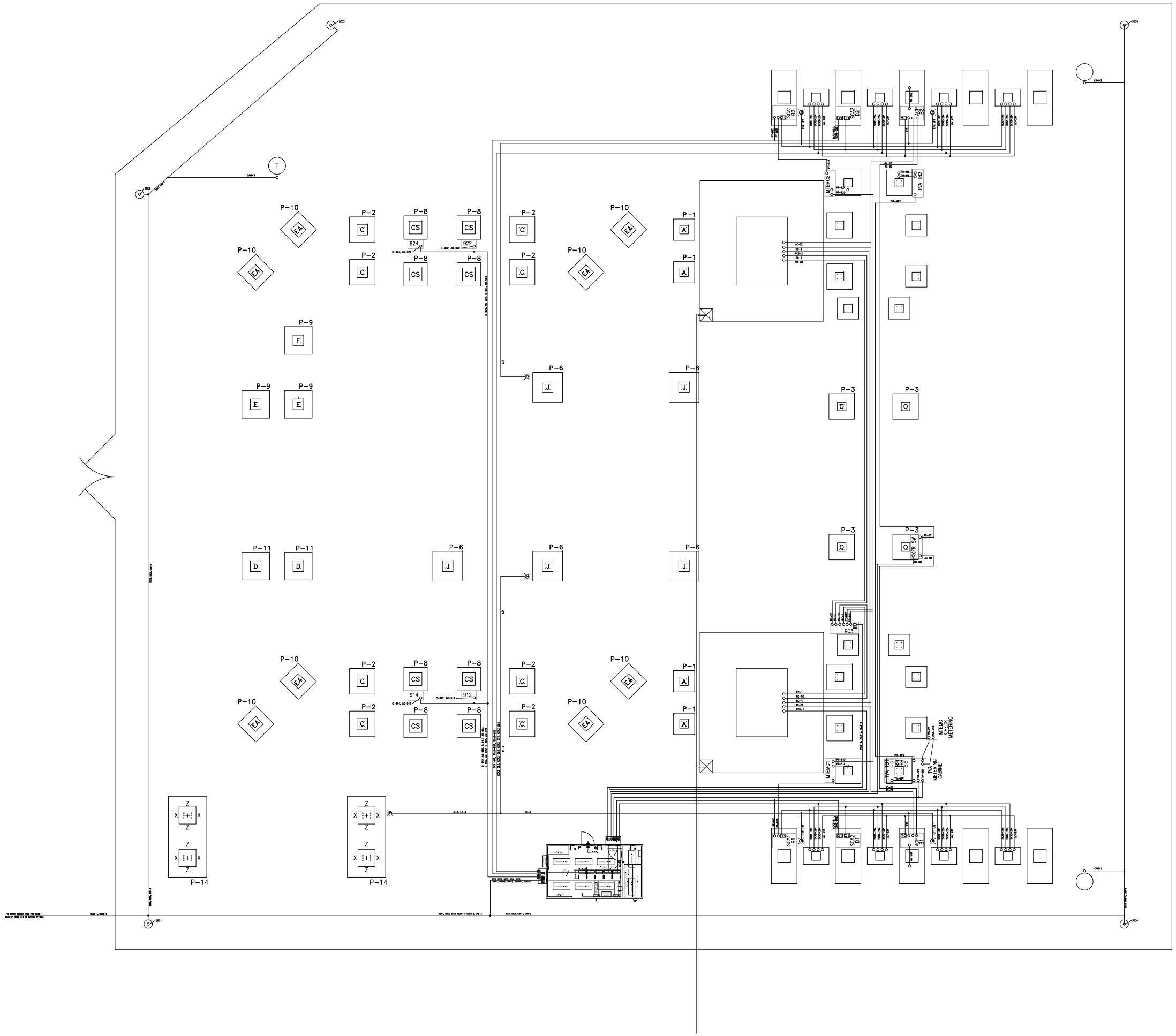
BARFIELD SUBSTATION
GENERAL ARRANGEMENT

SCALE: NTS	APPROVED	DATE APRIL 18, 2024
PREPARED BY: LDT	DRAWING NO. BAR-090	SHEET 1
DRAWN BY: L TAYLOR		OF 1 SHEETS
CHECKED BY: LDT		

Exhibit D

Typical Cable/Conduit Details and Conduit Layout

(SAN-070)



DATE	REVISION	BY

MTEMC

SANFORD RD SUBSTATION

CABLE & CONDUIT SCHEDULE

SCALE: NTS	APPROVED	DATE AUGUST 22, 2023
PREPARED BY: LDT	DRAWING NO. SAN-070	SHEET 1
DRAWN BY: L TAYLOR		OF 4 SHEETS
CHECKED BY: LDT		

CABLE DESIGNATION	COLOR CODE	# OF WIRES	WIRE TYPE	WIRE SIZE	CIRCUIT FROM	CIRCUIT TO	CONDUIT IN	CONDUIT SIZE
S2A	E2	12/C	TC	#10 AWG	CTRL HSE PANEL #2	SCA2-B2	SCA2-B21	2-1/2"
S1A	E2	12/C	TC	#10 AWG	CTRL HSE PANEL #2	SCA2-B1	SCA2-B11	2-1/2"
C-284	E2	9/C	TC	#10 AWG	BKR 284	SCA2-B2	SCA2-284	2-1/2"
C-274	E2	9/C	TC	#10 AWG	BKR 274	SCA2-B2	SCA2-274	2-1/2"
C-264	E2	9/C	TC	#10 AWG	BKR 264	SCA2-B2	SCA2-264	2-1/2"
C-254	E2	9/C	TC	#10 AWG	BKR 254	SCA2-B2	SCA2-254	2-1/2"
C-244	E2	9/C	TC	#10 AWG	BKR 244	SCA2-B1	SCA2-244	2-1/2"
C-234	E2	9/C	TC	#10 AWG	BKR 234	SCA2-B1	SCA2-234	2-1/2"
C-224	E2	9/C	TC	#10 AWG	BKR 224	SCA2-B1	SCA2-224	2-1/2"
C-214	E2	9/C	TC	#10 AWG	BKR 214	SCA2-B1	SCA2-214	2-1/2"
C-924	E2	12/C	TC	#10 AWG	CKT SWR 924	CTRL HSE PANEL #4	C-924	2-1/2"
C-922	E2	12/C	TC	#10 AWG	CKT SWR 922	CTRL HSE PANEL #4	C-922	2-1/2"
C-914	E2	12/C	TC	#10 AWG	CKT SWR 914	CTRL HSE PANEL #3	C-914	2-1/2"
C-912	E2	12/C	TC	#10 AWG	CKT SWR 912	CTRL HSE PANEL #3	C-912	2-1/2"
CT-23	E2	12/C	TC	#10 AWG	RC3 BOX	POWER XFMR #2	RC-2	2-1/2"
CT-22	E2	5/C	TC	#10 AWG	RC3 BOX	CTRL HSE PANEL #4	RC3-2	2-1/2"
CT-21	E2	9/C	TC	#10 AWG	RC3 BOX	CTRL HSE PANEL #4	RC3-2	2-1/2"
CT-13	E2	12/C	TC	#10 AWG	RC3 BOX	POWER XFMR #1	RC-1	2-1/2"
CT-12	E2	5/C	TC	#10 AWG	RC3 BOX	CTRL HSE PANEL #3	RC3-1	2-1/2"
CT-11	E2	9/C	TC	#10 AWG	RC3 BOX	CTRL HSE PANEL #3	RC3-1	2-1/2"
PT-284	E2	5/C	TC	#10 AWG	BKR 284	SCA1-B2	SCA1-284	2-1/2"
PT-274	E2	5/C	TC	#10 AWG	BKR 274	SCA1-B2	SCA1-274	2-1/2"
PT-264	E2	5/C	TC	#10 AWG	BKR 264	SCA1-B2	SCA1-264	2-1/2"
PT-254	E2	5/C	TC	#10 AWG	BKR 254	SCA1-B2	SCA1-254	2-1/2"
PT-B2E	E2	5/C	TC	#10 AWG	RC3 BOX	POWER XFMR #2	RC-2	2-1/2"
PT-B2D	E2	5/C	TC	#10 AWG	MTEMC PT-B2 BOX	RC3 BOX	PT-B2D	2-1/2"
PT-B2C	E2	5/C	TC	#10 AWG	SCA1-B2	CTRL HSE PANEL #4	PT-B2C	2-1/2"
PT-B2B	E2	5/C	TC	#10 AWG	MTEMC PT-B2 BOX	SCA1-B2	PT-B2B	2-1/2"
PT-B2A	E2	9/C	TC	#10 AWG	MTEMC B2 PT'S	MTEMC PT-B2 BOX	PT-B2A	1-1/2"
PT-244	E2	5/C	TC	#10 AWG	BKR 244	SCA1-B1	SCA1-244	2-1/2"
PT-234	E2	5/C	TC	#10 AWG	BKR 234	SCA1-B1	SCA1-234	2-1/2"
PT-224	E2	5/C	TC	#10 AWG	BKR 224	SCA1-B1	SCA1-224	2-1/2"
PT-214	E2	5/C	TC	#10 AWG	BKR 214	SCA1-B1	SCA1-214	2-1/2"
PT-B1E	E2	5/C	TC	#10 AWG	RC3 BOX	POWER XFMR #1	RC-1	2-1/2"
PT-B1D	E2	5/C	TC	#10 AWG	MTEMC PT-B1 BOX	RC3 BOX	PT-B1D	2-1/2"
PT-B1C	E2	5/C	TC	#10 AWG	SCA1-B1	CTRL HSE PANEL #3	PT-B1C	2-1/2"
PT-B1B	E2	5/C	TC	#10 AWG	MTEMC PT-B1 BOX	SCA1-B1	PT-B1B	2-1/2"
PT-B1A	E2	9/C	TC	#10 AWG	MTEMC B1 PT'S	MTEMC PT-B1 BOX	PT-B1A	1-1/2"

CABLE SCHEDULE

CABLE DESIGNATION	COLOR CODE	# OF WIRES	WIRE TYPE	WIRE SIZE	CIRCUIT FROM	CIRCUIT TO	CONDUIT IN	CONDUIT SIZE
DC-214	E2	12/C	TC	#10 AWG	DC PNL (CTRL HSE)	SCA2-B1	SCA2-B12	2-1/2"
DC-224	E2	5/C	TC	#10 AWG	DC PNL (CTRL HSE)	SCA2-B1	SCA2-B12	2-1/2"
DC-234	E2	12/C	TC	#10 AWG	DC PNL (CTRL HSE)	SCA2-B1	SCA2-B12	2-1/2"
DC-244	E2	5/C	TC	#10 AWG	DC PNL (CTRL HSE)	SCA2-B1	SCA2-B12	2-1/2"
DC-254	E2	12/C	TC	#10 AWG	DC PNL (CTRL HSE)	SCA2-B2	SCA2-B22	2-1/2"
DC-264	E2	5/C	TC	#10 AWG	DC PNL (CTRL HSE)	SCA2-B2	SCA2-B22	2-1/2"
DC-274	E2	12/C	TC	#10 AWG	DC PNL (CTRL HSE)	SCA2-B2	SCA2-B22	2-1/2"
DC-284	E2	5/C	TC	#10 AWG	DC PNL (CTRL HSE)	SCA2-B2	SCA2-B22	2-1/2"
DC-T1	E2	5/C	TC	#10 AWG	DC PNL (CTRL HSE)	RC3 BOX	RC3-3	2-1/2"
DC-T2	E2	5/C	TC	#10 AWG	DC PNL (CTRL HSE)	RC3 BOX	RC3-3	2-1/2"
DC-912	E2	5/C	TC	#10 AWG	DC PNL (CTRL HSE)	CKT SWR 912	C-912	2-1/2"
DC-914	E2	5/C	TC	#10 AWG	DC PNL (CTRL HSE)	CKT SWR 914	C-914	2-1/2"
DC-922	E2	5/C	TC	#10 AWG	DC PNL (CTRL HSE)	CKT SWR 922	C-922	2-1/2"
DC-924	E2	5/C	TC	#10 AWG	DC PNL (CTRL HSE)	CKT SWR 924	C-924	2-1/2"
DC-11	E2	5/C	TC	#10 AWG	POWER XFMR #1	RC3 BOX	RC-1C	2-1/2"
DC-21	E2	5/C	TC	#10 AWG	POWER XFMR #2	RC3 BOX	RC-2C	2-1/2"
PAR (FUTURE)					POWER XFMR #1	POWER XFMR #2	RC-4	2-1/2"
SEC-1	E2	12/C	TC	#10 AWG	CTRL HSE PANEL #1	SECURITY TWR #1	SEC-1	1-1/2"
SEC-2	E2	12/C	TC	#10 AWG	CTRL HSE PANEL #1	SECURITY TWR #2	SEC-2	1-1/2"
SEC-3	E2	12/C	TC	#10 AWG	CTRL HSE PANEL #1	SECURITY TWR #3	SEC-3	1-1/2"
SEC-4	E2	12/C	TC	#10 AWG	CTRL HSE PANEL #1	SECURITY TWR #4	SEC-4	1-1/2"
SEC-5	E2	12/C	TC	#10 AWG	CTRL HSE PANEL #1	SECURITY TWR #5	SEC-5	1-1/2"
F-214	N/A	4/C		200MICRON	BKR 214	CTRL HSE PANEL #2	SCA3-214	2-1/2"
F-224	N/A	4/C		200MICRON	BKR 224	CTRL HSE PANEL #2	SCA3-224	2-1/2"
F-234	N/A	4/C		200MICRON	BKR 234	CTRL HSE PANEL #2	SCA3-234	2-1/2"
F-244	N/A	4/C		200MICRON	BKR 244	CTRL HSE PANEL #2	SCA3-244	2-1/2"
F-254	N/A	4/C		200MICRON	BKR 254	CTRL HSE PANEL #2	SCA3-254	2-1/2"
F-264	N/A	4/C		200MICRON	BKR 264	CTRL HSE PANEL #2	SCA3-264	2-1/2"
F-274	N/A	4/C		200MICRON	BKR 274	CTRL HSE PANEL #2	SCA3-274	2-1/2"
F-284	N/A	4/C		200MICRON	BKR 284	CTRL HSE PANEL #2	SCA3-284	2-1/2"
F-T1	N/A	4/C		200MICRON	POWER XFMR #1	CTRL HSE PANEL #2	RC5-1	2-1/2"
F-T1G	N/A	4/C		200MICRON	POWER XFMR #1	CTRL HSE PANEL #2	RC5-1	2-1/2"
F-T1C	N/A	4/C		200MICRON	POWER XFMR #1	CTRL HSE PANEL #2	RC5-1	2-1/2"
F-T2	N/A	4/C		200MICRON	POWER XFMR #2	CTRL HSE PANEL #2	RC5-2	2-1/2"
F-T2G	N/A	4/C		200MICRON	POWER XFMR #2	CTRL HSE PANEL #2	RC5-2	2-1/2"
F-T2C	N/A	4/C		200MICRON	POWER XFMR #2	CTRL HSE PANEL #2	RC5-2	2-1/2"

CABLE SCHEDULE

DATE	REVISION	BY

MTEMC

SANFORD RD SUBSTATION

CABLE SCHEDULE

SCALE: NTS
PREPARED BY: LDT
CHECKED BY: LDT

APPROVED

DRAWING NO. SAN-070
DRAWN BY: LTAYLOR

DATE AUG. 22, 2023

SHEET 2 OF 4 SHEETS

CABLE SCHEDULE

CABLE DESIGNATION	COLOR CODE	# OF WIRES	WIRE TYPE	WIRE SIZE	CIRCUIT FROM	CIRCUIT TO	CONDUIT IN	CONDUIT SIZE
AC-CH	E1	4/C	TC	#2 AWG	AC PNL (CTRL HSE)	TRANSFER SWITCH	AC-CH	2-1/2"
AC-SS1	E1	3/C	RHW	2/0	AC PANEL B1 (YARD)	STA. SERVICE XFMR #1	AC-SS1	2-1/2"
AC-B1	E1	3/C	TC	#2 AWG	AC PANEL B1 (YARD)	TRANSFER SWITCH	AC-B1	2-1/2"
AC-T1	E1	4/C	TC	#6 AWG	AC PANEL B1 (YARD)	POWER XFMR #1	AC-T1	2-1/2"
AC-214	E1	4/C	TC	#10 AWG	AC PANEL B1 (YARD)	BKR 214	AC-214	1-1/2"
AC-224	E1	4/C	TC	#10 AWG	AC PANEL B1 (YARD)	BKR 224	AC-224	1-1/2"
AC-234	E1	4/C	TC	#10 AWG	AC PANEL B1 (YARD)	BKR 234	AC-234	1-1/2"
AC-244	E1	4/C	TC	#10 AWG	AC PANEL B1 (YARD)	BKR 244	AC-244	1-1/2"
AC-SS2	E1	3/C	RHW	2/0	AC PANEL B2 (YARD)	STA. SERVICE XFMR #2	AC-SS2	2-1/2"
AC-B2	E1	3/C	TC	#2 AWG	AC PANEL B2 (YARD)	TRANSFER SWITCH	AC-B2	2-1/2"
AC-T2	E1	4/C	TC	#6 AWG	AC PANEL B2 (YARD)	POWER XFMR #2	AC-T2	2-1/2"
AC-254	E1	4/C	TC	#10 AWG	AC PANEL B2 (YARD)	BKR 254	AC-254	1-1/2"
AC-264	E1	4/C	TC	#10 AWG	AC PANEL B2 (YARD)	BKR 264	AC-264	1-1/2"
AC-274	E1	4/C	TC	#10 AWG	AC PANEL B2 (YARD)	BKR 274	AC-274	1-1/2"
AC-284	E1	4/C	TC	#10 AWG	AC PANEL B2 (YARD)	BKR 284	AC-284	1-1/2"
AC-912	E1	4/C	TC	#10 AWG	AC PNL (CTRL HSE)	CKT SWR 912	AC-912	2-1/2"
AC-914	E1	4/C	TC	#10 AWG	AC PNL (CTRL HSE)	CKT SWR 914	AC-914	2-1/2"
AC-922	E1	4/C	TC	#10 AWG	AC PNL (CTRL HSE)	CKT SWR 922	AC-922	2-1/2"
AC-924	E1	4/C	TC	#10 AWG	AC PNL (CTRL HSE)	CKT SWR 924	AC-924	2-1/2"
PC-B1	E1	3/C	TC	#10 AWG	AC PANEL B1 (YARD)	B1 PHOTOCELL	PC-B1	1-1/2"
LT1	E1	3/C	TC	#10 AWG	B1 PHOTOCELL	YARD LIGHT #1	LT1	1-1/2"
LT2	E1	3/C	TC	#10 AWG	YARD LIGHT #1	YARD LIGHT #2	LT2	1-1/2"
LT3	E1	3/C	TC	#10 AWG	YARD LIGHT #2	YARD LIGHT #3	LT3	1-1/2"
LT4	E1	3/C	TC	#10 AWG	YARD LIGHT #3	YARD LIGHT #4	LT4	1-1/2"
PC-B2	E1	3/C	TC	#10 AWG	AC PANEL B2 (YARD)	B2 PHOTOCELL	PC-B2	1-1/2"
LT5	E1	3/C	TC	#10 AWG	B2 PHOTOCELL	YARD LIGHT #5	LT5	1-1/2"
LT6	E1	3/C	TC	#10 AWG	YARD LIGHT #5	YARD LIGHT #6	LT6	1-1/2"
LT7	E1	3/C	TC	#10 AWG	YARD LIGHT #6	YARD LIGHT #7	LT7	1-1/2"
TVA-M1	E1	6-1/C	TC	#10 AWG	TVA TEST BOX #1	TVA B1 CT'S	TVA-M1	1-1/2"
TVA-P1	E1	6-1/C	TC	#10 AWG	TVA TEST BOX #1	TVA B1 PT'S	TVA-P1	1-1/2"
TVA-M2	E1	6-1/C	TC	#10 AWG	TVA TEST BOX #2	TVA B2 CT'S	TVA-M2	1-1/2"
TVA-P2	E1	6-1/C	TC	#10 AWG	TVA TEST BOX #2	TVA B2 PT'S	TVA-P2	1-1/2"
TVA-MP1	E1	12/C	TC	#10 AWG	TVA TEST BOX #1	TVA METER CABINET	TVA-MP1	2-1/2"
TVA-MP2	E1	12/C	TC	#10 AWG	TVA TEST BOX #2	TVA METER CABINET	TVA-MP2	2-1/2"
TVA-SS1	E1	4/C	TC	#10 AWG	AC PNL (CTRL HSE)	TVA METER CABINET	TVA-SS1	2-1/2"
TVA-FP1	E1	4/C	TC	#10 AWG	CTRL HSE PANEL #1	TVA METER CABINET	TVA-FP1	2-1/2"
TVA-FP2	E1	4/C	TC	#10 AWG	CTRL HSE PANEL #1	TVA METER CABINET	TVA-FP1	2-1/2"
TVA-P3	E1	4/C	TC	#10 AWG	MTEMC CHECK METER #1	TVA METER CABINET	TVA-P3	2-1/2"
TVA-P4	E1	4/C	TC	#10 AWG	MTEMC CHECK METER #2	TVA METER CABINET	TVA-P3	2-1/2"
TVA-M11	E1	4/C	TC	#10 AWG	MTEMC CHECK METER #1	TVA METER CABINET	TVA-M11	2-1/2"
TVA-M12	E1	4/C	TC	#10 AWG	MTEMC CHECK METER #2	TVA METER CABINET	TVA-M11	2-1/2"

CABLE SCHEDULE

CABLE DESIGNATION	COLOR CODE	# OF WIRES	WIRE TYPE	WIRE SIZE	CIRCUIT FROM	CIRCUIT TO	CONDUIT IN	CONDUIT SIZE
DC1	E2	2/C	TC	#10 AWG	DC PNL (CTRL HSE)	RELAY PANEL #1		
DC2	E2	2/C	TC	#10 AWG	DC PNL (CTRL HSE)	RELAY PANEL #2		
DC3	E2	2/C	TC	#10 AWG	DC PNL (CTRL HSE)	RELAY PANEL #3		
DC4	E2	2/C	TC	#10 AWG	DC PNL (CTRL HSE)	RELAY PANEL #4		
DC-TELCO	E2	2/C	TC	#10 AWG	DC PNL (CTRL HSE)	RELAY PANEL #6		
P1-AC	E1	3/C	TC	#10 AWG	AC PNL (CTRL HSE)	RELAY PANEL #1		
TELCO-AC	E1	3/C	TC	#10 AWG	AC PNL (CTRL HSE)	RELAY PANEL #6		
DA-ALM		2/C	TC	#18 AWG	DOOR ALM (CTRL HSE)	RELAY PANEL #2		
D1-ALM		2/C	TC	#18 AWG	SMOKE DET (CTRL HSE)	RELAY PANEL #2		
PFA-ALM		2/C	TC	#18 AWG	POWER FAIL (CTRL HSE)	RELAY PANEL #2		
LA-ALM		2/C	TC	#18 AWG	LIGHTNING (CTRL HSE)	RELAY PANEL #2		
LHA-ALM		2/C	TC	#18 AWG	LOW HUM (CTRL HSE)	RELAY PANEL #2		
HHA-ALM		2/C	TC	#18 AWG	HIGH HUM (CTRL HSE)	RELAY PANEL #2		
LTEMP-ALM		2/C	TC	#18 AWG	LOW TEMP (CTRL HSE)	RELAY PANEL #2		
HTEMP-ALM		2/C	TC	#18 AWG	HIGH TEMP (CTRL HSE)	RELAY PANEL #2		
HD-ALM		2/C	TC	#18 AWG	HYDROGEN (CTRL HSE)	RELAY PANEL #2		
BC-ALM		5/C	TC	#18 AWG	BATT CHGR (CTRL HSE)	RELAY PANEL #2		

DATE	REVISION	BY

MTEMC

SANFORD RD SUBSTATION

CABLE SCHEDULE

SCALE: NTS
PREPARED BY: LDT
DRAWN BY: L TAYLOR
CHECKED BY: LDT

APPROVED

DRAWING NO. SAN-070

DATE AUG. 22, 2023

SHEET 3 OF 4 SHEETS

CONDUIT SCHEDULE

CONDUIT DESIGNATION	CIRCUIT FROM	CIRCUIT TO	CONDUIT TYPE	CONDUIT SIZE
PT-B1A	MTEMC B1 PT'S	MTEMC PT-B1 BOX	SCH.40 PVC	1-1/2"
PT-B1B	MTEMC PT-B1 BOX	SCA1-B1	SCH.40 PVC	2-1/2"
PT-B1C	SCA1-B1	CTRL HSE	SCH.40 PVC	2-1/2"
PT-B1D	MTEMC PT-B1 BOX	RC3 BOX	SCH.40 PVC	2-1/2"
SCA1-214	SCA1-B1	BKR 214	SCH.40 PVC	2-1/2"
SCA1-224	SCA1-B1	BKR 224	SCH.40 PVC	2-1/2"
SCA1-234	SCA1-B1	BKR 234	SCH.40 PVC	2-1/2"
SCA1-244	SCA1-B1	BKR 244	SCH.40 PVC	2-1/2"
PT-B2A	MTEMC B2 PT'S	MTEMC PT-B2 BOX	SCH.40 PVC	1-1/2"
PT-B2B	MTEMC PT-B2 BOX	SCA2-B2	SCH.40 PVC	2-1/2"
PT-B2C	SCA1-B2	CTRL HSE	SCH.40 PVC	2-1/2"
PT-B2D	MTEMC PT-B2 BOX	RC3 BOX	SCH.40 PVC	2-1/2"
SCA1-254	SCA1-B2	BKR 254	SCH.40 PVC	2-1/2"
SCA1-264	SCA1-B2	BKR 264	SCH.40 PVC	2-1/2"
SCA1-274	SCA1-B2	BKR 274	SCH.40 PVC	2-1/2"
SCA1-284	SCA1-B2	BKR 284	SCH.40 PVC	2-1/2"
RC-1	POWER XFMR #1	RC3 BOX	SCH.40 PVC	2-1/2"
RC-1C	POWER XFMR #1	RC3 BOX	SCH.40 PVC	2-1/2"
RC-2	POWER XFMR #2	RC3 BOX	SCH.40 PVC	2-1/2"
RC-2C	POWER XFMR #2	RC3 BOX	SCH.40 PVC	2-1/2"
RC3-1	RC3 BOX	CTRL HSE	SCH.40 PVC	2-1/2"
RC3-2	RC3 BOX	CTRL HSE	SCH.40 PVC	2-1/2"
RC3-3	RC3 BOX	CTRL HSE	SCH.40 PVC	2-1/2"
RC5-1	POWER XFMR #1	CTRL HSE	SCH.40 PVC	2-1/2"
RC5-2	POWER XFMR #2	CTRL HSE	SCH.40 PVC	2-1/2"
RC-4	POWER XFMR #1	POWER XFMR #2	SCH.40 PVC	2-1/2"
C-912	CKT SWR 912	CTRL HSE	SCH.40 PVC	2-1/2"
C-914	CKT SWR 914	CTRL HSE	SCH.40 PVC	2-1/2"
C-922	CKT SWR 922	CTRL HSE	SCH.40 PVC	2-1/2"
C-924	CKT SWR 924	CTRL HSE	SCH.40 PVC	2-1/2"
SCA2-B11	CTRL HSE	SCA2-B1	SCH.40 PVC	2-1/2"
SCA2-B12	CTRL HSE	SCA2-B1	SCH.40 PVC	2-1/2"
SCA2-214	SCA2-B1	BKR 214	SCH.40 PVC	2-1/2"
SCA2-224	SCA2-B1	BKR 224	SCH.40 PVC	2-1/2"
SCA2-234	SCA2-B1	BKR 234	SCH.40 PVC	2-1/2"
SCA2-244	SCA2-B1	BKR 244	SCH.40 PVC	2-1/2"
SCA2-B21	CTRL HSE	SCA2-B2	SCH.40 PVC	2-1/2"
SCA2-B22	CTRL HSE	SCA2-B2	SCH.40 PVC	2-1/2"
SCA2-254	SCA2-B1	BKR 254	SCH.40 PVC	2-1/2"
SCA2-264	SCA2-B1	BKR 264	SCH.40 PVC	2-1/2"
SCA2-274	SCA2-B1	BKR 274	SCH.40 PVC	2-1/2"
SCA2-284	SCA2-B1	BKR 284	SCH.40 PVC	2-1/2"
SCA3-214	BKR 214	CTRL HSE	SCH.40 PVC	2-1/2"
SCA3-224	BKR 224	CTRL HSE	SCH.40 PVC	2-1/2"
SCA3-234	BKR 234	CTRL HSE	SCH.40 PVC	2-1/2"
SCA3-244	BKR 244	CTRL HSE	SCH.40 PVC	2-1/2"
SCA3-254	BKR 254	CTRL HSE	SCH.40 PVC	2-1/2"
SCA3-264	BKR 264	CTRL HSE	SCH.40 PVC	2-1/2"
SCA3-274	BKR 274	CTRL HSE	SCH.40 PVC	2-1/2"
SCA3-284	BKR 284	CTRL HSE	SCH.40 PVC	2-1/2"

*** (SP) indicates a spare conduit. ***

CONDUIT SCHEDULE

CONDUIT DESIGNATION	CIRCUIT FROM	CIRCUIT TO	CONDUIT TYPE	CONDUIT SIZE
AC-CH	AC PNL (CTRL HSE)	TRANSFER SWITCH	SCH.40 PVC	2-1/2"
AC-SS1	AC PANEL B1 (YARD)	STA. SERVICE XFMR #1	SCH.40 PVC	2-1/2"
AC-B1	AC PANEL B1 (YARD)	TRANSFER SWITCH	SCH.40 PVC	2-1/2"
AC-T1	AC PANEL B1 (YARD)	POWER XFMR #1	SCH.40 PVC	2-1/2"
AC-214	AC PANEL B1 (YARD)	BKR 214	SCH.40 PVC	1-1/2"
AC-224	AC PANEL B1 (YARD)	BKR 224	SCH.40 PVC	1-1/2"
AC-234	AC PANEL B1 (YARD)	BKR 234	SCH.40 PVC	1-1/2"
AC-244	AC PANEL B1 (YARD)	BKR 244	SCH.40 PVC	1-1/2"
AC-SS2	AC PANEL B2 (YARD)	STA. SERVICE XFMR #2	SCH.40 PVC	2-1/2"
AC-B2	AC PANEL B2 (YARD)	TRANSFER SWITCH	SCH.40 PVC	2-1/2"
AC-T2	AC PANEL B2 (YARD)	POWER XFMR #2	SCH.40 PVC	2-1/2"
AC-254	AC PANEL B2 (YARD)	BKR 254	SCH.40 PVC	1-1/2"
AC-264	AC PANEL B2 (YARD)	BKR 264	SCH.40 PVC	1-1/2"
AC-274	AC PANEL B2 (YARD)	BKR 274	SCH.40 PVC	1-1/2"
AC-284	AC PANEL B2 (YARD)	BKR 284	SCH.40 PVC	1-1/2"
AC-912	AC PNL (CTRL HSE)	CKT SWR 912	SCH.40 PVC	2-1/2"
AC-914	AC PNL (CTRL HSE)	CKT SWR 914	SCH.40 PVC	2-1/2"
AC-922	AC PNL (CTRL HSE)	CKT SWR 922	SCH.40 PVC	2-1/2"
AC-924	AC PNL (CTRL HSE)	CKT SWR 924	SCH.40 PVC	2-1/2"
PC-B1	AC PANEL B1 (YARD)	B1 PHOTOCELL	SCH.40 PVC	1-1/2"
LT1	B1 PHOTOCELL	YARD LIGHT #1	SCH.40 PVC	1-1/2"
LT2	YARD LIGHT #1	YARD LIGHT #2	SCH.40 PVC	1-1/2"
LT3	YARD LIGHT #2	YARD LIGHT #3	SCH.40 PVC	1-1/2"
LT4	YARD LIGHT #3	YARD LIGHT #4	SCH.40 PVC	1-1/2"
PC-B2	AC PANEL B2 (YARD)	B2 PHOTOCELL	SCH.40 PVC	1-1/2"
LT5	B2 PHOTOCELL	YARD LIGHT #5	SCH.40 PVC	1-1/2"
LT6	YARD LIGHT #5	YARD LIGHT #6	SCH.40 PVC	1-1/2"
LT7	YARD LIGHT #6	YARD LIGHT #7	SCH.40 PVC	1-1/2"
TVA-M1	TVA TEST BOX #1	TVA B1 CT'S	SCH.40 PVC	1-1/2"
TVA-P1	TVA TEST BOX #1	TVA B1 PT'S	SCH.40 PVC	1-1/2"
TVA-M2	TVA TEST BOX #2	TVA B2 CT'S	SCH.40 PVC	1-1/2"
TVA-P2	TVA TEST BOX #2	TVA B2 PT'S	SCH.40 PVC	1-1/2"
TVA-MP1	TVA TEST BOX #1	TVA METER CABINET	SCH.40 PVC	2-1/2"
TVA-MP2	TVA TEST BOX #2	TVA METER CABINET	SCH.40 PVC	2-1/2"
TVA-SS1	AC PNL (CTRL HSE)	TVA METER CABINET	SCH.40 PVC	2-1/2"
TVA-FP1	CTRL HSE	TVA METER CABINET	SCH.40 PVC	2-1/2"
TVA-P3	MTEMC CHECK METER #1	TVA METER CABINET	SCH.40 PVC	2-1/2"
TVA-M11	MTEMC CHECK METER #1	TVA METER CABINET	SCH.40 PVC	2-1/2"

CONDUIT SCHEDULE

CONDUIT DESIGNATION	CIRCUIT FROM	CIRCUIT TO	CONDUIT TYPE	CONDUIT SIZE
SEC-1	CTRL HSE	SEC. TOWER #1	SCH.40 PVC	1-1/2"
SEC-2	CTRL HSE	SEC. TOWER #2	SCH.40 PVC	1-1/2"
SEC-3	CTRL HSE	SEC. TOWER #3	SCH.40 PVC	1-1/2"
SEC-4	CTRL HSE	SEC. TOWER #4	SCH.40 PVC	1-1/2"
SEC-5	CTRL HSE	SEC. TOWER #5	SCH.40 PVC	1-1/2"
TELCO-1	CTRL HSE	EXIT CKT POLE	SCH.40 PVC	2-1/2"
TELCO-2	CTRL HSE	EXIT CKT POLE	SCH.40 PVC	2-1/2"
CAM-1	CTRL HSE	STATIC POLE	SCH.40 PVC	2-1/2"
CAM-2	CTRL HSE	STATIC POLE	SCH.40 PVC	2-1/2"
CAM-3	CTRL HSE	STATIC POLE	SCH.40 PVC	2-1/2"

DATE	REVISION	BY

MTEMC

SANFORD RD SUBSTATION

CONDUIT SCHEDULE

SCALE: NTS
PREPARED BY: LDT
DRAWN BY: L.TAYLOR
CHECKED BY: LDT

APPROVED

DRAWING NO. SAN-070

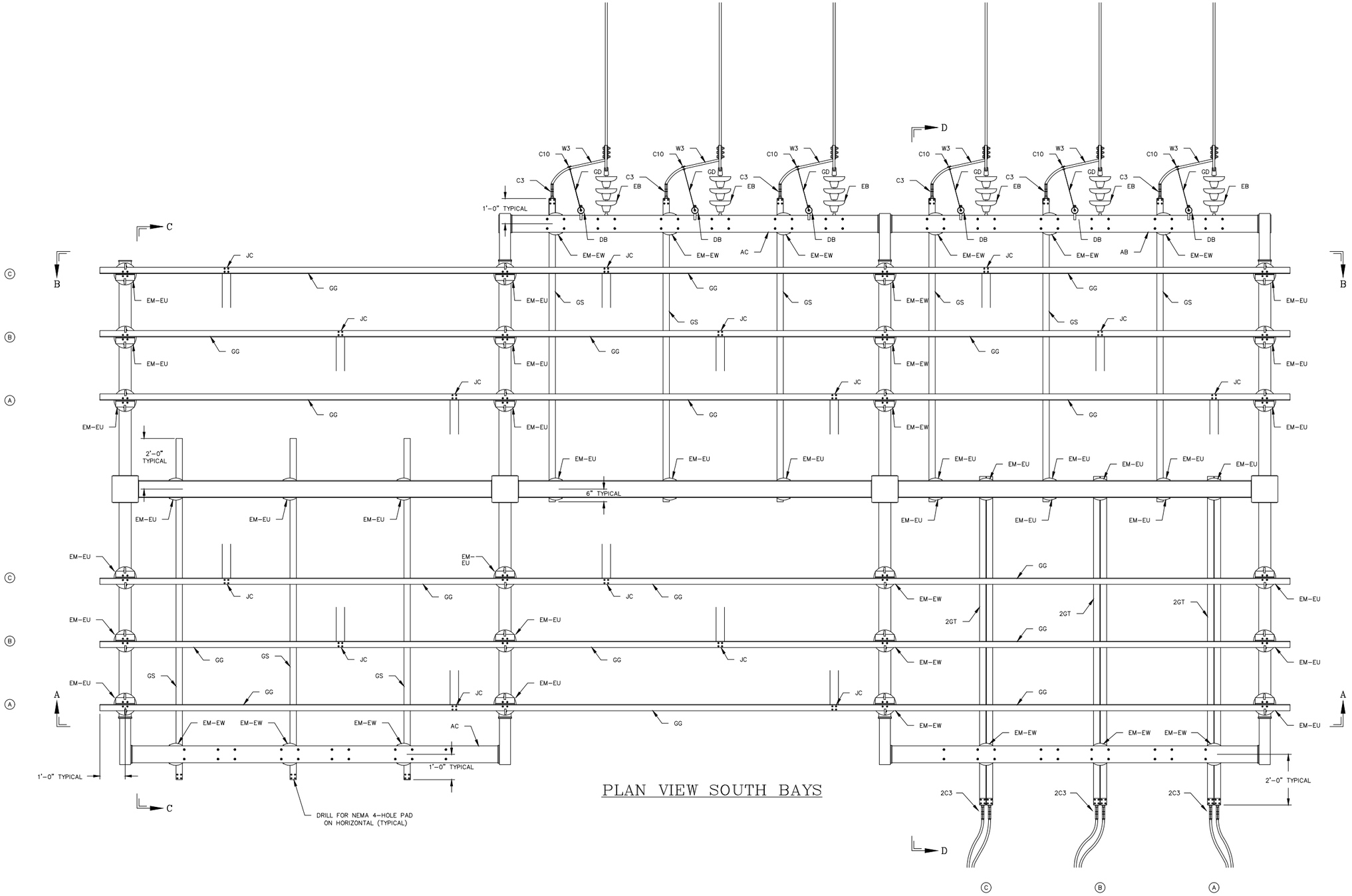
DATE AUG. 22, 2023

SHEET 4 OF 4 SHEETS

Exhibit E

Typical Distribution Bay Details

(LAK-100)



PLAN VIEW SOUTH BAYS

DATE	REVISION	BY

MTEMC

LAKEVIEW SUBSTATION

DISTRIBUTION BAYS PLAN, SECTION, AND ELEVATION VIEWS

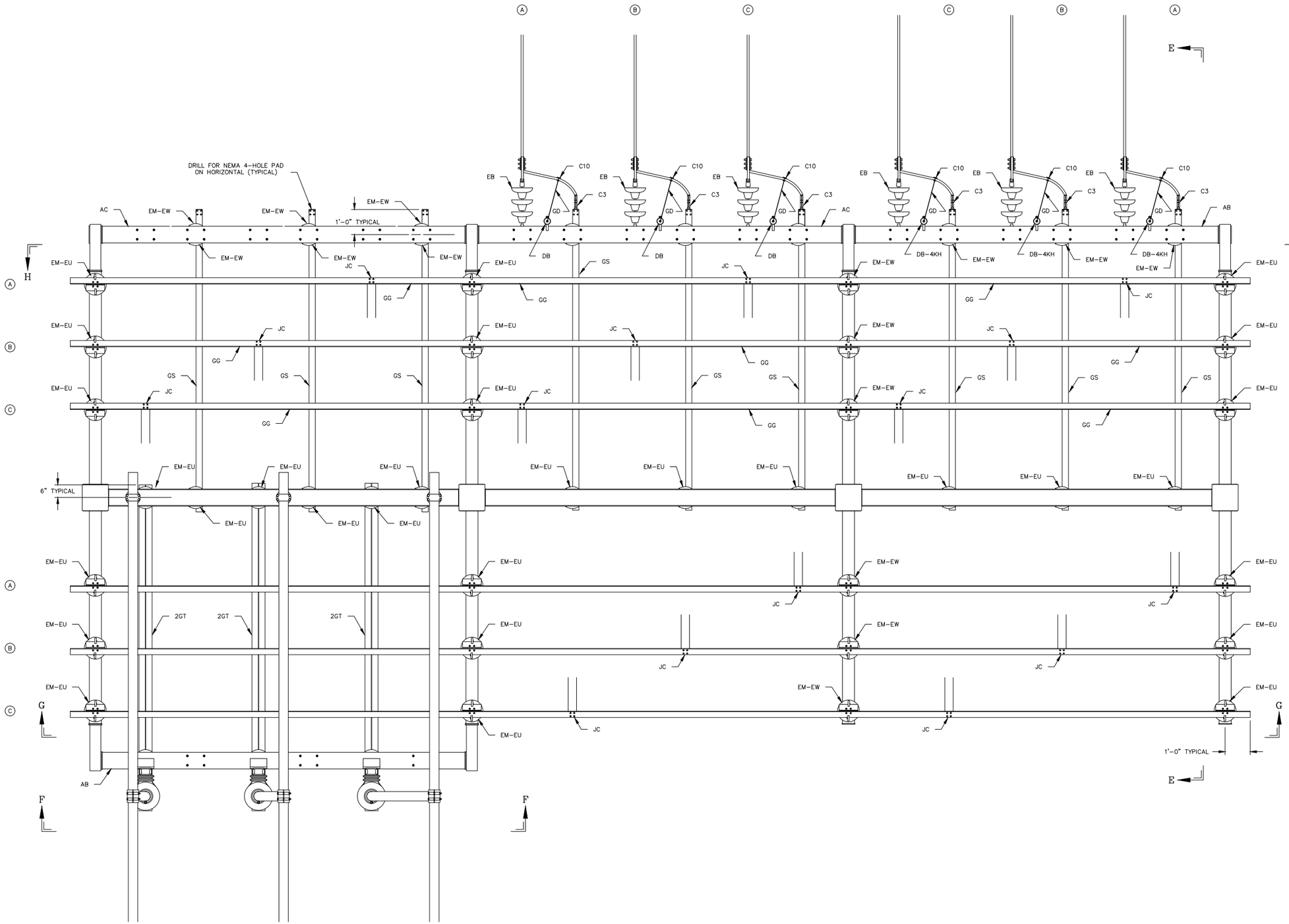
SCALE: 1/2" = 1'–0"
PREPARED BY:
DRAWN BY: B. Blarry
CHECKED BY: KAM

APPROVED

DRAWING NO. LAK–100

DATE DEC. 23, 1993

SHEET 1 OF 8 SHEETS



PLAN VIEW NORTH BAYS

1" = 2'-0"

DATE	REVISION	BY

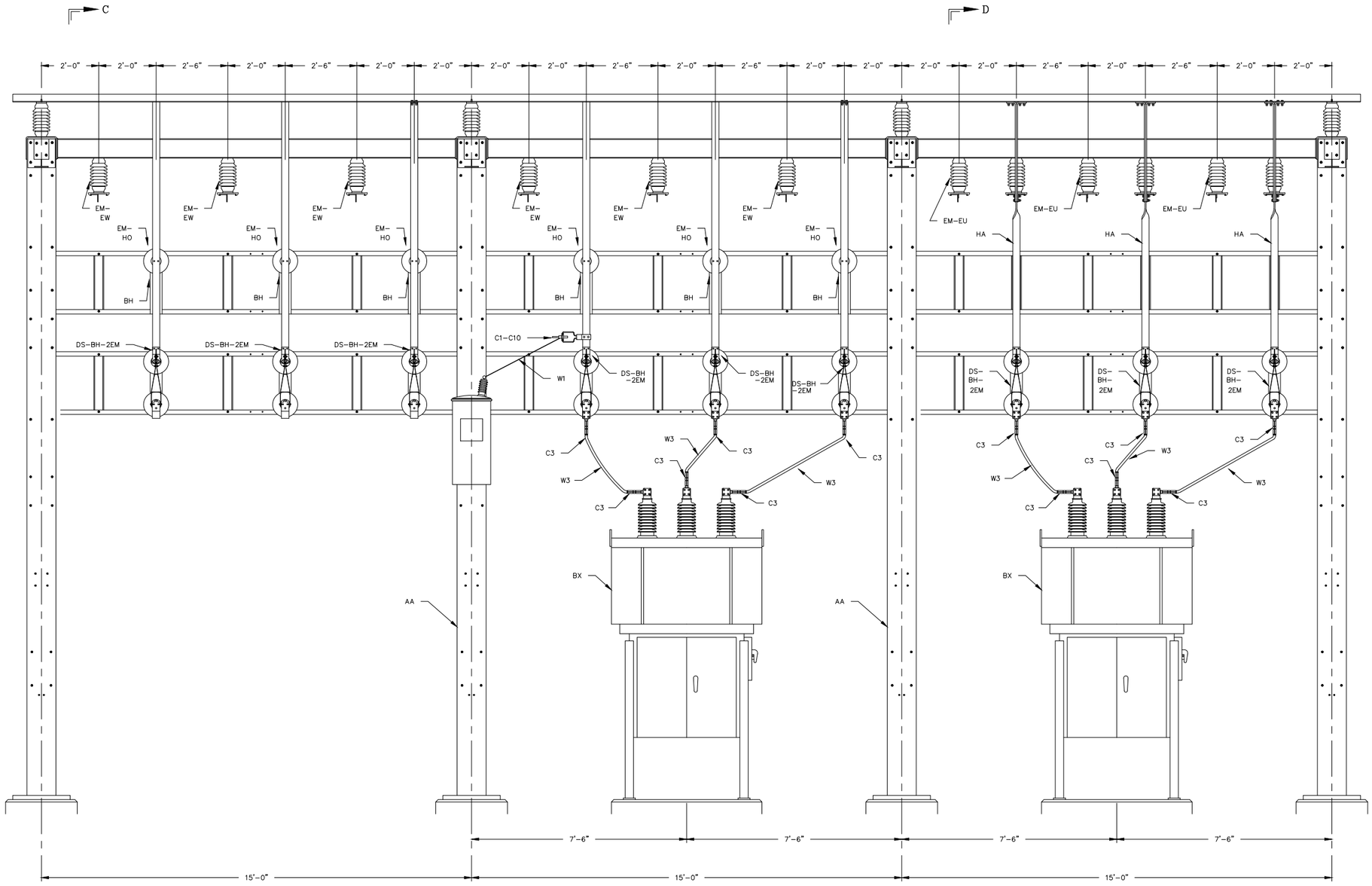
MTEMC

LAKEVIEW SUBSTATION
DISTRIBUTION BAYS PLAN,
SECTION, AND ELEVATION VIEWS

SCALE: 1/2" = 1'-0"
PREPARED BY:
DRAWN BY: R. Blarry
CHECKED BY: KAM

APPROVED
DRAWING NO. LAK-100

DATE DEC. 23, 1993
SHEET 2 OF 8 SHEETS



SECTION A–A

SOUTH BAYS

1" = 2'–0"

DATE	REVISION	BY

MTEMC

LAKEVIEW SUBSTATION
DISTRIBUTION BAYS PLAN,
SECTION, AND ELEVATION VIEWS

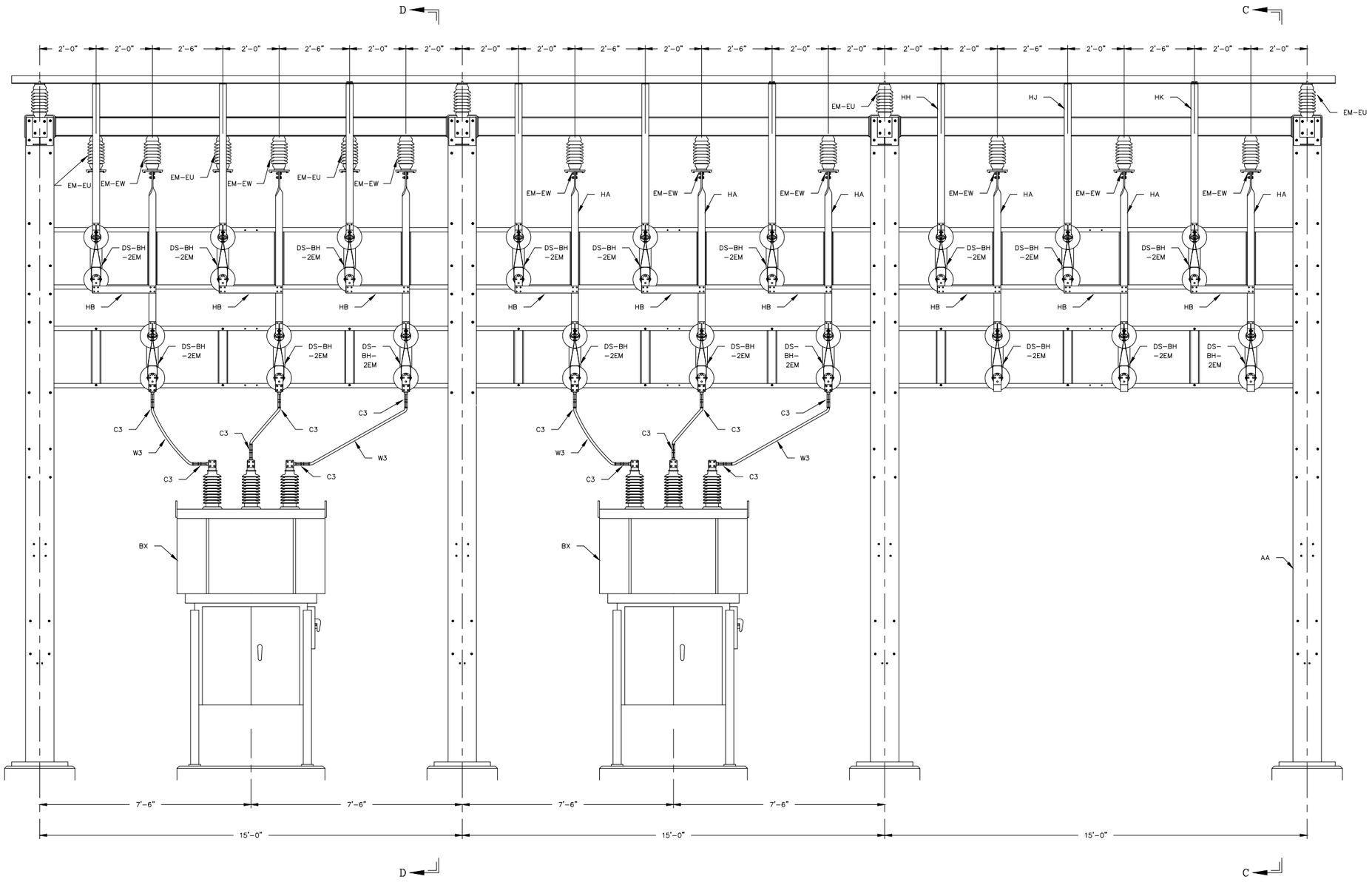
SCALE: 1/2" = 1'–0"
PREPARED BY:
DRAWN BY: E. Blarry
CHECKED BY: KAM

APPROVED

DRAWING NO.
LAK–100

DATE
DEC. 23, 1993

SHEET 3
OF 8 SHEETS



SECTION B-B

SOUTH BAYS

1" = 2'-0"

DATE	REVISION	BY

MTEMC

LAKEVIEW SUBSTATION
DISTRIBUTION BAYS PLAN,
SECTION, AND ELEVATION VIEWS

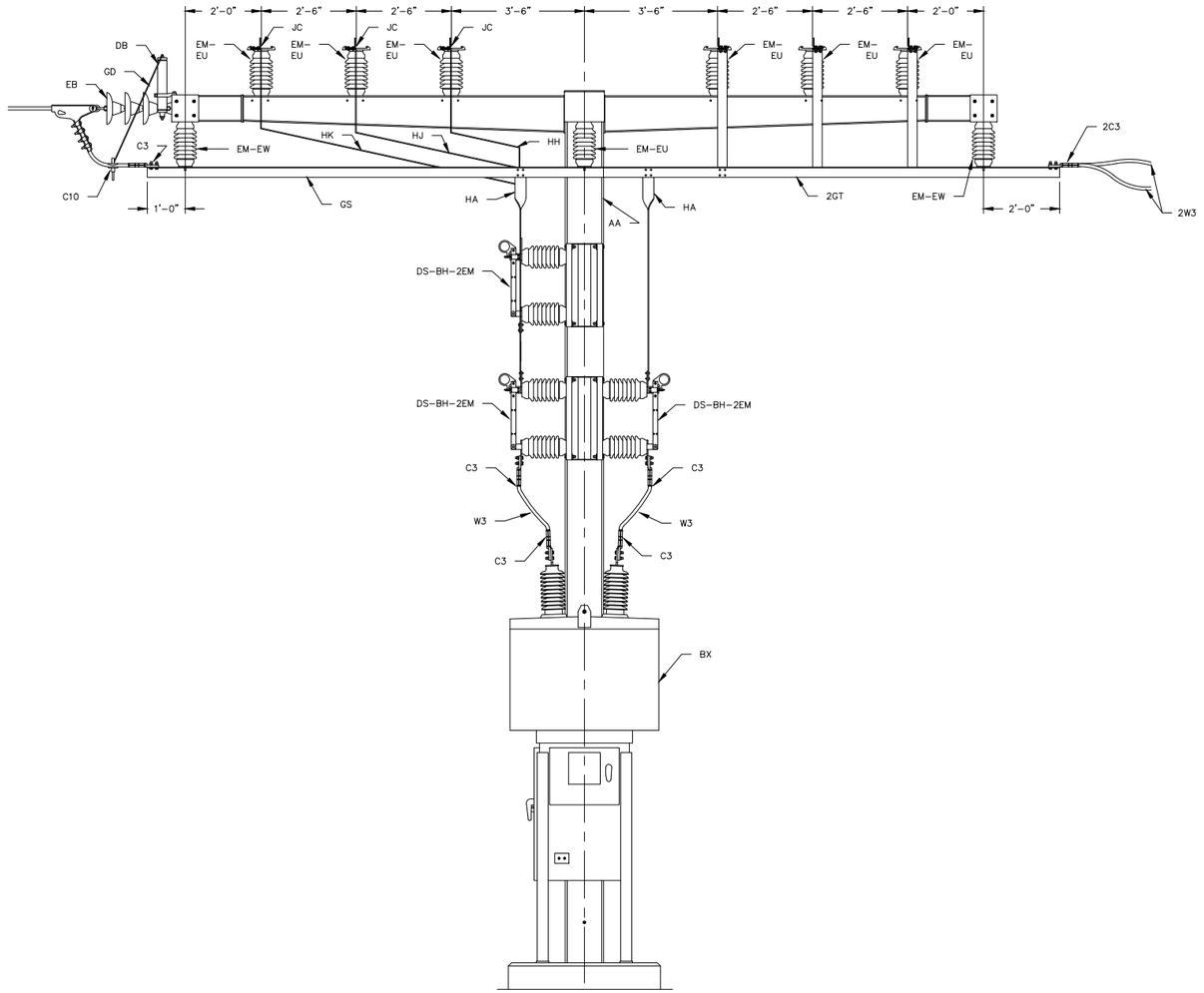
SCALE: 1/2" = 1'-0"
PREPARED BY:
DRAWN BY: E. Glarey
CHECKED BY: KAM

APPROVED

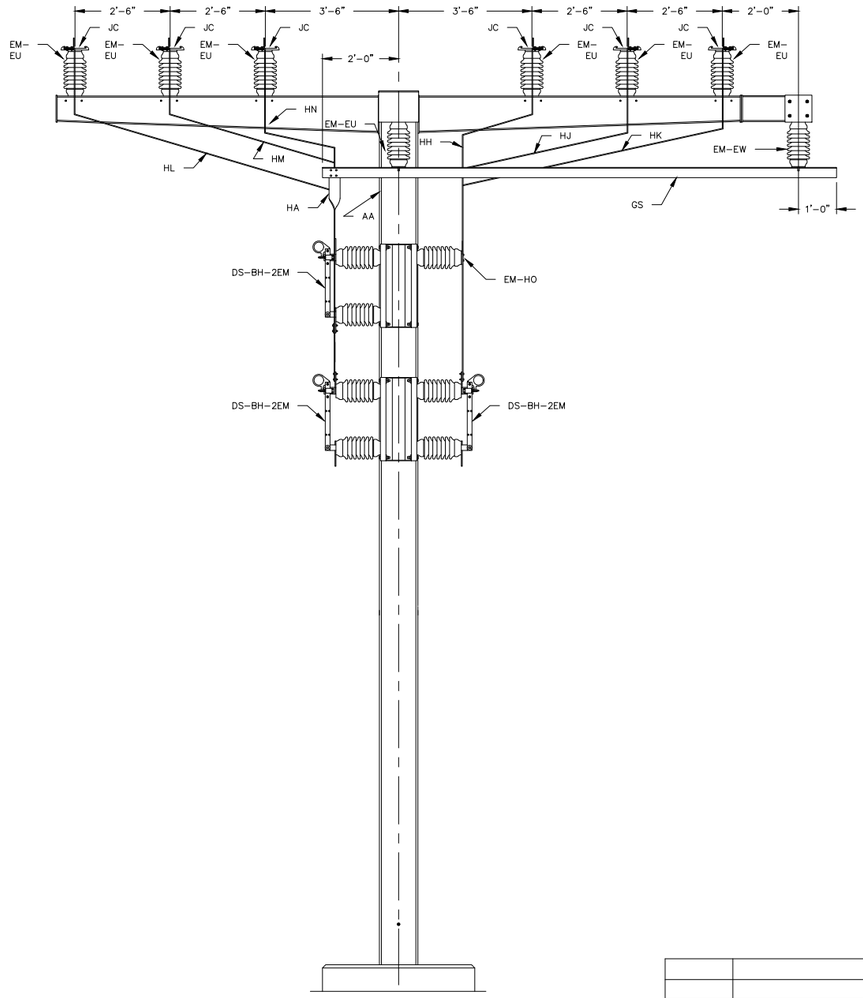
DRAWING NO.
LAK-100

DATE
DEC. 23, 1993

SHEET 4
OF 8 SHEETS



SECTION D–D



SECTION C–C

SOUTH BAYS

NOTES:

1. THIS DRAWING FOR WESTINGHOUSE V.C.B. 38 KV.

DATE	REVISION	BY

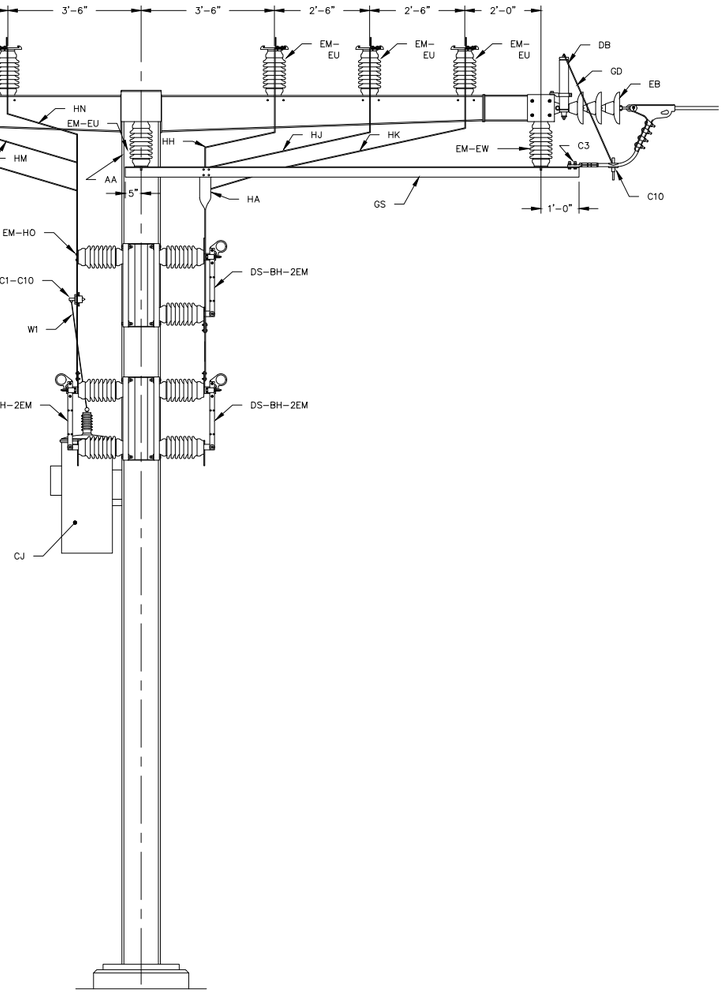
MTEMC

LAKEVIEW SUBSTATION
DISTRIBUTION BAYS PLAN,
SECTION, AND ELEVATION VIEWS

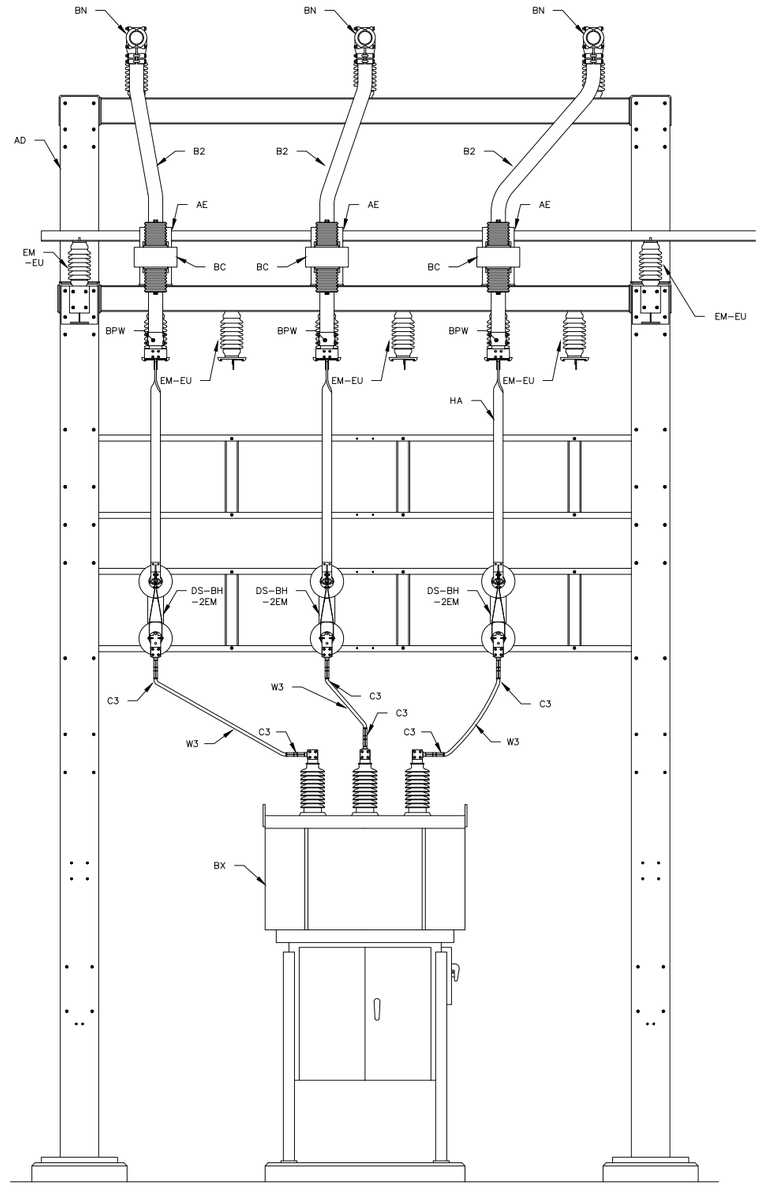
SCALE: 1/2" = 1'–0"
PREPARED BY:
DRAWN BY: E. Blarry
CHECKED BY: KAM

APPROVED
DRAWING NO. LAK–100

DATE DEC. 23, 1993
SHEET 5 OF 8 SHEETS



SECTION E-E



SECTION F-F

NORTH BAYS

DATE	REVISION	BY

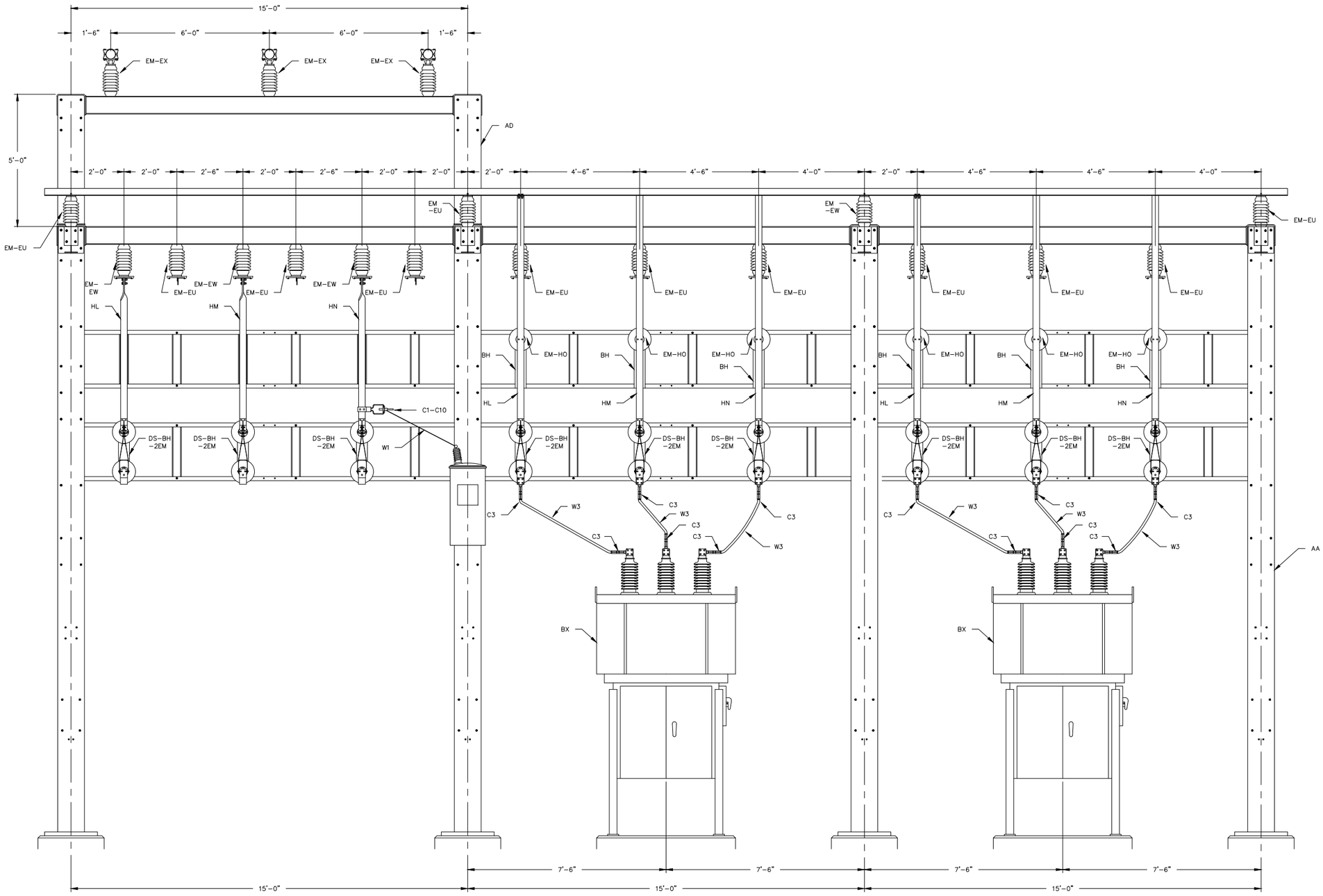
MTEMC

LAKEVIEW SUBSTATION
DISTRIBUTION BAYS PLAN,
SECTION, AND ELEVATION VIEWS

SCALE: 1/2" = 1'-0"
PREPARED BY:
DRAWN BY: B. Blarry
CHECKED BY: KAM

APPROVED
DRAWING NO. LAK-100

DATE DEC. 23, 1993
SHEET 6
OF 8 SHEETS



SECTION G-G

NORTH BAYS

1" = 2'-0"

DATE	REVISION	BY

MTEMC

LAKEVIEW SUBSTATION
DISTRIBUTION BAYS PLAN,
SECTION, AND ELEVATION VIEWS

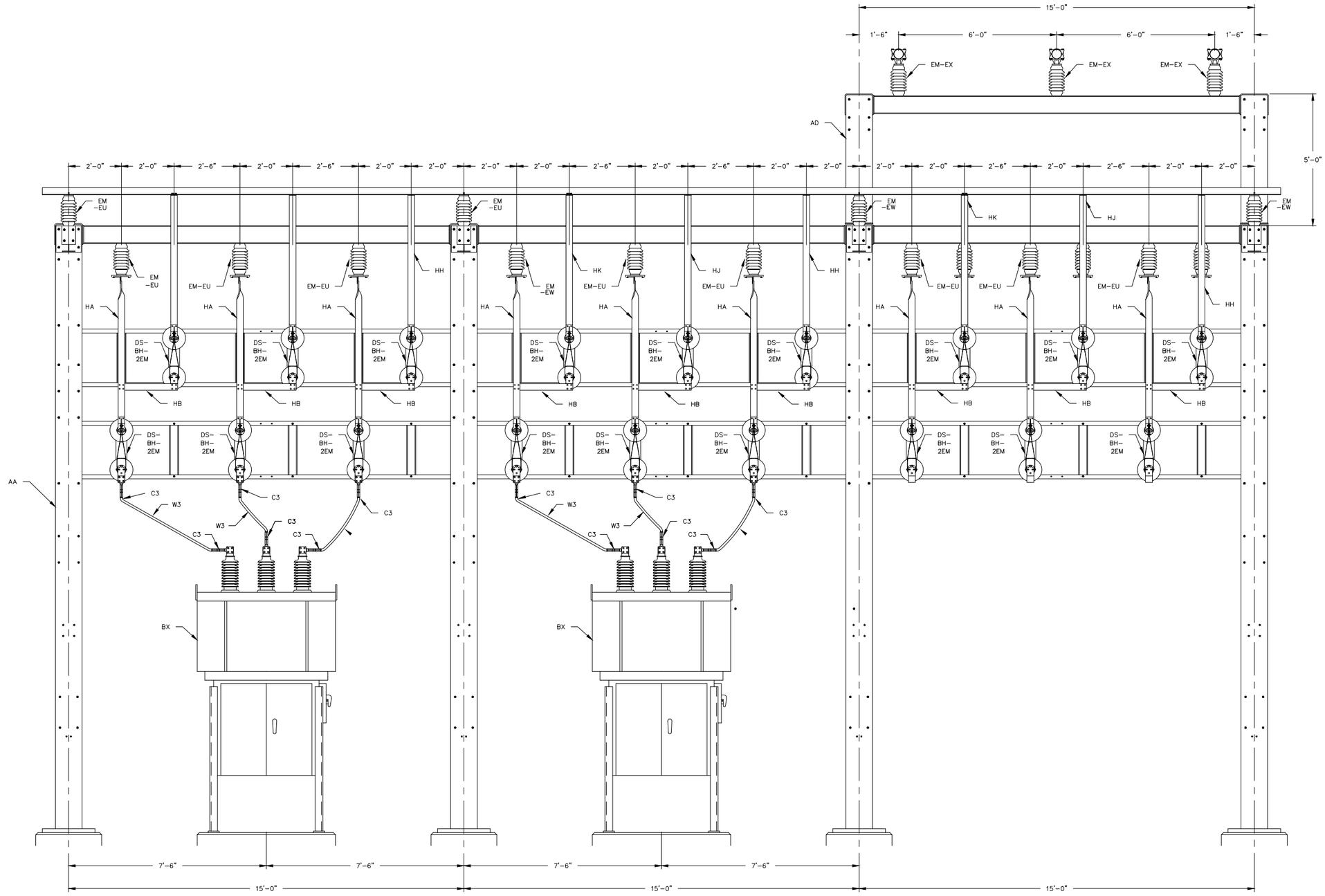
SCALE: 1/2" = 1'-0"
PREPARED BY:
DRAWN BY: R. Blarry
CHECKED BY: KAM

APPROVED

DRAWING NO.
LAK-100

DATE
DEC. 23, 1993

SHEET 7
OF 8 SHEETS



SECTION H-H

NORTH BAY

1" = 2'-0"

DATE	REVISION	BY

MTEMC

LAKEVIEW SUBSTATION
DISTRIBUTION BAYS PLAN,
SECTION, AND ELEVATION VIEWS

SCALE: 1/2" = 1'-0"
PREPARED BY:
DRAWN BY: R. Blarry
CHECKED BY: KAM

APPROVED

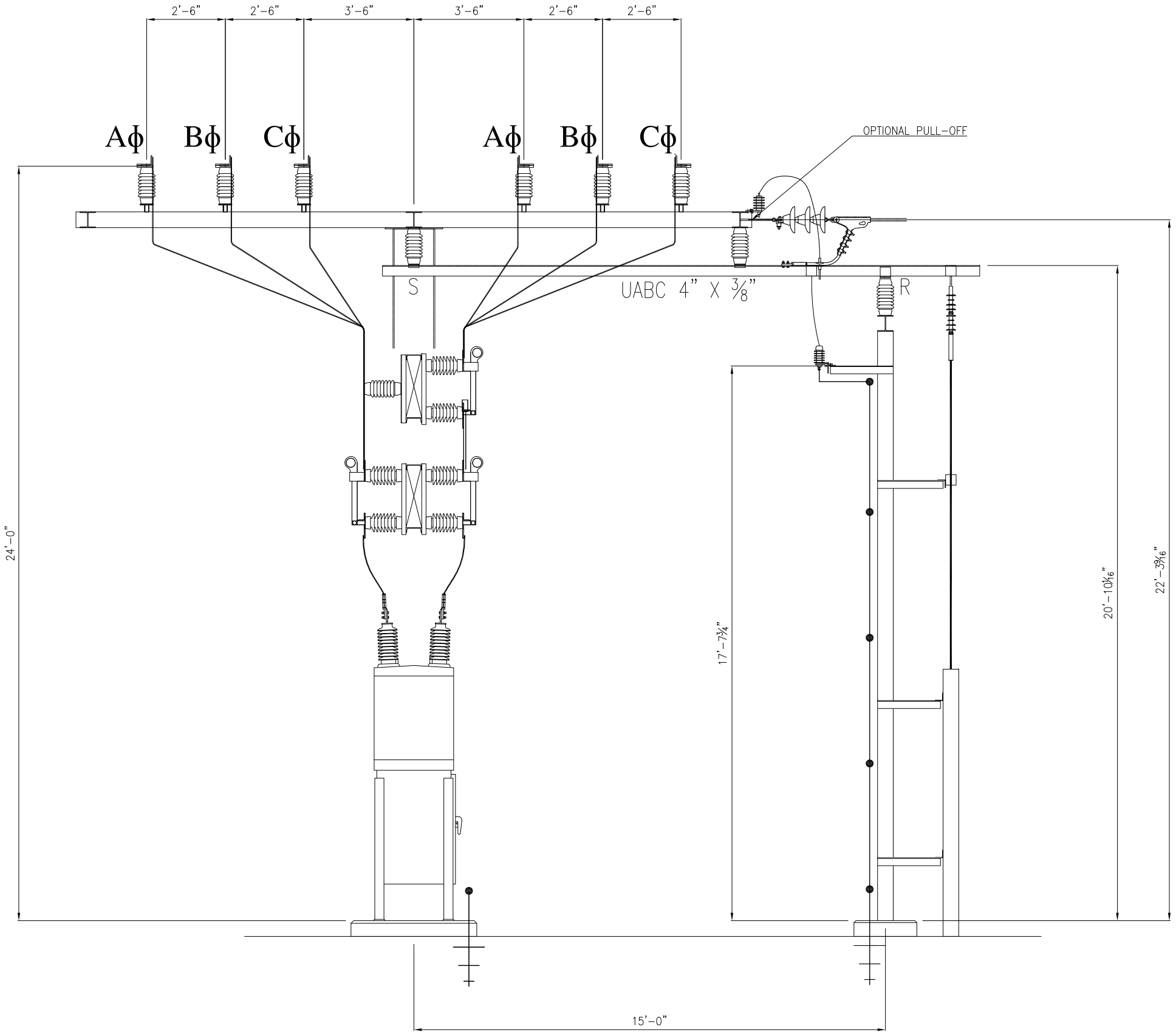
DRAWING NO.
LAK-100

DATE
DEC. 23, 1993

SHEET 8
OF 8 SHEETS

Exhibit F

Riser Structure and Underground Exit Circuit Details



DATE	REVISION	BY

MTEMC

BARFIELD SUBSTATION

RISER STRUCTURE DETAILS (TYPICAL)

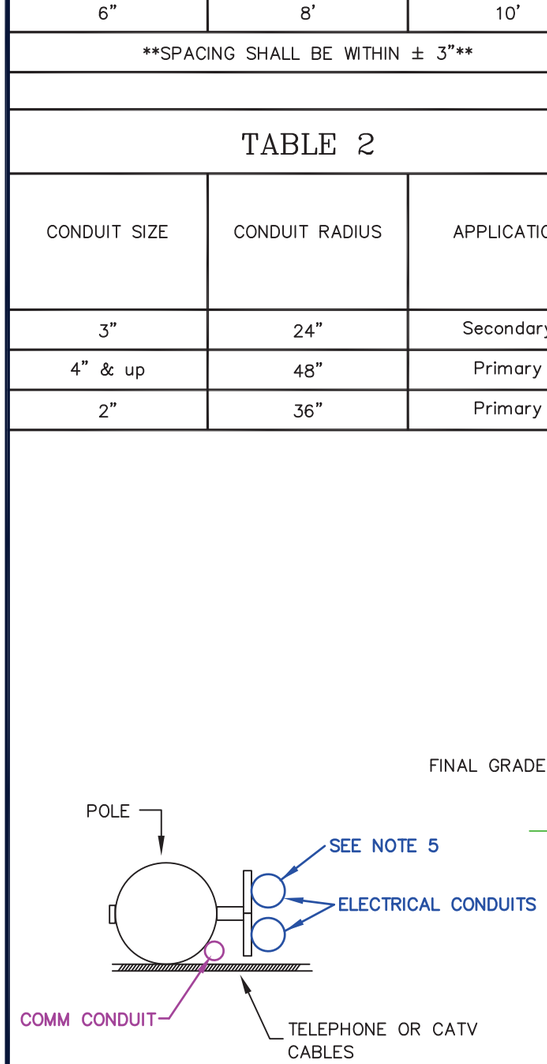
SCALE: NTS	APPROVED	DATE APRIL 10, 2025
PREPARED BY: AKF	DRAWING NO. BAR-100	SHEET 1
DRAWN BY: A FERREE		OF 1 SHEETS
CHECKED BY: AKF		

TABLE 1

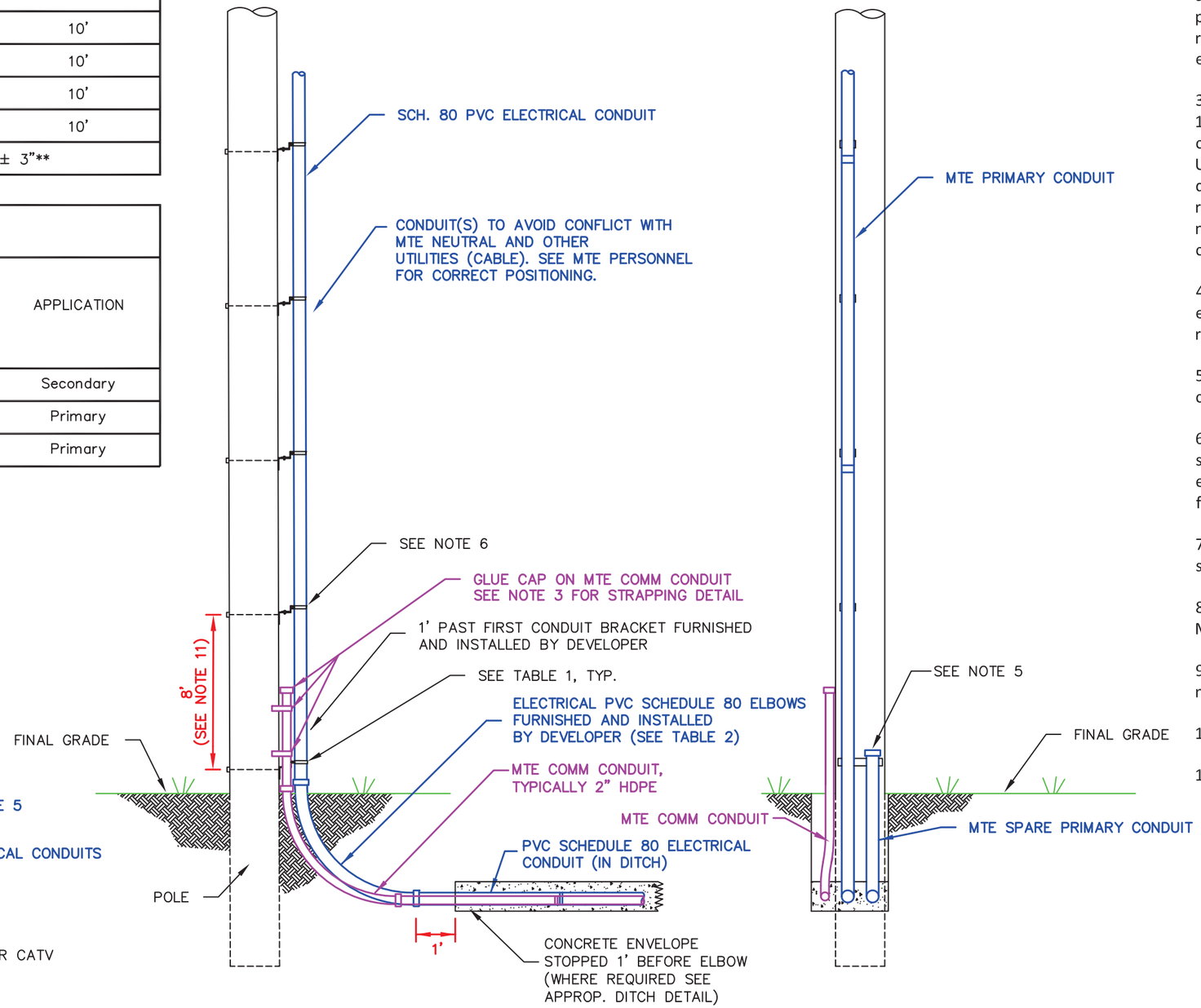
CONDUIT SIZE	CONDUIT CONTAINING CUSTOMER OWNED WIRING SUPPORT SPACING	CONDUIT CONTAINING MTE OWNED WIRING SUPPORT SPACING
2"	5'	10'
2½" – 3"	6'	10'
3½" – 5"	7'	10'
6"	8'	10'
SPACING SHALL BE WITHIN ± 3"		

TABLE 2

CONDUIT SIZE	CONDUIT RADIUS	APPLICATION
3"	24"	Secondary
4" & up	48"	Primary
2"	36"	Primary



PLAN VIEW



SIDE ELEVATION

FRONT ELEVATION

Notes:

1. See ditch details elsewhere in these specifications for ditch dimensions and requirements.

2. Prior to any excavation closer than 3' to the pole, the developer shall provide 24 hours notice to MTE to arrange for MTE inspector to be present during excavation. Work shall be arranged such that the required encasement and backfill will take place the same day as excavation.

3. Developer shall furnish and install schedule 80 PVC riser conduit 12" above the first MTE bracket. Also, glue appropriate cap on top of conduit. All electrical conduit shall meet NEMA TC-2, WC 1094A, and UL651 Specs. Comm conduit shall be furnished and installed by the developer. All 2" comm conduit shall be HDPE SDR 13.5 orange with a red stripe. Comm conduit to be run 3' up pole above final grade. A minimum of ½" stainless steel straps shall be used to strap the comm conduit to the pole approximately 12" and 30"above final grade.

4. Above the developer supplied and installed electrical conduit that ends 12" above the lowest bracket, MTE will provided and install the remaining riser conduit.

5. Developer shall glue cap on any spare elbows and all comm conduit. It must be a cap; tape will not be approved.

6. Conduit-to-pole brackets shall standoff conduit 4" from pole and shall be furnished and installed for 1' past lowest conduit bracket of electric riser conduit by the developer. See listed approved materials for the accepted brackets in Appendix B.

7. Conduit in the last 20' of ditch prior to meeting riser pole elbow shall be level in order for riser pole conduit to be plumb.

8. Developer must coordinate specific conduit risers location with MTE before installation is begun.

9. Long couplings as defined in Appendix B shall be used as necessary when splicing the gray electrical conduit.

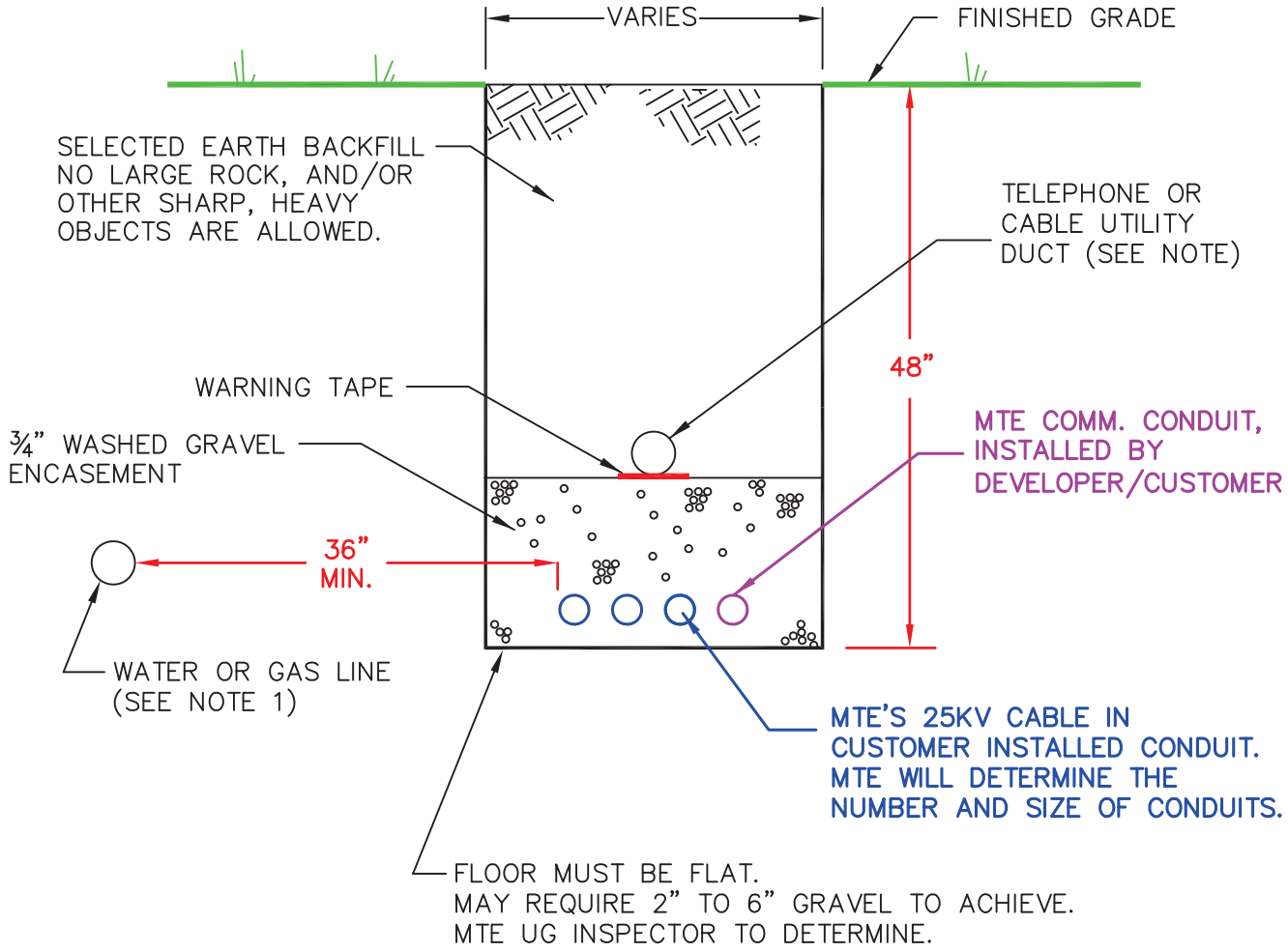
10. See Table 1 for conduit support spacing.

11. NESC requires 8' between bottom support two brackets.

Middle Tennessee Electric

RISER POLE CONDUIT INSTALLATION (TYPICAL)

DRAWING NUMBER:	REVISED DATE:
RP–1	JULY 1, 2023
	SCALE: NONE
	SHEET: 1 OF 1



Notes:

1. Conduits run horizontal to water or gas lines must have a minimum 36" horizontal separation.
2. Telephone or cable utility minimum separation from MTE ducts shall be either:
   a.) 36" parallel
   b.) 12" vertical
3. All foreign utility perpendicular crossings must have 12" minimum separation from MTE ducts.
4. Electrical conduit shall be gray PVC schedule 40 with long integeral bells. The size and number as specified by MTE and indicated on the plans. Long couplings as defined in Appendix B shall be used as necessary. Comm conduit shall be 2" HDPE SDR 13.5, orange with red stripe, for main comm line and mulit-drop conduits. Comm conduit is 1" PVC sch. 40 for single drops.
5. Install Jetline pull string with minimum 200 lb tensile strength in each conduit.
6. Omit telephone or catv utility duct requirement if not being installed.
7. If conductor is not to be initially installed in the duct bank, a #14 thhn cu tracer wire shall be installed inside one of the interior conduits or center conduit if an odd number of conduits are installed. If one end of the conduit is just a stub out 10 feet or longer, the tracer wire shall be bent back to the outside of the conduit and securely taped such that the wire can't be pulled out easily. There shall be 10' tails left in all enclosures for MTE to connect to ground. See MTE local engineering for questions.
8. Developer/owner is responsible for providing MTE a clean and obstruction free conduit system.

Middle Tennessee Electric

PRIMARY DITCH DETAIL

DRAWING NUMBER:	REVISED DATE:
2G	JAN. 2, 2023
	SCALE: NONE
	SHEET: 1 OF 1

Exhibit G

TVA Metering CT's and PT's

RITZ INSTRUMENT TRANSFORMERS, INC.

Instrument Transformers

Voltage Transformers

VEF 15-20 Single Pole
VZF 15-20 Double Pole

General Description

Ritz manufactures an extensive line of cast epoxy resin insulated transformers across the voltage range of 5.5 kV to 72.5 kV. This brochure describes outdoor Voltage Transformers in the 15kV class with performance ratings coinciding with industry standard product offerings. Ritz, because of product depth, familiarity with international standards and custom design capability can also design a solution to your specific needs.

Construction

The core and coil assembly is encapsulated in cycloaliphatic epoxy resin in a single process, performed under vacuum, using the pressure gelation method. The resin color is grey. Brown is available by special order. Epoxy resin was chosen because of its excellent tracking resistance, high mechanical strength, ability to withstand ultraviolet radiation, superior weathering characteristics and its noncumbustibility.

Primary Terminals

Primary line terminals are tin plated copper studs with connectors capable of accommodating #10 to #1 AWG conductor. The H2 neutral terminal on single bushing models is insulated to withstand a 19 kV test level. Line terminals are detachable so that alternate terminal configurations can be considered.

Secondary Terminals

Secondary terminals are bronze clamp type with a large diameter hole. A ground terminal is also provided for grounding of the secondaries at the transformer.

Terminal Box

The cast aluminum terminal box has one inch conduit hubs on both ends and a knock out for a one inch conduit fitting on the bottom. The box is attached to the transformer body by four bolts in an industry standard pattern and can easily be detached, simplifying change out procedures.

Base Plate

The base is made of marine grade aluminum and is securely attached to the transformer body. Industry standard mounting dimensions and a single hole ground pad 90° to the mounting plate are provided.

Nameplates

Nameplate data is engraved on blackened stainless steel plates.

Mounting

The transformers can be mounted in the horizontal, vertical or suspended position.

Tests

Routine tests in compliance with IEEE are standard. In addition internal partial discharge is performed as a routine test with acceptance criteria of < 20pC at 1.2Vm/√3 and <50pC at 1.2 VM. Test cards are included with each unit.

Commissioning and Maintenance

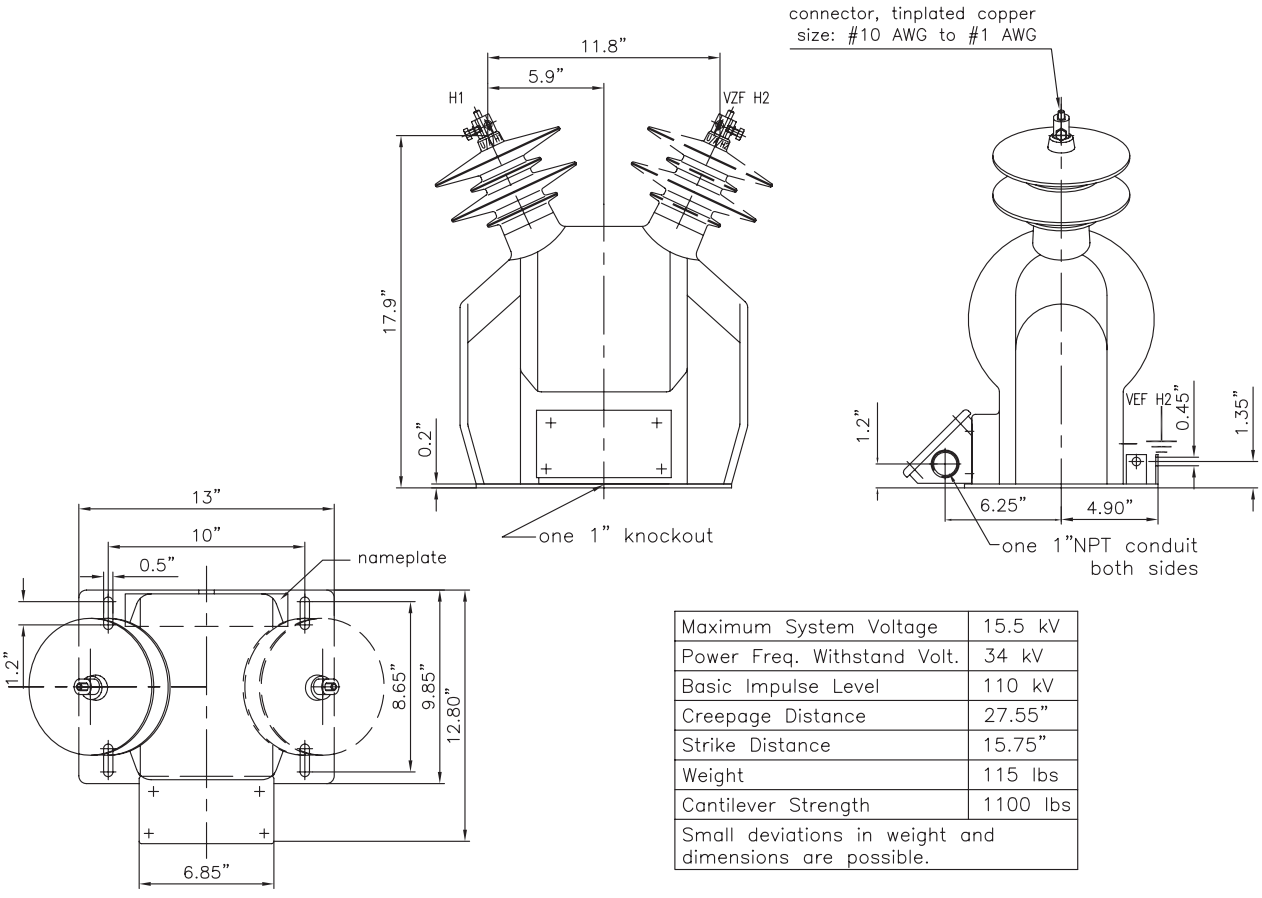
Transformers are supplied ready for service. No special tools are required. Instruction manuals are provided with each shipment. Periodic wiping down of the units with silicone grease is recommended.

Voltage Transformer Type: VEF 15-20

Primary Voltage (V)	Winding Ratio	Catalog Number	IEEE Accuracy Class, 60HZ	Thermal Rating (VA)
7200/12470 GY	60:1	122031010 60305	0.3WXYZ	1500
8400/14400 GY	70:1	122031010 60306	0.3WXYZ	1500

Voltage Transformer Type: VZF 15-20

Primary Voltage (V)	Winding Ratio	Catalog Number	IEEE Accuracy Class, 60HZ	Thermal Rating (VA)
7200/12470 Y	60:1	122030010 60320	0.3WXYZ	1500
7620/13200 Y	63.5:1	122030010 60321	0.3WXYZ	1500
8400/14400 Y	70:1	122030010 60322	0.3WXYZ	1500
12000/12000 Y	100:1	122030010 60323	0.3WXYZ	1500
13200/13200 Y	110:1	122030010 60324	0.3WXYZ	1500
14400/14400 Y	120:1	122030010 60325	0.3WXYZ	1500



Maximum System Voltage	15.5 kV
Power Freq. Withstand Volt.	34 kV
Basic Impulse Level	110 kV
Creepage Distance	27.55"
Strike Distance	15.75"
Weight	115 lbs
Cantilever Strength	1100 lbs
Small deviations in weight and dimensions are possible.	

RITZ Instrument Transformers

RITZ INSTRUMENT TRANSFORMERS, INC.
25 Hamburg Avenue • Lavonia, GA 30553 USA
706-376-3769 • www.ritzusa.com
e-mail: info@ritzusa.com

SALES REPRESENTATIVE

RITZ INSTRUMENT TRANSFORMERS, INC.

Instrument Transformers

Current Transformer

GIFD 25-03

General Description

Ritz manufactures an extensive line of cast epoxy resin insulated transformers across the voltage range of 5.5 kV to 72.5 kV. This brochure describes outdoor window type Current Transformers for the 25kV class and below. The type GIFD is suitable for high current metering and relaying. Industry standard performance ratings are shown on the reverse page. Ritz, because of product depth, familiarity with international standards and custom design capability can also design a solution to your specific needs.

Construction

The toroidal core and winding assembly is encapsulated in cycloaliphatic epoxy resin in a single process, performed under vacuum, using the pressure gelation method. The resin color is grey. Brown is available by special order. Epoxy resin was chosen because of its excellent tracking resistance, high temperature rating, high mechanical strength, ability to withstand ultraviolet radiation, superior weathering characteristics and its noncombustibility.

Thermal & Dynamic Rating

Short time thermal rating is 100 times nominal current rating.

Dynamic short time rating is 2.5 times the thermal rating.

Primary Opening

The GIFD 25-03 has a window with a 5 inch diameter. It can also be purchased with an optional primary bar assembly kit with spade terminals.

Terminal Box

The cast aluminum terminal box has one inch conduit hubs on both ends and a knock out for a one inch conduit fitting on the bottom. The box is attached to the transformer body by four bolts in an industry standard pattern and can easily be detached, simplifying change out procedures.

Base Plate

The base is made of marine grade aluminum and is securely attached to the transformer body. Industry standard mounting dimensions and a single hole ground pad 90° to the mounting plate are provided.

Nameplates

Nameplate data is engraved on blackened stainless steel plates

Mounting

The transformers can be mounted in the horizontal, vertical or suspended position.

Tests

Routine tests in compliance with IEEE are standard. In addition internal partial discharge is performed as a routine test with acceptance criteria of < 20pC at 1.2Vm/√3 and <50pC at 1.2 Vm. Test cards are included with each unit.

Commissioning and Maintenance

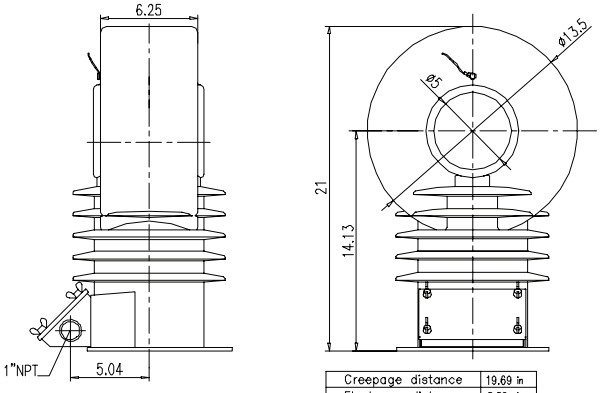
Transformers are supplied ready for service. No special tools are required. Instruction manuals are provided with each shipment. Periodic wiping down of the units with silicone grease is recommended.

CURRENT TRANSFORMER TYPE GIFD 25-03

Current Ratio	Catalogue Number	ANSI Accuracy Class 60 Hz		Rating Factor (at 55°C)
		Meter	Relay	
200:5	112053003 05500	0.3B-0.5	C50	2.0
300:5	112053003 05501	0.3B-1.0	C50	2.0
400:5	112053003 05502	0.3B-1.0	C100	2.0
600:5	112053003 05503	0.3B-1.8	C100	2.0
800:5	112053003 05504	0.3B-2.0	C200	2.0
1000:5	112053003 05505	0.3B-2.0	C200	2.0
1200:5	112053003 05506	0.3B-2.0	C200	2.0
1500:5	112053003 05507	0.3B-2.0	C400	2.0
2000:5	112053003 05508	0.3B-2.0	C400	2.0
2500:5	112053003 05509	0.3B-2.0	C400	2.0
3000:5	112053003 05510	0.3B-2.0	C600	2.0
4000:5	112053003 05511	0.3B-2.0	C600	1.5
5000:5	112053003 05512	0.3B-2.0	C800	1.5
200/400:5	112053003 05513	Tap 0.3B-0.5 Full 0.3B-0.9	Tap C40 Full C80	Tap 1.5 Full 1.5
300/600:5	112053003 05514	Tap 0.3B-0.9 Full 0.3B-1.8	Tap C50 Full C100	Tap 2.0 Full 2.0
400/800:5	112053003 05515	Tap 0.3B-1.0 Full 0.3B-2.0	Tap C100 Full C200	Tap 2.0 Full 2.0
500/1000:5	112053003 05516	Tap 0.3B-1.0 Full 0.3B-2.0	Tap C100 Full C200	Tap 2.0 Full 2.0
600/1200:5	112053003 05517	Tap 0.3B-1.0 Full 0.3B-2.0	Tap C100 Full C200	Tap 2.0 Full 2.0
750/1500:5	112053003 05518	0.3B-2.0	Tap C200 Full C400	Tap 2.0 Full 2.0
800/1600:5	112053003 06806	0.3B-2.0	Tap C200 Full C400	Tap 2.0 Full 2.0
1000/2000:5	112053003 05519	0.3B-2.0	Tap C200 Full C400	Tap 2.0 Full 2.0
1500/3000:5	112053003 05520	0.3B-2.0	Tap C200 Full C400	Tap 2.0 Full 2.0
2000/4000:5	112053003 05521	0.3B-2.0	Tap C400 Full C800	Tap 2.0 Full 1.5
2500/5000:5	112053003 05522	0.3B-2.0	Tap C400 Full C800	Tap 2.0 Full 1.5
1000:5	112053003 05525	0.15B-1.8(ER)1% to 150% Irated	----------	1.5
2000:5	112053003 05526	0.15B-1.8(ER)1% to 150% Irated	----------	1.5

TYPE: GIFD 25-03

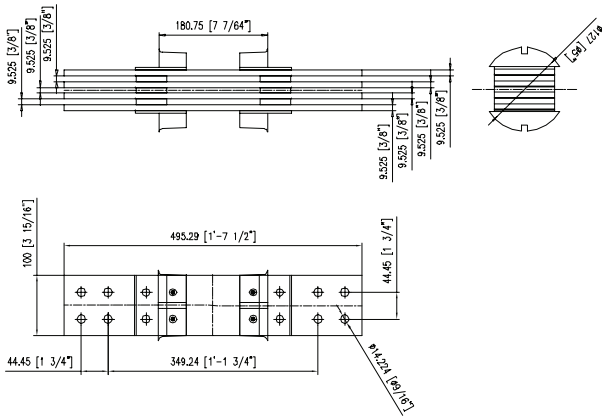
Cast-resin-outdoor-current-transformer, Um = 25.5 kV

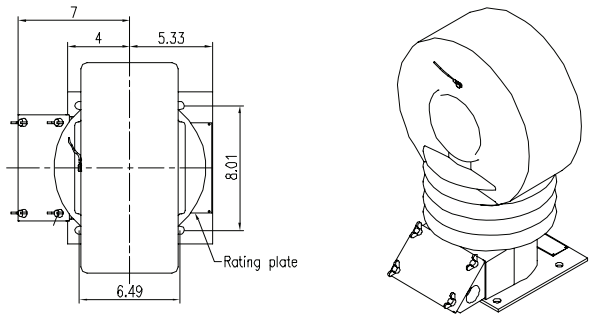


Creepage distance	19.69 in
Flashover distance	6.89 in
Weight approx.	60 lbs.

All dimensions in inches.
Small deviations in dimensions and construction possible !

GIFD 25-03
busbar, kit >4000A to 5000A





Optional Bus Bar Kit

Catalog Number	Current Rating (A)	Description
608122 36611	<1200	1 bar
608122 37611	>1200 to 2500	2 bars
608122 38611	>2500 to 4000	3 bars
608122 39611	>4000 to 5000	4 bars

RITZ INSTRUMENT TRANSFORMERS, INC.
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SALES REPRESENTATIVE

Exhibit H

Substation Equipment and Material Specifications

SPECIFICATIONS

SUBSTATION CIRCUIT SWITCHER SPECIFICATION

This specification gives the general requirements for a substation circuit switcher that will be used for transformer protection. All ratings specified shall be considered minimum. The bidders shall list all exceptions to this specification or specify that no exceptions exist.

The device shall be an outdoor substation type S&C Series 2030 circuit switcher, three pole single throw, rated 161 kV, 750 kV BIL, 1200 Amp, with a SF6 interrupter contact environment. The circuit switcher shall be capable of interrupting a minimum 20,000 amps symmetrical by ANSI standards.

The circuit switcher shall be equipped to group operate three phase candlestick interrupters electrically by remote or local control. Electric operation shall be arranged for control trip from 125 volts DC and control closing from 125 volts DC. Low SF6 gas alarm shall be provided for scada indication. Trip coil monitoring shall be provided with the circuit switcher.

The interrupter units shall be activated through a stored energy device.

The circuit switcher shall be provided with all standard accessories including, without limitation, the following:

1. Four(4) hole NEMA terminal pads suitable for either copper or aluminum connections.

2. Weatherproof mechanism housings containing the following:
   - 2.1. Motor operating mechanism
   - 2.2. Necessary auxiliary and cut-off switches
   - 2.3. Mechanically operated non-resettable operation counter
   - 2.4. Necessary wiring and terminal blocks
   - 2.5. Necessary heaters and thermostatic controls:
     The thermostatically controlled space heater shall be rated for single-phase 240 volts. It shall be sized so that it may function properly to prevent condensation when connected at 120 volts alternating current. **It is to be wired for 120 volt operation.**

3. Low profile, two column galvanized steel mounting frame, 12 feet high for 120 inch phase spacing. Anchor bolt setting plan shall be three(3) legs spaced 120 inches apart with the anchor bolts placed in a twenty(20) inch square pattern for each leg. Other leg designs must be included in the bid package.

4. NEMA standard copper faced frame grounding pad.

5. Standard assembly will be performed by the contractor.

6. A duplex receptacle with ground-fault circuit interrupter and convenience-light lampholder with switch located inside the operator enclosure is to be provided.

7. Complete sets of all drawings, wiring diagrams, descriptive data, and installation/maintenance instruction sheets pertaining to the circuit switcher and all associated equipment shall be mailed to the MTE Corporate Office with the shipment of the circuit switchers. There is also to be a complete set of drawings, wiring diagrams, descriptive data, and installation/maintenance instruction sheets in each circuit switcher. (Assuming they are identical circuit switchers, that means 4 total extra copies). A CD with a professional looking label is to be furnished containing all drawings, data, etc.

8. Approval Drawings shall be provided to MTE before the manufacture of the breaker. One set will be returned to the contractor/packager. Approval by MTE shall not relieve the contractor of the responsibility for the correctness of the drawings furnished by the contractor nor the compliance with the specifications, unless so stated by MTE at the time of approval.

9. Accepted manufacturer is S&C. No other manufacturer will be accepted. S&C is aware of MTE’s standard circuit switcher design.

All apparatus included under these specifications and supplied by the switch manufacturer shall be in accordance with the latest NEMA, ANSI, and IEEE standards.

This Specification is for 4 circuit switchers for MTE's Barfield Substation located in Murfreesboro, Tennessee. Two (2) circuit switchers for primary protection, and two (2) for backup protection.

161kV 1200 Amp Substation Disconnect Switch Specification

The switch shall be an outdoor type, group operated, airbreak switch, vertical break, three pole, single throw with the following minimum electrical requirements:

1200 Amps	Continuous current (30° C rise)
40,000 Amps	Momentary current
161 kV	Nominal Voltage
169 kV	MCOV
750 kV	BIL.

The switch shall be provided with all standard accessories without limitation to just the list below and all options in the list below.

1. The switch shall operate by means of a crank type control with adjustable mounting height. The crank shall be lockable in either the closed or open position by means of a pad lock.

2. A full fault rated flexible ground strap shall be attached to either the control rod or control handle for bonding to the supporting structure.

3. All rotating parts shall use needle, roller, or ball bearings. All bearings shall be maintenance free for the life of the switch. Under no condition shall a bearing be part of the circuit or grounding path.

4. The control handle and control rod shall be able to be mounted to either leg of the switch supporting structure.

5. Arching horns shall be provided.

6. Blade contacts shall be silver welded to copper. Mating contacts shall be spring loaded for constant pressure. Blades shall engage using a rotating action.

7. Each pole shall be independently adjustable in position to ensure simultaneous closure.

8. Each insulator or bearing support shall have leveling screws so that each insulator may be aligned independently.

9. All ferrous material shall be either stainless steel or heavy galvanized.

10. Terminal pads shall be NEMA four(4) hole spacing and suitable for both copper and aluminum connections.

11. Approval drawings shall be provided to MTE prior to manufacture of the switch. Approval drawings will be returned to the contractor/packager with markups or notes. Approval by MTE shall not relieve the manufacturer of the responsibility for the correctness of the drawings furnished by the contractor nor the compliance with the specifications, unless so stated by MTE at the time of approval.

The switch shall be MindCore AVX16112, or an approved equivalent. Approval of any proposed equivalent must be obtained from MTE prior to submitting a proposal. Proposed equivalents shall be submitted to MTE a minimum of five (5) days prior to the proposal due date to be considered.

All apparatus included under this specification and supplied by the switch manufacturer shall be in accordance with the latest NEMA, ANSI, and IEEE standards. The switch shall be new and without defect.

The manufacturer/contractor/packager must include a list of any and all exceptions to this specification with the proposal. If there are not any exceptions, then this must also be stated in writing.

161kV 2000 Amp Substation Disconnect Switch Specification

The switch shall be an outdoor type, group operated, airbreak switch, upright mounted, vertical break, three pole, single throw with the following minimum electrical requirements:

2000 Amps	Continuous current (30° C rise)
100,000 Amps	Momentary current
164,000 Amps	Peak Withstand
161 kV	Nominal Voltage
169 kV	MCOV
750 kV	BIL.

This switch shall be supplied complete with mounting bases and all standard accessories. Additional features shall include the following:

1. The switch shall operate by means of a crank type control with adjustable mounting height. The crank shall be lockable in either the closed or open position by means of a pad lock.

2. A full fault rated flexible ground strap shall be attached to either the control rod or control handle for bonding to the supporting structure.

3. All rotating parts shall use needle, roller, or ball bearings. All bearings shall be maintenance free for the life of the switch. Under no condition shall a bearing be part of the circuit or grounding path.

4. Horizontal phase spacing shall be adjustable from eight(8) feet six(6) inches to twelve(12) feet zero(0) inches.

5. The control handle and control rod shall be able to be mounted to either leg of the switch supporting structure.

6. Quick Break Arching Horns (WHIP) shall be provided.

7. Blade contacts shall be silver welded to copper. Mating contacts shall be spring loaded for constant pressure. Blades shall engage using a rotating action.

8. Each pole shall be independently adjustable in position to ensure simultaneous closure.

9. Each insulator or bearing support shall have leveling screws so that each insulator may be aligned independently.

10. All ferrous material shall be either stainless steel or heavy galvanized.

11. Terminal pads shall be drilled for NEMA four(4) hole spacing and suitable for both copper and aluminum connections.

12. Approval drawings shall be provided to MTE prior to manufacture of the switch. Approval drawings will be returned to the manufacturer with markups or notes. Approval by MTE shall not relieve the manufacturer of the responsibility for the correctness of the drawings furnished by the contractor nor the compliance with the specifications, unless so stated by MTE at the time of approval.

The switch shall be MindCore AVX16120, or an approved equal. Approval of any proposed equivalent must be obtained from MTE prior to submitting a proposal. Proposed equivalents shall be submitted to MTE a minimum of five (5) days prior to the proposal due date to be considered.

All apparatus included under this specification and supplied by the switch manufacturer shall be in accordance with the latest NEMA, ANSI, and IEEE standards. The switch shall be new and without defect.

The manufacturer must include a list of any and all exceptions to this specification with the proposal. If there are not any exceptions, then this must also be stated in writing.

Each bidder shall provide temperature rise data for the switch that is bid. More than one switch may be bid if the manufacturer has more than one type of applicable switch. Bidders not previously approved shall also submit a users list with a contact name and phone number.

25 kV SUBSTATION SWITCH SPECIFICATIONS

25 kV Group Operated 2000 Amp Switch

Group operated disconnect switch, 23 kV, 2000 Amp, 100,000 amp momentary, 150 kV BIL, vertical break, aluminum current carrying parts, worm gear operating mechanism, 4 hole NEMA terminal pads suitable for both copper and aluminum connectors, with WHIP TYPE ARCHING HORNS. Southern States EV-2-232000 or an approved equivalent. Approval of any proposed equivalent must be obtained from MTE prior to submitting a proposal. Proposed equivalents shall be submitted to MTE a minimum of five (5) days prior to the proposal due date to be considered.

25 kV 1200 Amp Distribution Bay Switches

1200 Amp continuous loading (30° C maximum temperature rise), 23 kV, station class, outdoor, hook operated disconnect switch, vertical mounting, single blade, 61,000 Amps momentary loading, current carrying parts to be copper or bronze, all contact surfaces to be silver plated, terminal pads to be tin plated, terminal pads to be drilled four-hole NEMA standard, 90° blade stop. Southern States PBO23600 or an approved equivalent. Approval of any proposed equivalent must be obtained from MTE prior to submitting a proposal. Proposed equivalents shall be submitted to MTE a minimum of five (5) days prior to the proposal due date to be considered.

Substation Nuts, Bolts and Washer Standards For Bolted Bus Connections

Stainless Steel

Bolts

½ “ x “length” – 13 Stainless Steel hex bolts, class 2A, ASTM 304, Alloy (18-8)

Washers

½” Stainless Steal lock washer, ASTM 304

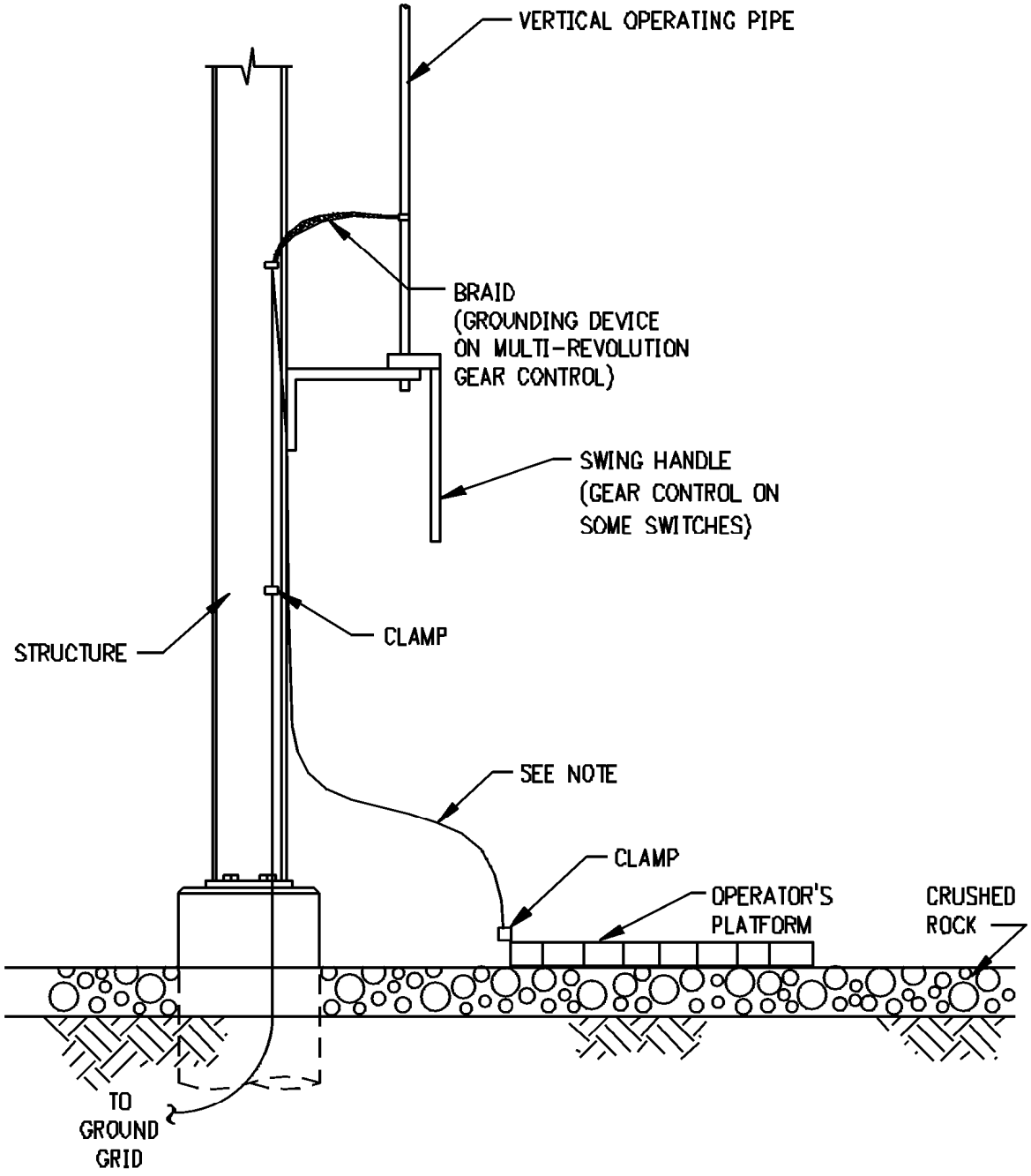
½” Stainless Steel Belleville washer, preset, 17-7 PH alloy, 1.063 outside diameter, 0.531” inside diameter, 0.109 thickness, 0.017 internal height, 3000 pounds load/flat (Key Belleville catalogue number K1063-E-10907)

Nuts

½” x 13 UNC Class 2B hex nut, silicon bronze, full hard (in accordance with ANSI/ASME B18.2.2 as last revised)

Exhibit I

Typical Switch Grounding



NOTE:
THIS CONDUCTOR HAS TO BE INSTALLED ABOVE GRADE FOR VISUAL INSPECTION DURING ROUTINE SUBSTATION MAINTENANCE.

Figure 9-37: Typical Switch Grounding

Exhibit J

Decorative Wall Specification

MODULAR CONNECTIONS CONCRETE WALL SPECIFICATIONS

1.1.0 Scope

1.1.1 The following specification covers design, materials, finish, sizes, maintenance and installation of Modular Concrete Wall Systems.

1.2.0 General

1.2.1 The panels and columns shall be solid, reinforced precast concrete.

1.3.0 Design

1.3.1 Panels shall be joined at concrete intermediate and corner columns.

1.3.2 The wall system shall be designed to withstand 30/06 rifle fire at 15' distance per UL 752 Level 4 standards (accredited testing required).

1.3.3 The wall system shall maintain a minimum 2hr fire rating based on 4" thick panels and will increase for the 6" thick panel to a 4hr rating per IBC 2009.

1.3.4 The system shall be designed to withstand storm conditions up to 100 miles per hour wind speed standard, assuming installed per Modular Connection specifications.

1.3.5 The concrete panels and columns structural calculations are based upon a minimum concrete compressive strength of 4500 PSI at 28 days. However, 5000PSI concrete shall be utilized in fabrication.

1.3.6 Lifting systems shall be integral in the fabrication process for easy lifting and placement of both the panels and columns of this system. Any required lifting brackets shall be provided by manufacturer and shall be returned upon project completion.

1.4.0 Materials

1.4.1 The precast concrete shall be designed in accordance with the "Building Code Requirements for Reinforced Concrete" (ACI 318-95) by the American Concrete Institute.

1.4.2 Reinforcing bar detailing, fabricating, and placing shall conform to the "ACI Standard: Details and Detailing of Concrete Reinforcement" (ACI 315-80, revised 1986) and the "Manual of Engineering and Placing Drawings for Reinforced Concrete Structures " (ACI 315R-80, revised 1988) by the American Concrete Institute. The most current editions of Concrete Reinforcing Steel Institute's "Reinforcing Bar Detailing" and "Placing Reinforcing Bars" may also be used.

1.4.3 Concrete reinforcement: Deformed bars – new billet steel complying with ASTM A615-87 including supplement S1 and having a minimum yield strength of 60,000 PSI. Welded wire fabric – smooth wire fabric complying with ASTM A185-85.

1.4.4 Splicing of reinforcing bars shall conform to the requirements of ACI 318-89 building code, sections 12.15, 12.16, and 12.17.

1.4.5 Anchors and inserts shall be structural steel and comply with ASTM A36.

1.5.0 Finish

1.5.1 The final aesthetic of the wall is TBD. For the purpose of this proposal, the finish of the panels shall be simulated split face block. The color and coating are undetermined at this point.

1.5.2 The structural column shall have a textured and painted finish unless otherwise specified by the end user prior to purchase.

1.5.3 Decorative banding and concrete accent finishes will be installed as per the approved design.

1.5.4 All components of the Modular Concrete Wall System shall arrive at the job site with the final finish complete and ready to assemble.

1.6.0 Sizes

1.6.1 Panel sections are to be 10’ in height and 6” thick. Panel section lengths will be determined by the final design of wall.

1.7.0 Gates

1.7.1 Gates systems shall be provided and installed by others.

1.8.0 Maintenance

1.8.1 Modular Concrete Fence System shall be virtually maintenance free. Adherence to maintenance procedures is required for coatings and anti-graffiti sealers per the original manufacturer’s guidelines.

1.9.0 Installation

1.9.1 Modular Concrete Fence System shall be installed by others according to installation directions provided by Manufacturer.

Exhibit K

Site Geotechnical Investigation Report

Report of Geotechnical Exploration

Middle Tennessee Electric (MTE)
New Substation
Barfield Road

Murfreesboro, Rutherford County, Tennessee

Prepared for
Ragan-Smith Associates, Inc.
Nashville, Tennessee

Prepared by:
TTL, Inc.
Nashville, Tennessee

Project No. 000230803410.00
July 16, 2024

July 16, 2024

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Mr. Eric M. Parl. P.E.
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RE: Report of Geotechnical Exploration
Middle Tennessee Electric (MTE) New Substation
Barfield Road near New Salem Highway
Murfreesboro, Rutherford County, Tennessee
TTL Project No. 000230803410.00

Dear Mr. Parl:

TTL, Inc. (TTL), is pleased to submit this Report of Geotechnical Exploration for the above-referenced project. Please contact us if you have questions regarding the report or if additional services are needed.

The enclosed report contains a brief description of the site conditions and our understanding of the project. The geotechnical recommendations in this report are based on our understanding of the proposed development, the results of our field exploration, and our experience with similar projects. Our overall scope of services for this project included performing environmental assessments of the site, and reports of those assessments have been submitted under separate covers.

We appreciate the opportunity to be of professional service during this phase of the project, and we look forward to working with you during construction.

Respectfully submitted,

TTL, Inc.

DOUGLAS O. BELL
REGISTERED ENGINEER
AGRICULTURE
COMMERCE
No. 00117767
STATE OF TENNESSEE

Douglas O. Bell, PE
Principal Engineer

Leanna S. Whitwell, PE
Regional Manager – Geotechnical Services

Attachments

CONTENTS

1.0 PROJECT INFORMATION

1.1 Project Description

Information about the project was provided by Mr. Parl (RS) in e-mail and telephone conversations since October 27, 2023. We received PDF file "MTE Evaluation 07.27.2023.pdf," which contains an untitled and undated drawing showing two site layout options for the MTE substation

Updated information was received from Mr. Parl (RS) on June 3, 2024. We received PDF file "2024.06.03 MTE Barfield 23-0331.pdf," which includes three preliminary civil design drawings of the substation prepared by RS.

Our understanding of the project is summarized in the table below.

Item	Description
Site Location	The site consists of about 4.4 acres of partly wooded property on the east side of Barfield Road and south of New Salem Highway in Murfreesboro, Tennessee. A Site Location Map is included in Appendix A.
Proposed Development	The project consists of constructing a new electrical substation. The substation will have space for two circuits, each including a transformer, switchgear, breakers, dead end towers, and other equipment.
Foundation Loads and Settlement Limits	We have not been provided with information about anticipated foundation loads or settlement limits.
Grading	Provided topographic information shows site grades range from elevation 600 feet (southwest) to elevation 588 feet (southeast) along the southern margin and from elevation 596 feet (northwest) to elevation 591 feet (northeast) across the northern margin, except for the pile of fill which has a peak elevation of about 618 feet. Refer to the Exploration Location Plan in Appendix A to see topographic contours of the site provided by RS. We understand site grading will generally include new fills across the site, except in the northeast quadrant of the substation where existing grades above planned grades. Fill thickness will generally be less than about 5 feet relative to existing grades across most of the site.
Pavements	Information suggests the substation will have a gravel surface that will only be used infrequently by service vehicles.

Please contact us if the above information is not correct so we can modify our proposal, if needed.

1.2 Authorization

This geotechnical exploration was authorized by an e-mail from Mr. Parl (RS) on June 3, 2024. The exploration was conducted in accordance with the terms and conditions of the "Standard Form of Agreement Between Ragan Smith and Consultant" dated February 24, 2022, between RS and TTL, and with TTL Proposal No. 000230803410.00, dated October 31, 2023.

1.3 Scope of Services

The scope of the exploration included 10 test pit excavations, earth electrical resistivity testing, geotechnical laboratory testing of selected samples, engineering analyses, and preparing this report.

Assessment of environmental conditions was beyond the scope of this geotechnical exploration, but the overall scope of our services on the project included environmental assessments for potential petroleum contamination, threatened and endangered species, and waters of the US. Our findings were reported under separate covers. As a result of a recommendation in our Phase I environmental site assessment report dated December 13, 2023, we also had an environmental professional observe the excavation of test pits into existing fill for indications of contaminants in the fill. Results of those observations were reported under separate cover on June 17, 2024.

2.0 EXPLORATION FINDINGS

2.1 Site Conditions

Item	Description
Existing Conditions	The site is currently undeveloped and partly wooded land with small- to medium diameter trees and underbrush. Two gravel driveways from Barfield Road cross the southern part of the site to provide access to a cellular communication tower located east of the site. An asphalt driveway turnout from Barfield Road provides access to the site and leads to a gravel path that crosses the site toward the east. The northeast quadrant of the site contains piles of existing fill with exposed limestone boulders and several truck wheels and tires along the edges of the piles. The piles extend up to about 22 feet above surrounding grades. We also observed construction and demolition debris, such as concrete curbs, sheets and rolls of welded wire fabric, and water meter covers on the ground surface.
Existing Topography	The ground surface at the site is relatively level, but a pile of fill covers the northeast quadrant of the property and rises as much as 22 feet above the surrounding grades, according to topographic contours on the provided civil drawings.

Photographs depicting general conditions of the study area at the time of our field activities are shown below.

View looking south from near the center of the site

View looking northeast from near the center of the site
(Note fill and debris piles in middle of photograph)

View looking east from near the northwest corner of the site (Note fill and debris piles)

View looking north from the gravel drive near the eastern margin of the site, showing rubble concrete slabs, welded wire fabric, truck wheels and tires, and limestone cobbles and boulders

View looking south from near the northeast corner of the site

2.2 Site Geology

The Geologic Map of the Murfreesboro Quadrangle, Tennessee, dated 1964, indicates the site is underlain by the Ordovician-aged Ridley Limestone formation, which typically consists of a hard, brownish-gray, fine-grained, medium- to massive-bedded limestone with occasional shale partings. The limestone weathers to produce a layer of residual soil which is typically brown or reddish-brown silty clay with chert. The soil/rock interface of this geologic unit is typically irregular, with soil-filled slots extending into the bedrock unit and more weather-resistant bedrock pinnacles protruding up into the soil overburden. The soils contained within the soil-filled slots are often wet and soft.

Limestone is susceptible to solution weathering and development of sinkholes and other karst features. Topographic contours on the geologic map did not indicate depressions at the site or in the immediate vicinity. We did not see evidence of surface depressions or possible karst conditions at the site during our field activities, although piles of fill and areas of vegetation could have masked such indicators. Recommendations are provided later to reduce the potential of future sinkhole formation as a result of the planned site development.

Piles of fill were present at the site. Fill can be problematic for site development when it has not been compacted in thin lifts. Uncompacted or poorly compacted fill can be a source of unpredictable and excessive settlements and can lead to poor structural performance. Fill that has been placed without engineering observation can sometimes contain objectionable inclusions or constituents, such as organics (tree trunks or brush piles), junk and debris, trash, excessively wet or high plasticity soils, or large boulders. When such undesirable inclusions are present, the consistency or density of the fill cannot necessarily be correlated with conventional indicators, such as drive-sample blow counts or estimates of unconfined compressive strength of cohesive soils. For this reason, consistency descriptions of fill layers are typically not included on test pit logs.

2.3 Subsurface Stratigraphy

Subsurface conditions were explored by excavating ten test pits at the approximate locations shown on the Exploration Location Plan in Appendix A. The exploration methods are described in Appendix B. Soil descriptions follow the Unified Soil Classification System (USCS), which is described in ASTM D2487 and D2488. Stratigraphy from the test pits is summarized below.

SUBSURFACE STRATIGRAPHY

Stratum	Approximate Depth to Bottom of Stratum	Material Description	Properties[1]
Surface Materials	1 inch to 6 inches	Topsoil	N/A
Fill (TP-02 and TP-04)	2.0 feet and 1.5 feet	Mixture of limestone cobbles and boulders with lean clay. Rock:soil ratio of 30%:70% (TP-04) and 80%:20% (TP-02). Generally poor rock-to-rock contact. Boulders typically 1.5 feet to 3 feet nominal size, with some as large as 4 feet. Lean clay (USCS CL) is typically brown and moist.	N/A
Residual Soil	6 inches to 3.5 feet, but depths less than 2.5 feet	Lean Clay (USCS CL), stiff to very stiff, red-brown, moist	PPV: 1.0 tsf to 2.5 tsf MC: 13% to 24% LL: 42 and 46 PI: 21 and 26
Refusal[2]	6 inches to 3.5 feet	Assumed limestone bedrock or limestone boulders in fill	N/A

[1] PPV = Pocket penetrometer value; tsf = tons per square foot; MC = moisture content; LL = liquid limit; PI = plasticity index
[2]Exploration of refusal materials was not included in our scope of services

Additional information about the subsurface stratigraphy encountered at the boring locations is provided on test pit logs in Appendix A. The test pit logs represent our interpretation of the subsurface conditions at the test locations based on tests and observations performed during excavation operations, visual classification of the samples by a geoprofessional, and laboratory tests conducted on the selected samples. The depths of boundaries between strata are indicated by horizontal lines on the test pit logs, but the transition between strata may be more gradual than shown. Conditions may vary at locations away from or between the test pit locations.

2.4 Groundwater Conditions

Groundwater was not encountered at the test pit locations. Groundwater generally means a continuous water surface present below the ground surface year-round resulting from long-term accumulation of water above or between relatively impervious subsurface strata, such as clays or bedrock. The groundwater surface, sometimes called the "water table," can fluctuate up or down throughout the year due to seasonal changes in climate, precipitation, vegetation, surface runoff, water levels in nearby water bodies, and other factors. Laterally discontinuous perched or trapped pockets of groundwater are also common.

2.5 Earth Electrical Resistivity (EER)

EER testing was performed at one location (EER-01) indicated on the Exploration Location Plan in Appendix A. The EER tests indicated resistivities between 7,460 ohm-cm and 62,000 ohm-cm, depending on array orientation and A-spacing. Individual test results are presented in Appendix A, and the field test methods are described in Appendix B.

3.0 GEOTECHNICAL CONSIDERATIONS

The following geotechnical considerations are based on data collected or developed during this project, our experience with similar projects, and our knowledge of sites with similar surface and subsurface conditions.

3.1 Existing Fill

Existing fill was excavated to depths of 1.5 feet and 2 feet in test pits TP-04 and TP-02, respectively, which were performed at the edge of the large pile of fill at the site. Indications of garbage, junk, debris, trash, organic particles, or other objectionable materials were not exposed at these test pits, but such unsuitable materials were visible in the slopes of the fill mound. Leaving the existing fill in place beneath the substation could result in adverse differential and total settlements leading to a risk of poor performance, such as cracks in building walls and floors, or sticking doors. Similarly, settlements of pavements constructed over existing fill could result in depressions or "birdbaths" which disrupt drainage, and excessive settlement could damage the pavement layers leading to loss of support for vehicles. Existing fill should also be removed from proposed permanent slopes (cut and fill slopes) to reduce the potential for slope failures resulting from weak fill.

The preliminary grading plan shows much of the existing fill will be removed to achieve final grades. Where existing fill extends below planned final grades, we recommend completely removing the existing fill within planned construction areas and replacing it with new compacted fill. Test pits TP-02 and TP-04 encountered excavator refusal below existing fill, and it is possible the refusal condition was caused by large boulders or debris in the fill instead of limestone bedrock. Considering the other test pits completed away from the fill piles on the site also encountered refusal at shallow depths, we expect the existing fill does not likely extend much deeper than indicated by the test pit logs, but we suggest the contractor and owner be prepared for deeper undercutting, perhaps as deep as 5 feet below the prevailing site grades.

The existing fill consists of a variable mixture of clay soil and limestone cobbles and boulders. We do not recommend re-using the excavated materials as new fill. However, it may be possible to crush and hoe-ram individual limestone boulders and cobbles to produce crushed stone with small enough particle sizes to use as fill in parts of the site as a way to reduce the cost of importing fill from off-site. If this approach is considered, we recommend the crushed materials do not include rubble concrete and the processed materials should meet requirements for limestone “shot-rock” fill given in Section 4.3 of this report.

3.2 Difficult Excavation Conditions

Excavator refusal materials were encountered at depths less than 3.5 feet below ground surface (bgs). The data indicate shallow bedrock is present below the site. Grading information provided suggests mass grading will generally require placing up to about 5 feet of new compacted fill, with the thickest fills expected in the east and northeast part of the site. We expect cuts for site grading will generally be less than a few feet deep, except for removal and undercutting of existing fill. Excavations for foundations and utilities at the site could extend below refusal depths and may require blasting or hoe-ramming to remove the refusal material. Also, removing the existing fill will likely require some hoe-ramming and blasting to reduce the size of limestone boulders enough to facilitate their removal from the site. We recommend the project budget include a contingency for rock excavation. Additional comments about excavations are provided in Section 4.2, later in this report.

3.3 Lack of Soil for Use as Fill

The boring data indicate very little residual soils are present at the site. Since existing grades are below final grades across the site, we do not anticipate very much, if any, borrow materials will be generated from the site during mass grading. The project schedule and budget should account for having to use off-site borrow as compacted fill.

3.4 Groundwater Control

Although groundwater was not encountered in the test pits, the shallow depth to bedrock below the site can cause water to build up or perch above the top of bedrock, especially after extended periods of wet weather or shorter periods of heavy rainfall. The contractor should be prepared to remove groundwater from shallow excavations during construction where excavation depths approach or

extend below refusal depths. Where final grades will not be more than 4 feet above bedrock levels, we recommend providing a permanent groundwater control system consisting of a drainage layer of clean crushed stone (TDOT No. 57 or No. 67) to drain by gravity to a suitable daylight outlet. Additional recommendations about the drainage layer are provided later in Section 4.4.3.

3.5 Earth Electrical Resistivity Considerations

Based on the results of the EER tests, the on-site soils and bedrock appear to have relatively high electrical resistivity. This may require the grounding system for the substation to be more robust to account for the high resistivity.

4.0 EARTHWORK RECOMMENDATIONS

4.1 Subgrade Preparation and Stabilization

4.1.1 Stripping and Existing Fill Removal

Subgrade preparation should begin with stripping, clearing, and grubbing to remove organic-laden topsoil, trees, other surface vegetation and all existing fill from planned construction areas.

- Clearing and grubbing should include the primary root mass.
- Stripping should extend 10 feet beyond construction limits or to the property lines, whichever is less.
- Organic-laden strippings should be removed from the site or disposed of at designated on-site areas located outside limits of current or future development.
- Strippings may be stockpiled for re-use as topsoil during landscaping if they are suitable for that purpose.
- Strippings should not be used to build permanent slopes.
- Existing fill should be completely removed, including undercutting it from areas below planned site grades, and disposed of off-site.

4.1.2 Proofrolling

After stripping and undercutting, the stability of exposed subgrades in areas to receive fill or in areas excavated below former grade should be evaluated by proofrolling.

- Perform proofrolling with a rubber-tired vehicle having a gross vehicle weight of at least 20 tons (such as a loaded, tandem-axle dump truck).
- Proofrolling equipment should make multiple closely-spaced overlapping passes in perpendicular directions over the subgrade at a walking pace.
- The subgrade should be relatively smooth and free of wheel ruts, loose clods of soil, or loose gravel, and the subgrade should not be desiccated, cracked, wet, or frozen at the time of proofrolling.
- A representative of the geotechnical engineer should observe the proofrolling to identify, document, and mark areas of unstable subgrade response, such as pumping, rutting, or shoving, if any.

- Proofrolling may not be required where exposed subgrades consist of bedrock.

4.1.3 Subgrade Stabilization

The following methods are options for producing stable subgrade conditions depending on the nature of the unstable condition, the location and size of the unstable area, and the time available to address the unstable condition. We expect undercutting to be the primary method of addressing unstable subgrade conditions, if any, because of the shallow depth to bedrock.

- Compacting In-Place
  - This means using a large vibratory roller or vibratory sheepsfoot roller to compact the exposed subgrade.
  - If the subgrade is still unstable after multiple passes with the vibratory rollers or vibratory sheepsfoot roller, a different stabilization method will be required.
- Undercutting
  - This means simply excavating to remove the unstable soil conditions.
  - It is usually the most expedient and cost-effective means of dealing with unstable conditions when less than 3 feet of additional undercutting is needed.
  - It requires disposing of the excavated unstable soils and replacing the undercut excavation with new compacted gravel (small shot rock, i.e., <6 inches) or TDOT mineral aggregate base (MAB) fill.
  - Backfill can be compacted soil fill or MAB.

Although the overburden layer is relatively thin, the soil is primarily clay that can be softened by exposure to wet weather, so subgrade stabilization may still be needed in areas of the site.

4.2 Excavation Conditions

The residual overburden soils encountered by the test pits can be excavated by conventional earthmoving equipment. Excavations extending below test pit refusal depths will likely require blasting or hoe-ramming to facilitate removal. Existing fill may require rock excavation methods or rock crushing to facilitate removal.

4.2.1 Rock Removal

After soil is removed, it may be possible to remove a small amount of the upper interval of weathered bedrock (typically less than 2 feet to 3 feet) using heavy-tracked equipment, with or without the use of ripping tools. Removal of more competent bedrock from deep or confined excavations will likely require jackhammering, hoe-ramming, or blasting.

In general, we recommend the vibrations induced by blasting or hoe-ramming be limited to prevent damage to surrounding structures. Pre-blast and post-blast surveys should be performed on existing structures within the area surrounding the site where vibrations are likely to be felt. Blasting should be monitored by vibration instruments and knowledgeable personnel to document the level of blast vibrations. The contractor will need to comply with Tennessee blasting laws and other appropriate regulations. It will also be important for the blasting to be controlled to avoid damaging the bedrock

subgrade beneath foundation bearing levels. If the blasting activities are not properly controlled, the bedrock below planned foundation elevations can be fractured and weakened or heaved out of place requiring over-excavation during foundation installation. As an additional service, we can assist you with blast monitoring and development of specifications to control blasting, if required.

The project schedule may require that rock excavation occurs simultaneously with building construction. It will be important for the blasting vibrations to be maintained to within safe limits for the "young" concrete. We recommend blasting not be performed near concrete that is less than 48 hours old.

4.2.2 Temporary Slopes/OSHA Soil Types

Temporary construction excavations less than 20 feet deep should be sloped or shored by the contractor in accordance with OSHA requirements. The residual overburden soils appear to be OSHA Type B soils. OSHA requires temporary excavation slopes no steeper than 1-horizontal to 1-vertical (1H:1V) through Type B soils. Weathered rock and bedrock might be considered Type A soil or Stable Rock, depending on its condition. OSHA allows temporary slopes as steep as 3H:4V for Type A soils and near-vertical for Stable Rock. The contractor's "competent person" should evaluate temporary excavations daily and determine the specific soil types and temporary slope or shoring measures necessary according to OSHA requirements. While temporary excavations taller/deeper than 20 feet are not expected, we remind you these excavations must be designed specifically by a registered engineer and cannot be made based on OSHA soil types. Design of temporary excavations was not part of our scope of services. TTL is not responsible for stability of excavations, shoring, or job site safety, which are the sole responsibility of the general contractor.

4.3 Compacted Fill

Compacted fill is new fill material (typically soil but can also include crushed stone and shot-rock) placed as backfill in undercut excavations and utility excavations, or placed to raise final site grades above existing site grades below slopes, the substation pad, and equipment foundations. Fill that is placed outside of current or proposed development areas is sometimes called "common fill" or "general fill." Materials that do not meet compacted fill requirements may sometimes be used in these "common" or "general" fill areas. In addition, materials that meet requirements for compacted fill may also be used in these areas. Junk, garbage, organic strippings, and other deleterious materials (which can decay, rot, or corrode over time) should not be used as fill in any site areas.

Criteria for fill characteristics, compaction procedures, and compaction control are listed in the table below. The on-site residual clay soils could be reused as compacted fill if they meet the requirements for compacted fill given in this report. However, due to the small amount of residual lean clay soil and the depth it was encountered, the project schedule and budget should account for the need for off-site fill.

Fill operations should not begin until representative soil samples are collected from proposed borrow areas and tested for plasticity and moisture/density relationship (allow 3 to 4 days for sampling and testing soil). The test results will be used to determine whether or not the proposed borrow material

meets project specifications. A TTL representative should be present full-time to monitor and test the placement of compacted fill materials.

MATERIAL TYPE	CHARACTERISTICS	COMPACTION PROCEDURES	COMPACTION CONTROL[1, 2]
SOIL	Maximum particle size: 3 inches. Maximum gravel and oversize particle content: 15 percent retained on a ¾-inch sieve. Maximum allowable organic content: 3 percent by weight, but large roots are not allowed. Liquid Limit: Not more than 50. Plasticity Index: Not more than 25.	Maximum loose lift thickness: 8 inches. Compaction requirement: Compaction should be to at least 95 percent of the standard Proctor (ASTM D 698) maximum dry density. Moisture content at time of compaction: within plus to minus 3 percent of the material's optimum moisture content.	Equipment Pad Areas: One field density test every 2,500 square feet per lift, with a minimum of two tests per lift. Pavement Areas and Slopes: One field density test every 10,000 square feet per lift, with a minimum of two tests per lift. Utility Trenches: One field density test per structure or one test per every 100 linear feet, per lift. Field density tests of compacted soil fill should be done using either the nuclear method (ASTM D6938), the sand cone method (ASTM D1556), or the drive-cylinder method (ASTM D2937), as appropriate for the fill materials. Proofrolling lifts of fill SHOULD NOT be permitted as a means of evaluating compaction of soil fill for compliance with these recommendations.
MINERAL AGGREGATE BASE (MAB)	Type A, Class A, and Grading C or D in accordance with Section 903.05 of the Tennessee Department of Transportation (TDOT) specifications.		
LIMESTONE SHOT-ROCK	Shot-rock size: Not more than 24 inches. Percentage of soil: Not more than 10 percent by volume. Gradation: Adequate fines and smaller rock pieces to effectively "choke" the larger rock pieces by filling voids or open spaces between rock pieces.	Spreading: The larger rock pieces should lie flat and not overlap each other. Maximum lift thickness: Not more than 30 inches and not more than 6 inches thicker than largest shot-rock particle. Compaction Requirements: The fill should be compacted by making multiple passes with a CAT D8 bulldozer, or equal. Our geotechnical engineer should provide additional recommendations based on actual conditions and equipment available. The number of passes should be sufficient to demonstrate the material is densified and stable.	A technician working under the direction of our geotechnical engineer should observe shot-rock fill placement and compaction techniques. The technician should document fill constituents, lift thickness, and compaction techniques.

[1] For preliminary planning only. Our technician/engineer should determine the actual test frequency.
[2] In addition, the fill must be stable under the influence of compaction equipment. Heavy construction traffic should not be allowed to travel on compacted fill areas, except on designated haul roads, to reduce the potential for damaging a previously compacted fill subgrade. This limitation may not apply to shot-rock fill.

If grading occurs during wet, cool weather, when drying soils is more difficult and time-consuming, the grading contractor may have difficulty achieving suitable moisture conditions for proper compaction of soil fill. As an alternative, MAB stone may be considered for use as fill. The MAB will not be as moisture-sensitive as soil, but some weather delays may still be experienced if MAB is utilized as fill. Refer to the soil fill compaction procedures and compaction control listed in the table below for placing MAB.

Shot-rock fill materials can be used to backfill undercut excavations or as new fill below the substation pad, at least up to shallow foundation bearing levels. Clean shot-rock fill materials can be placed

without moisture conditioning and can typically be placed and compacted during wet, cool weather with little delay. These materials are also typically able to accommodate construction traffic with only limited subgrade degradation. Therefore, these materials may be considered for compacted fill if grading occurs during wet, cool weather. Refusal materials excavated at the site may be used as shot-rock fill if they meet the particle size and gradation requirements listed in this report section.

Excavations made within shot-rock fill may be significantly larger than similar excavations in soil due to the particle size of the rocks within the shot-rock fill. It may be desirable to limit the maximum rock particle size in the shot-rock fill to 6 inches or less near the upper part of the fill to reduce the size of utility and footing excavations through shot-rock fill. If lifts of shot-rock thinner than the maximum lift thickness are required based on site grades, the maximum particle size of the shot-rock should be reduced to be at least 6 inches less than the lift thickness. We recommend placing a layer of MAB stone over shot-rock fill to close voids at the surface to reduce pathways for soil migration into the shot-rock over time.

The surface of any filled area can experience settlement due to compression of the underlying soils, and sometimes additional settlement results from consolidation of thick soil fills due to their own self-weight. For this project, we do not expect fills more than about 5 feet thick. Settlements of soil fills less than 8 feet thick typically occur mostly during the course of construction. However, soil fills thicker than about 8 feet could continue to experience settlement from the self-weight of the fill for weeks or months after completion of fill placement, which could adversely affect utilities, structures, or pavements supported by the fill. We should be notified to provide recommendations for settlement monitoring of soil fill if it will be thicker than 8 feet.

4.4 Drainage Considerations

4.4.1 Surface Water

Site development and excavations should not be performed during or immediately following periods of heavy precipitation. Positive surface drainage should be maintained during grading operations and construction to prevent water from ponding on the surface. Surface water run-off from off-site areas should be diverted around the site using berms or ditches. The surface can be rolled smooth to enhance drainage if precipitation is expected, but should be scarified prior to resuming compaction. Maintaining proper site drainage during construction is important because clays at the site may be sensitive to increases in moisture content and may quickly become wet, soft, and unstable if water is allowed to pond on them.

Subgrades damaged by construction equipment should be promptly repaired. Our geoprofessional should provide recommendations for treatment if the subgrade materials become wet, dry, or frozen. Degradation of the near surface soils should be expected if they are subjected to freeze/thaw. When work activities are interrupted by heavy rainfall, fill operations should not be resumed until the moisture content and density of the previously placed fill materials are as recommended in this report.

4.4.2 Construction Groundwater Control

Groundwater was not encountered in the test pit excavations. Localized zones of "trapped" or "perched" water can sometimes develop in the soil overburden, in rock-laden fill zones, or at the soil/bedrock interface, especially after extended wet weather. We recommend the contractor plan to provide groundwater control during construction because the shallow bedrock below the site could create perched water conditions. Normally, groundwater inflow can be removed from construction excavations by pumping from a sump near the point of seepage. Our geotechnical engineer should be contacted for guidance if heavy seepage occurs or there is evidence of soil particle migration. Design of the temporary groundwater control measures for construction is the responsibility of the contractor.

4.4.3 Permanent Groundwater Control

In this geologic region, groundwater often flows along joints, bedding planes, or fractures in bedrock and can seep out of vertical cuts or up from below horizontal subgrades cut into bedrock. Sometimes the seepage can be highly preferential, such that seepage may emerge from few locations, or even only one location. Therefore, it is possible for groundwater seepage to develop along the bedrock surface. Additionally, infiltration of water through overburden or fill can cause perched water to develop on the bedrock surface. While water can perch to levels well above the bedrock level, we generally expect water to perch less than 4 feet above bedrock. Therefore, we recommend providing a drainage layer of clean crushed stone (TDOT No. 57 or No. 67) on the rock subgrade before placing fill that will not be thicker than about 4 feet. A separate drainage layer may not be required if shot-rock fill will be used to raise site grades instead of soil fill because the shot-rock fill should allow seepage or infiltration to drain through the fill, but the following recommendations for drain pipes and filter fabric should still be included.

The drainage layer should be at least 6 inches thick and should be separated from soil layers below or above it by a nonwoven needle-punched filter fabric (Mirafi 140N, or equal). The fabric should be overlapped at ends and edges per the manufacturer's recommendation, but we recommend a minimum overlap of 1 foot. Corrugated, perforated collector pipes should periodically be provided within the drainage layer to collect water and drain it to a suitable gravity outlet ("daylight"). Rodent guards should be used at daylight outlets to prevent rodents from nesting in the outlet and clogging the drain pipe.

4.5 Permanent Slopes

Slopes constructed on site should be considered as a structural element of the development and should be constructed entirely with properly placed and compacted fill. Review of provided drawings indicate fill slopes up to about 9 feet high and inclined at 3H:1V or flatter are part of the project. Experience indicates soil fill slopes of these heights and inclination are typically stable. These recommendations are based on our experience with similar materials in this area and not on a detailed slope stability analysis. We recommend the horizontal distance between the crest of any slope and the outside edge of a pavement be at least 5 feet or the vertical height of the slope divided by 3, whichever is larger. For structures supported on shallow foundations behind the crest of a slope, the horizontal distance between the crest of the slope and the outside face of the footing should be at least 10 feet

or the vertical height of the slope divided by 2, whichever is larger. Underground pipes (water, sewer, storm, etc.) planned behind the crest of a slope should be constructed as far as practical from the slope edge because leakage can lead to slope instability.

It is difficult to compact fill slopes without creating a zone of loose, poorly compacted material at the slope's face. If possible, we recommend fill slopes be overbuilt (meaning fill is placed beyond the planned slope face) and then cut back to the desired configuration. If this is not feasible, a bulldozer should track up and down the slope to attempt to provide some compactive effort, but the surface of the slope may experience shallow sloughs or erosion over time. Shallow sloughing failures are possible during periods of high rainfall and should be promptly repaired to prevent the failure from spreading.

Material should not be stockpiled within 10 feet behind the crest of a slope and should not exceed the height of the slope. We should be contacted to provide additional recommendations for taller slopes or larger stockpiles if desired. The ground behind the crest of the slope should be sloped to direct surface water away from the crest of the slope, or a drainage swale or berm should be provided. In addition, both cut and fill slope faces should be protected from erosion using a vegetative cover. Seed and mulch, or erosion matting with embedded seed, are options for developing a vegetative cover.

The recommendations in this section assume soil fill will be used to construct fill slopes at the site. If slopes are constructed using shot-rock fill, it may be possible to construct slopes as steep as 1.5H:1V. We should be contacted to provide additional analysis and recommendations if shot-rock fill will be used to construct fill slopes.

4.6 Karst Considerations

The site is located in a region that is historically susceptible to the development of sinkholes and other karst features. We did not observe existing surface depressions or other indications of possible sinkholes or other karst features at the site during our exploration. It is possible that sinkholes could develop at the site in the future. It has been our experience that new sinkholes are more likely to occur during site grading than afterward because incipient sinkholes not visible at the surface may appear in response to the natural drainage mechanisms being disrupted by removal of vegetation or altering of grades. Because sinkholes typically result from movement of water through the subsurface regime, it is important to reduce the quantity of surface water that is allowed to infiltrate the planned station pad area. The recommendations below are provided to reduce the potential for sinkhole development as a result of construction activities:

- Control storm water drainage by properly grading the site to promote complete and rapid runoff of surface water away from construction areas and avoid the ponding of water in open excavations.
- Locate detention/stormwater detention areas as far as practical from the substation pad.
- Construct underground plumbing systems in a leak-proof manner.
- Provide ditches or pipes for discharge of stormwater, to the extent practical.

- Evaluate areas of suspected sinkhole development, such as abnormally thick topsoil deposits, depressions, and locations of soil collapse or voids within the overburden.
- Where sinkholes or incipient sinkholes are detected, perform remedial treatment as recommended by our geotechnical engineer, based on the actual conditions encountered.

Sinkholes can typically be repaired satisfactorily to allow construction, but the repairs must be designed based on the specific site conditions. We can provide additional services to assist you with sinkhole repair at your request.

5.0 SUBSTATION RECOMMENDATIONS

5.1 Seismic Design

Based on the 2021 edition of the International Building Code (IBC) and results of our exploration, we recommend Seismic Site Class B be used for seismic design of the structures where foundation bearing elevations are within 10 feet of the underlying bedrock. Seismic Site Class C should be used if foundations bear more than 10 feet above the underlying bedrock. If seismic design parameters based on the recommended site class produces excessive forces or an unfavorable Seismic Design Category, it may be possible to reduce seismic design forces by measuring the shear wave velocity profile at the site and, if necessary, performing a site-specific seismic study. Please contact us to discuss these options if the site classification results in excessive seismic design forces.

5.2 Shallow Foundations

Based on encountered conditions and our recommended site preparation, the substation equipment can be supported by shallow footings or mat foundations. While mast and A-frame structures are typically supported by deep foundations, it may be possible to support these structures using shallow mat foundations to avoid having to extend deep foundations into bedrock.

5.2.1 Design Recommendations

SHALLOW FOUNDATION DESIGN RECOMMENDATIONS

Design Considerations	Value
Suitable bearing materials	Compacted Soil Fill, Compacted Shot-Rock Fill, or Limestone Bedrock
Minimum bearing depth below exterior grade	1.5 feet
Allowable net bearing pressure for sustained loads	3,000 psf for Soil Fill 8,000 psf for Shot-Rock Fill 15,000 psf for Limestone Bedrock (or more – contact TTL if higher bearing pressure is needed)
Allowable net bearing pressure for transient loads (wind or seismic)	4,000 psf for Soil Fill 10,000 psf for Shot-Rock Fill 20,000 psf for Limestone Bedrock
Minimum isolated spread footing width Minimum wall footing width	2 feet 1.5 feet

Design Considerations	Value
Ultimate coefficient of friction between concrete and bearing material for lateral load resistance	0.35 for soil bearing 0.5 for shot-rock fill 0.65 for rock bearing
Minimum factor of safety for lateral resistance from friction	1.5
Ultimate passive pressure from soil against vertical face of footing for lateral load resistance (Do Not Use if footing is formed)	250 psf per vertical foot Neglect resistance in top 1 foot
Minimum factor of safety for lateral resistance from passive soil pressure	2.0
Total unit weight for backfill over footing for computing ultimate lateral or uplift resistance	100 pcf
Minimum factor of safety for uplift resistance from soil backfill weight	2.0

We understand design of shallow footings may also require vertical subgrade reaction modulus values. We recommend using a vertical subgrade reaction modulus of 100 pounds per square inch per inch of settlement (i.e., 100 pci) to analyze footings. The recommended value applies to a 1-foot-square loaded area and should be adjusted to account for the size and shape of the actual foundation, depending on the input values required by the method of analysis.

5.2.2 Construction Recommendations

Given the planned grading and considering the shallow bedrock at the site, it is possible that footing bearing levels may expose different bearing materials within the same excavation or for the same structure. If this occurs, one of the different materials should be undercut at least 2 feet and replaced with new compacted fill or the excavation should be extended to reach bedrock and the resulting excavation backfilled with lean concrete back to bearing elevation. For example, if most of the bearing surface consists of soil, but a small area of rock is present, then the rock should be removed to a depth of at least 2 feet and replaced with compacted soil fill. Conversely, if most of the bearing area is rock, but a small area of soil is exposed, then the soil should be undercut deep enough to expose bedrock and the undercut should be backfilled with lean concrete.

Additional design and construction considerations are provided below:

- The foundation bearing surface should be level and free of loose or soft soil, unsuitable material (such as debris, trash, etc.), ponded water, or desiccation cracks.
- The foundation excavation should be backfilled with concrete the same day the footing excavation is made.
- If the footing excavation is left open overnight, the contractor should protect soil bearing materials against degradation from exposure. One method commonly used is placing a “mud-mat” of lean concrete, but other similar methods may also be appropriate. Protective layers should not be placed until after the bearing surface has been evaluated to confirm it is suitable for the design bearing pressure. Protective measures may not be needed for shot-rock fill or bedrock bearing materials.

- Surface water should not be allowed to flow into the footing excavation. Water that enters the excavation, either from surface flow, precipitation, or other sources, should be promptly removed, even if the bearing level is covered by a protective layer, like a mud-mat.
- The footing should be poured directly against the sides of the excavation. If the footing is formed, the excavated space around the finished footing should be cleaned of soft or loose soil and then backfilled as soon as practicable using soil compacted to the requirements for compacted fill given in the table in Section 4.3.
- Our geoprofessional should observe the foundation bearing surface to check whether or not the exposed subgrade conditions are consistent with the materials encountered by the borings. The foundation bearing surface should be observed and assessed to ensure the bearing elevation is on compacted fill material.

5.3 Deep Foundations

Deep foundations consisting of directly embedded poles, drilled shafts, or micropile foundations are typically used to support poles, H-structures, and A-frame structures when a relatively deep soil profile is available. However, deep foundations can be expensive when it becomes necessary to drill through shallow bedrock, like encountered at this site. Also, exploring below the excavator refusal depths to sample the bedrock was not in our scope of services, so we do not have specific data to allow final design of rock-supported foundations. We will discuss preliminary design and construction recommendations for deep foundations in the following sections, but additional exploration of the bedrock conditions should be performed before final design is completed.

5.3.1 Design Considerations

Drilled shafts and direct embedment provide support through a combination of end bearing capacity and skin friction to resist axial compressive and uplift loads, but micropiles provide support only from skin friction. Allowable load capacity is directly related to the strengths of the soil and rock layers surrounding the deep foundations, and the vertical load capacity can be directly calculated with closed-form equations using the strength parameters for the different materials. The mast or A-frame structure foundations are typically not controlled by vertical movements of the foundations because vertical loads are typically small compared to the vertical capacities of the foundations, and at this site vertical movements will also be reduced because the foundations will be embedded within limestone bedrock. Therefore, design of mast and A-frame foundations does not often require knowledge of the vertical load-settlement behavior of the foundations, so it is not usually necessary to measure or estimate the vertical compressibility of the foundation materials.

However, the response to lateral loads and overturning moments is usually controlled by the deflection and rotation of the foundation rather than the available strength of the foundation soil and rock. Predicting the lateral response of the foundation requires knowledge of the lateral load vs. deflection characteristics of the different soil and rock layers penetrated by the foundation. Estimating the load vs. deflection characteristics requires modulus parameters in addition to strength parameters of the soil and rock. With these parameters, the lateral response of the foundation is then analyzed for

different loading conditions to evaluate what magnitude of loads and moments can be applied to keep the lateral deflection and rotation of the foundation within operational limits for the pole.

A closed-form equation to directly compute the lateral deflection and rotation of the foundation in response to applied loads and moments in not available, except perhaps for simple loads and homogenous (not layered) foundation materials. Computer analysis is needed to evaluate the lateral response of combined loads and moments and/or layered foundation stratigraphy, especially when the foundation materials include both soil layers and rock layers. Two computer programs are commonly used to perform the calculations to predict lateral response of the pole foundations: LPILE (Lateral analysis of Piles) and MFAD (Moment Foundation Analysis and Design). Both programs use strength and deformation/deflection properties of the various foundation soils to develop load-deflection curves (often referred to as "p-y" curves) for the different materials. The LPILE program uses Mohr-Coulomb strength parameters (cohesion, c, and friction angle, phi) and horizontal modulus of subgrade reaction, k, to develop the p-y curves. The MFAD program also uses Mohr-Coulomb strength parameters, but it needs a deformation modulus, E_d, instead of the k-value that LPILE uses.

The two programs compute p-y curves for rock differently. LPILE uses a correlation with the unconfined compressive strength of the intact rock to compute the p-y curve. MFAD attempts to model the response of the rock mass (the larger volume of rock within the zone of influence around the foundation), which may be adversely affected by weaknesses (joints, fractures, voids, soil seams, weathered zones, etc.) within the rock. The relative quality of the rock mass is quantified by estimating a parameter called the Rock Mass Rating (RMR), which considers six characteristics of the rock mass:

- Uniaxial compressive strength of intact rock
- RQD
- Spacing of joints
- Condition of joints
- Groundwater conditions
- Rock joint orientation relative to foundation load

The RMR value of a rock layer is obtained by assigning a point value for each of the six conditions and summing the point values. Table C-4 from the MFAD User Manual shows how the various point values are determined. The RMR values are then used to select effective cohesion, effective friction angle, and deformation modulus of the rock mass for the MFAD analysis.

Please contact us once the type of fill (soil or shot-rock) to raise site grades has been selected and information about pole or mast diameters and loads is available. We can perform computer modeling to estimate the performance of such foundations in response to anticipated loads and overturning moments as an additional service. However, additional exploration may be needed to obtain samples of the bedrock to measure RQD and rock strength to inform the lateral analyses model.

5.3.2 Directly Embedded Poles

Constructing directly-embedded poles requires drilling a vertical hole with a diameter at least 12 inches greater than the diameter of the pole deep enough below the ground surface to provide the

desired pole response to foundation loads and moments. We recommend a minimum embedment depth of either three hole-diameters below the ground surface or two hole-diameters below the top of unweathered bedrock, whichever is deeper. We recommend drilling the hole at least one foot deeper than the design bottom of the pole to allow for a bedding layer of concrete to be placed over the bottom of the hole to assist with full contact of the bottom of the pole with the bearing surface. We recommend preliminary design of directly embedded foundations to resist axial compressive loads be based on the allowable bearing pressures recommended for shallow foundations on the various foundation materials. We should be contacted if different bearing values are needed.

Drilling the hole into bedrock should be done in a way to prevent fracturing or weakening the rock mass; blasting should not be performed to loosen the bedrock before drilling the direct-embed hole. The bottom of the hole should be reasonably level and free of loose soil and obvious defects, such as voids, fractures, or weathered rock. The drilling contractor should be prepared to use temporary steel casing through the overburden to prevent caving of soil into the rock socket. The sides of the rock socket should be observed to check that it is clean, rough, and does not contain excessive seams of soil or weathered limestone. The contractor should be prepared to remove minor groundwater seepage for inspection and placement of concrete.

We recommend the grout or concrete used to backfill the annulus between the pole and the sides of the drilled hole have a 28-day compressive strength of at least 3,000 psi, or greater, if needed to resist expected shear forces developed within the foundation. The slump of the grout or concrete should be high enough to allow the grout or concrete to complete fill the annulus and make good contact with the bottom and sides of the hole and prevent arching between the side of the hole and the pole, but the slump should be low enough to prevent settlement and segregation of aggregate included in the concrete, if any. We recommend a slump between 4 inches and 6 inches at the time of placement. The pole should be plumbed and then temporarily supported for at least three days or until the grout or concrete achieves at least 50 percent of the design 28-day strength. We recommend delaying attaching wires, insulators, or other pole-mounted parts or equipment until the grout or concrete has reached at least 90 percent of the design 28-day strength.

We recommend construction of the directly embedded foundation be monitored by TTL. We should observe and document how the holes are drilled and confirm the proper diameter and embedment depth are achieved. The side of the rock socket, if any, should be observed to check that it is clean, rough, does not contain excessive seams of soil or weathered limestone, and generally exposes soil and rock conditions similar to those expected based on the boring data. We recommend monitoring grout or concrete placement and testing the grout or concrete for slump, air content, unit weight, and temperature for compliance with project requirements. One set of six compressive strength test cylinders (4-inch-diameter by 8-inch-long) should be cast for each pole foundation. The grout or concrete strength should be monitored by testing two cylinders at ages of 3 days, 7 days, and 28 days after placement.

5.3.3 Drilled Shaft Foundations

A drilled shaft foundation consists of a drilled hole into which a reinforcing steel cage, anchor bolts, and structural concrete are placed. The pole is then bolted to the top of the drilled shaft. A drilled shaft should be designed with straight sides (no bells or under-reams) and should extend deep enough below the ground surface or top of bedrock to produce a condition of fixity with regard to lateral load and overturning moments. This can generally be accomplished with embedment depths at least three times the diameter of the drilled shaft, except in cases of significant overturning moments, which may require deeper embedment.

Resistance to compressive loads applied to a drilled shaft foundation will mostly be provided by end bearing against the material at the bottom of the shaft. Skin friction capacity derived from soil materials is usually neglected, but side resistance from a rock socket can be considerable and may be used, if needed. The minimum shaft diameter should be 30 inches regardless of the design skin friction and end bearing capacities. Drilled shafts should have a minimum length of 3 times the shaft diameter or 10 feet, whichever is longer. We recommend preliminary design of drilled shafts to resist axial compressive loads be based on end bearing capacity recommended for shallow foundations for the different bearing materials. Side resistance in a rock socket, if needed, can be 10 ksf for preliminary design.

The bottom bearing surface should be level and free of loose soil and obvious defects, such as voids, fractures, or weathered rock. The side of the rock socket, if needed, should be observed to check that it is clean, rough, does not contain excessive seams of soil or weathered limestone, and generally exposes soil and rock conditions similar to those expected based on the boring data. Each reinforcing cage should be observed for the correct sizes, strength, and dimensions of reinforcing bars, and the type, size, and placement of anchor bolts should also be checked. We recommend monitoring concrete placement and testing the concrete for slump, air content, unit weight, and temperature for compliance with project requirements. Placement of concrete into a dewatered hole can be by the free-fall method so long as the concrete flow is directed vertically down the shaft and not allowed to strike reinforcing steel or the sides of the casing. One set of six compressive strength test cylinders (4-inch-diameter by 8-inch-long) should be cast for each pole foundation. The grout or concrete strength should be monitored by testing two cylinders at ages of 3 days, 7 days, and 28 days after placement.

5.3.4 Micropile Foundations

Individual micropile foundation support elements may consist of a single central steel bar (typically a threaded bar, like a Dywidag bar) encased in a neat cement grout and installed within a small-diameter hole (typically not more than 10 inches) that is usually drilled with rotary percussive drilling equipment. Other designs utilize a high-strength steel pipe encased in grout instead of a central threaded bar. Micropile foundations derive their capacity from adhesion developed between the grout backfill and rock. Micropiles should be installed by a specialty geotechnical contractor experienced with this method of construction.

Design of the micropile foundation elements is typically performed as a design-build contract with the micropile contractor because the contractor's specific means and methods (equipment and

procedures) often result in the most competitive pricing compared to requiring various contractors to bid a standard design. We recommend the following for design of micropiles for the project.

Design Consideration	Value
Allowable Bond Stress between Grout and Soil	Neglect
Allowable Bond Stress between Grout and Intensely to Moderately Fractured Limestone	Neglect
Allowable Bond Stress between Grout and Weathered Limestone or Non-continuous bedrock (including soil filled and open zones)	Neglect
Allowable Bond Stress between Grout and Competent Limestone	100 psi
Minimum Grout Thickness Around Micropile Central Reinforcement	1 inch
Allowable End Bearing Pressure for Axial Compression	Neglect
Minimum Length of Competent Rock Bond Zone	5 feet
Minimum Diameter of Micropile Drilled Hole	4 inches
Minimum Center-to-Center Spacing of Micropiles	Greater of 3 diameters or 16 inches

The micropile lengths could vary because of subsurface conditions encountered. The specialty contractor performing the micropile design-build should take the variable subsurface conditions into account in their design and be prepared to lengthen or add piles, if needed, in response to specific conditions at each location. We should be authorized to provide additional services to review the contractor's design submittal for interpretation and implementation of our recommendations.

The lateral capacities of groups of micropile foundations, or the response of the micropile groups in terms of expected lateral deflections and moments, will depend on variables such as the number and arrangement of micropiles in the group, the design of the individual micropiles (diameter, length, bar size, casing, grout strength, etc.), and the specific subsurface conditions at those locations required to resist lateral loads. Consequently, analysis of micropiles to resist lateral loads was not performed as part of this exploration. The design-build specialty contractor should provide lateral load analyses to confirm adequate lateral capacity and acceptable lateral deflections as part of the foundation design. If needed, micropiles can be battered (installed at an angle) to provide additional lateral capacity. Once preliminary design of micropile foundations is complete, we should be authorized for additional services to review those critical and typical foundation groups to confirm the lateral load capacities.

Pile load tests or proof tests should be considered to verify the axial compressive and uplift capacities of the micropiles. Load tests should be performed on "sacrificial" test piles outside of actual foundation areas. Proof testing can be considered for production piles as an uplift test with a center-pull hydraulic ram to avoid the need for a large reaction frame and reaction piles. The installation of test piles and the load or proof testing of the piles should be observed by our geotechnical engineer. The procedures for conducting axial compressive and uplift pile load tests are outlined in ASTM D1143. We recommend using the Quick Test procedure with no more than a 1-hour hold at the maximum test load, since the bedrock materials are not typically susceptible to creep displacements. The test piles should be loaded to at least 2.5 times the design load for the pile. Proof tests should load the piles to

1.5 times the design load of the piles. We should review the results of the load tests and any proposed design modifications for compatibility with the original design intent of the foundations. Alternatively, Dynamic Pile Testing may also be used (ASTM D4945), as well as the Rapid Load Test (ASTM D7383).

Considerable judgment and experience will be required to evaluate pile lengths relative to the materials needed to provide the design adhesion. The contractor selected for micropile construction should have at least 5 years of experience installing micropiles in geologic settings and subsurface conditions similar to those at this site. The installation of all micropile foundations should be observed and documented on a full-time basis by our geotechnical engineer.

6.0 LIMITATIONS

This geotechnical engineering report has been prepared for the exclusive use of our Client for specific application to this project. The report has been prepared in accordance with generally accepted geotechnical engineering practices using that level of care and skill ordinarily exercised by licensed members of the engineering profession currently practicing under similar conditions in the same locale. No warranties, expressed or implied, are intended or made.

TTL understands this geotechnical engineering report will be used by the Client and various designers and contractors involved with the project. TTL should be invited and authorized to attend project meetings (in person or teleconferencing) or to address applicable issues relating to the geotechnical engineering aspects of the project. TTL should also be retained to review the final construction plans and specifications to evaluate if the information and recommendations in this geotechnical engineering report has been properly interpreted and implemented in the design and specifications. This report has not been prepared as, and should not be used as, a design or specification document to be directly implemented by the contractor. The contractor and applicable subcontractors should familiarize themselves with this report prior to the start of their construction activities, contact TTL for any interpretation or clarification of the report, retain the services of their own consultants to interpret this report, or perform additional geotechnical testing prior to bidding and construction.

This geotechnical engineering report is based on the information provided to us by the Client and various other individuals and entities associated with the project, exploratory borings within the project limits, and our engineering analyses and evaluation. The Client and readers of this geotechnical engineering report should realize that subsurface variations and anomalies can and may exist across the site and between the exploration locations. Site conditions can change due to the modifying effects of seasonal and climatic conditions, such that conditions at times after the exploration may be different than reported herein. The nature and extent of such site or subsurface variations may not become evident until construction commences or is in progress. If site and subsurface anomalies or variations are encountered, TTL should be contacted immediately and authorized to evaluate such conditions and, if necessary, provide applicable recommendations.

Unless stated otherwise in this report or in the contract documents between TTL and Client, our scope of services for the geotechnical exploration did not include, either specifically or by implication, any environmental or biological assessment of the site, or any identification or prevention of pollutants, hazardous materials or conditions at the site. Our overall scope did include performing environmental

assessment services, and reports of those assessments have been submitted under separate covers. Also, permitting, site safety, excavation support, and dewatering requirements are the responsibility of others.

Should the nature, design, or location of the project, be modified, the geotechnical engineering recommendations and guidelines provided in this document will not be considered valid unless TTL is authorized to review the changes and either verifies or modifies the applicable recommendations in writing.

Additional information about the use and limitations of a geotechnical report is provided within the Geoprofessional Business Association document included at the end of this report.

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept*

responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are not final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for information purposes only.* To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

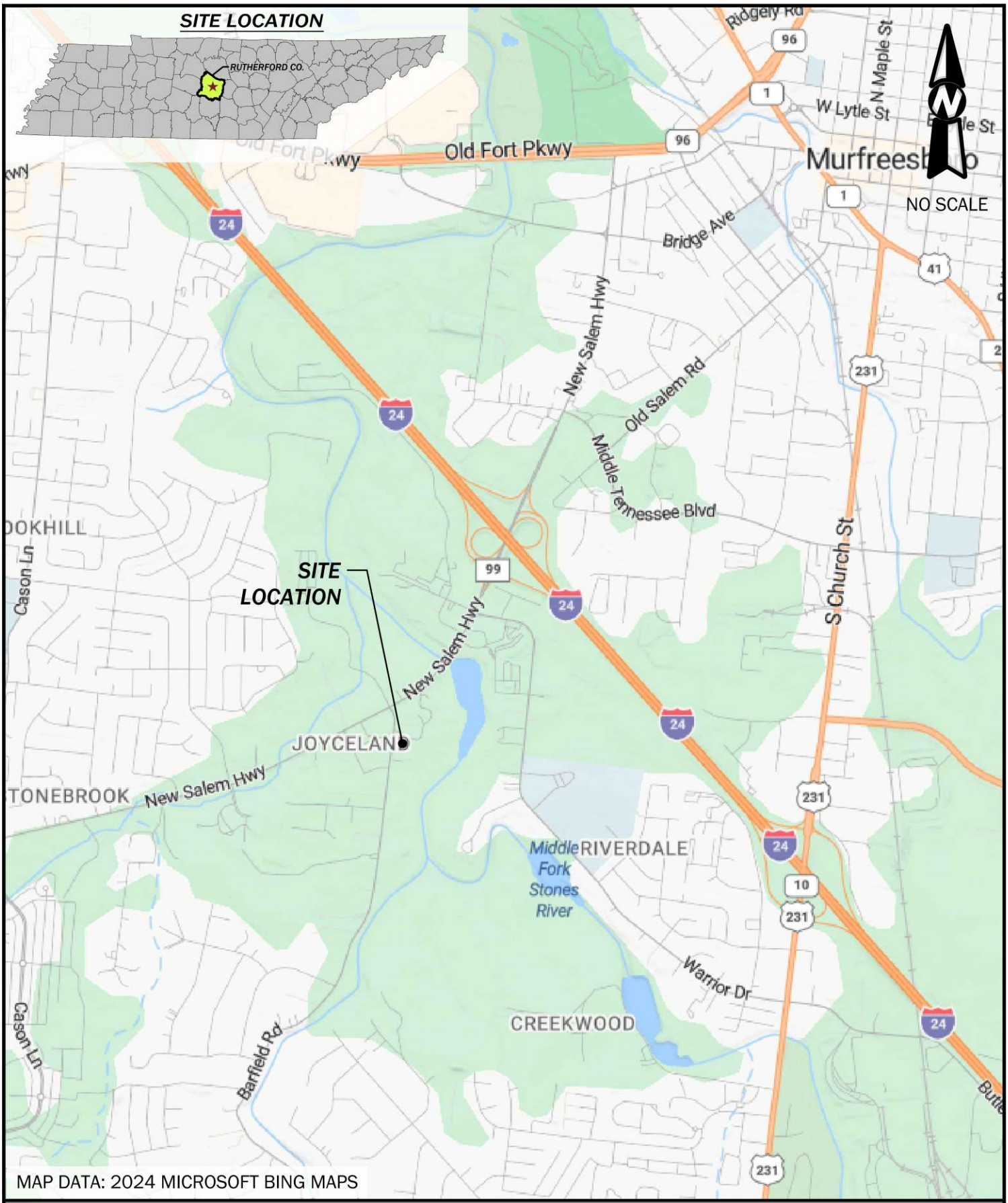
Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration*** by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org

APPENDIX A
ILLUSTRATIONS



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624 Grassmere Park, Suite #14 | Nashville, TN 37211
615.331.7770 | www.ttlusa.com

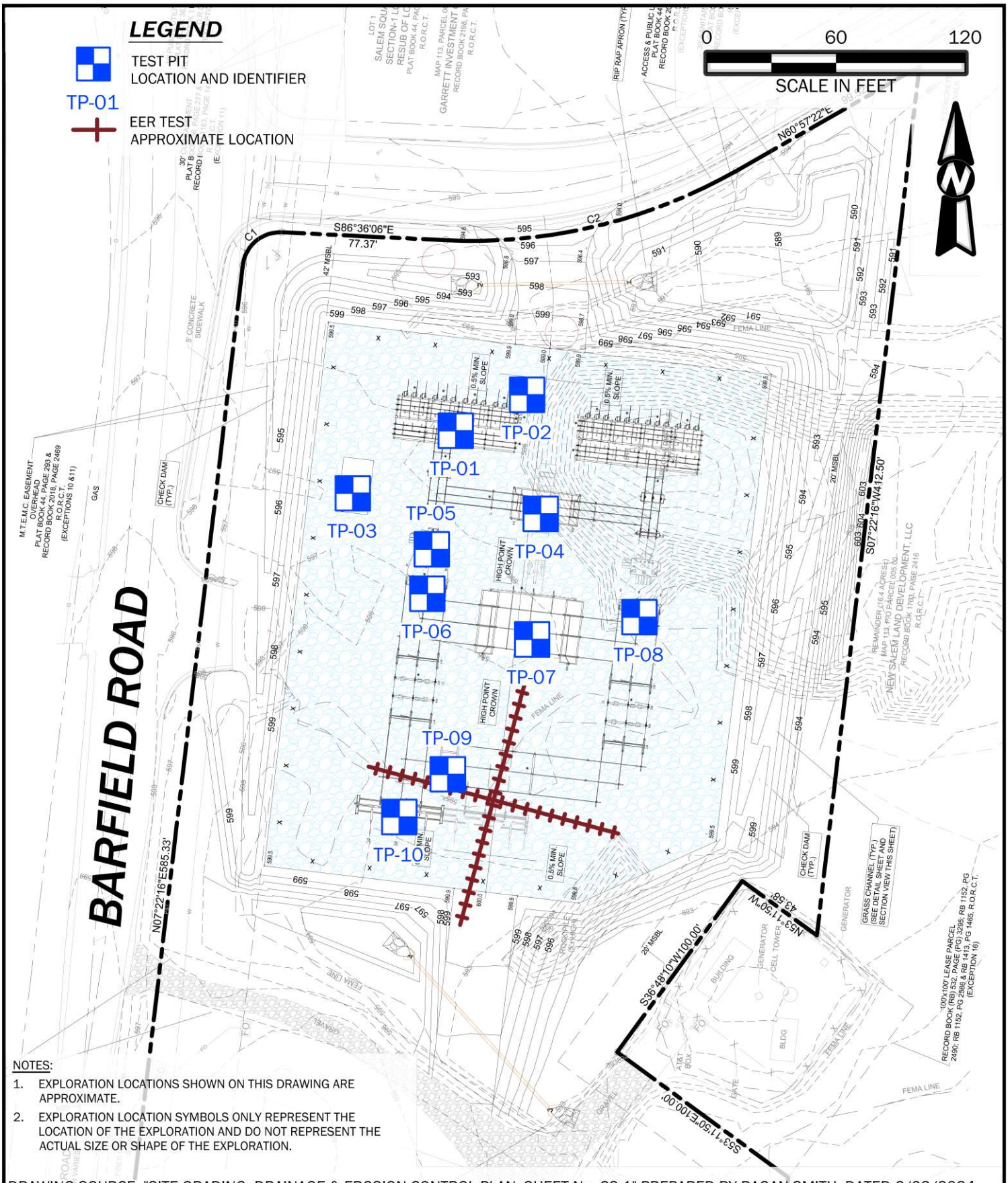
MIDDLE TENNESSEE ELECTRIC NEW SUBSTATION

RAGAN-SMITH ASSOCIATES, INC.

BARFIELD ROAD
MURFREESBORO, RUTHERFORD COUNTY, TENNESSEE

Drawn By:	J P F
Checked By:	C J F
Date:	06-27-2024
Proj. No.:	000230803410.00
File Name:	23-08-03410.00_Substation.dwg

Sheet Title
SITE LOCATION MAP



NOTES:

1. EXPLORATION LOCATIONS SHOWN ON THIS DRAWING ARE APPROXIMATE.
2. EXPLORATION LOCATION SYMBOLS ONLY REPRESENT THE LOCATION OF THE EXPLORATION AND DO NOT REPRESENT THE ACTUAL SIZE OR SHAPE OF THE EXPLORATION.

DRAWING SOURCE: "SITE GRADING, DRAINAGE & EROSION CONTROL PLAN, SHEET No. C2.1" PREPARED BY RAGAN SMITH, DATED 6/03/2024.

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MIDDLE TENNESSEE ELECTRIC NEW SUBSTATION

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Sheet Title
EXPLORATION LOCATION PLAN

SOIL LEGEND

FINE- AND COARSE-GRAINED SOIL INFORMATION

FINE-GRAINED SOILS (SILTS AND CLAYS)

SPT N-Value	Consistency	Estimated Q_u (TSF)
0 - 1	Very Soft	0 - 0.25
2 - 4	Soft	0.25 - 0.5
5 - 8	Firm	0.5 - 1.0
9 - 15	Stiff	1.0 - 2.0
16 - 30	Very Stiff	2.0 - 4.0
31+	Hard	4.0+

Q_u = Unconfined Compression Strength

COARSE-GRAINED SOILS (SANDS AND GRAVELS)

SPT N-Value	Relative Density
0 - 4	Very Loose
5 - 10	Loose
11 - 30	Medium Dense
31 - 50	Dense
51+	Very Dense

PARTICLE SIZE

Name	Size (US Std. Sieve)
Boulders	>300 mm (>12 in.)
Cobbles	75 mm to 300 mm (3 - 12 in.)
Coarse Gravel	19 mm to 75 mm (3/4 - 3 in.)
Fine Gravel	4.75 mm to 19 mm (#4 - 3/4 in.)
Coarse Sand	2 mm to 4.75 mm (#10 - #4)
Medium Sand	0.425 mm to 2 mm (#40 - #10)
Fine Sand	0.075 mm to 0.425 mm (#200 - #40)
Silts and Clays	< 0.075 mm (< #200)

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Terms	Percent of Dry Weight
"Trace"	< 15
"With"	15 - 30
Modifier	> 30

RELATIVE PROPORTIONS OF CLAYS AND SILTS

Descriptive Terms	Percent of Dry Weight
"Trace"	< 5
"With"	5 - 12
Modifier	> 12

CRITERIA FOR DESCRIBING MOISTURE CONDITION

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp, but no visible water
Wet	Visible free water, usually soil is below water table

CRITERIA FOR DESCRIBING CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure
Moderate	Crumbles or breaks with considerable finger pressure
Strong	Will not crumble or break with finger pressure

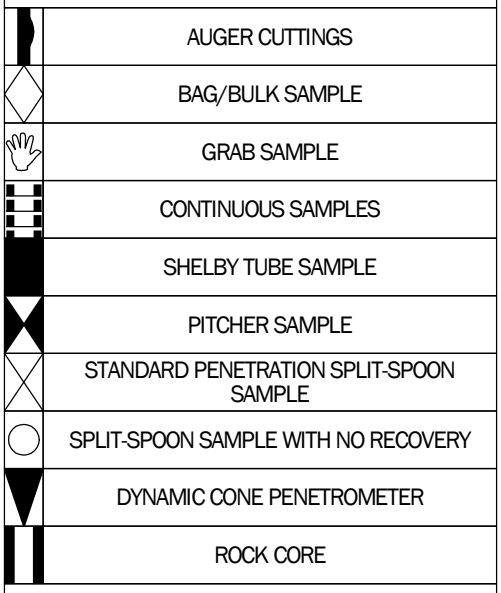
CRITERIA FOR DESCRIBING STRUCTURE

Description	Criteria
Stratified	Alternating layers of varying material or color with layers at least 6 mm thick; note the thickness
Laminated	Alternating layers of varying material or color with the layers less than 6 mm thick; note thickness
Fissured	Breaks along definite planes of fracture with little resistance to fracturing
Slickensided	Fracture planes appear polished or glossy, sometimes striated
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown
Lensed	Inclusion of small pockets of different soils such as small lenses of sand scattered through a mass of clay; note thickness
Homogeneous	Same color and appearance throughout

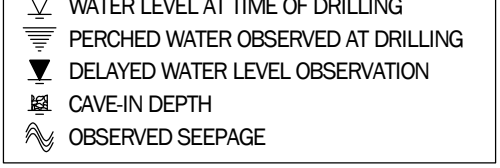
ABBREVIATIONS AND ACRONYMS

WOH	Weight of Hammer	N-Value	Sum of the blows for last two 6-in increments of SPT
WOR	Weight of Rod		
Ref.	Refusal	NA	Not Applicable or Not Available
ATD	At Time of Drilling	OD	Outside Diameter
DCP	Dynamic Cone Penetrometer	PPV	Pocket Penetrometer Value
Elev.	Elevation	SFA	Solid Flight Auger
ft.	feet	SH	Shelby Tube Sampler
HSA	Hollow Stem Auger	SS	Split-Spoon Sampler
ID	Inside Diameter	SPT	Standard Penetration Test
in.	inches	USCS	Unified Soil Classification System
lbs	pounds		

SAMPLERS AND DRILLING METHODS



WATER LEVEL SYMBOLS



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UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

COARSE GRAINED SOILS (>50% of the material is larger than the #200 sieve)	GRAVELS (>50% of coarse fraction is larger than the #4 sieve)	CLEAN GRAVEL WITH <5% FINES	Cu > 4 Cc = 1-3	GW	Well-graded gravels, gravel-sand mixtures with trace or no fines
			Cu < 4 and/or Cc < 1 Cc > 3	GP	Poorly-graded gravels, gravel-sand mixtures with trace or no fines
		GRAVEL WITH 5% TO 12% FINES	Cu > 4 Cc = 1-3	GW-GM	Well-graded gravels, gravel-sand mixtures with silt fines
				GW-GC	Well-graded gravels, gravel-sand mixtures with clay fines
			Cu < 4 and/or Cc < 1 Cc > 3	GP-GM	Poorly-graded gravels, gravel-sand mixtures with silt fines
				GP-GC	Poorly-graded gravels, gravel-sand mixtures with clay fines
		GRAVEL WITH MORE THAN 12% FINES		GM	Silty gravels, gravel-silt-sand mixtures
				GC	Clayey gravels, gravel-sand-clay mixtures
				GC-GM	Clayey gravels, gravel-sand-clay-silt mixtures
	SANDS (>50% of coarse fraction is smaller than the #4 sieve)	CLEAN SAND WITH <5% FINES	Cu > 6 Cc = 1-3	SW	Well-graded sands, sand-gravel mixtures with trace or no fines
			Cu < 6 and/or Cc < 1 Cc > 3	SP	Poorly-graded sands, sand-gravel mixtures with trace or no fines
		SAND WITH 5% TO 12% FINES	Cu > 6 Cc = 1-3	SW-SM	Well-graded sands, sand-gravel mixtures with silt fines
				SW-SC	Well-graded sands, sand-gravel mixtures with clay fines
			Cu < 6 and/or Cc < 1 Cc > 3	SP-SM	Poorly-graded sands, sand-gravel mixtures with silt fines
				SP-SC	Poorly-graded sands, sand-gravel mixtures with clay fines
		SAND WITH MORE THAN 12% FINES		SM	Silty sands, sand-gravel-silt mixtures
				SC	Clayey sands, sand-gravel-clay mixtures
				SC-SM	Clayey sands, sand-gravel-clay-silt mixtures
FINE GRAINED SOILS (>50% of material is smaller than the #200 sieve)		SILTS & CLAYS (Liquid Limit less than 50)		ML	Inorganic silts with low plasticity
				CL	Inorganic clays of low plasticity, gravelly or sandy clays, silty clays, lean clays
				CL-ML	Inorganic clay-silts of low plasticity, gravelly clays, sandy clays, silty clays, lean clays
				OL	Organic silts and organic silty clays of low plasticity
		SILTS & CLAYS (Liquid Limit more than 50)		MH	Inorganic silts of high plasticity, elastic silts
				CH	Inorganic clays of high plasticity, fat clays
				OH	Organic clays and organic silts of high plasticity

USCS - HIGHLY ORGANIC SOILS

Primarily organic matter, dark in color, organic odor

PT	Peat, humus, swamp soils with high organic contents

OTHER MATERIALS

- BITUMINOUS CONCRETE (ASPHALT)
- CONCRETE
- CRUSHED STONE/AGGREGATE BASE
- TOPSOIL
- FILL
- UNDIFFERENTIATED ALLUVIUM
- UNDIFFERENTIATED OVERBURDEN
- BOULDERS AND COBBLES

UNIFORMITY COEFFICIENT

$$C_u = D_{60}/D_{10}$$

COEFFICIENT OF CURVATURE

$$C_C = (D_{30})^2/(D_{60} \times D_{10})$$

Where:

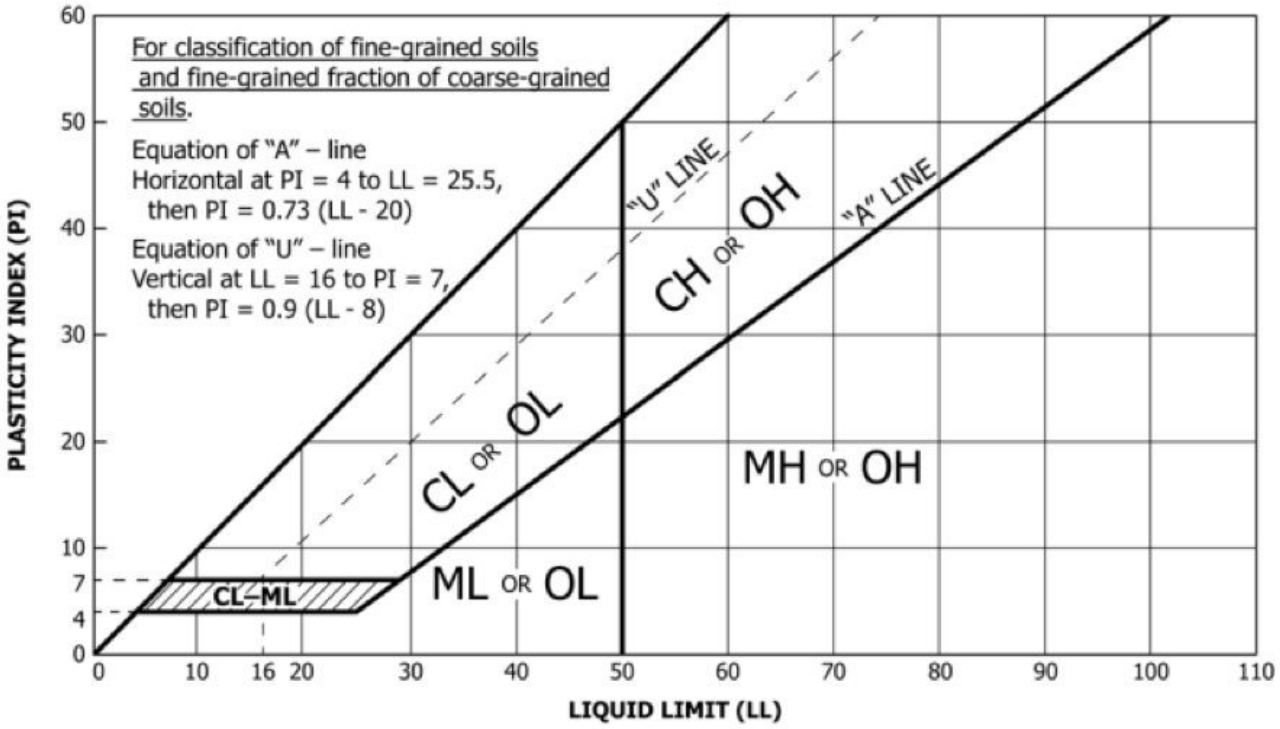
D_{60} = grain diameter at 60% passing

D_{30} = grain diameter at 30% passing

D_{10} = grain diameter at 10% passing

TTL

PLASTICITY CHART FOR USCS CLASSIFICATION OF FINE-GRAINED SOILS



IMPORTANT NOTES ON TEST BORING RECORDS

1) The report and graphics key are an integral part of these logs. All data and interpretations in this log are subject to the explanations and limitations stated in the report.

2) Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual or differ from those shown. Solid lines are used to indicate a change in the material type, particularly a change in the USCS classification. Dashed lines are used to separate two materials that have the same material type, but that differ with respect to two or more other characteristics (e.g. color, consistency).

3) No warranty is provided as to the continuity of soil or rock conditions between individual sample locations.

4) Logs represent general soil and rock conditions observed at the point of exploration on the date indicated.

5) In general, Unified Soil Classification System (USCS) designations presented on the logs were based on visual classification in the field and were modified where appropriate based on gradation and index property testing.

6) Fine-grained soils that plot within the hatched area on the Plasticity Chart, and coarse-grained soils with between 5% and 12% passing the #200 sieve require dual USCS symbols as presented on the previous page.

7) If the sampler is not able to be driven at least 6 inches, then 50/X" indicates that the sampler advanced X inches when struck 50 times with a 140-pound hammer falling 30 inches.

8) If the sampler is driven at least 6 inches, but cannot be driven either of the subsequent two 6-inch increments, then either 50/X" or the sum of the second 6-inch increment plus 50/X" for the third 6-inch increment will be indicated.
Example 1: Recorded SPT blow counts are 16 - 50/4", the SPT N-value will be shown as N = 50/4"
Example 2: Recorded SPT blow counts are 18 - 25 - 50/2", the SPT N-value will be shown as N = 75/8"

Middle Tennessee Electric New Substation

Ragan Smith

Barfield Road

Murfreesboro, Rutherford County, Tennessee

TP-01

Contractor:	Rollins Construction	Project No.:	000230803410.00	Comments: Groundwater was not encountered upon completion.
Logged By:	C. Fullmer	Date Excavated:	06/14/24	
Equipment:	CAT 420 F2	Test Pit Depth:	3.5 ft	Backfilled with excavated materials upon completion.
Coordinates:	N/A	Ground Elev.:	N/A	

Elevation (ft)	Depth (ft)	Graphic Log	Materials Description	Moisture Content (%)	PPV (tsf)	Sample Type	Remarks
			RESIDUUM: LEAN CLAY, very stiff, red-brown, with some fine roots, moist (CL)		2.5	■	
					2.0	■	
			3.5				
			Excavator refusal at 3.5 feet				
590	5						

Middle Tennessee Electric New Substation

Ragan Smith

Barfield Road

Murfreesboro, Rutherford County, Tennessee

TP-02

Contractor:	Rollins Construction	Project No.:	000230803410.00	Comments: Groundwater was not encountered upon completion.
Logged By:	C. Fullmer	Date Excavated:	06/14/24	
Equipment:	CAT 420 F2	Test Pit Depth:	2 ft	Backfilled with excavated materials upon completion.
Coordinates:	N/A	Ground Elev.:	N/A	

Elevation (ft)	Depth (ft)	Graphic Log	Materials Description	Moisture Content (%)	PPV (tsf)	Sample Type	Remarks
			TOPSOIL, 1 inch <0.1 **FILL**: loose soil and rock mixture, approximately 80% rock and 20% soil, Soil: LEAN CLAY, brown and moist (CL), Rock: Limestone shot-rock. Typically 18 inch boulders with poor rock to rock contact. Maximum boulder size was approximately 3 feet.				
			2.0 Test pit terminated at 2 feet				
590	5						

Middle Tennessee Electric New Substation

Ragan Smith

Barfield Road

Murfreesboro, Rutherford County, Tennessee

TP-03

Contractor:	Rollins Construction	Project No.:	000230803410.00	Comments: Groundwater was not encountered upon completion.
Logged By:	C. Fullmer	Date Excavated:	06/14/24	
Equipment:	CAT 420 F2	Test Pit Depth:	0.5 ft	Backfilled with excavated materials upon completion.
Coordinates:	N/A	Ground Elev.:	N/A	

Elevation (ft)	Depth (ft)	Graphic Log	Materials Description	Moisture Content (%)	PPV (tsf)	Sample Type	Remarks
			TOPSOIL, 4 inches (0.3)				
			RESIDUUM: LEAN CLAY, brown, with a trace of chert gravel (fine to coarse), moist (CL) (0.5)				
			Excavator refusal at 0.5 foot				
595							
	5						
590							

Middle Tennessee Electric New Substation

Ragan Smith

Barfield Road

Murfreesboro, Rutherford County, Tennessee

TP-04

Contractor:	Rollins Construction	Project No.:	000230803410.00	Comments: Groundwater was not encountered upon completion.
Logged By:	C. Fullmer	Date Excavated:	06/14/24	
Equipment:	CAT 420 F2	Test Pit Depth:	1.5 ft	Backfilled with excavated materials upon completion.
Coordinates:	N/A	Ground Elev.:	N/A	

Elevation (ft)	Depth (ft)	Graphic Log	Materials Description	Moisture Content (%)	PPV (tsf)	Sample Type	Remarks
			TOPSOIL, 0.5 inch <0.1 **FILL**: loose soil and rock mixture, approximately 70% soil and 30% rock. Soil: LEAN CLAY, brown and moist (CL), Rock: Limestone shot-rock (angular). Typically, 36 inches with poor rock to rock contact. Maximum boulder size was approximately 4 feet.				
			1.5				
			Excavator refusal at 1.5 feet				
595							
	5						

Middle Tennessee Electric New Substation

Ragan Smith

Barfield Road

Murfreesboro, Rutherford County, Tennessee

TP-05

Contractor:	Rollins Construction	Project No.:	000230803410.00	Comments: Groundwater was not encountered upon completion. Backfilled with excavated materials upon completion.
Logged By:	C. Fullmer	Date Excavated:	06/14/24	
Equipment:	CAT 420 F2	Test Pit Depth:	2.5 ft	
Coordinates:	N/A	Ground Elev.:	N/A	

Elevation (ft)	Depth (ft)	Graphic Log	Materials Description	Moisture Content (%)	PPV (tsf)	Sample Type	Remarks
			TOPSOIL, 5 inches				
			0.4				
			RESIDUUM: LEAN CLAY, firm, brown, moist (CL)		1.0		
			2.5				
			Excavator Refusal at 2.5 feet				
590	5						

Middle Tennessee Electric New Substation

Ragan Smith

Barfield Road

Murfreesboro, Rutherford County, Tennessee

TP-06

Contractor:	Rollins Construction	Project No.:	000230803410.00	Comments: Groundwater was not encountered upon completion.
Logged By:	C. Fullmer	Date Excavated:	06/14/24	
Equipment:	CAT 420 F2	Test Pit Depth:	0.5 ft	Backfilled with excavated materials upon completion.
Coordinates:	N/A	Ground Elev.:	N/A	

Elevation (ft)	Depth (ft)	Graphic Log	Materials Description	Moisture Content (%)	PPV (tsf)	Sample Type	Remarks
			TOPSOIL, 6 inches				
			0.5				
			Excavator refusal at 0.5 foot				
590	5						

Middle Tennessee Electric New Substation

Ragan Smith

Barfield Road

Murfreesboro, Rutherford County, Tennessee

TP-07

Contractor:	Rollins Construction	Project No.:	000230803410.00	Comments: Groundwater was not encountered upon completion.
Logged By:	C. Fullmer	Date Excavated:	06/14/24	
Equipment:	CAT 420 F2	Test Pit Depth:	0.5 ft	Backfilled with excavated materials upon completion.
Coordinates:	N/A	Ground Elev.:	N/A	

Elevation (ft)	Depth (ft)	Graphic Log	Materials Description	Moisture Content (%)	PPV (tsf)	Sample Type	Remarks
			TOPSOIL, 3 inches — 0.3				
			RESIDUUM: LEAN CLAY, red-brown, moist (CL) — 0.5				
			Excavator refusal at 0.5 foot				
595							
	5						
590							

Middle Tennessee Electric New Substation

Ragan Smith

Barfield Road

Murfreesboro, Rutherford County, Tennessee

TP-08

Contractor:	Rollins Construction	Project No.:	000230803410.00	Comments: Groundwater was not encountered upon completion.
Logged By:	C. Fullmer	Date Excavated:	06/14/24	
Equipment:	CAT 420 F2	Test Pit Depth:	2.5 ft	Backfilled with excavated materials upon completion.
Coordinates:	N/A	Ground Elev.:	N/A	

Elevation (ft)	Depth (ft)	Graphic Log	Materials Description	Moisture Content (%)	PPV (tsf)	Sample Type	Remarks
			TOPSOIL, 6 inches				
			0.5				
595			**RESIDUUM**: LEAN CLAY, firm, with a trace of sand (fine to coarse) with some fine roots, moist (CL)		1.0		
			2.5				
			Excavator refusal at 2.5 feet				
	5						
590							

Middle Tennessee Electric New Substation

Ragan Smith

Barfield Road

Murfreesboro, Rutherford County, Tennessee

TP-09

Contractor:	Rollins Construction	Project No.:	000230803410.00	Comments: Groundwater was not encountered upon completion.
Logged By:	C. Fullmer	Date Excavated:	06/14/24	
Equipment:	CAT 420 F2	Test Pit Depth:	0.5 ft	Backfilled with excavated materials upon completion.
Coordinates:	N/A	Ground Elev.:	N/A	

Elevation (ft)	Depth (ft)	Graphic Log	Materials Description	Moisture Content (%)	PPV (tsf)	Sample Type	Remarks
			TOPSOIL, 4 inches (0.3)				
			RESIDUUM: LEAN CLAY, light brown, moist (CL) (0.5)				
			Excavator refusal at 0.5 foot				
590	5						

Middle Tennessee Electric New Substation

Ragan Smith

Barfield Road

Murfreesboro, Rutherford County, Tennessee

TP-10

Contractor:	Rollins Construction	Project No.:	000230803410.00	Comments: Groundwater was not encountered upon completion. Backfilled with excavated materials upon completion.
Logged By:	C. Fullmer	Date Excavated:	06/14/24	
Equipment:	CAT 420 F2	Test Pit Depth:	2 ft	
Coordinates:	N/A	Ground Elev.:	N/A	

Elevation (ft)	Depth (ft)	Graphic Log	Materials Description	Moisture Content (%)	PPV (tsf)	Sample Type	Remarks
			TOPSOIL, 3 inches — 0.3				
			RESIDUUM: LEAN CLAY, stiff, light brown with gray mottling, moist (CL)		2.0		
			— 2.0				
			Excavator refusal at 2 feet				
590	5						

Laboratory Results Summary

Middle Tennessee Electric New Substation
000230803410.00

Ragan Smith
Murfreesboro, TN

Boring ID	Sample ID	Depth (ft)	Moisture Content (%)	LL	PL	PI	%Gravel	% Sand	% Fines	Dry Density (PCF)	% Finer than 0.02mm	USCS Classification
TP-01		1	13.3	42	21	21						
TP-01		3	21.7									
TP-02		1	24.3									
TP-04		1	18.2	46	20	26						
TP-05		1	17.4									
TP-08		1	16.5									
TP-10		1	20.6									

EARTH ELECTRICAL RESISTIVITY REPORT

MTE Substation

Murfreesboro, Rutherford County, Tennessee

TTL Project Number: 000230803410.00

Test Date: 13-06-24 | Project Location: Murfreesboro, Rutherford County, Tennessee

Test Latitude: 35.8184 | Test Longitude: -86.4202

Test Number: EER-01, A | Test Direction: East to West

Surface Soil Type: Clay | Technician: CJF

Instrument Used: AEMC Model 6471 | Calibration Date: 07-05-23

Method Used: Test A Wenner Array (4 Pin) ASTM G 57

Test No.	Probe Depth (feet)	A Spacing (feet)	Meter Reading	Resistance	Multiplier	Earth Resistivity OHM-CM
A	0.3	2	24.70	24.70	383	9,460
A	0.3	4	20.90	20.90	766	16,010
A	0.3	6	13.50	13.50	1,149	15,500
A	0.3	8	8.91	8.91	1,532	13,700
A	0.3	10	7.55	7.55	1,915	14,400
A	0.3	20	7.33	7.33	3,830	28,100
A	0.3	30	7.07	7.07	5,745	40,600
A	0.3	40	7.14	7.14	7,660	54,700

EARTH ELECTRICAL RESISTIVITY REPORT

MTE Substation

Murfreesboro, Rutherford County, Tennessee

TTL Project Number: 000230803410.00

Test Date: 13-06-24 | Project Location: Murfreesboro, Rutherford County, Tennessee

Test Latitude: 35.8184 | Test Longitude: -86.4202

Test Number: EER-01, B | Test Direction: North to South

Surface Soil Type: Clay | Technician: CJF

Instrument Used: AEMC Model 6471 | Calibration Date: 07-05-23

Method Used: Test B Wenner Array (4 Pin) ASTM G 57

Test No.	Probe Depth (feet)	A Spacing (feet)	Meter Reading	Resistance	Multiplier	Earth Resistivity OHM-CM
B	0.3	2	26.10	26.10	383	10,000
B	0.3	4	9.74	9.74	766	7,460
B	0.3	6	8.08	8.08	1,149	9,280
B	0.3	8	7.52	7.52	1,532	11,500
B	0.3	10	7.10	7.10	1,915	13,600
B	0.3	20	7.91	7.91	3,830	30,300
B	0.3	30	8.18	8.18	5,745	47,000
B	0.3	40	8.09	8.09	7,660	62,000

APPENDIX B
REFERENCE MATERIALS

EXPLORATION PROCEDURES

Field Locating of Explorations

Exploratory test pits and electrical earth resistivity arrays were located in the field using a hand-held global positioning system (GPS) unit (Garmin Montana 680t). The locations shown on the Exploration Location Plan in Appendix A should not be considered more accurate than implied by the methods used. Surveying the test locations for vertical and horizontal control by a Professional Land Surveyor was beyond the scope of this exploration.

Test Pit Excavations

Test pit excavations were made by a Caterpillar 420 F2 backhoe. Each excavation proceeded in small depth increments, typically 1 foot. A TTL geoprofessional documented the conditions exposed by the excavations, classified the soil using the Unified Soil Classification System (USCS) defined by ASTM D2487 and D2488, and collected representative grab samples of the soil. The consistency of the exposed soils was measured using a Pocket Penetrometer at regular depth intervals or at apparent changes in stratigraphy. Pocket penetrometer testing consisted of forcing a flat-tipped steel rod with a ¼-inch-diameter circular cross-section into the soil a distance of ¼ inch. The steel rod is connected to a calibrated spring which measures the force required to push the device into the soil and correlates the force with the unconfined compressive strength of the soil in tons per square foot (tsf), which is equal to the undrained shear strength in kips per square foot (ksf). The data collected from the test pits are presented on test pit logs in Appendix A.

Groundwater Measurements

Each test pit was checked for the presence of groundwater after completion using a measuring tape. The depth to groundwater, if encountered, was recorded and is reported on the test pit logs in Appendix A.

Backfilling Test Pits

Each test pit excavation was backfilled to the ground surface with excavated soils after making groundwater measurements. Backfill was placed in lifts and tamped with the bucket of the backhoe, but we caution the backfill should not be considered as “compacted” fill suitable to support additional fill, foundations, slabs, or pavements. Backfill may settle over time. Return trips to the site to top-off backfill that had settled were not part of our scope of services.

Earth Electrical Resistivity (EER)

EER testing was performed at one location using the Wenner array method (ASTM G57) consisting of an AEMC Model 6471 resistivity meter connected to four electrodes in a linear array. The electrodes were embedded 4 inches below the ground surface. Testing consisted of measuring the resistivity across the four electrodes for each of a series of equal spacings between electrodes, called the “A-spacing.” Resistivity measurements were made for eight A-spacings, in feet, of 2, 4, 6, 8, 10, 20, 30, and 40. The A-spacing correlates with (but is not the same as) the depth of testing below the array.

Two arrays, labeled A and B, oriented perpendicular to each other, were performed for the test. Individual test results are presented in Appendix A.

LABORATORY PROCEDURES

Classification and Index Testing

Select samples were tested for the following properties in general accordance with the applicable ASTM standards:

- Water content (ASTM D2216); and
- Atterberg limits (ASTM D4318).

Results of the tests are presented on the Laboratory Results Summary sheet in Appendix A.

Exhibit L

General Bill of Materials for Control House

BILL OF MATERIALS
MTE - Barfield Substation

Item#	Manufacturer	Catalog#	Description	Quantity
1		PANELS	RELAY PANEL: 90"H x 24"W x 24"D, SEE MTE DRAWINGS FOR DETAILS.	5
2	SEL	24402H12B1B11630 2440#2CK2	DISCRETE PROGAMMABLE AUTOMATION CONTROLLER; MOUNTING: HORIZONTAL RACK MOUNTING; I/O OPTIONS: 48 DIGITAL INPUT, 0 DIGITAL OUTPUT (48DI, 0DO); CONTROL VOLTAGE: 24 VDC/VAC DIGITAL INPUT VOLTAGE; SERIAL PORT 2: EIA-232, STANDARD; ETHERNET CONNECTION OPTIONS: DUAL COPPER 10/100BASE-T, STANDARD; COMMUNICATIONS PROTOCOL: DNP3, STANDARD; CONFORMAL COATING: NONE.	1
3	SEL	24070003B 2407#0201	GPS SATELLITE-SYNCHRONIZED CLOCK; FIRMWARE: STANDARD; OPTIONAL COMMUNICATIONS PORT: NONE; ANTENNA: GPS ANTENNA WITH 75 FEET OF CABLE; PACKAGING: CLOCK WITH 19" RACK-MOUNT BRACKET.	1
4	SEL	252301H13A0A0XX KEY:7533	ANNUNCIATOR PANEL WITH COMMUNICATIONS, FIRMWARE: STANDARD; POWER SUPPLY: 125/250 VDC OR VAC; HARDWARE MOUNTING: HORIZONTAL RACK MOUNT, 5U; COMMUNICATION OPTIONS: 2 EIA-232 REAR PORTS, 1 EIA-232 FRONT PORT; SERIAL COMMUNICATIONS PROTOCOLS: STANDARD PLUS DNP 3.00 LEVEL 2 SLAVE; AUXILIARY CARD: EIA-232 OR EIA-485 SERIAL COMMUNICATION CARD; CONTROL INPUT VOLTAGE: 125 VDC OR VAC; CONFORMAL COAT: NONE	1
5	SEL	3350#QQYT	REAL TIME AUTOMATION CONTROLLER; MOUNTING: HORIZONTAL RACK MOUNT, 3U; POWER SUPPLY: 125/250 VDC, 120/240 VAC.	2
6	SEL	751001AA01A1A85AC00 751#6CMH	FEEDER PROTECTION RELAY, HIGH-SIDE OF TRANSFORMER; FRONT PANEL: 5-INCH COLOR TOUCHSCREEN WITH 8 PUSHBUTTONS; SLOT A POWER SUPPLY VOLTAGE: 110-250 VDC (110-240 VAC), 50/60 HZ; SLOT A DIGITAL INPUT VOLTAGE: 125 VDC/VAC; SLOT B ETHERNET (PORT 1): SINGLE 10/100BASE-T ETHERNET; SLOT B REAR SERIAL PORT (PORT 3): EIA-232; SLOT C: SERIAL COMM (EIA-232/485); SLOT D: 4 DI / 4 DO ELECTROMECHANICAL (FORM A), 125 VDC/VAC; SLOT E: 4 DI / 4 DO ELECTROMECHANICAL (FORM A), 125 VDC/VAC; SLOT Z VOLTAGE INPUTS: 3-PHASE AC VOLTAGE (300 VAC); SLOT Z CURRENT INPUTS: 5 AMP PHASE, 5 AMP NEUTRAL; CONFORMAL COAT: NONE.	2
7	SEL	07872EE1AA01A7985A200 787#H2KH	TRANSFORMER PROTECTION RELAY; MODEL OPTIONS: 2-WINDING CURRENT DIFFERENTIAL, 1 NEUTRAL CURRENT AND 3 VOLTAGE INPUTS; FRONT PANEL: 5-INCH COLOR TOUCHSCREEN WITH 8 PUSHBUTTONS; SLOT A POWER SUPPLY VOLTAGE: 110-250 VDC (110-240 VAC); SLOT A DIGITAL INPUT VOLTAGE: 125 VDC/VAC; SLOT B ETHERNET (PORT 1): SINGLE 10/100BASE-T ETHERNET; SLOT B REAR SERIAL PORT (PORT 3): EIA-232; SLOT C: SERIAL COMM (EIA-232/485); SLOT D: 4 DI / 4 DO ELECTROMECHANICAL (FORM A), 125 VDC/VAC; SLOT E: 5 AMP NEUTRAL AC CURRENT INPUT / 3-PHASE AV VOLTAGE (300 VAC) INPUTS; SLOT Z CURRENT INPUTS: 6-PHASE AC CURRENT INPUT (5 AMP WINDING 1 / 5 AMP WINDING 2); SLOT Z VOLTAGE INPUTS: NA; CONFORMAL COAT: NONE.	2
8	SEL	751001AA01A7085AC00 751#BC94	FEEDER PROTECTION RELAY, LOW-SIDE OF TRANSFORMER; FRONT PANEL: 5-INCH COLOR TOUCHSCREEN WITH 8 PUSHBUTTONS; SLOT A POWER SUPPLY VOLTAGE: 110-250 VDC (110-240 VAC), 50/60 HZ; SLOT A DIGITAL INPUT VOLTAGE: 125 VDC/VAC; SLOT B ETHERNET (PORT 1): SINGLE 10/100BASE-T ETHERNET; SLOT B REAR SERIAL PORT (PORT 3): EIA-232; SLOT C: SERIAL COMM (EIA-232/485); SLOT D: 4 DI / 4 DO ELECTROMECHANICAL (FORM A), 125 VDC/VAC; SLOT E: VSYNC (300 VAC) / VBAT (300 VDC) / 4 ARC-FLASH DETECTION INPUTS; SLOT Z VOLTAGE INPUTS: 3-PHASE AC VOLTAGE (300 VAC); SLOT Z CURRENT INPUTS: 5 AMP PHASE, 5 AMP NEUTRAL; CONFORMAL COAT: NONE.	2
9	SEL	951031B2 9510#0101 KEY: 1913	CONTROL SWITCH MODULE; LED INPUT VOLTAGE: 125 VDC; LED/BUTTON COLOR COMBINATION: OPEN = GREEN, CLOSE = RED; PUSHBUTTON GUARDS: WITH GUARDS WITH CONFIGURABLE LABELS.	4
10	SEL	0735LX20944EFXB4XX16201XX 735#MDCK	MULTI-FUNCTION METER; ENCLOSURE TYPE: NONE; METERING FORM: FORM 9 (4-WIRE WYE; 3 PTS, 3CTS); SLOT A POWER SUPPLY VOLTAGE: 110-240 VAC 50/60 HZ, 110-250 VDC; CONTROL INPUT VOLTAGE: 125 VDC/VAC; SLOT B ETHERNET: SINGLE 10/100 BASE-T; SLOT B SERIAL PORT 3: EIA 485 INCLUDES PORT 2 EIA-232 STANDARD; SLOT C COMMS: EIA-232, EIA-485; SLOT D I/O: 4 DI / 4 DO ELECTROMECHANICAL; CURRENT CLASS: CL2/10/20, OPTIMIZED FOR LOW-END ACCURACY; SYSTEM FREQUENCY: 60 HZ; SOFTWARE BUNDLE: NONE; CONFORMAL COAT: NONE.	2
11	***TVA	TVA UFLS	TVA UFLS PRE-WIRED RELAY INSERT. FURNISHED BY TVA AND INSTALLED BY CONTROL HOUSE MANUFACTURER.	1
12	STATES	402-D-B	TEST SWITCH, TYPE SMH, 2-POLE, BACK CONNECTED, RATED FOR 250V DC, 30A	10

13	ABB	FR3GJ76036J76	FT-19R TEST SWITCH ASSEMBLY, THREE RACK UNIT MOUNTING HEIGHT, GRAY (ANSI61 SMOOTH SURFACE), THREE 10 POLE TEST SWITCHES WITH THE FOLLOWING ARRANGEMENT: POSITION A: C-C C-C C-C P P P P POSITION B: T T T T T T T T T T POSITION C: C-C C-C C-C P P P P	2
14	ABB	FR3GJ76M24036	FT-19R TEST SWITCH ASSEMBLY, THREE RACK UNIT MOUNTING HEIGHT, GRAY (ANSI61 SMOOTH SURFACE), THREE 10 POLE TEST SWITCHES WITH THE FOLLOWING ARRANGEMENT: POSITION A: C-C C-C C-C P P P P POSITION B: C-C C-C C-C C-C P P POSITION C: T T T T T T T T T T	2
15	ABB	FR3GM24T91036	FT-19R TEST SWITCH ASSEMBLY, THREE RACK UNIT MOUNTING HEIGHT, GRAY (ANSI61 SMOOTH SURFACE), THREE 10 POLE TEST SWITCHES WITH THE FOLLOWING ARRANGEMENT: POSITION A: C-C C-C C-C C-C P P POSITION B: P P P P T T T T T T POSITION C: T T T T T T T T T T	2
16	ESW	24304RE	INSTRUMENT AND CONTROL SWITCH, SERIES 24, ROTARY TAP, OVAL HANDLE, 4 DECK, TRIPLE THROW WITH OFF, WITH THE FOLLOWING ENGRAVING: TITLE: "BANK SWITCH", 11 O'CLOCK POSITION: "BANK 1", 12 O'CLOCK POSITION: "NORMAL", 1 O'CLOCK POSITION: "PARALLEL", 2 O'CLOCK: "BANK 2". SEE ATTACHED CONFIGURATION SHEET.	1
17	GE	116B6708G43A73C4	INDICATION LIGHT, TYPE ET-16, LED, 125 VDC, CLEAR LENSE CAP WITH AMBER LED LAMP. TWO SPARES.	4
18	GE	EB27B04S	TERMINAL BLOCK, 4 POLE, SHORTING TYPE, NO WHITE MARKING STRIP, RATED FOR 600V, 30A, BRASS NICKEL PLATED SCREWS AND CONNECTORS, WIRE RANGE #10 TO #16 AWG COPPER WIRE. (WITH PROVISIONS FOR HOLDING 4 SHORTING PINS WHEN NOT IN USE)	10
19	GE	EB25B12	TERMINAL BLOCK, 12 POLE, STRAIGHT STRAP TYPE, WITH WHITE MARKING STRIP, RATED FOR 600V, 75A, BRASS NICKEL PLATED STUDS AND CONNECTORS, WIRE RANGE #10 TO #16 AWG COPPER WIRE.	66
20	BUSSMAN	H25030-2S	FUSEBLOCK, 2 POLE, CLASS H(K), RATED FOR 250V, 30A.	22
21	BUSSMAN	H25030-3S	FUSEBLOCK, 3 POLE, CLASS H(K), RATED FOR 250V, 30A.	2
22	BUSSMAN	NON-10	FUSE, 10 AMP. 10 SPARE.	60
23	SEL	SEL-2800M1 KEY:1177	EIA-232 FIBER-OPTIC TRANSCEIVER, 0-40,000 BAUD, 500m, MALE DB-9 CONNECTOR, PLASTIC SHELL ENCLOSURE.	0
24	SEL	SEL-2810MR KEY:1378	MULTI MODE FIBER OPTIC TRANSCEIVERWITH IRIG-B RECEIVER, 0-20000 BITS PER SECOND, 500 M, EIA-232 MALE DB-9 CONNECTOR.	22
25	SEL	SEL-2810MT KEY:1390	MULTI-MODE FIBER-OPTIC TRANSCEIVER, EIA-232, WITH IRIG-B TRANSMITTER OR RECEIVER, 0-20,000 BITS PER SECOND, 500 m, MALE DB-9 CONNECTOR, IRIG-B TRANSMITTER.	20
26	SEL	C478A-15FT	CABLE, DATA & IRIG, SEL-3530 (DTE) TO SEL 700 SERIES W/ IRIG.	24
27	SEL	C605A-12FT	CABLE, DATA & IRIG, SEL-3530 (DTE) TO SEL 700 SERIES W/ IRIG.	8
28	SEL	C605A-18FT	CABLE, DATA & IRIG, SEL-3530 (DTE) TO SEL 700 SERIES W/ IRIG.	8
29	SEL	C953-5FT	CABLE, BNC TO BNC, FOR SEL 3530 COMM PROCESSOR TO SEL 2407.	2
30	MEAN WELL		POWER SUPPLY, NDR-120-24.	1
31	SEL	C605A-6FT	CABLE, DATA & IRIG, SEL-3530 (DTE) TO SEL 700 SERIES W/ IRIG.	2
32	EXELTECH	XP-1100-120V	POWER INVERTER XP-1100 WITH 5.25" X 19" FACE PLATE 020-00132-400	1
33	FBO*		CABLE, CAT6. 1 SPARE.	5
34	FBO*		SERIAL CABLE	1
35	MIDDLE ATLANTIC PRODUCTS	QMA-D3LK	HEAVY DUTY RACK MOUNT STORAGE DRAWER, LOCKING; COLOR: BLACK; RACKING HEIGHT: 3U, DIMENSIONS: 15.875" W X 14.5" D.	2
36	SYNACCESS	NP-05B	NETWORK CONTROLLED POWER STRIP, 5 OUTLETS, 1 RS232 PORT.	1
37	CyberPower	CPS1215RMS	Basic PDU, 120V/15A, 12 Outlets, 15ft Power Cord, 1U Rackmount	2
38	FBO*	DIN RAIL	RAILING FOR MOUNTING 24V POWER SUPPLY.	1
39				
40				
41	Tripp-Lite	SRDINRAIL2U	Adjustable Rack-Mount DIN Rail Kit	1
42	Hubbell	DRUB15	DIN Rail Utility Box, Complete Unit- Duplex Receptacle, 1) 15A 125V, 2-Pole 3-Wire Grounding, 5-15R, Gray.	2
43	Eaton	FAZ-C15/1-NA-DC-SP	15 Amp, 1-Pole, FAZ Series Din Rail Mount Circuit Breaker, 125V DC, 10 kAIC. C Curve, 5 - 10X In Current Rating. UL 489.	2
44	Eaton	FAZ-C10/1-NA-SP	10 Amp, 1-Pole, FAZ Series Din Rail Mount Circuit Breaker, 277/480V AC, 48V DC, 10 kAIC. C Curve, 5 - 10X In Current Rating. UL 489.	1
45	Weidmuller	380660000	DIN Rail Mount Terminal Block, 2 Positions, 12 AWG, 6 AWG, 16 mm², Screw, 76 A	6
46	Cisco	CBS110-24PP-NA	Cisco Business CBS110-24PP-NA Unmanaged Switch | 24 Port GE | Partial PoE | 2x1G SFP Shared	1

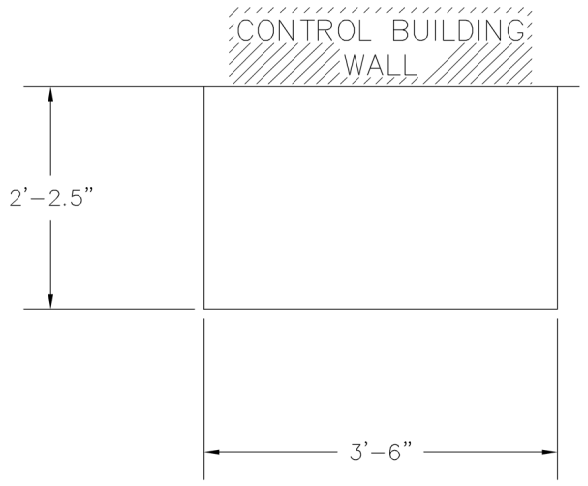
47	Juniper	EX4100-H	EX4100-H Ethernet Switch with 24 ports	1
48	Total Cable Solutions	FLP-03B-04802-3501-00602	Fiber Patch Panel	1
49	CUBE-iT Wall-Mount Cabinet	11890-736	CUBE-iT Wall-Mount Cabinet; Gen 3; 36"H x 24"W x 18"D (910 mm x 610 mm x 460 mm); 19U; #12-24 Tapped Rails; Solid Metal Door; Black.	1
50	SEL	915900573	SEL TRANSCEIVER MOUNTING KIT	22
51	SEL	SEL-2812MRX0	MULTI-MODE FIBER-OPTIC TRANSCEIVER, EIA-232, WITH IRIG-B, MALE DB-9 CONNECTOR, IRIG-B RECEIVER.	2

FBO*= FURNISHED BY OWNER/INSTALLED BY OWNER

***= TO BE PROVIDED AND INSTALLED BY MTEMC

Exhibit M

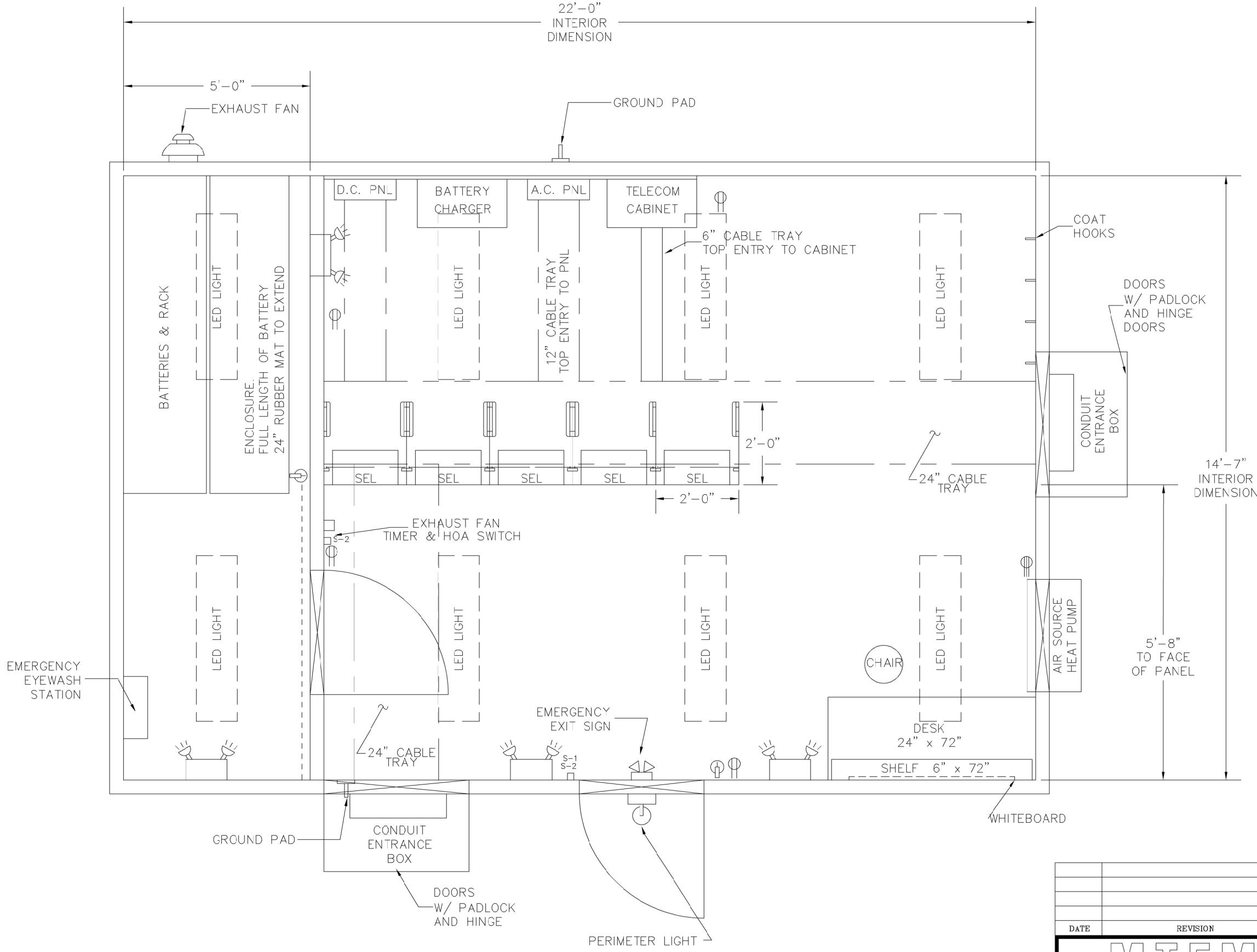
General Control House Layout and Details



CONDUIT ENTRANCE BOX #1
BOTTOM PANEL
TOP VIEW

LEGEND

S-1	120V, 20A LIGHT SWITCH FOR CONTRO_ BUILDING PERIMETER LIGHTS.
S-2	120V, 20A LIGHT SWITCH FOR CONTRO_ BUILDING INDOOR LIGHTS.
S-3	120V, 20A LIGHT SWITCH FOR YARD EMERGENCY LIGHTING.
120VAC	120V AC RECEPTACLE.
240VAC	240VAC, 30A RECEPTACLE
	TELEPHONE OUTLET.
	FIRE EXTINGJSHER
	12VDC EMERGENCY BATTERY-PACK 2 BULB LIGHT W/LIGHTED EXIT SIGN.
	CONTRO_ BUILDING PERIMETER LIGHT



DATE	REVISION	BY

MTEMC

BARFIELD SUBSTATION

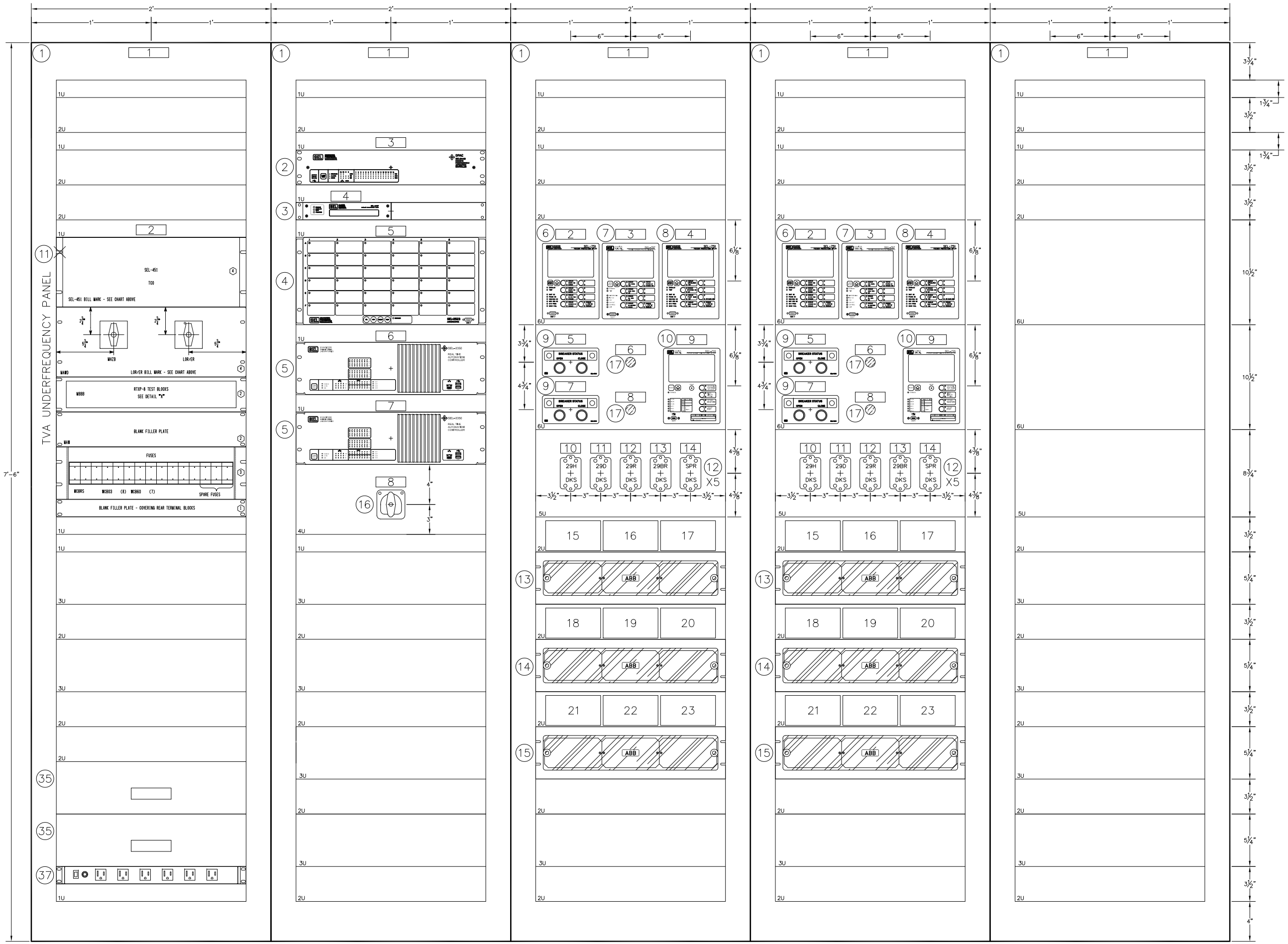
GENERAL LAYOUT - CONTROL BUILDING

SCALE: N.T.S.	APPROVED	DATE FEB. 11, 2025
PREPARED BY: AKF	DRAWING NO. BAR-161	SHEET 1
DRAWN BY: A. FERREE		OF 1 SHEETS
CHECKED BY: AKF		

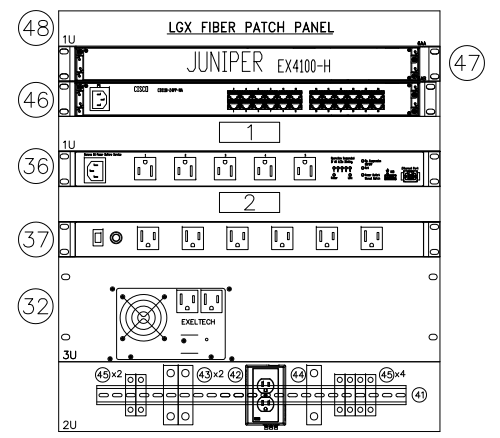
Exhibit N

General Relay / Control Panel Layout and Details

FRONT VIEW



TELECOMMUNICATIONS PANEL (49)



1. PANELS ARE 19" RACK MOUNT STYLE.
2. 1U = 1-3/4"
3. NAMEPLATES SHALL BE FASTENED TO PANEL WITH STAINLESS SCREWS.

(XX) – BILL OF MATERIAL ITEM NUMBER

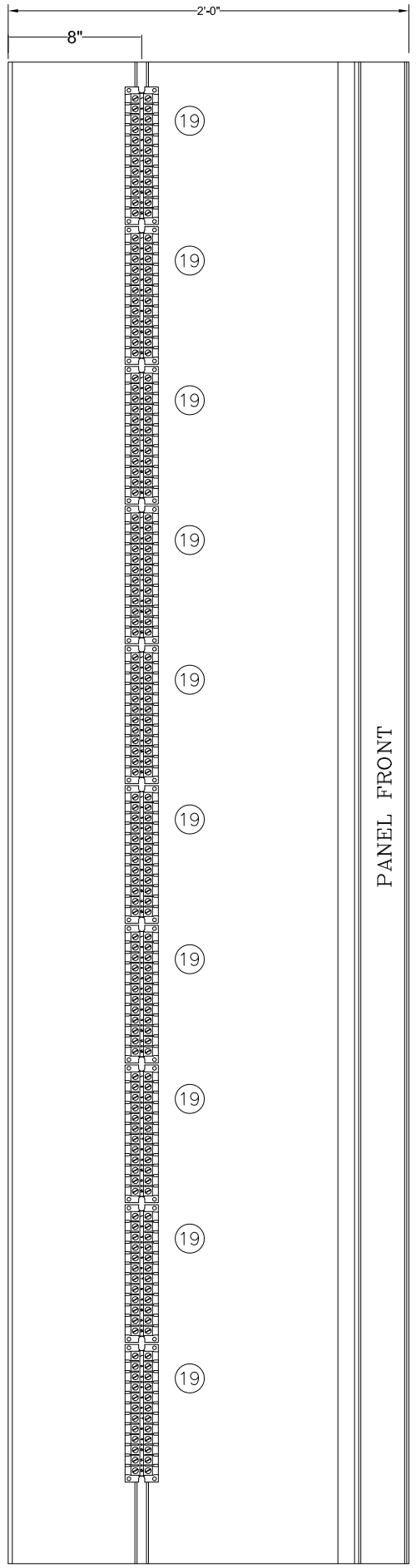
XX – NAMEPLATE NUMBER

DATE	REVISION	BY

MTEMC

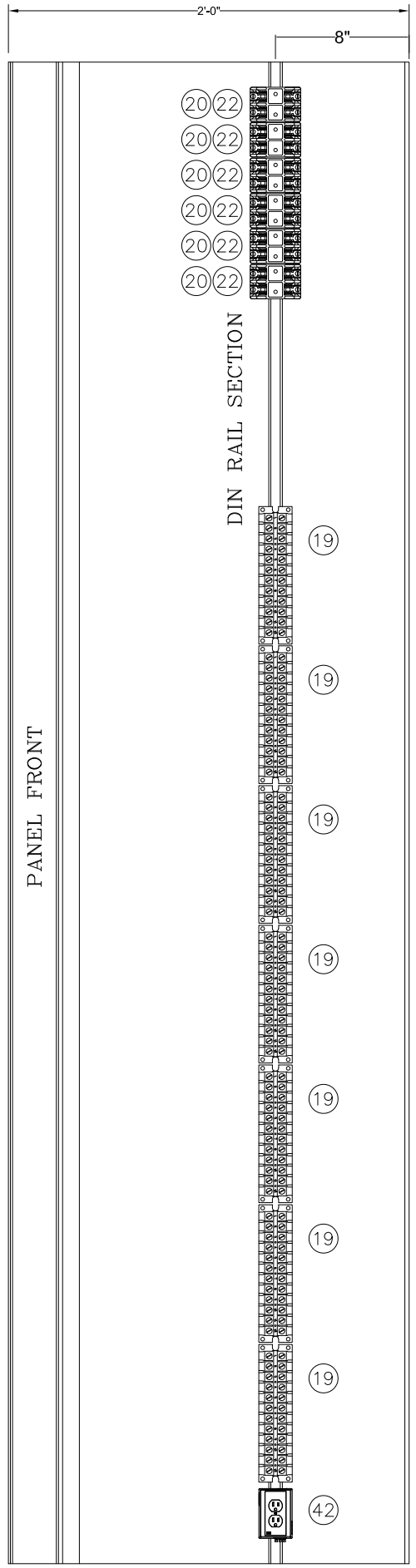
BARFIELD SUBSTATION
SWITCHBOARD LAYOUTS

SCALE: NTS	APPROVED	DATE FEB. 11, 2025
PREPARED BY: AKF	DRAWING NO. BAR-140	SHEET 1
DRAWN BY: A FERREE		OF 11 SHEETS
CHECKED BY: AKF		



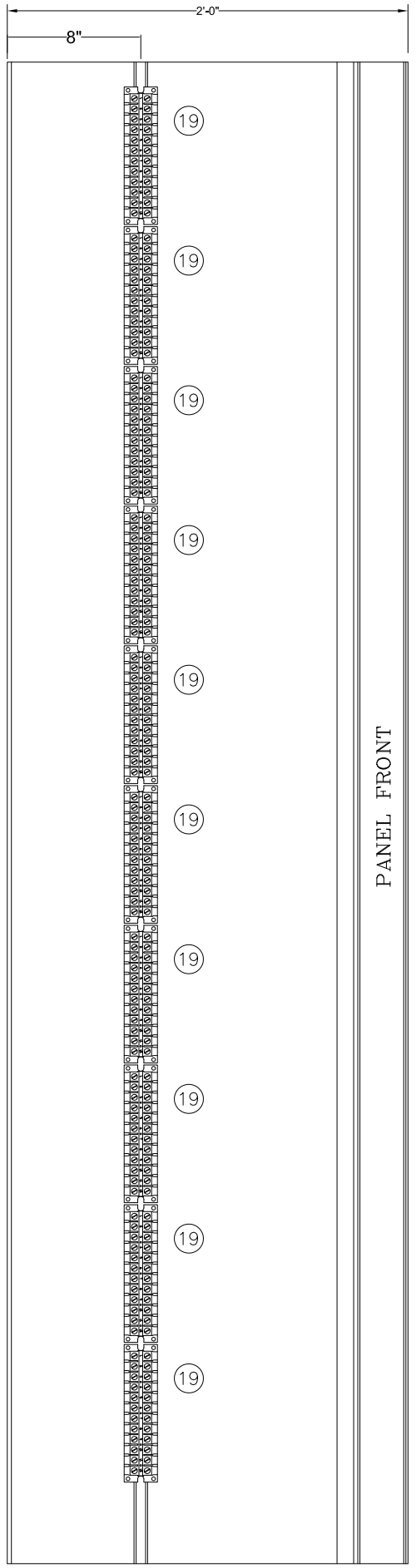
PANEL #1

LEFT SIDE (REAR VIEW)



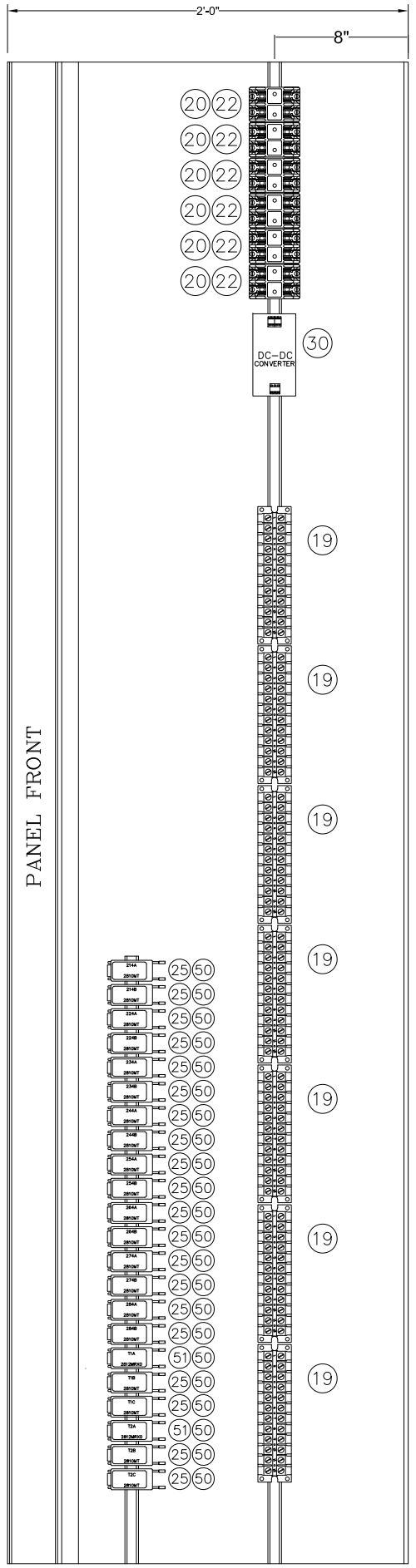
PANEL #1

RIGHT SIDE (REAR VIEW)



PANEL #2

LEFT SIDE (REAR VIEW)



PANEL #2

RIGHT SIDE (REAR VIEW)

1. PANELS ARE 19" RACK MOUNT STYLE.
2. 1U = 1-3/4"
3. NAMEPLATES SHALL BE FASTENED TO PANEL WITH STAINLESS SCREWS.

(XX) – BILL OF MATERIAL ITEM NUMBER

XX – NAMEPLATE NUMBER

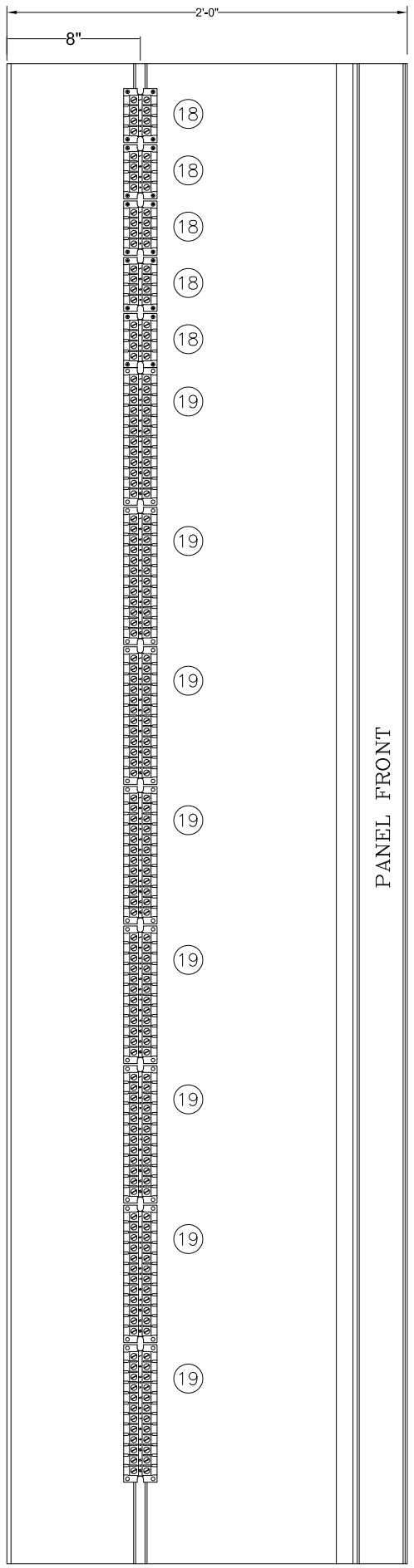
DATE	REVISION	BY

MTEMC

BARFIELD SUBSTATION

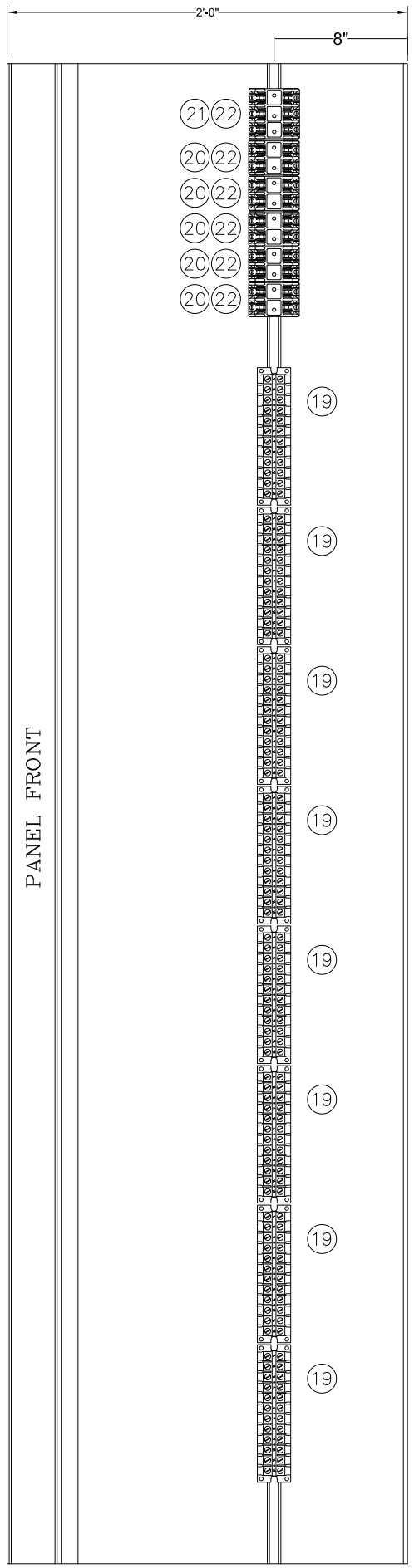
SWITCHBOARD LAYOUTS

SCALE: NTS	APPROVED	DATE APRIL 10, 2025
PREPARED BY: AKF	DRAWING NO. BAR-140	SHEET 2
DRAWN BY: A FERREE		OF 11 SHEETS
CHECKED BY: AKF		



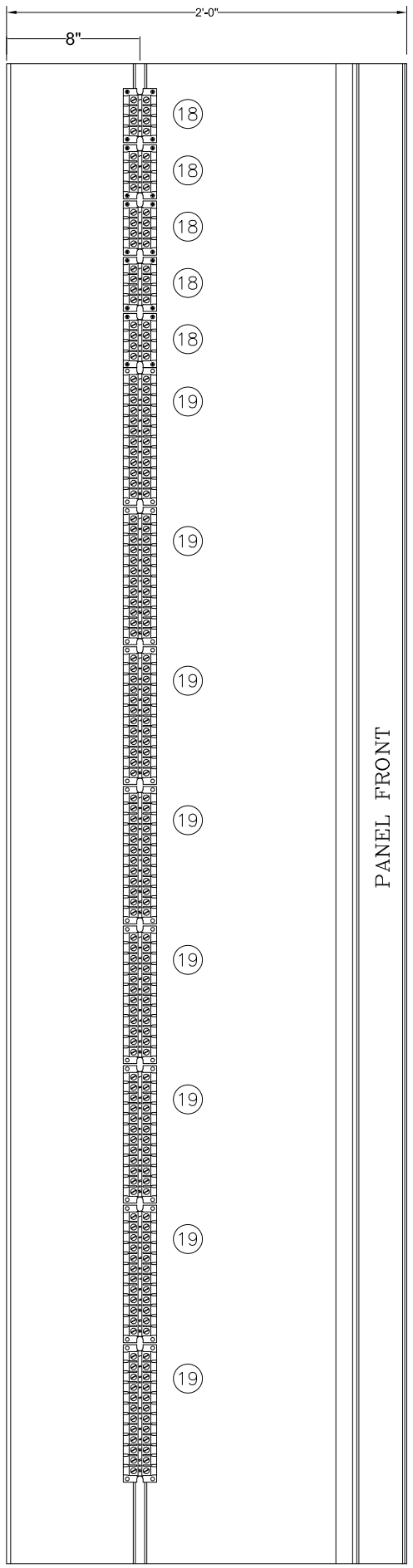
PANEL #3

LEFT SIDE (REAR VIEW)



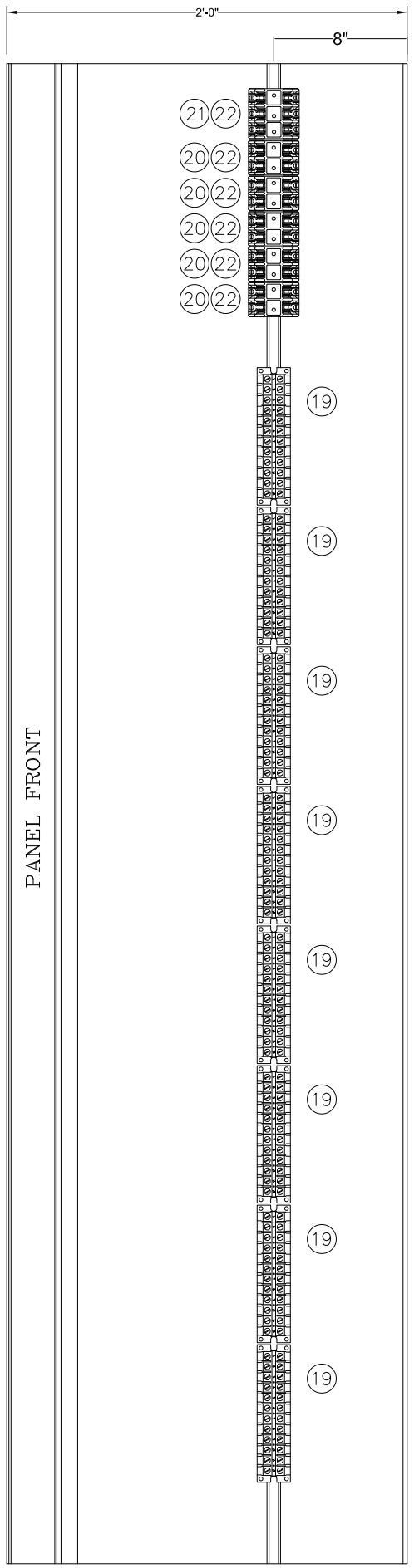
PANEL #3

RIGHT SIDE (REAR VIEW)



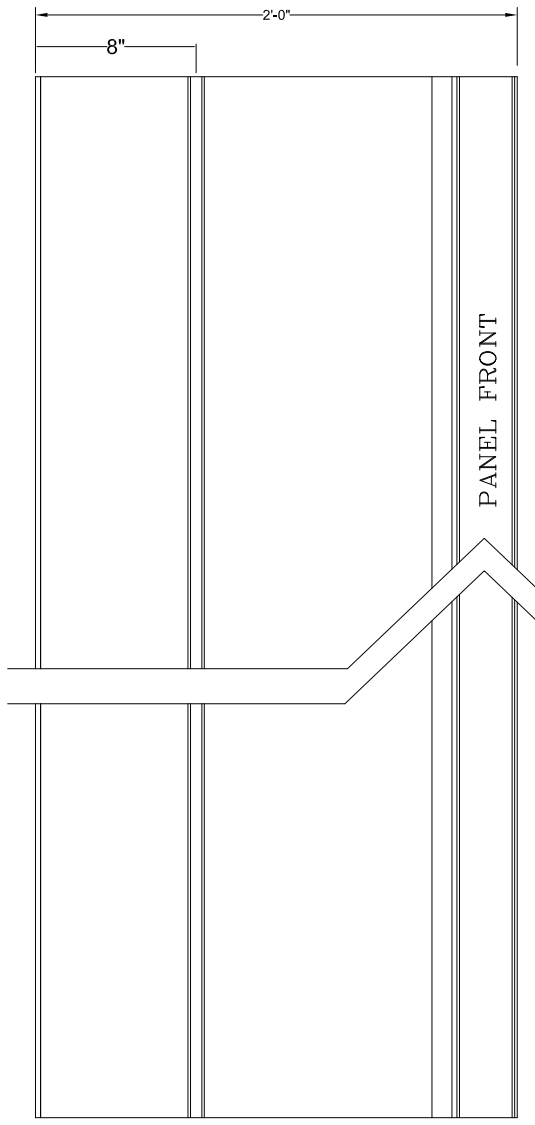
PANEL #4

LEFT SIDE (REAR VIEW)



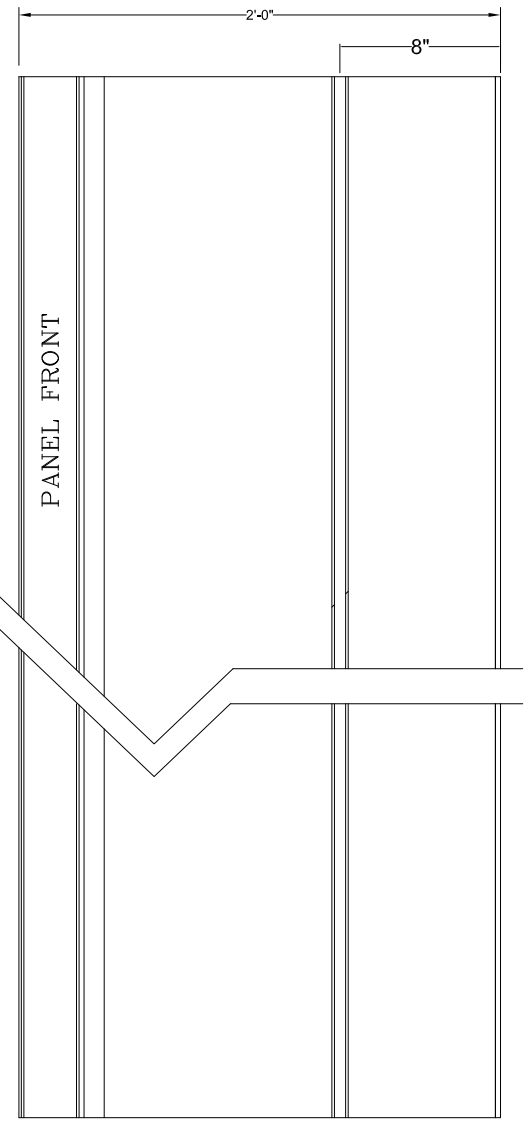
PANEL #4

RIGHT SIDE (REAR VIEW)



PANEL #5

LEFT SIDE (REAR VIEW)



PANEL #5

RIGHT SIDE (REAR VIEW)

1. PANELS ARE 19" RACK MOUNT STYLE.
2. 1U = 1-3/4"
3. NAMEPLATES SHALL BE FASTENED TO PANEL WITH STAINLESS SCREWS.

(XX) – BILL OF MATERIAL ITEM NUMBER

[XX] – NAMEPLATE NUMBER

DATE	REVISION	BY

MTEMC

BARFIELD SUBSTATION

SWITCHBOARD LAYOUTS

SCALE: NTS	APPROVED	DATE FEB. 22, 2025
PREPARED BY: AKF	DRAWING NO. BAR-140	SHEET 3
DRAWN BY: A FERREE		OF 11 SHEETS
CHECKED BY: AKF		

Exhibit O

Nameplate Schedule

PANEL#1 NAMEPLATES

NO.	SIZE	TEXT HEIGHT	LINE 1	UNDERFREQUENCY	LINE 3
1	1" x 3"	1/8"	PANEL NO. 1		
2	1" x 3"	1/8"	TVA	UNDERFREQUENCY	SCHEME
3	1" x 3"	1/8"			
4	1" x 3"	1/8"			
5	1" x 3"	1/8"			
6	1" x 3"	1/8"			
7	1" x 3"	1/8"			
8	1" x 3"	1/8"			
9	1" x 3"	1/8"			
10	1" x 3"	1/8"			
11	1" x 3"	1/8"			
12	1" x 3"	1/8"			
13	1" x 3"	1/8"			
14	1" x 3"	1/8"			
15	1" x 3"	1/8"			
16	1" x 3"	1/8"			
17	1" x 3"	1/8"			
18	1" x 3"	1/8"			
19	1" x 3"	1/8"			
20	1" x 3"	1/8"			

PANEL#2 NAMEPLATES

NO.	SIZE	TEXT HEIGHT	LINE 1	LINE 2	LINE 3
1	1" x 3"	1/8"	PANEL NO. 2		
2	1" x 3"	1/8"			
3	1" x 3"	1/8"	2440	STATION DPAC	24VDC
4	1" x 3"	1/8"	GPS CLOCK		
5	1" x 3"	1/8"	30	STATION	ANNUNCIATOR
6	1" x 3"	1/8"	3350-1	COMMUNICATION	RTAC PROCESSOR
7	1" x 3"	1/8"	3350-2	LOGIC	RTAC PROCESSOR
8	1" x 3"	1/8"	43BNK	BANK SELECTOR	SWITCH
9	3" x 5.5"	1/8"	SEE DETAIL		
10	3" x 5.5"	1/8"	SEE DETAIL		
11	3" x 5.5"	1/8"	SEE DETAIL		
12	1" x 3"	1/8"			
13	1" x 3"	1/8"			
14	1" x 3"	1/8"			
15	1" x 3"	1/8"			
16	1" x 3"	1/8"			
17	1" x 3"	1/8"			
18	1" x 3"	1/8"			
19	1" x 3"	1/8"			
20	1" x 3"	1/8"			

PANEL#5 NAMEPLATES

NO.	SIZE	TEXT HEIGHT	LINE 1	LINE 2	LINE 3
1	1" x 3"	1/8"	PANEL NO. 5		
2	1" x 3"	1/8"			
3	1" x 3"	1/8"			
4	1" x 3"	1/8"			
5	1" x 3"	1/8"			
6	1" x 3"	1/8"			
7	1" x 3"	1/8"			
8	1" x 3"	1/8"			
9	3" x 5.5"	1/8"			
10	3" x 5.5"	1/8"			
11	3" x 5.5"	1/8"			

PANEL#3 NAMEPLATES

NO.	SIZE	TEXT HEIGHT	LINE 1	LINE 2	LINE 3
1	1" x 3"	1/8"	PANEL NO. 3		
2	1" x 3"	1/8"	751-1H	H.S. OVERCURRENT	RELAY
3	1" x 3"	1/8"	787-1	DIFFERENTIAL	RELAY
4	1" x 3"	1/8"	751-1L	L.S. OVERCURRENT	RELAY
5	1" x 3"	1/8"	01CS-912	PRIMARY	CIRCUIT SWITCHER
6	1" x 3"	1/8"	CKT SW 912	DC POWER	TRIP COIL
7	1" x 3"	1/8"	01CS-914	BACKUP	CIRCUIT SWITCHER
8	1" x 3"	1/8"	CKT SW 914	DC POWER	TRIP COIL
9	1" x 3"	1/8"	MFM-1	METERING	LOW-SIDE
10	1" x 2"	1/8"	29H-1	BANK#1 H.S. O.C.	CUT-OUT
11	1" x 2"	1/8"	29D-1	BANK#1 DIFF.	CUT-OUT
12	1" x 2"	1/8"	29R-1	BANK#1 L.S. O.C.	CUT-OUT
13	1" x 2"	1/8"	29BR-1	BANK#1 OPP. C.S.	CUT-OUT
14	1" x 3"	1/8"			
15	3" x 5.5"	1/8"	SEE DETAIL		
16	3" x 5.5"	1/8"	SEE DETAIL		
17	3" x 5.5"	1/8"	SEE DETAIL		
18	3" x 5.5"	1/8"	SEE DETAIL		
19	3" x 5.5"	1/8"	SEE DETAIL		
20	3" x 5.5"	1/8"	SEE DETAIL		
21	3" x 5.5"	1/8"	SEE DETAIL		
22	3" x 5.5"	1/8"	SEE DETAIL		
23	3" x 5.5"	1/8"	SEE DETAIL		

PANEL#4 NAMEPLATES

NO.	SIZE	TEXT HEIGHT	LINE 1	LINE 2	LINE 3
1	1" x 3"	1/8"	PANEL NO. 4		
2	1" x 3"	1/8"	751-2H	H.S. OVERCURRENT	RELAY
3	1" x 3"	1/8"	787-2	DIFFERENTIAL	RELAY
4	1" x 3"	1/8"	751-2L	L.S. OVERCURRENT	RELAY
5	1" x 3"	1/8"	01CS-922	PRIMARY	CIRCUIT SWITCHER
6	1" x 3"	1/8"	CKT SW 922	DC POWER	TRIP COIL
7	1" x 3"	1/8"	01CS-924	BACKUP	CIRCUIT SWITCHER
8	1" x 3"	1/8"	CKT SW 924	DC POWER	TRIP COIL
9	1" x 3"	1/8"	MFM-2	METERING	LOW-SIDE
10	1" x 2"	1/8"	29H-2	BANK#2 H.S. O.C.	CUT-OUT
11	1" x 2"	1/8"	29D-2	BANK#2 DIFF.	CUT-OUT
12	1" x 2"	1/8"	29R-2	BANK#2 L.S. O.C.	CUT-OUT
13	1" x 2"	1/8"	29BR-2	BANK#2 OPP. C.S.	CUT-OUT
14	1" x 3"	1/8"			
15	3" x 5.5"	1/8"	SEE DETAIL		
16	3" x 5.5"	1/8"	SEE DETAIL		
17	3" x 5.5"	1/8"	SEE DETAIL		
18	3" x 5.5"	1/8"	SEE DETAIL		
19	3" x 5.5"	1/8"	SEE DETAIL		
20	3" x 5.5"	1/8"	SEE DETAIL		
21	3" x 5.5"	1/8"	SEE DETAIL		
22	3" x 5.5"	1/8"	SEE DETAIL		
23	3" x 5.5"	1/8"	SEE DETAIL		

TELECOM PANEL NAMEPLATES

NO.	SIZE	TEXT HEIGHT	LINE 1	LINE 2	LINE 3
1	1" x 3"	1/8"	PRIMARY POWER	(INVERTER POWER)	
2	1" x 3"	1/8"	BACKUP POWER	(HOUSE POWER)	
3	1" x 3"	1/8"			
4	1" x 3"	1/8"			
5	1" x 3"	1/8"			
6	1" x 3"	1/8"			
7	1" x 3"	1/8"			
8	1" x 3"	1/8"			
9	1" x 3"	1/8"			

NOTES:

1. NAMEPLATES SHALL BE BLACK PHENOLIC WITH WHITE CORE. RESULT IS A BLACK NAMEPLATE WITH WHITE LETTERING.

XX - NAMEPLATE NUMBER

DATE	REVISION	BY

MTEMC

BARFIELD SUBSTATION
NAMEPLATE SCHEDULE

SCALE: 1/4" = 1"
PREPARED BY: AKF
DRAWN BY: A FERREE
CHECKED BY: AKF

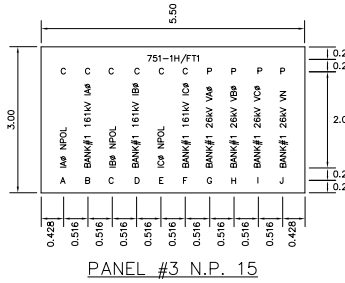
APPROVED

DRAWING NO.
BAR-140

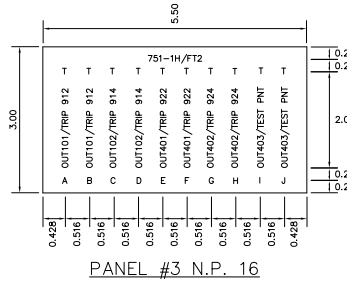
DATE
FEB. 11, 2025

SHEET 4
OF 11 SHEETS

NAMEPLATE DETAILS
(SEE DWG 140-4)



PANEL #3 N.P. 15



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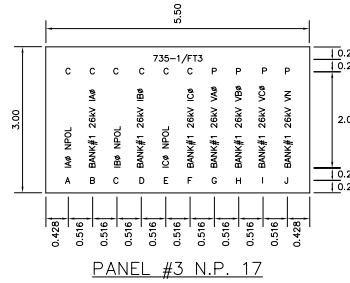

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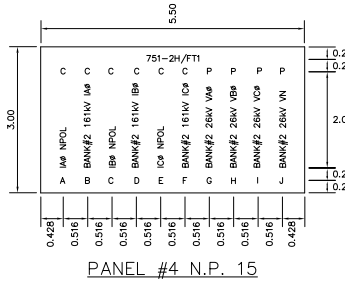

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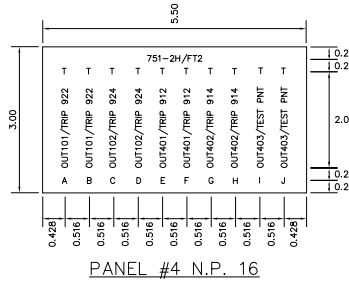
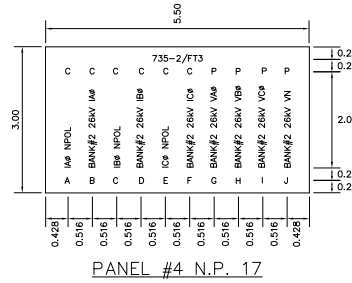


PANEL #4 N.P. 16



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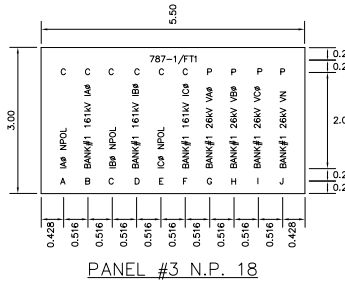

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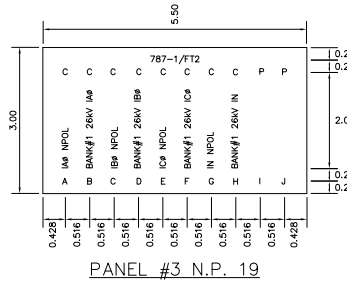

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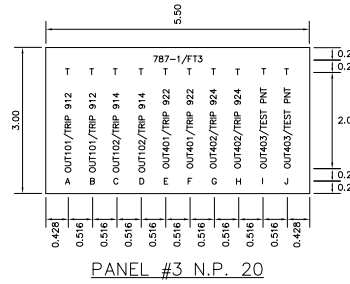

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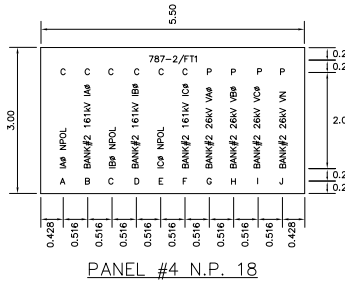

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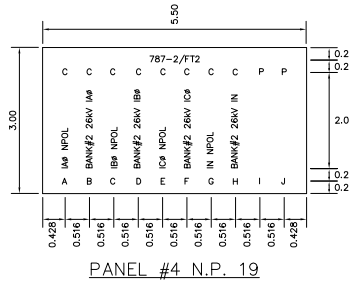

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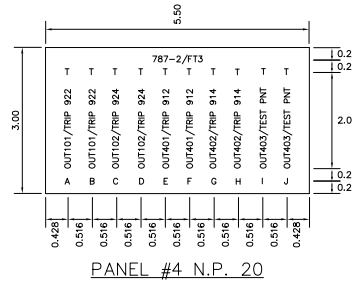

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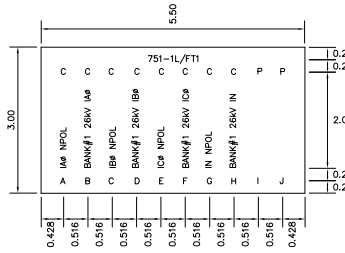

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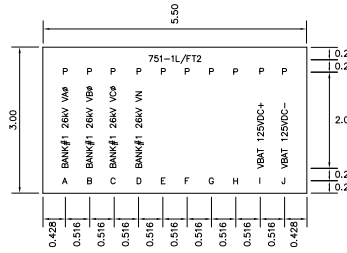
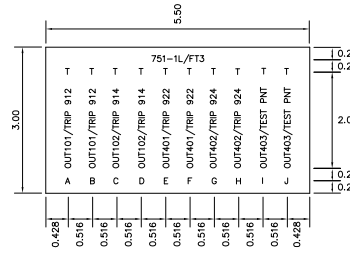
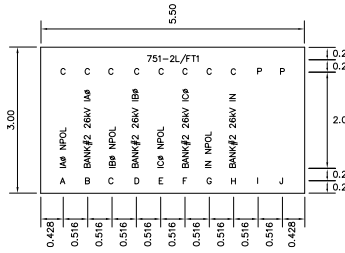


PANEL #3 N.P. 22



PANEL #3 N.P. 23



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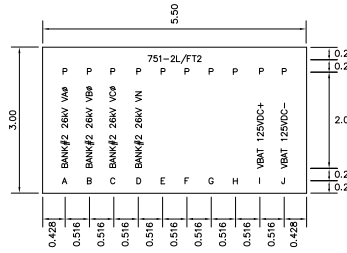
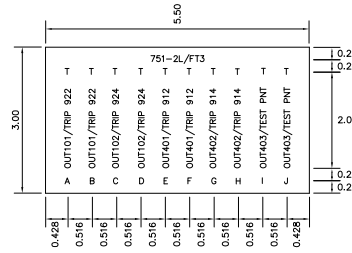
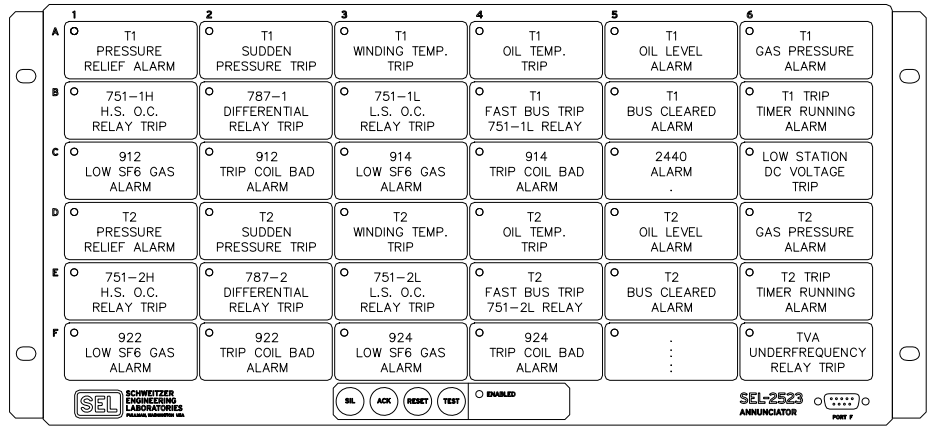


PANEL #4 N.P. 22

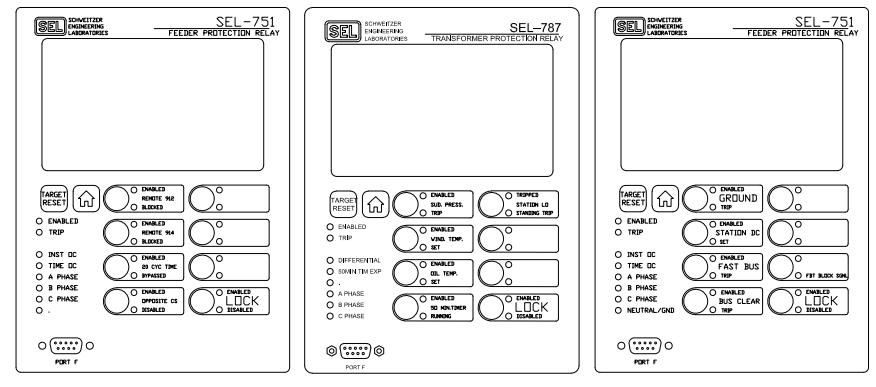


PANEL #4 N.P. 23

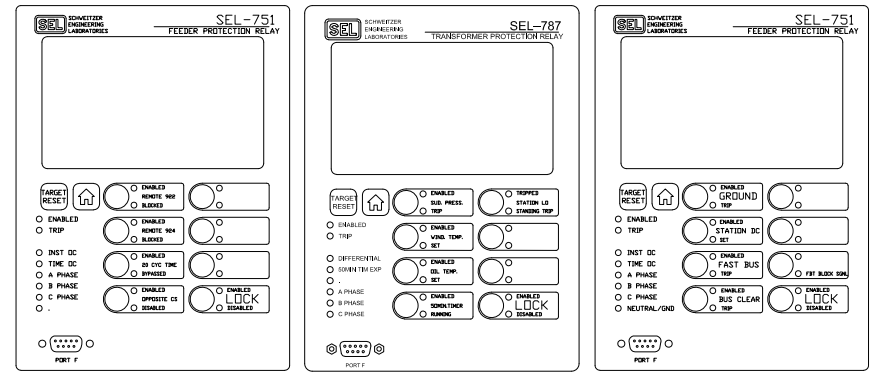
ANNUNCIATOR NAMEPLATE DETAILS



RELAY LABEL DETAILS PANEL #3



RELAY LABEL DETAILS PANEL #4



NOTES:

1. NAMEPLATES SHALL BE BLACK PHENOLIC WITH WHITE CORE. RESULT IS A BLACK NAMEPLATE WITH WHITE LETTERING.

XX - NAMEPLATE NUMBER

DATE	REVISION	BY

MTEMC

BARFIELD SUBSTATION
NAMEPLATE SCHEDULE

SCALE: 1/4" = 1"	APPROVED	DATE FEB. 11, 2025
PREPARED BY: AKF	DRAWING NO. BAR-140	SHEET 5
DRAWN BY: A FERREE		OF 11 SHEETS
CHECKED BY: AKF		

Exhibit P

Point-to-Point Wiring Diagrams

LEFT

PANEL NO. 1

(REAR VIEW)

RIGHT

1LB1

1	.
2	.
3	.
4	.
5	.
6	.
7	.
8	.
9	.
10	.
11	.
12	.

1LB2

1	.
2	.
3	.
4	.
5	.
6	.
7	.
8	.
9	.
10	.
11	.
12	.

1LB3

1	.
2	.
3	.
4	.
5	.
6	.
7	.
8	.
9	.
10	.
11	.
12	.

1LB4

1	.
2	.
3	.
4	.
5	.
6	.
7	.
8	.
9	.
10	.
11	.
12	.

1LB5

1	.
2	.
3	.
4	.
5	.
6	.
7	.
8	.
9	.
10	.
11	.
12	.

1LB6

1	.
2	.
3	.
4	.
5	.
6	.
7	.
8	.
9	.
10	.
11	.
12	.

1LB7

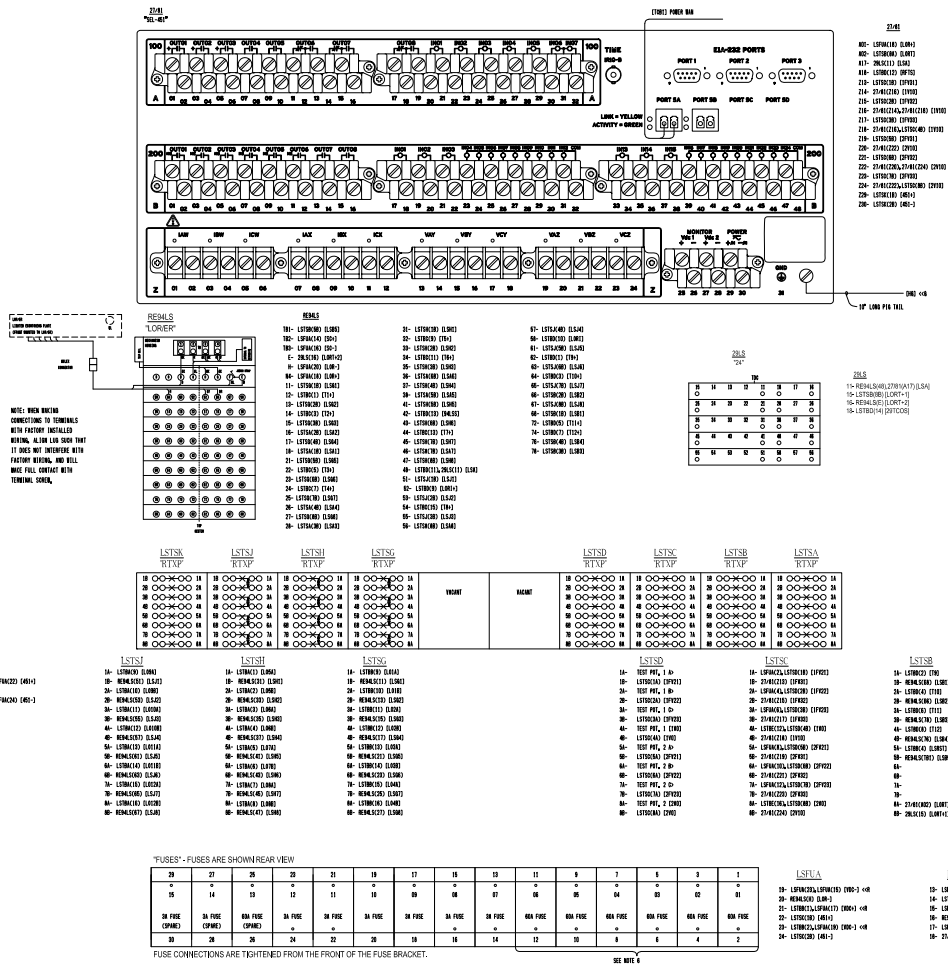
1	.
2	.
3	.
4	.
5	.
6	.
7	.
8	.
9	.
10	.
11	.
12	.

1LB8

1	.
2	.
3	.
4	.
5	.
6	.
7	.
8	.
9	.
10	.
11	.
12	.

1LB9 (SPARE)

1LB10 (SPARE)



1FU1

1	1RB1-1, 1FU2-1
2	LSTBB(1)
3	1RB1-2, 1FU2-3
4	LSTBB(2)

1FU2

1	1FU1-1, 1FU3-1
2	.
3	1FU1-3, 1FU3-3
4	.

1FU3

1	1FU2-1, 1FU4-1
2	.
3	1FU2-3, 1FU4-3
4	.

1FU4

1	1FU3-1, 1FU5-1
2	.
3	1FU3-3, 1FU5-3
4	.

1FU5

1	1FU4-1, 1FU6-1
2	.
3	1FU4-1, 1FU6-1
4	.

1FU6

1	1FU5-1
2	.
3	1FU5-3
4	.

2/C TO DC PANEL BOARD

DC1

1RB1

1FU1-1	1 P1+	RD
1FU1-3	2 P1−	BK
.	3 .	.
.	4 .	.
.	5 .	.
.	6 .	.
.	7 .	.
.	8 .	.
.	9 .	.
.	10 .	.
.	11 .	.
.	12 .	.

1RB2

LSTBB(3)	1 94UF+R	2RB2-1
LSTBB(4)	2 94UF−R	2RB2-2
LSTBC(1)	3 94UF+T	2RB3-1
LSTBC(2)	4 94UF−T	2RB3-2
.	5 .	.
.	6 .	.
.	7 .	.
.	8 .	.
.	9 .	.
.	10 .	.
.	11 .	.
.	12 .	.

3/C TO AC PANEL BOARD

P1-AC

1RB3

REC−H	1 P1 AC+	BK
REC−N	2 P1 AC−	WH
REC−G	3 P1 GND	GN
.	4 .	.
.	5 .	.
.	6 .	.
.	7 .	.
.	8 .	.
.	9 .	.
.	10 .	.
.	11 .	.
.	12 .	.

1RB4

1	.
2	.
3	.
4	.
5	.
6	.
7	.
8	.
9	.
10	.
11	.
12	.

1RB5

1	.
2	.
3	.
4	.
5	.
6	.
7	.
8	.
9	.
10	.
11	.
12	.

1RB6

1	.
2	.
3	.
4	.
5	.
6	.
7	.
8	.
9	.
10	.
11	.
12	.

1RB7 (SPARE)

NOTES

1. RED TEXT DENOTES CT CKTS W/ #10AWG.
2. PT & DC CKTS GET #14AWG.
3. RTU WIRING TO BE #16AWG.

DATE	REVISION	BY

MTEMG

BARFIELD SUBSTATION

SWITCHBOARD WIRING DIAGRAM

SCALE: NTS

PREPARED BY: AKP

DRAWN BY: A. FERREE

CHECKED BY: AKP

APPROVED

DRAWING NO. BAR-140

DATE FEB. 11, 2025

SHEET 6 OF 11 SHEETS

LEFT

TO SCA2–B1 — S1A

2LB1

– OR/BK	BK	1	214SEL+	2AA–Z06, 2LB1–3
– YE/BK	RD	2	214SEL	2AA–A01
– BR/BK	BL	3	224SEL+	2LB1–1, 2LB1–5
– BK/RD	OR	4	224SEL	2AA–A03
	YE	5	234SEL+	2LB1–3, 2LB1–7
	BR	6	234SEL	2AA–A05
	RD/BK	7	244SEL+	2LB1–5, 2LB1–9
	BL/BK	8	244SEL	2AA–A08

TO SCA2–B2 — S2A

	BK	9	254SEL+	2LB1–7, 2LB1–11
	RD	10	254SEL	2AA–A09
	BL	11	264SEL+	2LB1–9, 2LB2–1
	OR	12	264SEL	2AA–A11

2LB2

– OR/BK	YE	1	274SEL+	2LB1–11, 2LB2–3
– YE/BK	BR	2	274SEL	2AA–A13
– BR/BK	RD/BK	3	284SEL+	2LB2–1, 2LB2–5
– BK/RD	BL/BK	4	284SEL	2AA–A15
.		5	P1 SEL+	2LB2–3, 2LB2–7
.		6	P1 SEL	2AA–A17
2AB–2		7	P2 SEL+	2LB2–5, 2LB2–9
2AB–3		8	P2 SEL	2AA–A19
3RB2–5		9	P3 SEL+	2LB2–7, 2LB2–11
3RB2–6		10	P3 SEL	2AA–A21
4RB2–5		11	P4 SEL+	2LB2–9, 2LB3–1
4RB2–6		12	P4 SEL	2AA–A23

2LB3

BUILDING ALARM DA–ALM	BK	1	DALM+	2LB2–11, 2LB3–3
	WH	2	DALM	2AA–A25
.		3	Z1 INT+	2LB3–1, 2LB3–5
.		4	Z1 INT	2AA–A27
.		5	Z2 INT+	2LB3–3, 2LB3–7
.		6	Z2 INT	2AA–A29
.		7	ENVIR+	2LB3–5, 2LB4–1
.		8	ENVIR	2AA–A31
.		9	.	.
.		10	.	.
.		11	.	.
.		12	.	.

2LB4

BUILDING ALARM D1–ALM	BK	1	.	2LB3–7, 2LB4–3
	WH	2	.	2AA–B01
BUILDING ALARM PFA–ALM	BK	3	.	2LB4–1, 2LB4–5
	WH	4	.	2AA–B03
BUILDING ALARM LA–ALM	BK	5	.	2LB4–3, 2LB4–7
	WH	6	.	2AA–B05
BUILDING ALARM LHA–ALM	BK	7	.	2LB4–5, 2LB4–9
	WH	8	.	2AA–B07
BUILDING ALARM HHA–ALM	BK	9	.	2LB4–7, 2LB4–11
	WH	10	.	2AA–B09
BUILDING ALARM TMP–ALM	BK	11	.	2LB4–9, 2LB5–1
	WH	12	.	2AA–B11

2LB5

BUILDING ALARM HTMP–ALM	BK	1	.	2LB4–11, 2LB5–3
	WH	2	.	2AA–B13
BUILDING ALARM HD–ALM	BK	3	.	2LB5–1, 2LB5–5
	WH	4	.	2AA–B15
BUILDING ALARM BC–ALM	BK	5	BCH K1+	2LB5–3, 2LB5–7
	RD	6	BCH K1–	2AA–B17
.		7	.	2LB5–5, 2LB5–9
	WH	8	BCH K2–	2AA–B19
.		9	.	2LB5–7, 2LB5–11
	GN	10	BCH K3–	2AA–B21
.		11	.	2LB5–9, 2LB6–1
	OR	12	BCH K5–	2AA–B23

2LB6

.	1	.	2LB5–11, 2LB6–3
.	2	.	2AA–B25
.	3	.	2LB6–1, 2LB6–5
.	4	.	2AA–B27
.	5	.	2LB6–3, 2LB6–7
.	6	.	2AA–B29
.	7	.	2LB6–5, 2LB7–1
.	8	.	2AA–B31
.	9	.	.
.	10	.	.
.	11	.	.
.	12	.	.

2LB7

TO SECURITY TOWER SEC1	RD	1	.	2LB6–7, 2LB7–3
	BL	2	.	2AA–C01
	.	3	.	2LB7–1, 2LB7–5
	OR	4	.	2AA–C03
	.	5	.	2LB7–3, 2LB7–7
TO SECURITY TOWER SEC2	YE	6	.	2AA–C05
	RD	7	.	2LB7–5, 2LB7–9
	BL	8	.	2AA–C07
	.	9	.	2LB7–7, 2LB7–11
	OR	10	.	2AA–C09
	.	11	.	2LB7–9, 2LB8–1
	YE	12	.	2AA–C11

2LB8

TO SECURITY TOWER SEC3	RD	1	.	2LB7–11, 2LB8–3
	BL	2	.	2AA–C13
	.	3	.	2LB8–1, 2LB8–5
	OR	4	.	2AA–C15
	.	5	.	2LB8–3, 2LB8–7
TO SECURITY TOWER SEC4	YE	6	.	2AA–C17
	RD	7	.	2LB8–5, 2LB8–9
	BL	8	.	2AA–C19
	.	9	.	2LB8–7, 2LB8–11
	OR	10	.	2AA–C21
	.	11	.	2LB8–9, 2LB9–1
	YE	12	.	2AA–C23

2LB9

TO SECURITY TOWER SEC5	RD	1	.	2LB8–11, 2LB9–3
	BL	2	.	2AA–C25
	.	3	.	2LB9–1, 2LB9–5
	OR	4	.	2AA–C27
	.	5	.	2LB9–3, 2LB9–7
	YE	6	.	2AA–C29
	.	7	.	2LB9–5
	.	8	.	2AA–C31
	BK	9	.	2PS1–V, 2LB9–10
	BK	10	.	2LB9–9, 2LB9–11
	BK	11	.	2LB9–10
	.	12	.	.

PANEL NO. 2

NOTES
1. RED TEXT DENOTES CT CKTS W/ #10AWG.
2. PT & DC CKTS GET #14AWG.

2440 — 2AA

A01	2LB1–2	B01	2LB4–2
A02	2AA–Z07, 2AA–A04	B02	2AA–A32, 2AA–B04
A03	2LB1–4	B03	2LB4–4
A04	2AA–A02, 2AA–A06	B04	2AA–B02, 2AA–B06
A05	2LB1–6	B05	2LB4–6
A06	2AA–A04, 2AA–A08	B06	2AA–B04, 2AA–B08
A07	2LB1–8	B07	2LB4–8
A08	2AA–A06, 2AA–A10	B08	2AA–B06, 2AA–B10
A09	2LB1–10	B09	2LB4–10
A10	2AA–A08, 2AA–A12	B10	2AA–B08, 2AA–B12
A11	2LB1–12	B11	2LB4–12
A12	2AA–A10, 2AA–A14	B12	2AA–B10, 2AA–B14
A13	2LB2–2	B13	2LB5–2
A14	2AA–A12, 2AA–A16	B14	2AA–B12, 2AA–B16
A15	2LB2–4	B15	2LB5–4
A16	2AA–A14, 2AA–A18	B16	2AA–B14, 2AA–B18
A17	2LB2–6	B17	2LB5–6
A18	2AA–A16, 2AA–A20	B18	2AA–B16, 2AA–B20
A19	2LB2–8	B19	2LB5–8
A20	2AA–A18, 2AA–A22	B20	2AA–B18, 2AA–B22
A21	2LB2–10	B21	2LB5–10
A22	2AA–A20, 2AA–A24	B22	2AA–B20, 2AA–B24
A23	2LB2–12	B23	2LB5–12
A24	2AA–A22, 2AA–A26	B24	2AA–B22, 2AA–B26
A25	2LB3–2	B25	2LB6–2
A26	2AA–A24, 2AA–A28	B26	2AA–B24, 2AA–B28
A27	2LB3–4	B27	2LB6–4
A28	2AA–A26, 2AA–A30	B28	2AA–B26, 2AA–B30
A29	2LB3–6	B29	2LB6–6
A30	2AA–A28, 2AA–A32	B30	2AA–B28, 2AA–B32
A31	2LB3–8	B31	2LB6–8
A32	2AA–A30, 2AA–B02	B32	2AA–B30, 2AA–C02
A33	.		
A34	.		
A35	.		
A36	.		

C01	2LB7–2	Z01	2RB5–1
C02	2AA–B32, 2AA–C04	Z02	2RB5–2
C03	2LB7–4	Z03	.
C04	2AA–C02, 2AA–C06	Z04	.
C05	2LB7–6	Z05	.
C06	2AA–C04, 2AA–C08	Z06	2PS1–+V, 2LB1–1
C07	2LB7–8	Z07	2PS1––V, 2AA–A02
C08	2AA–C06, 2AA–C10	Z08	.
C09	2LB7–10	Z09	.
C10	2AA–C08, 2AA–C12		
C11	2LB7–12		
C12	2AA–C10, 2AA–C14		
C13	2LB8–2		
C14	2AA–C12, 2AA–C16		
C15	2LB8–4		
C16	2AA–C14, 2AA–C18		
C17	2LB8–6		
C18	2AA–C16, 2AA–C20		
C19	2LB8–8		
C20	2AA–C18, 2AA–C22		
C21	2LB8–10		
C22	2AA–C20, 2AA–C24		
C23	2LB8–12		
C24	2AA–C22, 2AA–C26		
C25	2LB9–2		
C26	2AA–C24, 2AA–C28		
C27	2LB9–4		
C28	2AA–C26, 2AA–C30		
C29	2LB9–6		
C30	2AA–C28, 2AA–C32		
C31	2LB9–8		
C32	2AA–C30		

PORT 1A	.
PORT 1B	.
PORT 2	.
PORT 3	2DA–COM 22 (C605)
IRIG IN	.
IRIG OUT	.
GND	GND–1

2407 — 2BA

1	.
2	2LB2–7, 2CA–103
3	2LB2–8, 2CA–105
4	2FU2–2
5	2FU2–4
6	GND–2
7	GND–3

ANT	TO ANTENNA
MOD	.
OUT1	2DA–IRIG–B IN (C953)
OUT2	.
OUT3	2EA–IRIG–B IN (C953)
OUT4	.
OUT5	.
OUT6	.
SERIAL	.

2523 — 2CA

01	.	24	2CA–22, 2CA–26	47	.	70	2CA–68, 2CA–72
02	2CA–98, 2CA–04	25	.	48	2CA–46, 2CA–50	71	.
03	.	26	2CA–24, 2CA–28	49	.	72	2CA–70, 2CA–74
04	2CA–02, 2CA–06	27	.	50	2CA–48, 2CA–52	73	2RB4–2
05	.	28	2CA–26, 2CA–30	51	.	74	2CA–72, 2CA–76
06	2CA–04, 2CA–08	29	.	52	2CA–50, 2CA–54	75	2RB4–4
07	.	30	2CA–28, 2CA–32	53	.	76	2CA–74, 2CA–78
08	2CA–06, 2CA–10	31	.	54	2CA–52, 2CA–56	77	2RB4–6
09	.	32	2CA–30, 2CA–34	55	.	78	2CA–76, 2CA–80
10	2CA–08, 2CA–12	33	2RB5–1	56	2CA–54, 2CA–58	79	2RB4–8
11	.	34	2CA–32, 2CA–36	57	.	80	2CA–78, 2CA–107
12	2CA–10, 2CA–14	35	.	58	2CA–56, 2CA–60	81	.
13	.	36	2CA–34, 2CA–38	59	.	82	.
14	2CA–12, 2CA–16	37	.	60	2CA–58, 2CA–62	83	.
15	.	38	2CA–36, 2CA–40	61	.	84	.
16	2CA–14, 2CA–18	39	.	62	2CA–60, 2CA–64	85	.
17	.	40	2CA–38, 2CA–42	63	.	86	.
18	2CA–16, 2CA–20	41	.	64	2CA–62, 2CA–66	87	.
19	.	42	2CA–40, 2CA–44	65	.	88	.
20	2CA–18, 2CA–22	43	.	66	2CA–64, 2CA–68	89	.
21	.	44	2CA–42, 2CA–46	67	.	90	.
22	2CA–20, 2CA–24	45	.	68	2CA–66, 2CA–70	91	.
23	.	46	2CA–44, 2CA–48	69	2RB5–3	92	.

93	.		
94	.		
95	.		
96	.		
97	2FU3–2, 2RB4–1		
98	2FU3–4, 2CA–02		
99	.		
100	.		
101	.		
102	.		
103	2BA–2, 2DA–A04		
104	.		
105	2BA–3, 2DA–A05		
106	2RB4–10		
107	2CA–B0		
108	2RB4–12		
PORT 1	.		
PORT 2	2DA–COM 23 (C605)		
PORT 3	.		
PORT 4C	.		
PORT 4A	.		
IRIG–B	.		
GND	GND–4		

3350–1 — 2DA

A01	.	B01	2RB2–1	B25	.	COM 1	214B–2810MT (C478A)
A02	.	B02	2RB2–2	B26	.	COM 2	224B–2810MT (C478A)
A03	.	B03	.	B27	.	COM 3	234B–2810MT (C478A)
A04	2CA–103, 2EA–A04	B04	.	B28	.	COM 4	244B–2810MT (C478A)
A05	2CA–105, 2EA–A05	B05	.	B29	.	COM 5	254B–2810MT (C478A)
A06	.	B06	.	B30	.	COM 6	264B–2810MT (C478A)
PSA01	.	B07	.	B31	.	COM 7	274B–2810MT (C478A)
PSA02	.	B08	.	B32	.	COM 8	284B–2810MT (C478A)
PSA03	.	B09	.	B33	.	COM 9	3AC–PORT 3 (C605)
PSA04	.	B10	.	B34	.	COM 10	3AB–PORT 3 (C605)
PSA05	2FU4–2	B11	.	B35	.	COM 11	3AA–PORT 3 (C605)
PSA06	2FU4–4	B12	.	B36	.	COM 12	3BA–PORT 2 (C605)
PSA07	GND–5	B13	.	B37	.	COM 13	4AC–PORT 3 (C605)
DSPPT	.	B14	.	B38	.	COM 14	4AB–PORT 3 (C605)
USB3	4DA–KEYBOARD	B15	.	B39	.	COM 15	4AA–PORT 3 (C605)
USB4	4BA–MONITOR	B16	.	B40	.	COM 16	4BA–PORT 2 (C605)
USB5	.	B17	.	B41	.	COM 17	.
USB6	.	B18	.	B42	.	COM 18	T1A–2810MT (C478A)
ETH1	6AA–0/0/0 (CAT6)	B19	.	B43	.	COM 19	T1B–2810MT (C478A)
ETH2	.	B20	.	B44	.	COM 20	T2A–2810MT (C478A)
ETH3	.	B21	.	B45	.	COM 21	T2B–2810MT (C478A)
ETH4	.	B22	.	B46	.	COM 22	2AA–PORT 3 (C605)
IRIG–B/IN	2BA–OUT1 (C953)	B23	.	B47	.	COM 23	2CA–PORT 2 (C605)
IRIG–B/OUT	.	B24	.	B48	.	COM 24	.

COM 25	.		
COM 26	.		
COM 27	.		
COM 28	.		
COM 29	.		
COM 30	.		
COM 31	.		
COM 32	.		
COM 33	.		
COM 34	.		
COM 35	.		
COM 36	.		
COM 37	.		
COM 38	.		
COM 39	.		
COM 40	.		
COM 41	.		
COM 42	.		
COM 43	.		
COM 44	.		
COM 45	.		
COM 46	.		
COM 47	.		
COM 48	.		

3350–2 — 2EA

A01	.	B01	2RB2–1	B25	.	COM 1	214A–2810MT (C478A)
A02	.	B02	2RB2–2	B26	.	COM 2	224A–2810MT (C478A)
A03	.	B03	.	B27	.	COM 3	234A–2810MT (C478A)
A04	2DA–A04	B04	.	B28	.	COM 4	244A–2810MT (C478A)
A05	2DA–A05	B05	.	B29	.	COM 5	254A–2810MT (C478A)
A06	.	B06	.	B30	.	COM 6	264A–2810MT (C478A)
PSA01	.	B07	.	B31	.	COM 7	274A–2810MT (C478A)
PSA02	.	B08	.	B32	.	COM 8	284A–2810MT (C478A)
PSA03	.	B09	.	B33	2FA–16	COM 9	3AC–PORT 4C (C605)
PSA04	.	B10	.	B34	2EA–B18, 2EA–B36	COM 10	3AB–PORT 4C (C605)
PSA05	2FU5–2, 2RB3–1	B11	.	B35	2FA–26	COM 11	3AA–PORT 4C (C605)
PSA06	2FU5–4, 2EA–B18	B12	.	B36	2EA–B34, 2EA–B38	COM 12	3BA–PORT 3 (C605)
PSA07	GND–6	B13	.	B37	2FA–17	COM 13	4AC–PORT 4C (C605)
DSPPT	.	B14	.	B38	2EA–B36	COM 14	4AB–PORT 4C (C605)
USB3	.	B15	.	B39	.	COM 15	4AA–PORT 4C (C605)
USB4	.	B16	.	B40	.	COM 16	4BA–PORT 3 (C605)
USB5	.	B17	2RB3–2	B41	.	COM 17	.
USB6	.	B18	2EA–PSA06, 2EA–B34	B42	.	COM 18	T1C–2810MT (C478A)
ETH1	1AA–1/0/1 (CAT6)	B19	.	B43	.	COM 19	T2C–2810MT (C478A)
ETH2	.	B20	.	B44	.	COM 20	.
ETH3	.	B21	.	B45	.	COM 21	.
ETH4	.	B22	.	B46	.	COM 22	.
IRIG–B/IN	2BB–OUT3 (C953)	B23	.	B47	.	COM 23	.
IRIG–B/OUT	.	B24	.	B48	.	COM 24	.

COM 25	.		
COM 26	.		
COM 27	.		
COM 28	.		
COM 29	.		
COM 30	.		
COM 31	.		
COM 32	.		
COM 33	.		
COM 34	.		
COM 35	.		
COM 36	.		
COM 37	.		
COM 38	.		
COM 39	.		
COM 40	.		
COM 41	.		
COM 42	.		
COM 43	.		
COM 44	.		
COM 45	.		
COM 46	.		
COM 47	.		
COM 48	.		

RIGHT

2FU1

1	2FU5–1	
2	2PS1–L	
3	2FU5–3	
4	2PS1–N	

2FU2

1	2RB1–1, 2FU4–1	
2	2BA–4	
3	2RB1–2, 2FU4–3	
4	2BA–5	

2FU3

1	2RB1–1	
2	2CA–97	
3	2RB1–2	
4	2CA–98	

2FU4

1	2FU2–1, 2FU5–1	
2	2DA–PSA05	
3	2FU2–3, 2FU5–3	
4	2DA–PSA06	

2FU5

1	2FU4–1, 2FU1–1	
2	2EA–PSA05	
3	2FU4–3, 2FU1–3	
4	2EA–PSA06	

2FU6

1	.	
2	.	
3	.	
4	.	

24VDC–POWER SUPPLY — 2PS1

+V +V –V –V DC OK

GND N L

L	2FU1–2
N	2FU1–4
+V	2AA–Z06
+V	–
–V	2AA–Z07, 2LB9–9
–V	–
DC	–
OK	–
GND	GND–7

TO DC PANEL BOARD — DC2

2RB1

2FU3–1, 2FU2–1	1	P2+	RD	
2FU3–3, 2FU2–3	2	P2–	BK	
.	3	.	.	
.	4	.	.	
.	5	.	.	
.	6	.	.	
.	7	.	.	
.	8	.	.	
.	9	.	.	
.	10	.	.	
.	11	.	.	
.	12	.	.	

2RB2

2EA–B01	1	94UF+R	1RB2–1
2EA–B02	2	94UF–R	1RB2–2
.	3	.	.
.	4	.	.
.	5	.	.
.	6	.	.
.	7	.	.
.	8	.	.
.	9	.	.
.	10	.	.
.	11	.	.
.	12	.	.

2RB3

2FA–11, 2EA–PSA05	1	94UF+T	1RB2–3
2EA–B17	2	94UF–T	1RB2–4
.	3	.	.
.	4	.	.
.	5	.	.
.	6	.	.
.	7	.	.
.	8	.	.
.	9	.	.
.	10	.	.
.	11	.	.
.	12	.	.

2RB4

2CA–97, 2RB4–3	1	.
2CA–73	2	.
2RB4–1, 2RB4–5	3	.
2CA–75	4	.
2RB4–3, 2RB4–7	5	.
2CA–77	6	.
2RB4–5, 2RB4–9	7	.
2CA–79	8	.
2RB4–7, 2RB4–11	9	.
2CA–106	10	.
2RB4–9, 2RB5–1	11	.
2CA–108	12	.

2RB5

2RB4–11, 2RB5–3	1	2440AL+	2AA–Z01
2CA–33	2	2440AL–	2AA–Z02
2RB5–1	3	BCH–SUM+	
2CA–69	4	BCH–SUM	
.	5	.	.
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2RB6

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MTEMC

BARFIELD SUBSTATION
SWITCHBOARD WIRING DIAGRAM

DATE		
REVISION		
BY		

SCALE: NTS
PREPARED BY: AKF
DRAWN BY: A. FERREE
CHECKED BY: AKF

APPROVED

DRAWING NO. BAR–140

DATE FEB. 11, 2025

SHEET 7 OF 11 SHEETS

LEFT

PANEL NO. 2

(CONTINUED FROM SHEET 7)

RIGHT

2LB9

1	.	2LB8-11, 2LB9-3
2	.	2AA-C25
3	.	2LB9-1, 2LB9-5
4	.	2AA-C27
5	.	2LB9-3, 2LB9-7
6	.	2AA-C29
7	.	2LB9-5
8	.	2AA-C31
9	.	.
10	.	.
11	.	.
12	.	.

2LB10

1	.	.
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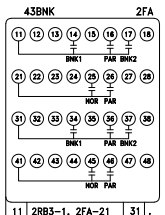
10	.	.
11	.	.
12	.	.

43BNK — 2FA



11	2RB3-1, 2FA-21	31	.
12	–	32	.
13	–	33	.
14	2FA-16	34	.
15	–	35	.
16	2FA-14, 2EA-B33	36	.
17	2EA-B37	37	.
18	–	38	.
21	2FA-11	41	.
22	–	42	.
23	–	43	.
24	–	44	.
25	2FA-26	45	.
26	2FA-25, 2EA-B35	46	.
27	–	47	.
28	–	48	.

2RB7

1	.	.
2	.	.
3	.	.
4	.	.
5	.	.
6	.	.
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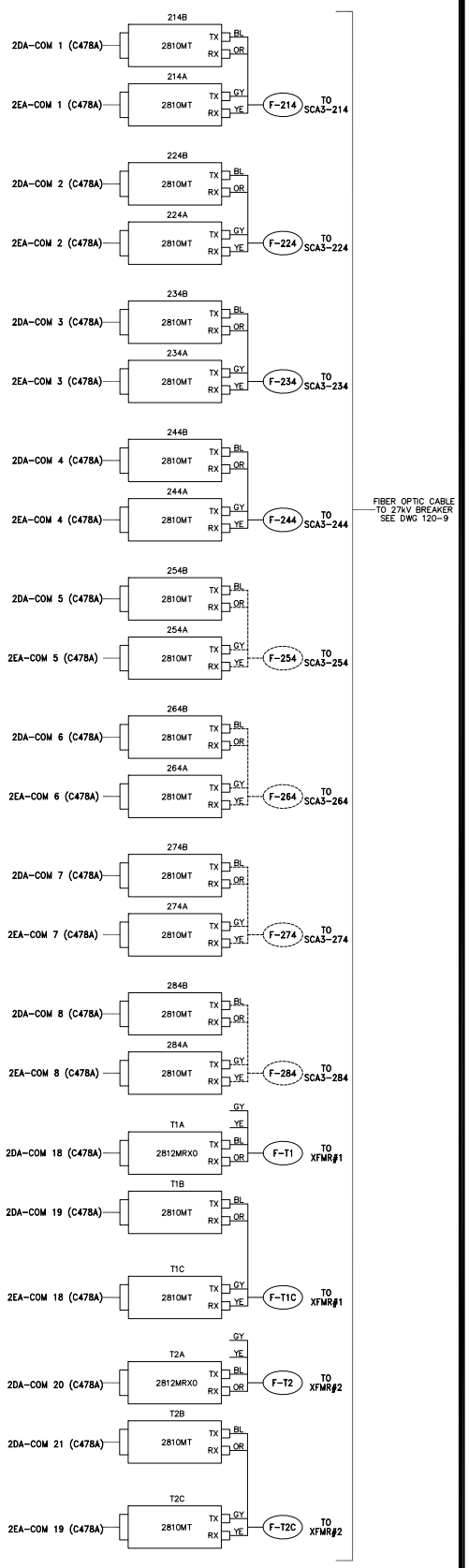
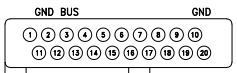


GND BUS — GND



1	2AA-GND	11	.
2	2BA-6	12	.
3	2BA-7	13	.
4	2CA-GND	14	.
5	2DA-PSA07	15	.
6	2EA-PSA07	16	.
7	2PS1-GND	17	.
8	.	18	.
9	.	19	.
10	.	20	.

NOTES

1. RED TEXT DENOTES CT CKTS W/ #10AWG.
2. PT & DC CKTS GET #14AWG.

DATE	REVISION	BY

MTEMC

BARFIELD SUBSTATION

SWITCHBOARD WIRING DIAGRAM

SCALE: NTS

PREPARED BY: AKF

DRAWN BY: A. FERRER

CHECKED BY: AKF

APPROVED

DRAWING NO. BAR-140

DATE FEB. 11, 2025

SHEET 8 OF 11 SHEETS

LEFT — PANEL NO. 3 (REAR VIEW) — RIGHT

TO RC3 BOX XFMR#1 — CT-11

BK	1	1TA	3EA-4
RD/BK	2	1TB	3EA-8
BL/BK	3	1TC	3EA-12
OR/BK	4	1TN	3FB-10

3SB1

YE	1	1G — 3GC-16
BR	2	G1 — 3FB-14
.	3	.
.	4	.

3SB2

TO RC3 BOX XFMR#1 — CT-12

BK	1	1HA — 3EC-4
RD	2	1HB — 3EC-8
BL	3	1HC — 3EC-12
OR	4	1HN — 3FC-10

3SB3

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.	2	.
.	3	.
.	4	.

3SB4

TO CKT SW 912 — C-912

.	1	.
.	2	.
.	3	.
.	4	.

3SB5

BL	1	912T+	3BC-10
OR	2	912T−	.
YE	3	912T	3BB-1
BR	4	912RL	3AA-D12
RD/BK	5	912TCM	3AC-D14
BL/BK	6	912SF6	3AC-D16
OR/BK	7	912C+	3AC-D07
YE/BK	8	912C−	3AC-D10
BR/BK	9	912C	3AC-D08
BK/RD	10	912GL	3BC-09
.	11	.	.
.	12	.	.

3LB1

4LB2-3	1	912TRIP+	3GA-2, 3AA-D11
4LB2-4	2	912TRIP−	3DB-2
4LB2-1	3	TRIP922+	3EB-10
4LB2-2	4	TRIP922−	3DC-2
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3LB2

TO CKT SW 914 — C-914

BL	1	914T+	3CC-10
OR	2	914T−	.
YE	3	914T	3CC-11
BR	4	914RL	3AA-D14
RD/BK	5	914TCM	3AC-E14
BL/BK	6	914SF6	3AC-E16
OR/BK	7	914C+	3AC-E07
YE/BK	8	914C−	3AC-E10
BR/BK	9	914C	3AC-E08
BK/RD	10	914GL	3CC-09
.	11	.	.
.	12	.	.

3LB3

4LB4-3	1	914TRIP+	3GA-6, 3AA-D13
4LB4-4	2	914TRIP−	3DC-4
4LB4-1	3	TRIP924+	3EB-14
4LB4-2	4	TRIP924−	3DB-4
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3LB4

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.	12	.

3LB5

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.	12	.

3LB6

3LB7 (SPARE)

3LB8 (SPARE)

751-1L — 3AA

Z01	3GC-1	D01	3GA-9
Z02	3GC-3	D02	3GA-11
Z03	3GC-5	D03	3GA-13
Z04	3GC-7	D04	3GA-15
Z05	3GC-9	D05	3GA-17
Z06	3GC-11	D06	3GA-19
Z07	3GC-15	D07	.
Z08	3GC-13	D08	.
Z09	3GB-1	D09	.
Z10	3GB-3	D10	.
Z11	3GB-5	D11	3LB2-1, 3AB-D11
Z12	3GB-7	D12	3LB1-4, 3AB-D12
E01	.	D13	3LB4-1, 3AB-D13
E02	.	D14	3LB3-4, 3AB-D14
E03	3GB-17	D15	.
E04	3GB-19	D16	.
E05	.	A01	3FU4-2
E06	.	A02	3FU4-4
E07	.	A03	3GA-1
E08	.	A04	3GA-3
E09	.	A05	3GA-5
E10	.	A06	3GA-7
E11	.	A07	3AB-A07, 3BA-A07
E12	.	A08	.
		A09	3AB-A09, 3BA-A09
		A10	.
		A11	.
		A12	.
		GND	GND-3

PORT 1	.
PORT 2/TX	.
PORT 2/RX	.
B01	.
B02	.
PORT 3	2DA-COM 11 (C605)
PORT 4A/1	.
PORT 4A/2	.
PORT 4A/3	.
PORT 4A/4	.
PORT 4A/5	.
PORT 4C	2EA-COM 11 (C605)

787-1 — 3AB

Z01	3FC-3	D01	3FA-9
Z02	3FC-1	D02	3FA-11
Z03	3FC-7	D03	3FA-13
Z04	3FC-5	D04	3FA-15
Z05	3FC-11	D05	3FA-17
Z06	3FC-9	D06	3FA-19
Z07	3FB-3	D07	.
Z08	3FB-1	D08	.
Z09	3FB-7	D09	.
Z10	3FB-5	D10	.
Z11	3FB-11	D11	3AA-D11, 3AC-D11
Z12	3FB-9	D12	3AA-D12, 3AC-D12
E01	.	D13	3AA-D13, 3AC-E11
E02	.	D14	3AA-D14, 3AC-E12
E03	.	D15	.
E04	.	D16	.
E05	.	A01	3FU3-2
E06	.	A02	3FU3-4
E07	3FB-15	A03	3FA-1
E08	3FB-13	A04	3FA-3
E09	3FC-13	A05	3FA-5
E10	3FC-15	A06	3FA-7
E11	3FC-17	A07	3AC-A07, 3AA-A07
E12	3FC-19	A08	.
		A09	3AC-A09, 3AA-A09
		A10	.
		A11	.
		A12	.
		GND	GND-2

PORT 1	.
PORT 2/TX	.
PORT 2/RX	.
B01	.
B02	.
PORT 3	2DA-COM 10 (C605)
PORT 4A/1	.
PORT 4A/2	.
PORT 4A/3	.
PORT 4A/4	.
PORT 4A/5	.
PORT 4C	2EA-COM 10 (C605)

751-1H — 3AC

Z01	3EC-3	D01	3EB-9
Z02	3EC-1	D02	3EB-11
Z03	3EC-7	D03	3EB-13
Z04	3EC-5	D04	3EB-15
Z05	3EC-11	D05	3EB-17
Z06	3EC-9	D06	3EB-19
Z07	.	D07	3LB1-7, 3BC-01
Z08	.	D08	3LB1-9
Z09	3EC-13	D09	3BC-02
Z10	3EC-15	D10	3LB1-8
Z11	3EC-17	D11	3AB-D11, 3BC-05
Z12	3EC-19	D12	3AB-D12, 3BC-06
E01	.	D13	3BC-05, 3AC-D15
E02	.	D14	3LB1-5
E03	.	D15	3AC-D13
E04	.	D16	3LB1-6
E05	.	A01	3FU2-2
E06	.	A02	3FU2-4
E07	3LB3-7, 3CC-01	A03	3EB-1
E08	3LB3-9	A04	3EB-3
E09	3CC-02	A05	3EB-5
E10	3LB3-8	A06	3EB-7
E11	3AB-D13, 3CC-05	A07	3LB2-5, 3AB-A07
E12	3AB-D14, 3CC-06	A08	.
E13	3CC-05, 3AC-E15	A09	3LB2-6, 3AB-A09
E14	3LB3-5	A10	.
E15	3AC-E13	A11	.
E16	3LB3-6	A12	.
		GND	GND-1

PORT 1	.
PORT 2/TX	.
PORT 2/RX	.
B01	.
B02	.
PORT 3	2DA-COM 9 (C605)
PORT 4A/1	.
PORT 4A/2	.
PORT 4A/3	.
PORT 4A/4	.
PORT 4A/5	.
PORT 4C	2EA-COM 9 (C605)

735-1 — 3BA

A01	3FU5-2	Z01	3EA-3
A02	3FU5-4	Z02	3EA-1
A03	.	Z03	3EA-7
A04	.	Z04	3EA-5
A05	.	Z05	3EA-11
A06	.	Z06	3EA-9
A07	3AA-A07	Z07	3EA-13
A08	.	Z08	3EA-15
A09	3AA-A09	Z09	3EA-17
A10	.	Z10	3EA-19
A11	.	PORT2	2DA-COM 12 (C605)
A12	.	PORT3	2EA-COM 12 (C605)
GND	GND-4		

CKTSW PWR 912 — 3BB

1	3BC-10, 3EB-2
2	3LB1-3, 3BC-11

CKTSW PWR 914 — 3CB

1	3CC-10, 3EB-6
2	3CC-11, 3DE-4

01-912 — 3BC

01	3AC-D07, 3BC-08
02	3AC-D09
03	.
04	.
05	3AC-D11, 3AC-D13
06	3AC-D12
07	.
08	3BC-01
09	3LB1-10
10	3LB1-1, 3BB-1
11	3BB-2, 3DE-2
12	.
13	.

01-914 — 3CC

01	3AC-E07, 3CC-08
02	3AC-E09
03	.
04	.
05	3AC-E11, 3AC-E13
06	3AC-E12
07	.
08	3CC-01
09	3LB3-10
10	3LB3-1, 3CB-1
11	3LB3-3, 3CB-2
12	.
13	.

3DA

1	.
2	.
3	.
4	.

29BR-1 — 3DB

1	3EB-12
2	3LB2-4
3	3EB-16
4	3LB4-4

29R-1 — 3DC

1	3GA-4
2	3DD-2, 3LB2-4
3	3GA-8
4	3DD-4, 3LB4-2

29D-1 — 3DD

1	3FA-4
2	3DE-2, 3DC-2
3	3FA-8
4	3DE-4, 3DC-4

29H-1 — 3DE

1	3EB-4
2	3BC-11, 3DD-2
3	3EB-8
4	3CB-2, 3DD-4

735-1/FT3 — 3EA

1	3BA-Z02
2	3GC-4
3	3BA-Z01
4	3SB1-1
5	3BA-Z04
6	3GC-8
7	3BA-Z03
8	3SB1-2
9	3BA-Z06
10	3GC-12
11	3BA-Z05
12	3SB1-3
13	3BA-Z07
14	3GB-2,3FC-14
15	3BA-Z08
16	3GB-4,3FC-16
17	3BA-Z09
18	3GB-6,3FC-18
19	3BA-Z10
20	3GB-8,3FC-20

751-1H/FT2 — 3EB

1	3AC-A03
2	3BB-1, 3FA-2
3	3AC-A04
4	3DE-1
5	3AC-A05
6	3CB-1, 3FA-6
7	3AC-A06
8	3DE-3
9	3AC-D01
10	3LB2-3, 3FA-10
11	3AC-D02
12	3DB-1, 3FA-12
13	3AC-D03
14	3LB4-3, 3FA-14
15	3AC-D04
16	3DB-3, 3FA-16
17	3AC-D05
18	3RB3-1
19	3AC-D06
20	3RB3-2

751-1H/FT1 — 3EC

1	3AC-Z02
2	3FC-4
3	3AC-Z01
4	3SB3-1
5	3AC-Z04
6	3FC-8
7	3AC-Z03
8	3SB3-2
9	3AC-Z06
10	3FC-12
11	3AC-Z05
12	3SB3-3
13	3AC-Z09
14	3FC-14
15	3AC-Z10
16	3FC-16
17	3AC-Z11
18	3FC-18
19	3AC-Z12
20	3FC-20

787-1/FT3 — 3FA

1	3AB-A03
2	3EB-2, 3GA-2
3	3AB-A04
4	3DD-1
5	3AB-A05
6	3EB-6
7	3AB-A06
8	3DD-3
9	3AB-D01
10	3EB-10, 3GA-10
11	3AB-D02
12	3EB-12, 3GA-12
13	3AB-D03
14	3EB-14,3GA-14
15	3AB-D04
16	3EB-16,3GA-16
17	3AB-D05
18	3RB3-3
19	3AB-D06
20	3RB3-4

787-1/FT2 — 3FB

1	3AB-Z08
2	3FB-6
3	3AB-Z07
4	3GC-2
5	3AB-Z10
6	3FB-2, 3FB-10
7	3AB-Z09
8	3GC-6
9	3AB-Z12
10	3FB-6, 3SB1-4
11	3AB-Z11
12	3GC-10
13	3AB-E08
14	3SB2-2
15	3AB-E07
16	3GC-14
17	.
18	.
19	.
20	.

787-1/FT1 — 3FC

1	3AB-Z02
2	3FC-6
3	3AB-Z01
4	3EC-2
5	3AB-Z04
6	3FC-2, 3FC-10
7	3AB-Z03
8	3EC-6
9	3AB-Z06
10	3FC-6, 3SB3-4
11	3AB-Z05
12	3EC-10
13	3AB-E09
14	3EA-14, 3EC-14
15	3AB-E10
16	3EA-16, 3EC-16
17	3AB-E11
18	3EA-18, 3EC-18
19	3AB-E12
20	3EA-20, 3EC-20

751-1L/FT3 — 3GA

1	3AA-A03
2	3FA-2, 3LB2-1
3	3AA-A04
4	3DC-1
5	3AA-A05
6	3FA-6, 3LB4-1
7	3AA-A06
8	3DC-3
9	3AA-D01
10	3FA-10
11	3AA-D02
12	3FA-12
13	3AA-D03
14	3FA-14
15	3AA-D04
16	3FA-16
17	3AA-D05
18	3RB3-5
19	3AA-D06
20	3RB3-6

751-1L/FT2 — 3GB

1	3AA-Z09
2	3FU1-2, 3EA-14
3	3AA-Z10
4	3FU1-4, 3EA-16
5	3AA-Z11
6	3FU1-6, 3EA-18
7	3AA-Z12
8	3RB1-4, 3EA-20
9	.
10	.
11	.
12	.
13	.
14	.
15	.
16	.
17	3AA-E03
18	3FU4-2
19	3AA-E04
20	3FU4-4

751-1L/FT1 — 3GC

1	3AA-Z01
2	3FB-4
3	3AA-Z02
4	3EA-2
5	3AA-Z03
6	3FB-8
7	3AA-Z04
8	3EA-6
9	3AA-Z05
10	3FB-12
11	3AA-Z06
12	3EA-10
13	3AA-Z08
14	3FB-16
15	3AA-Z07
16	3SB2-1
17	.
18	.
19	.
20	.

GND BUS — GND

1	3AC-GND	11	.
2	3AB-GND	12	.
3	3AA-GND	13	.
4	3BA-GND	14	.
5	.	15	.
6	.	16	.
7	.	17	.
8	.	18	.
9	.	19	.
10	.	20	.

3FU1

1	3RB1-1
2	3GB-2
3	3RB1-2
4	3GB-4
5	3RB1-3
6	3GB-6

3FU2

1	3RB2-1, 3FU3-1
2	3AC-A01
3	3RB2-2, 3FU3-3
4	3AC-A02

3FU3

1	3FU2-1, 3FU4-1
2	3AB-A01
3	3FU2-3, 3FU4-3
4	3AB-A02

3FU4

1	3FU3-1, 3FU5-1
2	3AA-A01, 3GB-18
3	3FU3-3, 3FU5-3
4	3AA-A02, 3GB-20

3FU5

1	3FU4-1
2	3BA-A01
3	3FU4-3
4	3BA-A02

3FU6

1	3RB1-1
2	3RB1-5
3	.
4	.

TO CT/PT BOX SCA1-B1 — PT-B1C

3RB1

3FU1-1, 3FU6-1	1	VA1 — BK
3FU1-3	2	VB1 — RD
3FU1-5	3	VC1 — BL
3RB1-6, 3GB-8	4	VN1 — OR
3FU6-2	5	VAT1 — YE
3RB1-4	6	VNT1
.	7	.
.	8	.
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.	10	.
.	11	.
.	12	.

TO DC PANEL BOARD — DC3

3RB2

3FU2-1	1	P3+ — RD
3FU2-3	2	P3− — BK
.	3	.
.	4	.
3AC-A07	5	P3SEL+ — 2LB2-9
3AC-A09	6	P3SEL — 2LB2-10
.	7	.
.	8	.
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.	10	.
.	11	.
.	12	.

3RB3

3EB-18	1	1HTST+
3EB-20	2	1HTST−
3FA-18	3	1TST+
3FA-20	4	1TST−
3GA-18	5	1LTST+
3GA-20	6	1LTST−
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.	10	.
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.	12	.

TRIP TEST POINTS

3RB4

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.	10	.
.	11	.
.	12	.

3RB5

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.	2	.
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.	4	.
.	5	.
.	6	.
.	7	.
.	8	.
.	9	.
.	10	.
.	11	.
.	12	.

3RB6

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.	2	.
.	3	.
.	4	.
.	5	.
.	6	.
.	7	.
.	8	.
.	9	.
.	10	.
.	11	.
.	12	.

3RB7

.	1	.
.	2	.
.	3	.
.	4	.
.	5	.
.	6	.
.	7	.
.	8	.
.	9	.
.	10	.
.	11	.
.	12	.

3RB8 (SPARE)

NOTES
1. RED TEXT DENOTES CT CKTS W/ #10AWG.
2. PT & DC CKTS GET #14AWG.

DATE	REVISION	BY

MTEMG

BARFIELD SUBSTATION
SWITCHBOARD WIRING DIAGRAM

SCALE: NTS
PREPARED BY: AKF
DRAWN BY: A. FERREE
CHECKED BY: AKF

APPROVED

DRAWING NO. BAR-140

DATE FEB. 11, 2025

SHEET 9 OF 11 SHEETS

LEFT — PANEL NO. 4 (REAR VIEW) — RIGHT

TO RC3 BOX XFMR#2 — CT-21

BK	1	2TA	4EA-4
RD/BK	2	2TB	4EA-8
BL/BK	3	2TC	4EA-12
OR/BK	4	2TN	4FB-10

4SB2

YE	1	2G	4GC-16
BR	2	G2	4FB-14
.	3	.	.
.	4	.	.

TO RC3 BOX XFMR#2 — CT-22

4SB3

BK	1	2HA	4EC-4
YE	2	2HB	4EC-8
RD	3	2HC	4EC-12
BL	4	2HN	4FC-10
OR			

4SB4

.	1	.
.	2	.
.	3	.
.	4	.

4SB5

.	1	.
.	2	.
.	3	.
.	4	.

TO CKT SW 922 — C-922

4LB1

BL	1	922T+	4BC-10
RD	OR	2	922T–	.
BK	YE	3	922T	4BB-1
BR	4	922RL	4AA-D12
RD/BK	5	922TCM	4AC-D14
BL/BK	6	922SF6	4AC-D16
OR/BK	7	922C+	4AC-D07
YE/BK	8	922C–	4AC-D10
BR/BK	9	922C	4AC-D08
BK/RD	10	922GL	4BC-09
.	11	.	.
.	12	.	.

4LB2

3LB2–3	1	922TRIP+	4GA–2, 4AA–D11
3LB2–4	2	922TRIP–	4DB–2
3LB2–1	3	TRIP912+	4EB–10
3LB2–2	4	TRIP912–	4DC–2
.	5	.	.
.	6	.	.
.	7	.	.
.	8	.	.
.	9	.	.
.	10	.	.
.	11	.	.
.	12	.	.

TO CKT SW 924 — C-924

4LB3

BL	1	924T+	4CC–10
RD	OR	2	924T–	.
BK	YE	3	924T	4CC–11
BR	4	924RL	4AA–D14
RD/BK	5	924TCM	4AC–E14
BL/BK	6	924SF6	4AC–E16
OR/BK	7	924C+	4AC–E07
YE/BK	8	924C–	4AC–E10
BR/BK	9	924C	4AC–E08
BK/RD	10	924GL	4CC–09
.	11	.	.
.	12	.	.

4LB4

3LB4–3	1	924TRIP+	4GA–6, 4AA–D13
3LB4–4	2	924TRIP–	4DC–4
3LB4–1	3	TRIP914+	4EB–14
3LB4–2	4	TRIP914–	4DB–4
.	5	.	.
.	6	.	.
.	7	.	.
.	8	.	.
.	9	.	.
.	10	.	.
.	11	.	.
.	12	.	.

4LB5

.	1	.
.	2	.
.	3	.
.	4	.
.	5	.
.	6	.
.	7	.
.	8	.
.	9	.
.	10	.
.	11	.
.	12	.

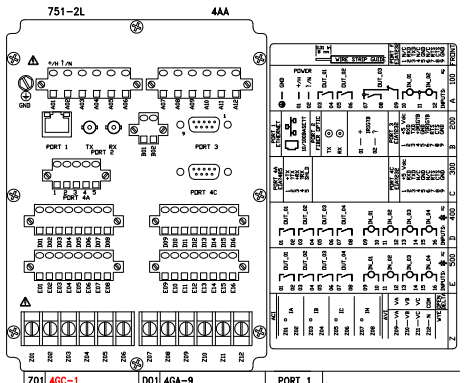
4LB6

.	1	.
.	2	.
.	3	.
.	4	.
.	5	.
.	6	.
.	7	.
.	8	.
.	9	.
.	10	.
.	11	.
.	12	.

4LB7 (SPARE)

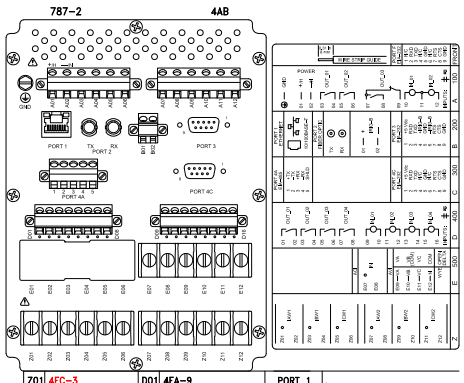
4LB8 (SPARE)

751–2L — 4AA



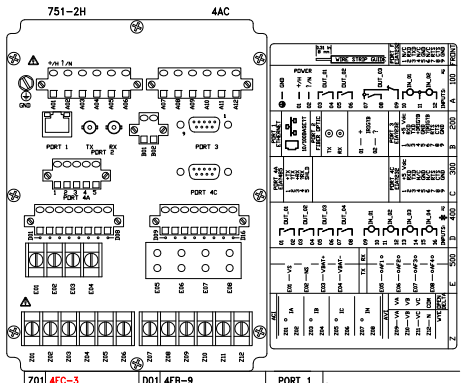
Z01	4GC–1	D01	4GA–9	PORT 1	.
Z02	4GC–3	D02	4GA–11	PORT 2/TX	.
Z03	4GC–5	D03	4GA–13	PORT 2/RX	.
Z04	4GC–7	D04	4GA–15	B01	.
Z05	4GC–9	D05	4GA–17	B02	.
Z06	4GC–11	D06	4GA–19	PORT 3	2DA–COM 15 (C605)
Z07	4GC–15	D07	.	PORT 4A/1	.
Z08	4GC–13	D08	.	PORT 4A/2	.
Z09	4GB–1	D09	.	PORT 4A/3	.
Z10	4GB–3	D10	.	PORT 4A/4	.
Z11	4GB–5	D11	4LB2–1, 4AB–D11	PORT 4A/5	.
Z12	4GB–7	D12	4LB1–4, 4AB–D12	PORT 4C	2EA–COM 15 (C605)
E01	.	D13	4LB4–1, 4AB–D13		
E02	.	D14	4LB3–4, 4AB–D14		
E03	4GB–17	D15	.		
E04	4GB–19	D16	.		
E05	.	A01	4FU4–2		
E06	.	A02	4FU4–4		
E07	.	A03	4GA–1		
E08	.	A04	4GA–3		
E09	.	A05	4GA–5		
E10	.	A06	4GA–7		
E11	.	A07	4AB–A07, 4BA–A07		
E12	.	A08	.		
		A09	4AB–A09, 4BA–A09		
		A10	.		
		A11	.		
		A12	.		
		GND	GND–3		

787–2 — 4AB



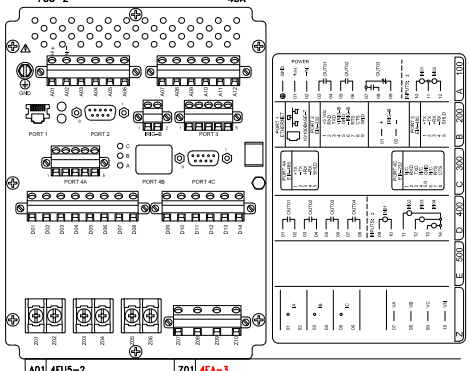
Z01	4FC–3	D01	4FA–9	PORT 1	.
Z02	4FC–1	D02	4FA–11	PORT 2/TX	.
Z03	4FC–7	D03	4FA–13	PORT 2/RX	.
Z04	4FC–5	D04	4FA–15	B01	.
Z05	4FC–11	D05	4FA–17	B02	.
Z06	4FC–9	D06	4FA–19	PORT 3	2DA–COM 14 (C605)
Z07	4FB–3	D07	.	PORT 4A/1	.
Z08	4FB–1	D08	.	PORT 4A/2	.
Z09	4FB–7	D09	.	PORT 4A/3	.
Z10	4FB–5	D10	.	PORT 4A/4	.
Z11	4FB–11	D11	4AA–D11, 4AC–D11	PORT 4A/5	.
Z12	4FB–9	D12	4AA–D12, 4AC–D12	PORT 4C	2EA–COM 14 (C605)
E01	.	D13	4AA–D13, 4AC–E11		
E02	.	D14	4AA–D14, 4AC–E12		
E03	.	D15	.		
E04	.	D16	.		
E05	.	A01	4FU3–2		
E06	.	A02	4FU3–4		
E07	4FB–15	A03	4FA–1		
E08	4FB–13	A04	4FA–3		
E09	4FC–13	A05	4FA–5		
E10	4FC–15	A06	4FA–7		
E11	4FC–17	A07	4AC–A07, 4AA–A07		
E12	4FC–19	A08	.		
		A09	4AC–A09, 4AA–A09		
		A10	.		
		A11	.		
		A12	.		
		GND	GND–2		

751–2H — 4AC



Z01	4EC–3	D01	4EB–9	PORT 1	.
Z02	4EC–1	D02	4EB–11	PORT 2/TX	.
Z03	4EC–7	D03	4EB–13	PORT 2/RX	.
Z04	4EC–5	D04	4EB–15	B01	.
Z05	4EC–11	D05	4EB–17	B02	.
Z06	4EC–9	D06	4EB–19	PORT 3	2DA–COM 13 (C605)
Z07	.	D07	4LB1–7, 4BC–01	PORT 4A/1	.
Z08	.	D08	4LB1–9	PORT 4A/2	.
Z09	4EC–13	D09	4BC–02	PORT 4A/3	.
Z10	4EC–15	D10	4LB1–8	PORT 4A/4	.
Z11	4EC–17	D11	4AB–D11, 4BC–05	PORT 4A/5	.
Z12	4EC–19	D12	4AB–D12, 4BC–06	PORT 4C	2EA–COM 13 (C605)
E01	.	D13	4BC–05, 4AC–D15		
E02	.	D14	4LB1–5		
E03	.	D15	4AC–D13		
E04	.	D16	4LB1–6		
E05	.	A01	4FU2–2		
E06	.	A02	4FU2–4		
E07	4LB3–7, 4CC–01	A03	4EB–1		
E08	4LB3–9	A04	4EB–3		
E09	4CC–02	A05	4EB–5		
E10	4LB3–8	A06	4EB–7		
E11	4AB–D13, 4CC–05	A07	4RB2–5, 4AB–A07		
E12	4AB–D14, 4CC–06	A08	.		
E13	4CC–05, 4AC–E15	A09	4RB2–6, 4AB–A09		
E14	4LB3–5	A10	.		
E15	4AC–E13	A11	.		
E16	4LB3–6	A12	.		
		GND	GND–1		

735–2 — 4BA

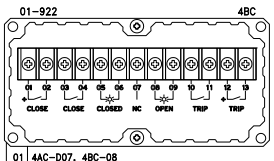


A01	4FU5–2	Z01	4EA–3
A02	4FU5–4	Z02	4EA–1
A03	.	Z03	4EA–7
A04	.	Z04	4EA–5
A05	.	Z05	4EA–11
A06	.	Z06	4EA–9
A07	4AA–A07	Z07	4EA–13
A08	.	Z08	4EA–15
A09	4AA–A09	Z09	4EA–17
A10	.	Z10	4EA–19
A11	.	PORT2	2DA–COM 16 (C605)
A12	.	PORT3	2EA–COM 16 (C605)
GND	GND–4		

CKTSW PWR 922 — 4BB

1	4BC–10, 4EB–2
2	4LB1–3, 4BC–11

01–922 — 4BC

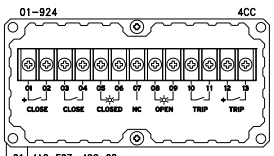


01	4AC–D07, 4BC–08	08	4BC–01
02	4AC–D09	09	4LB1–10
03	.	10	4LB1–1, 4BB–1
04	.	11	4BB–2, 4DE–2
05	4AC–D11, 4AC–D13	12	.
06	4AC–D12	13	.
07	.		

CKTSW PWR 924 — 4CB

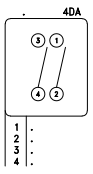
1	4CC–10, 4EB–6
2	4CC–11, 4DE–4

01–924 — 4CC



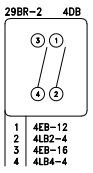
01	4AC–E07, 4CC–08	08	4CC–01
02	4AC–E09	09	4LB3–10
03	.	10	4LB3–1, 4CB–1
04	.	11	4LB3–3, 4CB–2
05	4AC–E11, 4AC–E13	12	.
06	4AC–E12	13	.
07	.		

4DA



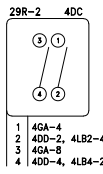
1	.
2	.
3	.
4	.

29BR–2 — 4DB



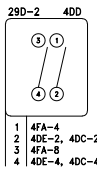
1	4EB–12
2	4LB2–4
3	4EB–16
4	4LB4–4

29R–2 — 4DC



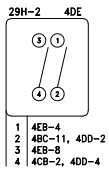
1	4GA–4
2	4DD–2, 4LB2–4
3	4GA–8
4	4DD–4, 4LB4–2

29D–2 — 4DD



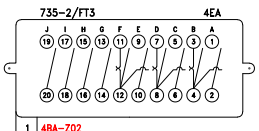
1	4FA–4
2	4DE–2, 4DC–2
3	4FA–8
4	4DE–4, 4DC–4

29H–2 — 4DE



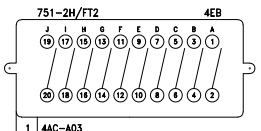
1	4EB–4
2	4BC–11, 4DD–2
3	4EB–8
4	4CB–2, 4DD–4

735–2/FT3 — 4EA



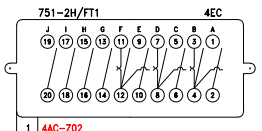
1	4BA–Z02
2	4GC–4
3	4BA–Z01
4	4SB1–1
5	4BA–Z04
6	4GC–8
7	4BA–Z03
8	4SB1–2
9	4BA–Z06
10	4GC–12
11	4BA–Z05
12	4SB1–3
13	4BA–Z07
14	4GB–2,4FC–14
15	4BA–Z08
16	4GB–4,4FC–16
17	4BA–Z09
18	4GB–6,4FC–18
19	4BA–Z10
20	4GB–8,4FC–20

751–2H/FT2 — 4EB



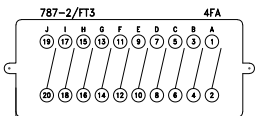
1	4AC–A03
2	4BB–1, 4FA–2
3	4AC–A04
4	4DE–1
5	4AC–A05
6	4CB–1, 4FA–6
7	4AC–A06
8	4DE–3
9	4AC–D01
10	4LB2–3, 4FA–10
11	4AC–D02
12	4DB–1, 4FA–12
13	4AC–D03
14	4LB4–3, 4FA–14
15	4AC–D04
16	4DB–3, 4FA–16
17	4AC–D05
18	4RB3–1
19	4AC–D06
20	4RB3–2

751–2H/FT1 — 4EC



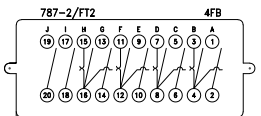
1	4AC–Z02
2	4FC–4
3	4AC–Z01
4	4SB3–1
5	4AC–Z04
6	4FC–8
7	4AC–Z03
8	4SB3–2
9	4AC–Z06
10	4FC–12
11	4AC–Z05
12	4SB3–3
13	4AC–Z09
14	4FC–14
15	4AC–Z10
16	4FC–16
17	4AC–Z11
18	4FC–18
19	4AC–Z12
20	4FC–20

787–2/FT3 — 4FA



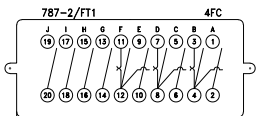
1	4AB–A03
2	4EB–2, 4GA–2
3	4AB–A04
4	4DD–1
5	4AB–A05
6	4EB–6
7	4AB–A06
8	4DD–3
9	4AB–D01
10	4EB–10, 4GA–10
11	4AB–D02
12	4EB–12, 4GA–12
13	4AB–D03
14	4EB–14,4GA–14
15	4AB–D04
16	4EB–16,4GA–16
17	4AB–D05
18	4RB3–3
19	4AB–D06
20	4RB3–4

787–2/FT2 — 4FB



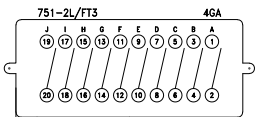
1	4AB–Z08
2	4FB–6
3	4AB–Z07
4	4GC–2
5	4AB–Z10
6	4FB–2, 4FB–10
7	4AB–Z09
8	4GC–6
9	4AB–Z12
10	4FB–6, 4SB1–4
11	4AB–Z11
12	4GC–10
13	4AB–E08
14	4SB2–2
15	4AB–E07
16	4GC–14
17	.
18	.
19	.
20	.

787–2/FT1 — 4FC



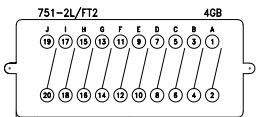
1	4AB–Z02
2	4FC–6
3	4AB–Z01
4	4EC–2
5	4AB–Z04
6	4FC–2, 4FC–10
7	4AB–Z03
8	4EC–6
9	4AB–Z06
10	4FC–6, 4SB3–4
11	4AB–Z05
12	4EC–10
13	4AB–E09
14	4EA–14, 4EC–14
15	4AB–E10
16	4EA–16, 4EC–16
17	4AB–E11
18	4EA–18, 4EC–18
19	4AB–E12
20	4EA–20, 4EC–20

751–2L/FT3 — 4GA



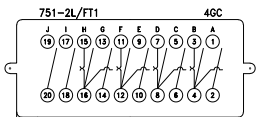
1	4AA–A03
2	4FA–2, 4LB2–1
3	4AA–A04
4	4DC–1
5	4AA–A05
6	4FA–6, 4LB4–1
7	4AA–A06
8	4DC–3
9	4AA–D01
10	4FA–10
11	4AA–D02
12	4FA–12
13	4AA–D03
14	4FA–14
15	4AA–D04
16	4FA–16
17	4AA–D05
18	4RB3–5
19	4AA–D06
20	4RB3–6

751–2L/FT2 — 4GB



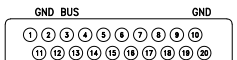
1	4AA–Z09
2	4FU1–2, 4EA–14
3	4AA–Z10
4	4FU1–4, 4EA–16
5	4AA–Z11
6	4FU1–6, 4EA–18
7	4AA–Z12
8	4RB1–4, 4EA–20
9	.
10	.
11	.
12	.
13	.
14	.
15	.
16	.
17	4AA–E03
18	4FU4–2
19	4AA–E04
20	4FU4–4

751–2L/FT1 — 4GC



1	4AA–Z01
2	4FB–4
3	4AA–Z02
4	4EA–2
5	4AA–Z03
6	4FB–8
7	4AA–Z04
8	4EA–6
9	4AA–Z05
10	4FB–12
11	4AA–Z06
12	4EA–10
13	4AA–Z08
14	4FB–16
15	4AA–Z07
16	4SB2–1
17	.
18	.
19	.
20	.

GND BUS — GND



1	4AC–GND	11	.
2	4AB–GND	12	.
3	4AA–GND	13	.
4	4BA–GND	14	.
5	.	15	.
6	.	16	.
7	.	17	.
8	.	18	.
9	.	19	.
10	.	20	.

4FU1

1	4RB1–1
2	4GB–2
3	4RB1–2
4	4GB–4
5	4RB1–3
6	4GB–6

4FU2

1	4RB2–1, 4FU3–1
2	4AC–A01
3	4RB2–2, 4FU3–3
4	4AC–A02

4FU3

1	4FU2–1, 4FU4–1
2	4AB–A01
3	4FU2–3, 4FU4–3
4	4AB–A02

4FU4

1	4FU3–1, 4FU5–1
2	4AA–A01, 4GB–18
3	4FU3–3, 4FU5–3
4	4AA–A02, 4GB–20

4FU5

1	4FU4–1
2	4BA–A01
3	4FU4–3
4	4BA–A02

4FU6

1	4RB1–1
2	4RB1–5
3	.
4	.

TO CT/PT BOX SCA1–B2 — PT–B2C

4RB1

4FU1–1, 4FU6–1	1	VA2	BK
4FU1–3	2	VB2	YE
4FU1–5	3	VC2	RD
4RB1–6, 4GB–8	4	VN2	BL
4FU6–2	5	VAT2	OR
4RB1–4	6	VNT2	.
.	7	.	.
.	8	.	.
.	9	.	.
.	10	.	.
.	11	.	.
.	12	.	.

TO DC PANEL BOARD — DC4

4RB2

4FU2–1	1	P4+	RD
4FU2–3	2	P4–	BK
.	3	.	.
.	4	.	.
4AC–A07	5	P4SEL+	2LB2–11
4AC–A09	6	P4SEL	2LB2–12
.	7	.	.
.	8	.	.
.	9	.	.
.	10	.	.
.	11	.	.
.	12	.	.

4RB3

4EB–18	1	2HTST+	.
4EB–20	2	2HTST–	.
4FA–18	3	2TST+	.
4FA–20	4	2TST–	.
4GA–18	5	2LTST+	.
4GA–20	6	2LTST–	.
.	7	.	.
.	8	.	.
.	9	.	.
.	10	.	.
.	11	.	.
.	12	.	.

TRIP TEST POINTS

4RB4

.	1	.
.	2	.
.	3	.
.	4	.
.	5	.
.	6	.
.	7	.
.	8	.
.	9	.
.	10	.
.	11	.
.	12	.

4RB5

.	1	.
.	2	.
.	3	.
.	4	.
.	5	.
.	6	.
.	7	.
.	8	.
.	9	.
.	10	.
.	11	.
.	12	.

4RB6

.	1	.
.	2	.
.	3	.
.	4	.
.	5	.
.	6	.
.	7	.
.	8	.
.	9	.
.	10	.
.	11	.
.	12	.

4RB7

.	1	.
.	2	.
.	3	.
.	4	.
.	5	.
.	6	.
.	7	.
.	8	.
.	9	.
.	10	.
.	11	.
.	12	.

4RB8 (SPARE)

NOTES
1. RED TEXT DENOTES CT CKTS W/ #10AWG.
2. PT & DC CKTS GET #14AWG.

DATE	REVISION	BY

MTEMG

BARFIELD SUBSTATION
SWITCHBOARD WIRING DIAGRAM

SCALE: NTS
PREPARED BY: AKF
DRAWN BY: A. FERREE
CHECKED BY: AKF

APPROVED

DRAWING NO. BAR–140

DATE FEB. 11, 2025

SHEET 10 OF 11 SHEETS

Exhibit Q

Communication Cables Diagram

751-1H 3AA
PORT 3
PORT 4C
C605
787-1 3AB
751-1L 3AC
735-1 3BA
PORT 2
751-2H 4AC
787-2 4AB
751-2L 4AA
735-2 4BA
JUNIPER 6AA
RADIO/ ANTENNA
CAT6
SUBSCRIBER MODULE
ANTENNA
2440 2AA
PORT 1A
PORT 1B
PORT 2
PORT 3
CISCO SWITCH 6AB
SEL-2523 2CA
3350-1 2DA
COM 33 COM 34 COM 35 COM 36 COM 37 COM 38 COM 39 COM 40 COM 41 COM 42 COM 43 COM 44 COM 45 COM 46 COM 47 COM 48
COM 17 COM 18 COM 19 COM 20 COM 21 COM 22 COM 23 COM 24 COM 25 COM 26 COM 27 COM 28 COM 29 COM 30 COM 31 COM 32
COM 9 COM 10 COM 11 COM 12 COM 13 COM 14 COM 15 COM 16 ETH 2 ETH 4
USB 5 USB 6
DISPLAYPORT
USB 3 USB 4
COM 1 COM 2 COM 3 COM 4 COM 5 COM 6 COM 7 COM 8 ETH 1 ETH 3
IN IRIG-B OUT
ETH1
IRIG-B IN
C953
2407
2BB
TX RX ANT OUT1 OUT2 OUT3 MOD OUT4 OUT5 OUT6 SERIAL
COM1 COM2 COM3 COM4 COM5 COM6 COM7 COM8
COM9 COM10 COM11 COM12 COM13 COM14 COM15 COM16 COM18 COM19 COM20 COM21 COM22 COM23 COM24
3350-2 2EA
RELAY PANEL NO. 2
MULTI-MODE FIBER OPTIC CABLE
C478A
214A 2810MT
214B 2810MT
224A 2810MT
224B 2810MT
234A 2810MT
234B 2810MT
244A 2810MT
244B 2810MT
254A 2810MT
254B 2810MT
264A 2810MT
264B 2810MT
274A 2810MT
274B 2810MT
284A 2810MT
284B 2810MT
T1A 2812MRX0
T1B 2810MT
T1C 2810MT
T2A 2812MRX0
T2B 2810MT
T2C 2810MT
TX RX GY YE BL OR
SPARE GY
SPARE YE
214A 2810MR
214B 2810MR
224A 2810MR
224B 2810MR
234A 2810MR
234B 2810MR
244A 2810MR
244B 2810MR
254A 2810MR
254B 2810MR
264A 2810MR
264B 2810MR
274A 2810MR
274B 2810MR
284A 2810MR
284B 2810MR
T1A REINHAUSEN CM-0847
T2A REINHAUSEN CM-0847
T1B 2810MR
T2B 2810MR
BKR 214
BKR 224
BKR 234
BKR 244
BKR 254
BKR 264
BKR 274
BKR 284
351S-214
351S-224
351S-234
351S-244
351S-254
351S-264
351S-274
351S-284
PORT 2
PORT 3
NULL MODEM
90-1 TAPCON 250-1 T1
CP-8050
X5
ETM-1 SEL2414
90-2 TAPCON 250-2 T2
ETM-2 SEL2414
CARD B200
PORT 1
IRIG-B

MTEMC

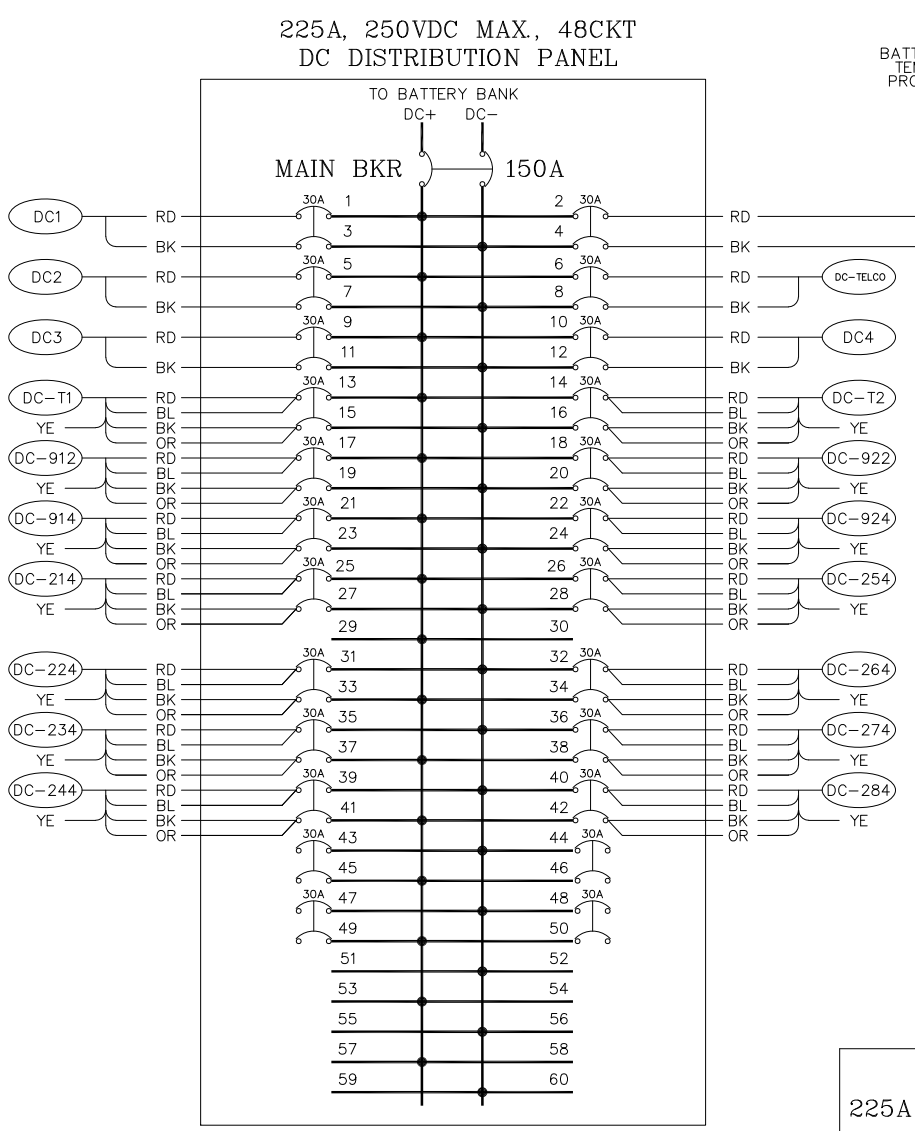
BARFIELD SUBSTATION
COMMUNICATIONS DIAGRAM

DATE	REVISION	BY

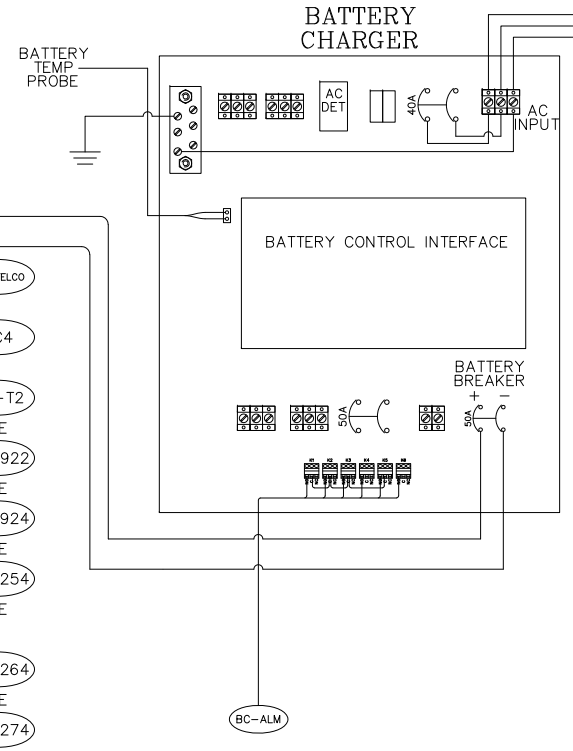
SCALE: N.T.S.
PREPARED BY: AKF
DRAWN BY: A.FERREE
CHECKED BY: AKF
APPROVED
DRAWING NO. BAR-120
DATE APRIL 1, 2025
SHEET 9
OF 9 SHEETS

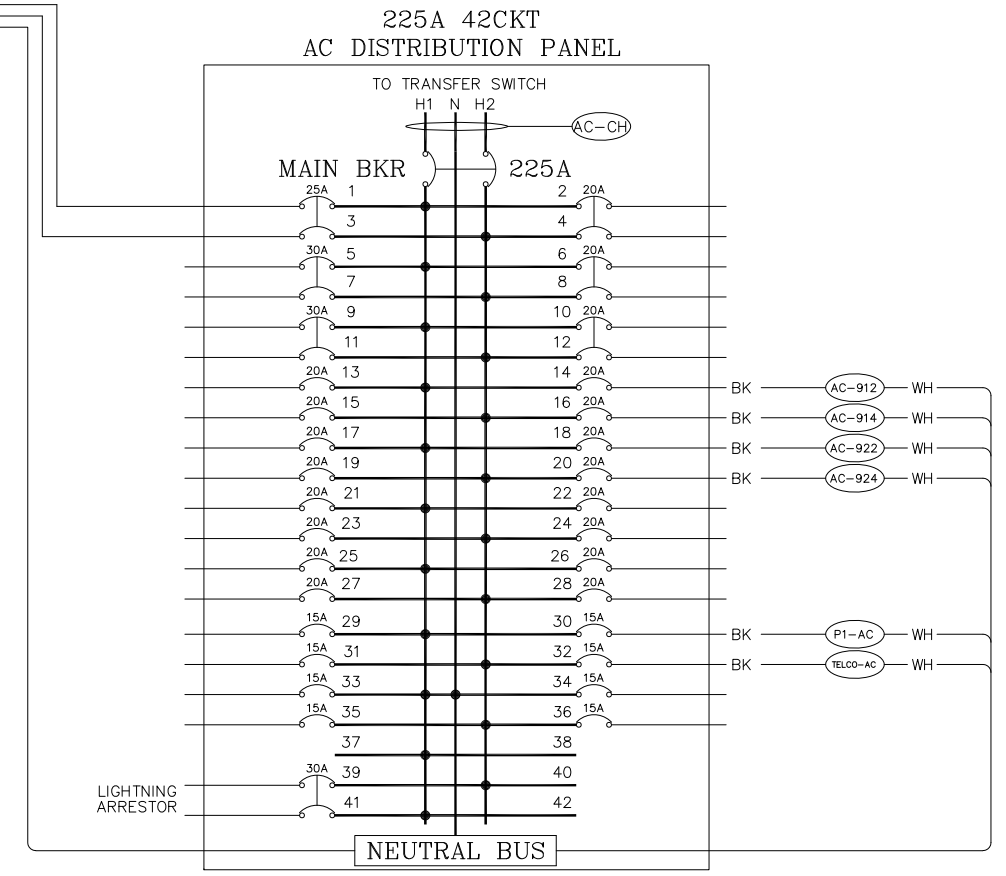
Exhibit R

AC and DC Panelboard Details



SWITCH HOUSE DC DISTRIBUTION PANEL





SWITCH HOUSE AC DISTRIBUTION PANEL

DC PANEL SCHEDULE

225A 130VDC 150A MAIN BKR

30 AMP RELAY PANEL #1	1	2	30 AMP BATTERY CHARGER
	3	4	
30 AMP RELAY PANEL #2	5	6	30 AMP TELECOM PANEL #6
	7	8	
30 AMP RELAY PANEL #3	9	10	30 AMP RELAY PANEL #4
	11	12	
30 AMP TRANSFORMER #1	13	14	30 AMP TRANSFORMER #2
	15	16	
30 AMP CKT SWR 912	17	18	30 AMP CKT SWR 922
	19	20	
30 AMP CKT SWR 914	21	22	30 AMP CKT SWR 924
	23	24	
30 AMP BREAKER 214	25	26	30 AMP BREAKER 254
	27	28	
	29	30	
30 AMP BREAKER 224	31	32	30 AMP BREAKER 264
	33	34	
30 AMP BREAKER 234	35	36	20 AMP BREAKER 274
	37	38	
30 AMP BREAKER 244	39	40	30 AMP BREAKER 284
	41	42	
30 AMP SPARE	43	44	30 AMP SPARE
	45	46	
30 AMP SPARE	47	48	30 AMP SPARE
	49	50	
	51	52	
	53	54	
	55	56	
	57	58	
	59	60	

CIRCUIT DIRECTORY

AC PANEL SCHEDULE

225 AMP 240 VOLT 1ø MAIN LUG

25 AMP BATTERY CHARGER	1	2	20 AMP POWER FAIL ALARM
	3	4	
30 AMP HVAC	5	6	20 AMP SPARE
	7	8	
30 AMP HOUSE REC	9	10	20 AMP SPARE
	11	12	
20 AMP BATT EXHAUST FAN	13	14	20 AMP 912 HEATER
20 AMP LIGHTS & EM LIGHTS	15	16	20 AMP 914 HEATER
20 AMP HOUSE REC	17	18	20 AMP 922 HEATER
20 AMP SPARE	19	20	20 AMP 924 HEATER
20 AMP SPARE	21	22	20 AMP TVA
20 AMP SPARE	23	24	20 AMP SPARE
20 AMP SPARE	25	26	20 AMP SMOKE DETECTORS
20 AMP SPARE	27	28	20 AMP TVA COMMS
15 AMP SPARE	29	30	15 AMP RELAY PANEL #1
15 AMP SPARE	31	32	15 AMP TELECOM PANEL #6
15 AMP SPARE	33	34	15 AMP SPARE
15 AMP SPARE	35	36	15 AMP SPARE
XX AMP EMPTY	37	38	XX AMP EMPTY
30 AMP LIGHTNING ARRESTOR	39	40	XX AMP EMPTY
	41	42	XX AMP EMPTY

CIRCUIT DIRECTORY

DATE	REVISION	BY

MTEMC

BARFIELD SUBSTATION
AUXILIARY WIRING DETAILS

SCALE: N.T.S.	APPROVED	DATE FEB. 11, 2025
CREATED BY: AKF	DRAWING NO. BAR−142	SHEET 1
DRAWN BY: A FERREE		OF 4 SHEETS
CHECKED BY: AKF		

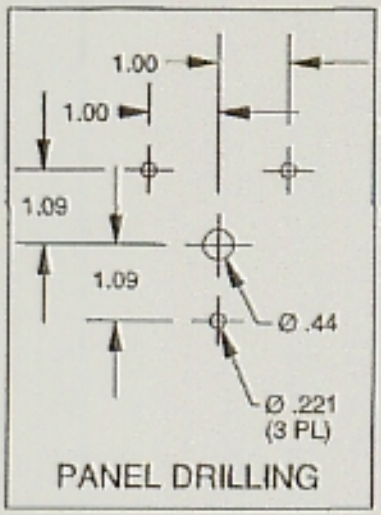
Exhibit S

Control Switch Specification Sheets

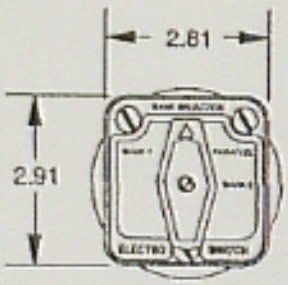
ELECTROSWITCH
UNIT OF ELECTRO SWITCH CORP.
WEYMOUTH, MASSACHUSETTS 02188
TEL: (781)335-5200 FAX: (781)335-4253

SERIES 24 CONTROL SWITCH

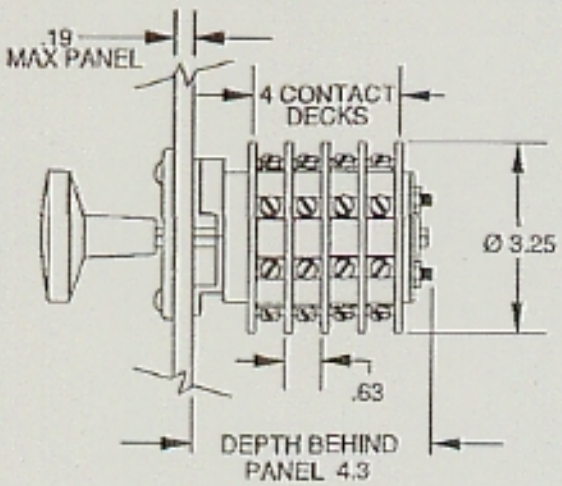
24304RE



PANEL DRILLING



(3) #10-32
MOUNTING SCREWS
SUPPLIED



8-32 X 0.25
BD. HD. TERMINAL SCREWS
SUPPLIED UNASSEMBLED.

SPECIAL FEATURES:
STOP SCREWS IN 2&6 (LIMIT CODE: -4G)

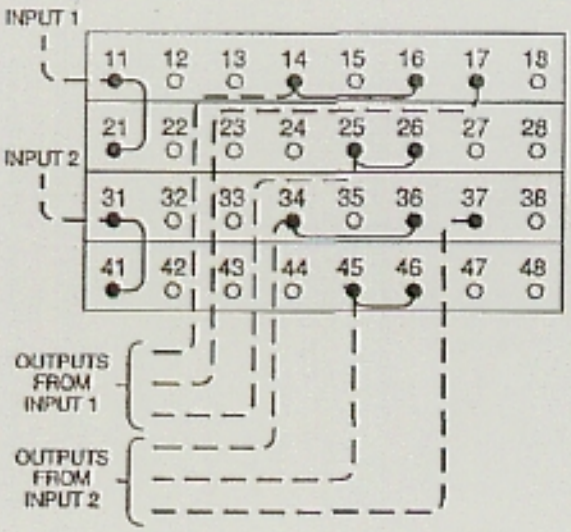
ACTION: MAINTAINED

TITLE: BANK SELECTION

DECK	CONTACTS HANDLE END	POSITION ENGRAVING: BANK 1	NORMAL	PARALLEL	BANK 2
		POSITION: 1	2	3	4
1	11 o—H—o 14	X			
	H—o 16			X	
	H—o 17				X
2	21 o—H—o 25	X	X		
	H—o 26		X	X	
3	31 o—H—o 34	X			
	H—o 36			X	
	H—o 37				X
4	41 o—H—o 45	X	X		
	H—o 46		X	X	

HANDLE POSITIONS

ENGRAVING CODE
010C-4B37G



● TERMINALS & JUMPERS SUPPLIED AS SHOWN

– – – – CUSTOMER SUPPLIED WIRING

CONTACT DECKS

DECKS 1 & 3 BBM

DECKS 2 & 4 MBB

REVISIONS:

MADE BY:	DATE:		REV.
CMM	12/31/02		0
APPR. BY: CMM	DATE: 12/31/02	SHEET 1 OF 1	