

PROJECT MANUAL FOR: CP231546 CHAMPIONS DRIVE SUBSTATION 69KV
TRANSFORMER FOUNDATIONS

PROJECT NUMBER: CP231546

AT
UNIVERSITY OF MISSOURI – COLUMBIA
COLUMBIA, MISSOURI

FOR:

THE CURATORS OF THE UNIVERSITY OF MISSOURI

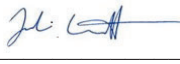
PREPARED BY:
JACOBS ENGINEERING GROUP, INC
777 MAIN STREET
FORT WORTH, TEXAS 76102
(T) 817-735-6000 (F) 817-735-6148

DATE: 9/17/2025

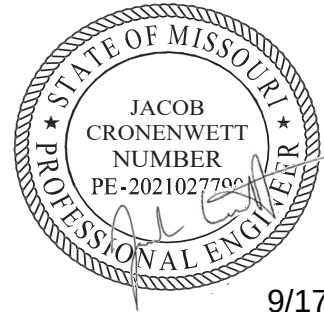
CP231546 CHAMPIONS DRIVE SUBSTATION 69KV TRANSFORMER FOUNDATIONS

I hereby certify that these Drawings and/or Specifications have been prepared by me, or under my supervision. I further certify that to the best of my knowledge these Drawings and/or Specifications are as required by and in compliance with Building Codes of the University of Missouri.

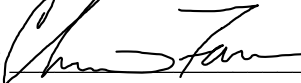
CIVIL: Jacob Cronenwett, PE

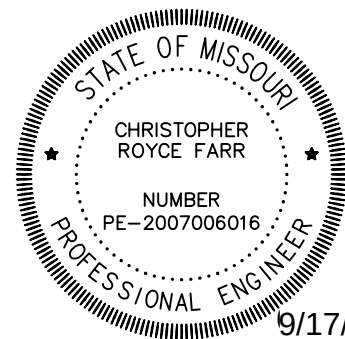
Signature: 

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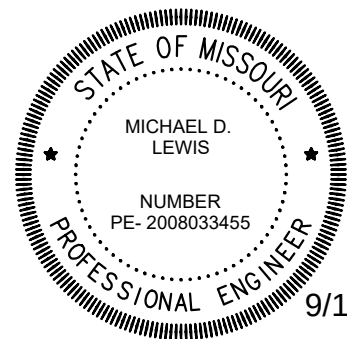
STRUCTURAL: Christopher Farr, PE, SE

Signature: 



ELECTRICAL: Michael Lewis, PE

Signature: 



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PROJECT MANUAL FOR: CP231546 CHAMPIONS DRIVE SUBSTATION 69KV
TRANSFORMER FOUNDATIONS

PROJECT NUMBER: CP231546

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PLANNING DESIGN & CONSTRUCTION

900 E. Stadium, Ste. 130
Columbia, Missouri 65211
Telephone: (573) 882-6800

ADVERTISEMENT FOR BIDS

Sealed bids for:

GENERAL SITE –
CHAMPIONS DRIVE SUBSTATION 69KV TRANSFORMER FOUNDATIONS
UNIVERSITY OF MISSOURI
COLUMBIA, MISSOURI
PROJECT NUMBER: CP231546

CONSTRUCTION ESTIMATE: \$604,475-671,638

will be received by the Curators of the University of Missouri, Owner, at Planning, Design & Construction, Room L100 (Front Reception Desk), General Services Building, University of Missouri, Columbia, Missouri 65211, until 1:30 p.m., C.S.T., October 14, 2025 and then immediately opened and publicly read aloud.

Drawings, specifications, and other related contract information may be obtained at <http://operations-webapps.missouri.edu/pdc/adsite/ad.html>. Electronic bid sets are available at no cost and may be printed as desired by the plan holders. No paper copies will be issued. If paper copies are desired, it is the responsibility of the user to print the files or have them printed.

Questions regarding the scope of work should be directed to Shumail Akhter with Jacobs at (732)-543-4315 or shumail.akhter@jacobs.com. Questions regarding commercial conditions should be directed to Ashley Karpel at (573) 882-1349 or karpela@missouri.edu.

A prebid meeting will be held at 1:30 p.m., C.S.T., October 2, 2025 in the General Services Bldg., Room 194B, followed by a site walk-through.

This project has participations goals for Minority Business Enterprises (MBE), Women Business Enterprises (WBE) and Service-Disabled Veteran Business Enterprises (SDVE) as follows: 10% MBE, 10% WBE and 3% SDVE. Please see the Information for Bidders and General Conditions for additional information about the MBE/WBE/SDVE Participation Goals.

The Owner reserves the right to waive informalities in bids and to reject any and all bids.

Individuals with special needs as addressed by the Americans with Disabilities Act may contact (573) 882-6800.

Advertisement Date: September 25, 2025

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SECTION 1.A

BID FOR LUMP SUM CONTRACT

Date: _____

BID OF _____
(hereinafter called "Bidder") a corporation* organized and existing under laws of the State of _____,
a partnership* consisting of _____,
an individual* trading as _____

a joint venture* consisting of _____.

*Insert Corporation(s), partnership or individual, as applicable.

TO: Curators of the University of Missouri
c/o Associate Vice Chancellor – Facilities
Room L100, General Services Building
University of Missouri – Columbia
Columbia, MO 65211

1. Bidder, in compliance with invitation for bids for construction work in accordance with Drawings and Specifications prepared by JACOBS ENGINEERING GROUP, INC., entitled "GENERAL SITE – CHAMPIONS DRIVE SUBSTATION 69KV TRANSFORMER FOUNDATIONS", project number CP231546, dated 9/17/2025 having examined Contract Documents and site of proposed work, and being familiar with all conditions pertaining to construction of proposed project, including availability of materials and labor, hereby proposes to furnish all labor, materials and supplies to construct project in accordance with Contract Documents, within time set forth herein at prices stated below. Prices shall cover all expenses, including taxes not covered by the University of Missouri's tax exemption status, incurred in performing work required under Contract documents, of which this Bid is a part.

Bidder acknowledges receipt of following addenda:

Addendum No. _____	Dated _____
Addendum No. _____	Dated _____
Addendum No. _____	Dated _____
Addendum No. _____	Dated _____

2. In the following Bid(s), amount (s) shall be written in both words and figures. In case of discrepancy between words and figures, words shall govern.

3. **BID PRICING**

a. **Base Bid:**

The Bidder agrees to furnish all labor, materials, tools, and equipment required to complete the construction of the new transformer foundations and associated electrical scope ; all as indicated on the Drawings and described in these Specifications for sum of:

DOLLARS (\$_____).

b. **Additive Alternate Bids:**

No Bid Alternatives have been identified for this solicitation.

c. **Unit Prices:**

(1) For changing specified quantities of work from those indicated by Contract Drawings and Specifications, upon written instructions of Owner, the following Unit Prices

shall prevail in accordance with General Conditions.

(2) The following Unit Prices include all labor, overhead and profit, materials, equipment, appliances, bailing, shoring, shoring removal, etc., to cover all work.

(3) The following Unit Prices are required where applicable to particular Base Bid and/or Alternate being submitted.

(4) Only a single Unit Price shall be given and it shall apply for either MORE or LESS work than that indicated on Drawings and called for in Specifications as indicated to be included in Base Bid and/or Alternates. In the event that more or less units than so indicated is actually furnished, Change Orders will be issued for increased or decreased amounts as approved by the Owner.

(5) Bidder understands that the Owner will not be liable for any Unit Price or any amount in excess of Base Bid and any Alternate(s) accepted at time of award of Contract, except as expressed in written Change Orders duly executed and delivered by Owner's Representative.

Drilled Pier in Unclassified Material (Reference Specification 316329) Unit Price for drilling in unclassified material as part of the concrete pier installation to reach the top of the rock socket as required by the geotechnical report and structural drawings/specifications. This includes all materials, equipment, and labor.

Size = (24)"

Base Bid Quantity = 650 lineal ft

Price = \$ _____ /lineal ft

Drilled Pier for Rock Socket (Reference Specification 316329) Unit Price for drilling rock socket as part of the concrete pier installation as required by the geotechnical report and structural drawings/specifications. This includes all materials, equipment, and labor.

Size = (24)"

Base Bid Quantity = 70 lineal ft

Price = \$ _____ /lineal ft

Slurry method not acceptable for temporary casing

Minimal Drill Rig Requirements:

- Machine must be equipped with an onboard digital depth finder
- Machines must be capable of drilling the specified diameter(s) and depth(s) shown in the contract documents
- Machines must be less than 20years old

4. PROJECT COMPLETION

- a. Contract Period - Contract period begins on the day the Contractor receives unsigned Contract, Performance Bond, Payment Bond, and "Instructions for Execution of Contract, Bonds, and Insurance Certificates." Bidder agrees to complete project within One hundred and fifty five days (155) calendar days from receipt of aforementioned documents. Fifteen (15) calendar days have been allocated in construction schedule for receiving aforementioned documents from Bidder.
- b. Commencement - Contractor agrees to commence work on this project after the "Notice to Proceed" is issued by the Owner. "Notice to Proceed" will be issued within seven (7) calendar days after Owner receives properly prepared and executed Contract documents listed in paragraph 4.a. above.
- c. Special scheduling requirements:
 - (1) The Contractor shall ensure the transformer pads are fully constructed, inspected, and ready to receive delivery of the transformers no later than February 27th, 2026.
 - (2) Owner furnished equipment includes two 69kV HICO transformers. Owner has purchased transportation, offloading, and installation of the transformers. Drawings of the transformers are included in Appendix B. The contractor shall be available for coordination of delivery and installation.

5. SUBCONTRACTOR LIST: (NOT USED)

6. MBE/WBE/SDVE PARTICIPATION

- a. SDVE Bonus Preference: A three (3) point bonus preference will be given to a Bidder that is a certified Service-Disabled Veteran Business Enterprise (SDVE) doing business as Missouri firm, corporation, or individual, or that maintains a Missouri office or place of business, as stated in the Information for Bidders. By indicating "Yes" below, the Bidder certifies that the Bidder is certified as an SDVE by the State of Missouri, Office of Administration.

Yes _____ No _____

- a. MBE/WBE/SDVE Participation Goals: The Bidder shall have a goal of providing participation in the contract of Minority Business Enterprises (MBE) of ten percent (10%) with Women Business Enterprises (WBE) of ten percent (10%), and with Service-Disabled Veteran Business Enterprises (SDVE) of three percent (3%) of the awarded contract price for work to be performed.
- b. Good Faith Effort Waiver: Requests for waiver of these goals due to good faith effort shall be submitted on the attached Application For Waiver form. A determination by the UM Executive Director of Facilities Planning and Development that a good faith effort has not been made by Bidder to achieve above stated goals may result in rejection of the bid.
- c. The undersigned Bidder proposes to perform work with the MBE/WBE/SDVE participation level set forth below. An MBE/WBE/SDVE Compliance Evaluation form shall be submitted with this bid for each MBE/WBE/SDVE subcontractor to be used on this project.

MBE PERCENTAGE PARTICIPATION: _____ percent (____%)

WBE PERCENTAGE PARTICIPATION: _____ percent (____%)

SDVE PERCENTAGE PARTICIPATION: _ percent (_____ %)

7. BIDDER'S ACKNOWLEDGMENTS

a. Bidder declares that he has had an opportunity to examine the site of the work and he has examined Contract Documents therefore; that he has carefully prepared his bid upon the basis thereof; that he has carefully examined and checked bid, materials, equipment and labor required thereunder, cost thereof, and his figures therefore. Bidder hereby states that amount, or amounts, set forth in bid is, or are, correct and that no mistake or error has occurred in bid or in Bidder's computations upon which this bid is based. Bidder agrees that he will make no claim for reformation, modifications, revisions or correction of bid after scheduled closing time for receipt of bids.

b. Bidder agrees that bid shall not be withdrawn for a period of ninety (90) days after scheduled closing time for receipt of bids.

c. Bidder understands that Owner reserves right to reject any or all bids and to waive any informalities in bidding.

d. Accompanying the bid is a bid bond, or a certified check, or an irrevocable letter of credit, or a cashier's check payable without condition to "The Curators of the University of Missouri" which is an amount at least equal to five percent (5%) of amount of largest possible total bid herein submitted, including consideration of Alternates.

e. Accompanying the bid is a Bidder's Statement of Qualifications. Failure of Bidder to submit the Bidder's Statement of Qualifications with the bid may cause the bid to be rejected. Owner does not maintain Bidder's Statements of Qualifications on file.

f. It is understood and agreed that bid security of two (2) lowest and responsive Bidders will be retained until Contract has been executed and an acceptable Performance Bond and Payment Bond has been furnished. It is understood and agreed that if the bid is accepted and the undersigned fails to execute the Contract and furnish acceptable Performance/Payment Bond as required by Contract Documents, accompanying bid security will be realized upon or retained by Owner. Otherwise, the bid security will be returned to the undersigned.

8. BIDDER'S CERTIFICATE

Bidder hereby certifies:

a. His bid is genuine and is not made in interest of or on behalf of any undisclosed person, firm or corporation, and is not submitted in conformity with any agreement or rules of any group, association or corporation.

b. He has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid.

c. He has not solicited or induced any person, firm or corporation to refrain from bidding.

d. He has not sought by collusion or otherwise to obtain for himself any advantage over any other Bidder or over Owner.

e. He will not discriminate against any employee or applicant for employment because of

race, color, religion, sex or national origin in connection with performance of work.

f. By virtue of policy of the Board of Curators, and by virtue of statutory authority, a preference will be given to materials, products, supplies, provisions and all other articles produced, manufactured, mined or grown within the State of Missouri. By virtue of policy of the Board of Curators, preference will also be given to all Missouri firms, corporations, or individuals, all as more fully set forth in "Information For Bidders."

9. BIDDER'S SIGNATURE

Note: All signatures shall be original; not copies, photocopies, stamped, etc.

Authorized Signature	Date
Printed Name	Title
Company Name	
Mailing Address	
City, State, Zip	
Phone No.	Federal Employer ID No.
Fax No.	E-Mail Address
Circle one: Individual Partnership Corporation Joint Venture	
If a corporation, incorporated under the laws of the State of _____	
Licensed to do business in the State of Missouri? ____yes ____no	

(Each Bidder shall complete bid form by manually signing on the proper signature line above and supplying required information called for in connection with the signature. Information is necessary for proper preparation of the Contract, Performance Bond and Payment Bond. Each Bidder shall supply information called for in accompanying "Bidder's Statement of Qualifications.")

END OF SECTION

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SECTION 1.B

BIDDER'S STATEMENT OF QUALIFICTION

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**UNIVERSITY OF MISSOURI
BIDDER'S STATEMENT OF QUALIFICATIONS**

Submit with Bid for Lump Sum Contract in separate envelope appropriately labeled. Attach additional sheet if necessary.

1. Company Name _____
Phone# _____ Fax #: _____
Address _____
2. Number of years in business _____. If not under present firm name, list previous firm names and types of organization.

3. List contracts on hand (complete the following schedule, include telephone number).

Project & Address	Owner/Owner's Representative	Phone Number	Architect	Amount of your Contract	Percent Completed
4. General character of work performed by your company personnel.

5. List important projects completed in the last five (5) years on a type similar to the work now bid for, including approximate cost and telephone number.

Project & Address	Owner/Owner's Representative	Phone Number	Architect	Amount of your Contract	Percent Completed
6. Other experience qualifying you for the work now bid.

7. No default has been made in any contract complete or incomplete except as noted below:
(a) Number of contracts on which default was made _____
(b) Description of defaulted contracts and reason therefor _____

8. Are you or your company certified by the State of Missouri, Office of Administration as a Minority Business Enterprise (MBE), Women Business Enterprise (WBE), or Service-Disabled Veteran Business Enterprise (SDVE)?
Yes _____ No _____

9. Have you or your company been suspended or debarred from working at any University of Missouri campus?

Yes _____ No _____ (If the answer is "yes", give details.)

10. Have any administrative or legal proceedings been started against you or your company alleging violation of any wage and hour regulations or laws?

Yes _____ No _____ (If the answer is "yes", give details.)

11. Workers Compensation Experience Modification Rates (last 3 yrs): _____ / _____ / _____

Incidence Rates (last 3 years): _____ / _____ / _____

12. List banking references.

13. (a) Do you have a current confidential financial statement on file with Owner?

Yes _____ No _____ (If not, and if desired, Bidder may submit such statement with bid, in a separate sealed and labeled envelope.)

- (b) If not, upon request will you file a detailed confidential financial statement within three (3) days?

Yes _____ No _____

Dated at _____ this _____ day of _____ 20____

Name of Organization

Signature

Printed Name

Title of Person Signing

END OF SECTION

SECTION 1.B.1

BIDDER'S STATEMENT OF QUALIFICATIONS
FOR ASBESTOS ABATEMENT

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**UNIVERSITY OF MISSOURI
BIDDER'S STATEMENT OF QUALIFICATIONS
FOR ASBESTOS ABATEMENT**

Submit with Bid for Lump Sum Contract in separate envelope appropriately labeled. Attach additional sheet if necessary.

1. Company Name _____ Phone# _____
Address _____
2. State of Missouri Registration number _____
3. Number of years in business _____ If not under present firm name, list previous firm names and types of organization.

4. List contracts on hand (complete the following schedule, include telephone number).

Project & Address	Owner/Owner's Representative	Phone Number	Architect	Amount of your Contract	Percent Completed
5. General character of work performed by your company personnel.

6. List important projects completed in the last five (5) years on a type similar to the work now bid for, including approximate cost and telephone number.

Project & Address	Owner/Owner's Representative	Phone Number	Architect	Amount of your Contract	Percent Completed
7. Other experience qualifying you for the work now bid.

8. No default has been made in any contract complete or incomplete except as noted below:
(a) Number of contracts on which default was made _____
(b) Description of defaulted contracts and reason therefor

9. Are you or your company certified by the State of Missouri, Office of Administration as a Minority Business Enterprise (MBE), Women Business Enterprise (WBE), or Service-Disabled Veteran Business Enterprise (SDVE)?

- Yes _____ No _____
10. Have you or your company been suspended or debarred from working at any University of Missouri campus?
Yes _____ No _____ (If the answer is "yes", give details.)
- _____
- _____
11. Have any administrative or legal proceedings been started against you or your company alleging violation of any wage and hour regulations or laws?
Yes _____ No _____ (If the answer is "yes", give details.)
- _____
- _____
12. Workers Compensation Experience Modification Rates (last 3 yrs): _____ / _____ / _____
Incidence Rates (last 3 years): _____ / _____ / _____
13. List banking references.
- _____
- _____
14. (a) Do you have a current confidential financial statement on file with Owner?
Yes _____ No _____ (If not, and if desired, Bidder may submit such statement with bid, in a separate sealed and labeled envelope.)
- (b) If not, upon request will you file a detailed confidential financial statement within three (3) days?
Yes _____ No _____

Dated at _____ this _____ day of _____ 20_____

Name of Organization

Signature

Printed Name

Title of Person Signing

SECTION 1.B.2

MBE/WBE/SDVE COMPLIANCE EVALUATION

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MBE/WBE/SDVE COMPLIANCE EVALUATION FORM

This form shall be completed by Bidders and submitted with the Bidder's Statement of Qualifications form for each MBE/WBE/SDVE firm that will perform work under the contract. The undersigned submits the following data with respect to this firm's assurance to meet the goal for MBE/WBE/SDVE Participation.

1. Project: _____
2. Name of General Contractor: _____
3. Name of MBE/WBE/SDVE Firm: _____
Address: _____
Phone No.: _____ Fax No.: _____
Status (check one) MBE _____ WBE _____ Service-Disabled Veteran _____
4. Describe the work to be performed. (List Base Bid work and any Alternate work separately):
Base Bid:

Alternate(s), (Identify separately):

5. Dollar amount of contract to be subcontracted to the MBE/WBE/SDVE firm:
Base Bid:
Alternate(s), (Identify separately):

6. Is the proposed firm certified as an MBE/WBE/SDVE by the State of Missouri, Office of Administration?
Yes _____ No _____

Signature: _____

Name: _____

Title: _____

Date: _____

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SECTION 1.B.3

APPLICATION FOR WAIVER

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APPLICATION FOR WAIVER

This form shall be completed and submitted with the Bidder's Statement of Qualifications. Firms wishing to be considered for award are required to demonstrate that a good faith effort has been made to meet the MBE/WBE/SDVE Participation Goals for that project. This form will be used to evaluate the extent to which a good faith effort has been made. The undersigned submits the following data with respect to the Bidder's efforts to meet the MBE/WBE/SDVE Participation Goals.

1. List pre-bid conferences your firm attended where MBE/WBE/SDVE Participation Goals were discussed.

2. Identify advertising efforts undertaken by your firm which were intended to recruit potential MBE/WBE/SDVE subcontractors or suppliers for various aspects of this project. Provide names of newspapers, dates of advertisements and copies of ads that were run.

3. Note specific efforts to contact in writing those MBE/WBE/SDVE firms capable of and likely to participate as subcontractors or suppliers for this project.

4. Describe steps taken by your firm to divide work into areas in which MBE/WBE/SDVE firms would be capable of performing.

5. What efforts were taken to negotiate with prospective MBE/WBE/SDVE? Include the names, addresses, and telephone numbers of MBE/WBE/SDVE firms contacted, a description of the information given to MBE/WBE/SDVE firms regarding plans and specifications for the assigned work, and a statement as to why additional agreements were not made with MBE/WBE/SDVE firms.

6. List reasons for rejecting an MBE/WBE/SDVE firm which has been contacted.

7. Describe the follow-up contacts with MBE/WBE/SDVE firms made by your firm after the initial solicitation.

8. Describe the efforts made by your firm to provide interested MBE/WBE/SDVE firms with sufficiently detailed information about the plans, specifications and requirements of the contract.

9. Describe your firm's efforts to locate MBE/WBE/SDVE firms.

Based on the above stated good faith efforts made to meet the MBE/WBE/SDVE Participation Goals, the Bidder hereby requests that the original goal be waived and that the percentage goal for this project be set at _____ percent.

The undersigned hereby certifies, having read the answers contained in the foregoing Application for Waiver, that they are true and correct to the best of his/her knowledge, information and belief.

Signature: _____

Name: _____

Title: _____

Company: _____

Date: _____

SECTION 1.B.4

AFFIDAVIT

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AFFIDAVIT

"The undersigned swears that the foregoing statements are true and correct and include all material information necessary to identify and explain the operation of

(name of firm) as well as the ownership thereof. Further, the undersigned agrees to provide through the prime contractor or directly to the Contracting Officer current, complete and accurate information regarding actual work performed on the project, the payment therefore and any proposed changes, if any, of the project, the foregoing arrangements and to permit the audit and examination of books, records and files of the named firm. Any material misrepresentation will be grounds for terminating any contract which may be awarded and for initiating action under federal or state laws concerning false statements."

Note - If, after filing this information and before the work of this firm is completed on the contract covered by this regulation, there is any significant change in the information submitted, you must inform the UM Executive Director of Facilities Planning and Development of the change either through the prime contractor or directly.

Signature: _____

Name: _____

Title: _____

Date: _____

Corporate Seal (where appropriate)

Date: _____

State of _____

County of _____

On this _____ day of _____, 20__, before me appeared _____ to me personally known, who, being duly sworn, did execute the foregoing affidavit, and did state that he or she was properly authorized by _____ to execute the affidavit and did so as his or her own free act and deed.

(Seal)

Notary Public

Commission expires: _____

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SECTION I.B.5

AFFIDAVIT OF MBE/WBE/SDVE PARTICIPATION

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AFFIDAVIT OF MBE/WBE/SDVE PARTICIPATION

The apparent low Bidder shall complete and submit this form within 48 hours of bid opening for each Minority Business Enterprise (MBE), Women Business Enterprise (WBE), and Service-Disabled Veteran Business Enterprise (SDVE) that will participate in the performance of the contract.

1. Name of MBE/WBE/SDVE Firm: _____
- Contact Name: _____
- Address: _____
- Phone No.: _____
- Status (check one) ☐ MBE ☐ WBE ☐ SDVE

2. Is the proposed MBE/WBE/SDVE firm certified by the State of Missouri, Office of Administration
Yes ☐ No ☐

Certification Number: _____

3. MBE/WBE/SDVE firm scope work and dollar amount of participation (List Base Bid and Alternate work separately):

	Scope of Work	Bid/Contract Amount	Final Dollar Amount (Complete at Project Closeout)
Base Bid			
Alternate #1			
Alternate #2			
Alternate #3			
Alternate #4			
Alternate #5			
Alternate #6			

Signature Page Follows

The undersigned certifies that the information contained herein (i.e. Scope of Work and Bid/Contract Amount) is true and correct to the best of their knowledge, information and belief.

General Contractor: _____ MBE/WBE/SDVE Firm: _____

Signature: _____ Signature: _____

Name: _____

Name: _____

Title: _____

Title: _____

Date: _____

Date: _____

Sign at Project Close Out

The undersigned certified that the information contained herein (i.e. Scope of Work and Final Dollar Amount) is true and correct to the best of their knowledge, information and belief. If the Final Dollar Amount is different than the Bid/Contract Amount, then attach a written justification for the difference.

General Contractor: _____

MBE/WBE/SDVE Firm: _____

Signature: _____

Signature: _____

Name: _____

Name: _____

Title: _____

Title: _____

Date: _____

Date: _____

SECTION 1.C
INFORMATION FOR BIDDERS

University of Missouri

INFORMATION FOR BIDDERS

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June 2025 Edition

1. Contract Documents and Definitions

1.1 The “Drawings,” “Specifications,” and “Contract Documents” are defined in the “General Conditions of the Contract for Construction.”

1.2 The Drawings, Specifications, and other Contract Documents may be obtained as indicated in the Advertisement for Bids.

1.3 As used herein, “Bid” refers to an offer or proposal submitted to the Owner to enter into a contract for the work identified in the Drawings, Specifications and other Contract Documents.

1.4 As used herein, “Bidder” means an individual or business entity that submits a Bid to the Owner as a prime bidder or general contractor.

1.5 All other terms used herein shall have the meanings defined herein or in the General Conditions of the Contract for Construction or other Contract Documents.

2. Bidder Obligations

2.1 Before submitting a Bid, each Bidder shall carefully examine the Drawings and Specifications and related Contract Documents, visit the site of the work, and fully inform themselves as to all existing conditions, facilities, restrictions, and other matters that could affect the work or the cost thereof.

2.2 Each Bidder shall include in their Bid the cost of all work and materials required to complete the contract in a first-class manner, as specified in the Drawings, Specifications, and other Contract Documents. All work shall be done as defined in the Specifications and as indicated on the Drawings.

2.3 Failure or omission of any Bidder to receive or to examine any form, instrument, addendum, or other document, or to visit the site of the work and acquaint themselves with existing conditions, shall in no way relieve the Bidder from any obligation with respect to their Bid or any awarded contract. No extra compensation will be allowed concerning any matter about which the Bidder should have fully informed themselves prior to submitting a Bid.

2.4 Submission of a Bid shall be deemed acceptance by the Bidder of the above obligations and every obligation required by the Contract Documents in the event the Bid is accepted by the Owner.

3. Interpretation of Documents

3.1 If any prospective Bidder is in doubt about the meaning of any part of the Drawings, Specifications, or other Contract Documents, the Bidder shall submit a written request to the Architect for an interpretation.

3.2 Any request for interpretation shall be delivered to the Architect at least one (1) week prior to time for receipt of bids.

3.3 A Bid shall be based only on an interpretation issued in the form of an addendum mailed to each person or business

entity that is on the Architect’s record as having received a set of the Contract Documents.

3.4 Bidders shall not be entitled to rely on oral interpretations or written statements not issued in an addendum from either the Architect or a representative, agent, or employee of the Owner.

4. Bids

4.1 Bids shall be submitted on a single “Bid for Lump Sum Contract” form (“Bid Form”) as furnished by the Owner or Architect. Bids shall be received separately or in combination as required by Bid Form

4.2 In addition to the Bid Form, the Bid shall include any documents or information required to be submitted by this Information for Bidders or the Contract Documents.

4.3 Bids shall include amounts for alternate bids, unit prices, and cost accounting data where required by the Bid Form.

4.4 Bidders shall apportion each base Bid between various phases of the work, where stipulated in the Bid Form.

4.5 Bids shall be presented in sealed envelopes, which shall be plainly marked “Bids for (indicate name of project from cover sheet)” and mailed or delivered to the building and room number specified in the Advertisement for Bids.

4.6 Each Bidder shall be responsible for actual delivery of their bid during business hours, and it shall not be sufficient to show that a Bid was mailed in time to be received before scheduled closing time for receipt of bids, nor shall it be sufficient to show that a Bid was somewhere in a university facility.

4.7 The Bidder’s price shall include all federal sales, excise, and similar taxes that may be lawfully assessed in connection with their performance of work and purchase of materials to be incorporated in the work. City and State taxes shall not be included as stated in the General Conditions of the Contract for Construction.

4.8 No Bidder shall stipulate in their Bid any conditions not contained in the Bid Form or Contract Documents. Inclusion of any additional conditions or taking exception to any terms may result in rejection of the Bid.

4.9 The Owner reserves the right to waive informalities in bids and to reject any or all bids.

5. Modification and Withdrawal of Bids

5.1 A Bidder may withdraw their Bid at any time before the scheduled closing time for receipt of bids. No Bidder may withdraw their Bid after the scheduled closing time for receipt of bids.

5.2 Only a written request for modification or correction of a previously submitted Bid, contained in a sealed envelope that is plainly marked “Modification of Bid on (name of project on cover sheet),” which is addressed in the same manner as a Bid and

received by Owner before the scheduled closing time for receipt of bids, will be accepted and the Bid modified in accordance with such written request.

6. Signing of Bids

6.1 All bids shall be signed manually, by an individual authorized to sign on behalf of the Bidder. The title or office held by the person signing for the Bidder shall appear below the signature.

6.2 A Bid should contain the full and correct legal name of the Bidder. If the Bidder is an entity registered with the Missouri Secretary of State, the Bidder's name on the Bid form should appear as shown in the Secretary of State's records.

6.3 A Bid from a partnership or joint venture shall be signed in the name of the partnership or joint venture by at least one partner or joint venturer or by an Attorney-in-Fact. If signed by Attorney-in-Fact there should be attached to the Bid, a Power of Attorney evidencing authority to sign the Bid executed by all partners or joint venturers.

6.4 A Bid from a corporation shall be signed by an officer of the corporation.

6.5 A Bid from a limited liability company (LLC) shall be signed by a manager or a managing member of the LLC.

6.6 A Bid from an individual or sole proprietor shall be signed in the name of the individual by the individual or an Attorney-in-Fact. If signed by Attorney-in-Fact there should be attached to the Bid, a Power of Attorney evidencing authority to sign the Bid executed by the individual.

7. Bid Security

7.1 Each Bid shall be accompanied by a Bid Bond, certified check, or cashier's check, acceptable to and payable without condition to "The Curators of the University of Missouri" in an amount at least equal to five percent (5%) of the Bidder's Bid including additive alternates ("Bid Security").

7.2 Bid security is required as a guarantee that the Bidder will enter into a written contract and furnish a Performance Bond within the time and in form as specified herein or in the Contract Documents; and, if successful Bidder fails to do so, the Bid Security will be realized upon or retained by the Owner. The apparent low Bidder shall notify the Owner in writing within forty-eight (48) hours of the Bid opening of any circumstance that may affect the Bid Security including, but not limited to, an error in the Bid. This notification will not guarantee release of the Bidder's security and/or the Bidder from the Bidder's obligations.

7.3 If a Bid Bond is given as a Bid Security, the amount of the Bid Bond may be stated as an amount equal to at least five percent (5%) of the Bid, including additive alternates, described in the Bid. The Bid Bond shall be executed by the Bidder and a responsible surety licensed in the State of Missouri with a Best's rating of no less than A-/XI.

7.4 It is specifically understood that the Bid Security is a guarantee and shall not be considered as liquidated damages for failure of Bidder to execute and deliver the contract and Performance Bond, nor limit or fix the Bidder's liability to the Owner for any damages sustained because of failure to execute and deliver the required contract and Performance Bond.

7.5 The Bid Security of the two (2) lowest, responsive, responsible bidders will be retained by the Owner until a contract has been executed and an acceptable Performance Bond has been furnished, as required hereby, when such Bid Security will be returned. The Bid Bonds of all other Bidders will be destroyed and all other alternative forms of Bid Security will be returned to them within ten (10) days after the Owner has determined the two (2) lowest, responsive, responsible bids.

8. Bidder's Statement of Qualifications

8.1 Each Bidder shall present evidence of their experience, qualifications, financial responsibility, and ability to carry out the terms of the contract by completing and submitting with their Bid the "Bidder's Statement of Qualifications" form included with the Bid documents.

8.2 Financial information required to be included with the Statement of Qualifications may be submitted by the Bidder in a separately sealed envelope, which will not be opened by the Owner during the public Bid opening.

8.3 The Bidder's Statement of Qualifications will be treated as confidential information by the Owner to the extent permitted by the Missouri Sunshine Law, Section 610.010, RSMo et seq.

8.4 Bids not accompanied by the Bidder's Statement of Qualifications may be rejected.

9. Award of Contract

9.1 The Owner reserves the right to let other contracts in connection with the work, including, but not limited to, contracts for furnishing and installation of furniture, equipment, machines, appliances, and other apparatus.

9.2 In awarding the contract, the Owner may take into consideration the ability of the Bidder, and their subcontractors, to handle promptly the additional work; the skill, facilities, capacity, experience, ability, responsibility, previous work, and financial standing of Bidder; the Bidder's ability to provide the required bonds and insurance; the quality, efficiency and construction of equipment proposed to be furnished; the period of time within which equipment is proposed to be furnished and delivered; success in achieving the specified MBE/WBE/SDVE Participation Goals or demonstrating a good faith effort to do so as described in Article 15 of this document; and the Bidder's status as suspended or debarred. Inability of any Bidder to meet the requirements mentioned above may be cause for rejection of their Bid.

10. Contract Execution

10.1 The awarded Bidder shall submit within fifteen (15) days from receipt of notice of award, the documents required in Article 9 of the General Conditions of the Contract for

Construction.

10.2 No bids will be considered binding upon the Owner until all such required documents have been furnished. Failure of Contractor to execute and submit such documents within the time specified will be treated, at the option of the Owner, as a breach of the Bidder's Bid Security and the Owner shall be under no further obligation to the Bidder.

11. Contract Security

11.1 When the Contract Sum exceeds \$50,000, the Contractor shall procure and furnish a Performance Bond and a Payment Bond in the form prepared by the Owner. Each bond shall be in the amount equal to one hundred percent (100%) of the Contract Sum, as well as adjustments to the Contract Sum. The Performance Bond shall secure and guarantee the Contractor's faithful performance of the Contract, including but not limited to the Contractor's obligation to correct any defects after final payment has been made as required by the Contract Documents. The Payment Bond shall secure and guarantee payment of all persons performing labor on the Project under the Contract and furnishing materials in connection with the Contract in accordance with Section 107.170, RSMo. These bonds shall be in effect through the duration of the Contract plus any Guaranty Period required by the Contract Documents.

11.2 The bonds required hereunder shall meet all requirements of Article 11 of the General Conditions of the Contract for Construction.

11.3 If the surety of any bond furnished by the Contractor is declared bankrupt or becomes insolvent or its right to conduct business in the State of Missouri is terminated, or it ceases to meet the requirements of this Article 11, the Contractor shall within ten (10) days substitute another bond and surety, both of which must be acceptable to the Owner. If the Contractor fails to make such substitution, the Owner may procure such required bonds on behalf of Contractor at Contractor's expense.

12. Time of Completion

12.1 The awarded Contractor shall agree to commence work within five (5) days of the date "Notice to Proceed" is received from the Owner, and the entire work shall be completed by the completion date specified or within the number of consecutive calendar days stated in the Special Conditions. The duration of the construction period, when specified in consecutive calendar days, shall begin when the contractor receives notice requesting the documents required in Article 9 of the General Conditions of the Contract for Construction.

13. Number of Contract Documents

13.1 The Owner will furnish the Contractor a copy of the executed contract, Performance Bond, and Payment Bond.

13.2 The Owner will furnish the Contractor the number of copies of complete sets of Drawings and Specifications for the work, as well as clarification and change order Drawings pertaining to change orders required during construction as set forth in the Special Conditions.

14. Missouri Products and Missouri Firms

14.1 The Curators of the University of Missouri have adopted a policy which is binding upon all employees and departments of the University of Missouri, and which by contract, shall be binding upon independent contractors and subcontractors with the University of Missouri whereby all other things being equal, and when the same can be secured without additional cost over foreign products, or products of other states, a preference shall be granted in all construction, repair and purchase contracts, to all products, commodities, materials, supplies, and articles mined, grown, produced, and manufactured in marketable quantity and quality in the State of Missouri, and to all firms, corporations or individuals doing business as Missouri firms, corporations, or individuals. Each Bidder submitting a Bid agrees to comply with and be bound by the foregoing policy.

14.2 MBE/WBE/SDVE Participation Award of Contract

14.2.1 Pursuant to Sections 37.020 and 34.074, RSM (and the implementing regulations adopted by the State of Missouri, Office of Administration), the University of Missouri System sets goals for the participation of Minority Business Enterprise, Women Business Enterprise and Service Disabled Veteran Business Enterprise (MBE/WBE/SDVE) Firms (as defined in Article 1 of the General Conditions of the Contract for Construction) in its construction projects. The applicable goals for each project shall be as stated in the Bid Form. The standard goals for University projects by location are identified in the document entitled MBE/WBE/SDVE Participation Goals; however, the Executive Director of Facilities Planning and Development may set higher or lower MBE or WBE goals for a specific project by reviewing the type of project, elements of work to be performed, time for contract performance, and geographical location, history of MBE/WBE and non-MBE/WBE utilization, and availability of ready, willing, and able certified MBE/WBEs.

14.2.2 The Bidder shall have a minimum goal of providing participation of Minority Business Enterprise, Women Business Enterprise and/or Service Disabled Veteran Business Enterprise (MBE/WBE/SDVE) Firms in the project, through self-performance, if a MBE/WBE/SDVE Firm, or by subcontracting with MBE/WBE/SDVE Firms as subcontractors, suppliers, or manufacturers, in the amount of the percent of contract price stated in the Bid Form ("MBE/WBE/SDVE Participation Goals"). The Owner will take into consideration the Bidder's success in achieving the MBE/WBE/SDVE Participation Goals in awarding the contract. Inability of any Bidder to meet one or more of the MBE/WBE/SDVE Participation Goals shall be cause for rejection of their Bid, unless the Bidder has demonstrated that they made a good faith effort to comply as set forth below.

14.2.3 In addition to the MBE/WBE/SDVE Participation Goals set forth in the Bid Form, a three (3) point bonus preference will be given to a Bidder that is a certified Service-Disabled Veteran Enterprises (SDVE) business doing business as Missouri firm, corporation, or individual, or that maintains a Missouri office or place of business. The bonus preference will **not** be given to a Bidder for the use of SDVE subcontractors, suppliers, or manufacturers. The bonus preference shall be calculated and applied by reducing the Bid amount of the SDVE Bidder by three

(3) percent of the apparent low, responsive Bidder's Bid. Based on this calculation, if the SDVE Bidder's resulting total Bid valuation is less than the Bid of the apparent low, responsive Bidder, the SDVE Bid becomes the apparent low, responsive Bid. This reduction is for evaluation purposes only and will have no impact on the actual amount(s) of the SDVE Bidder's Bid or the amount(s) of any contract awarded.

14.3 List of MBE/WBE/SDVE Firms

14.3.1 The Bidder shall submit, within forty-eight (48) hours of the receipt of bids to the University Contracting Officer, a list of MBE/WBE/SDVE Firms that will be performing as contractor, subcontractor, supplier, or manufacturer on the project. The list shall separately identify each MBE/WBE/SDVE Firm by name and address. If acceptance or non-acceptance of alternates will affect the designation of a subcontractor, supplier, or manufacturer, the Bidder shall provide information for each affected category.

14.3.2 Failure to include a complete list of MBE/WBE/SDVE Firms that will be used to meet the MBE/WBE/SDVE Participation Goals may be grounds for rejection of the Bid.

14.3.3 The list of MBE/WBE/SDVE Firms shall be submitted in addition to any other listing of subcontractors required in the Bid Form or elsewhere in this document.

14.4 MBE/WBE/SDVE Participation Computation

14.4.1 The Bidder may count toward the Supplier Diversity Goal only expenditures to MBE/WBE/SDVE Firms that perform a commercially useful function in the work of a contract. An MBE/WBE/SDVE Firm is considered to perform a commercially useful function when it is responsible for executing a distinct element of the work or contract and is carrying out its responsibilities by actually performing managing and supervising the work.

14.4.2 The Bidder may count toward its MBE/WBE/SDVE Participation Goals work granted to a second or subsequent tier subcontractor that is an MBE/WBE/SDVE Firm provided the MBE/WBE/SDVE Firm assumes the actual and contractual responsibility for performing work on the project. The Bidder may count toward its MBE/WBE/SDVE Participation Goals expenditures for materials and/or supplies obtained from an MBE/WBE/SDVE Firm, provided the MBE/WBE/SDVE Firm assumes the actual and contractual responsibility for the provision of the materials and/or supplies. To perform a commercially useful function, a supplier or manufacturer that is an MBE/WBE/SDVE Firm must be responsible for negotiating price, determining quality and quantity, ordering the material, installing (where applicable) and paying for the material itself.

14.4.3 An MBE/WBE/SDVE Firm does not perform a commercially useful function if its role is solely that of an extra participant in a transaction, contract, or project through which funds are passed in order to obtain the appearance of participation. In determining whether a firm is such an extra participant, the Owner will examine similar transactions, particularly those in which MBE/WBE/SDVE Firms do not participate.

14.4.4 A Bidder that is a certified MBE/WBE/SDVE may count one hundred percent 100% of the contract amount towards the applicable MBE/WBE/SDVE Participation Goal, less any amount awarded to another MBE/WBE/SDVE Firm. For projects with separate MBE/WBE/SDVE Participation Goals, the Bidder will be required to obtain participation in the other categories for which it is not certified through participation by subcontractors, suppliers, or manufacturers. Therefore, an MBE Bidder is expected to obtain the required WBE and SDVE participation; a WBE Bidder is expected to obtain the required MBE and SDVE participation; and a SDVE Bidder is expected to obtain the required MBE and WBE participation.

14.4.5 If the Bidder is a joint venture and the joint venture itself is certified as a MBE/WBE/SDVE Firm, the joint venture may count toward the MBE/WBE/SDVE Participation Goals that portion of the total dollar value of the work equal to the percentage of the ownership and control of the MBE/WBE/SDVE Firm that is a participant in the joint venture. When a MBE/WBE/SDVE Firm performs work as a participant in a joint venture where the joint venture is **not** separately certified as an MBE/WBE/SDVE Firm, only the portion of the Contract Sum equal to the distinct, clearly defined portion of the work that the MBE/WBE/SDVE Firm performs with its own forces shall count toward the MBE/WBE/SDVE Participation Goals.

14.4.6 If an MBE/WBE/SDVE Firm is certified in more than one category, that MBE/WBE/SDVE Firm may be used to satisfy more than one MBE/WBE/SDVE Participation Goal, provided that the MBE/WBE/SDVE Firm is awarded a sufficient percentage of the contract work to meet or exceed all applicable MBE/WBE/SDVE Participation Goals.

14.5 Certification of MBE/WBE/SDVE Firms

14.5.1 The Bidder shall submit, within forty-eight (48) hours of the time for receipt of bids, to the University Contracting Officer, the information requested in the "MBE/WBE/SDVE Compliance Evaluation Form" for every MBE/WBE/SDVE Firm the Bidder intends to award work to under the contract to meet the MBE/WBE/SDVE Participation Goals.

14.5.2 The Bidder is responsible for obtaining information regarding the certification status of an MBE/WBE/SDVE Firm. Firms must be certified as an MBE, WBE or SDVE, as applicable, by the State of Missouri, Office of Administration as of the date of bid opening.

14.6 MBE/WBE/SDVE Participation Waiver

14.6.1 The Bidder is required to make a good faith effort to locate and contract with MBE/WBE/SDVE Firms. If a Bidder has made a good faith effort to secure the required MBE/WBE/SDVE Participation and has failed, the Bidder shall submit within forty-eight (48) hours of the time for receipt of bids, to the University Contracting Officer the information requested in "Application for MBE/WBE/SDVE Participation Waiver." The Contracting Officer will review the Bidder's actions as set forth in the Bidder's "Application for Waiver" and any other factors deemed relevant by the Contracting Officer to determine if a good faith effort has been made to meet the MBE/WBE/SDVE Participation

Goal(s). If the Bidder is judged not to have made a good faith effort, the Bid may be rejected. Bidders who demonstrate that they have made a good faith effort to meet the MBE/WBE/SDVE Participation Goal(s) may be awarded the contract regardless of the actual percent of MBE/WBE/SDVE Participation, provided that the Bid is otherwise acceptable and is determined to be the lowest, responsive, responsible Bid.

14.6.2 To determine the good faith effort of the Bidder, the Contracting Officer may evaluate factors including, but not limited to, the following:

14.6.2.1 The bidder's attendance at pre-bid conferences for the solicitation;

14.6.2.2 The bidder's efforts and methods to provide M/WBEs and SDVEs with full sets of plans, specifications, or appropriate information in a timely manner to assist the M/WBE or SDVE in responding to the bidder's solicitation. This could include conducting market research to identify M/WBEs and SDVEs, and providing emails or written notices to all certified M/WBEs listed in OA's directory and listed SDVEs that specialize in the areas of work desired and which are located in the applicable area or surrounding areas as early in the acquisition process as practicable. Pro forma mailings to M/WBEs or SDVEs requesting bids are not alone sufficient to satisfy good faith efforts;

14.6.2.3 The bidder's efforts to make initial contact with at least three (3) M/WBEs and SDVEs for each category of work to be performed, its follow up with those contacted, and whether the bidder received a proposal for those categories of work;

14.6.2.4 The bidder's efforts to assist interested M/WBEs and SDVEs in obtaining bonding, lines of credit, or insurance or the efforts made to assist in obtaining necessary equipment, supplies, materials, or related assistance or services;

14.6.2.5 The extent to which the bidder divided work into projects suitable for subcontracting to M/WBEs and SDVEs including, where appropriate, breaking out contract work items into economically feasible units, for example, smaller tasks or quantities to facilitate M/WBE or SDVE participation, even when the bidder might otherwise prefer to perform the work with its own forces. Prime contractors are not, however, required to accept higher quotes from M/WBEs or SDVEs if the price difference is excessive or unreasonable, but the fact that there may be some additional costs involved in finding and using M/WBEs or SDVEs is not in itself sufficient reason for a bidder's failure to meet the contract M/WBE or SDVE percentage, as long as such costs are reasonable;

14.6.2.6 The bidder's ability to provide sufficient evidence in the form of documentation that supports the information provided;

14.6.2.7 The reasons provided by the bidder for the inability to reach a contract percentage and the ability of other bidders to meet the percentages, if applicable;

14.6.2.8 Actual past participation of M/WBEs and SDVEs achieved by the bidder; and

14.6.2.9 The rejection of an M/WBE or SDVE solely because its quotation for work was not the lowest received is not a sufficient good faith effort. However, a bidder is not required to accept an excessive or unreasonable quote in order to satisfy contract percentages.

Submittal of Forms

14.7.1 Within forty-eight (48) hours of the time for receipt of bids, the apparent low Bidder shall submit to the University Contracting Officer all MBE/WBE/SDVE Compliance Evaluation Form(s), and/or Application for Waiver with supporting information, and an "Affidavit of MBE/WBE/SDVE Participation" for every MBE/WBE/SDVE Firm the Bidder intends to award work on the contract. The affidavit will be signed by both the Bidder and the MBE/WBE/SDVE Firm. Failure to submit the documents in the time indicated may result in rejection of the Bid.

Additional Bid/Proposer Information

14.8.1 The Contracting Officer reserves the right to request from the apparent low Bidder additional, clarifying information regarding the Bidder's MBE/WBE/SDVE Participation and supporting documentation. The Bidder shall respond in writing to the Contracting Officer within twenty-four (24) hours of a request.

14.8.2 The Contracting Officer reserves the right to request additional information after the Bidder has responded to prior requests. This information may include follow-up and/or clarification of the information previously submitted.

14.8.3 The Bidder shall provide to the Owner information related to the MBE/WBE/SDVE Participation included in the Bidder's proposal, including, but not limited to, the complete Application for Waiver, evidence of certification of participating MBE/WBE/SDVE Firms, dollar amount of participation of MBE/WBE/SDVE Firms, information supporting a good faith effort as described above, and a list of all MBE/WBE/SDVE Firms that submitted bids to the Bidder with the MBE/WBE/SDVE Firm's price, and the name and the price of the firm awarded the scope of work.

15. List of Subcontractors

15.1 If a list of subcontractors is required on the Bid Form, the Bidder shall list the name, city, and state of the firm(s) that will accomplish that portion of the contract requested in the space provided. This list is separate from both the list of MBE/WBE/SDVE Firms required in Section 15.2 and the complete list of subcontractors required in Section 10.1 of this document. Should the Bidder choose to perform any of the listed portions of the work with its own forces, the Bidder shall enter its own name, city, and state in the space provided. If acceptance or

non-acceptance of alternates will affect the designation of a subcontractor, the Bidder shall provide that information on the Bid Form.

15.2 Failure of the Bidder to supply the list of subcontractors required or the listing of more than one subcontractor for any category without designating the portion of the work to be performed by each, shall be grounds for the rejection of the Bid. The Bidder can petition the Owner to change a listed subcontractor within forty-eight (48) hours of the Bid opening. The Owner reserves the right to make the final determination on a petition to change a subcontractor. The Owner will consider factors such as clerical and mathematical errors in the Bid, a listed subcontractor's inability to perform the work, etc. Any request to change a listed subcontractor shall include at a minimum, a Bid sheet showing tabulation of the Bid; all subcontractor bids with documentation of the time they were received by the contractor; and a letter from the listed subcontractor on their letterhead stating why they cannot perform the work if applicable. The Owner reserves the right to ask for additional information.

15.3 Upon award of the contract, the requirements of Article 10 herein and Article 5 of the General Conditions of the Contract for Construction will apply.

SECTION 1.D
GENERAL CONDITIONS

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University of Missouri

General Conditions

of the

Contract

for

Construction

June 2025 Edition

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ARTICLE 1 GENERAL PROVISIONS

1.1 Basic Definitions

As used in the Contract Documents, the following terms shall have the meanings and refer to the parties designated in these definitions.

1.1.1 Owner

The Owner is The Curators of the University of Missouri. The Owner may act through its Board of Curators or any duly authorized committee or representative thereof. The Owner may also be referred to herein as "University".

1.1.2 Contracting Officer

The Contracting Officer is the duly authorized representative of the Owner with the authority to execute contracts. Communications to the Contracting Officer shall be forwarded via the Owner's Representative.

1.1.3 Owner's Representative

The Owner's Representative is authorized by the Owner as the administrator of the Contract and will represent the Owner during the progress of the Work. Communications from the Architect to the Contractor and from the Contractor to the Architect shall be through the Owner's Representative, unless otherwise indicated in the Contract Documents.

1.1.4 Architect

When the term "Architect" is used herein, it shall refer to the Architect or the Engineer specified and defined in the Contract for Construction or its duly authorized representative. Communications to the Architect shall be forwarded to the address shown in the Contract for Construction.

1.1.5 Owner's Authorized Agent

When the term "Owner's Authorized Agent" is used herein, it shall refer to an employee or agency acting on the behalf of the Owner's Representative to perform duties related to code inspections, testing, operational systems check, certification or accreditation inspections, or other specialized work.

1.1.6 Contractor

The Contractor is the person or entity with whom the Owner has entered into the Contract for Construction. The term "Contractor" means the Contractor or the Contractor's authorized representative.

1.1.7 Subcontractor and Lower-tier Subcontractor

A Subcontractor is a person or organization who has a contract with the Contractor to perform any of the Work. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or its authorized representative. The term "Subcontractor" also is applicable to those furnishing materials to be incorporated in the Work whether

performed at the Owner's site or off site, or both. A lower-tier Subcontractor is a person or organization who has a contract with a Subcontractor or another lower-tier Subcontractor to perform any of the Work at the site. Nothing contained in the Contract Documents shall create contractual relationships between the Owner or the Architect and any Subcontractor or lower-tier Subcontractor of any tier.

1.1.8 Minority Business Enterprises (MBE)

Minority Business Enterprise (MBE) shall have the meaning set forth in Section 37.020, RSMo and the implementing regulations promulgated by the State of Missouri, Office of Administration.

1.1.9 Women Business Enterprise (WBE)

Women Business Enterprise (WBE) shall have the meaning set forth in Section 37.020, RSMo and the implementing regulations promulgated by the State of Missouri Office of Administration.

1.1.10 Service-Disabled Veteran Enterprise (SDVE)

Service-Disabled Veteran Enterprise (SDVE) shall have the same meaning as "Service-Disabled Veteran Business" set forth in Section 34.074, RSMo and the implementing regulations promulgated by the State of Missouri, Office of Administration.

1.1.11 MBE/WBE/SDVE Firm

MBE/WBE/SDVE Firm shall mean a business entity that is certified as an MBE, WBE, and/or SDVE by the State of Missouri, Office of Administration.

1.1.12 Work

Work shall mean supervision, labor, equipment, tools, material, supplies, incidentals operations and activities required by the Contract Documents or reasonably inferable by the Contractor therefrom as necessary to produce the results intended by the Contract Documents in a safe, expeditious, orderly, and workmanlike manner, and in the best manner known to each respective trade.

1.1.13 Approved

The terms "approved", "equal to", "directed", "required", "ordered", "designated", "acceptable", "compliant", "satisfactory", and similar words or phrases will be understood to have reference to action on the part of the Architect and/or the Owner's Representative.

1.1.14 Contract Documents

The Contract Documents consist of (1) the executed Contract for Construction, (2) these General Conditions of the Contract for Construction, (3) any Supplemental Conditions or Special Conditions identified in the Contract for Construction, (4) the Specifications identified in the Contract for Construction, (5) the Drawings identified in the Contract for Construction, (6) Addenda issued prior to the receipt of bids, (7) Contractor's bid addressed to Owner, including Contractor's completed Qualification Statement, (8) Contractor's Performance Bond and Contractor's Payment Bond, (9) Notice to Proceed, (10)

and any other exhibits and/or post bid adjustments identified in the Contract for Construction, (11) Advertisement for Bid, (12) Information for Bidders, and (13) Change Orders issued after execution of the Contract. All other documents and technical reports and information are not Contract Documents, including without limitation, Shop Drawings, and Submittals.

1.1.15 Contract

The Contract Documents form the Contract and are the exclusive statement of agreement between the parties. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior representations or agreements, either written or oral. The Contract Documents shall not be construed to create a contractual relationship of any kind between the Owner and a Subcontractor or any lower-tier Subcontractor.

1.1.16 Change Order

The Contract may be amended or modified without invalidating the Contract only by a Change Order, subject to the limitations in Article 7 and elsewhere in the Contract Documents. A Change Order is a written instrument signed by the Owner and the Contractor stating their agreement to a change in the Work, the amount of the adjustment to the Contract Sum, if any, and the extent of the adjustment to the Contract Time, if any. Agreement to any Change Order shall constitute a final settlement of all matters relating to the change in the Work which is the subject of the Change Order, including, but not limited to, all direct and indirect costs associated with such change and any and all adjustments of the Contract Sum, time and schedule.

1.1.17 Substantial Completion

The terms "Substantial Completion" or "substantially complete" as used herein shall be construed to mean the completion of the entire Work, including all submittals required under the Contract Documents, except minor items which in the opinion of the Architect, and/or the Owner's Representative will not interfere with the complete and satisfactory use of the facilities for the purposes intended.

1.1.18 Final Completion

The date when all punch list items are completed, including all closeout submittals and approval by the Architect is given to the Owner in writing.

1.1.19 Supplemental and Special Conditions

The terms "Supplemental Conditions" or "Special Conditions" shall mean the part of the Contract Documents which amend, supplement, delete from, or add to these General Conditions.

1.1.20 Day

The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

1.1.21 Knowledge

The terms "knowledge," "recognize" and "discover" their respective derivatives and similar terms in the Contract Documents, as used in reference to the Contractor, shall be interpreted to mean that which the Contractor knows or should know, recognizes, or should recognize and discovers or should discover in exercising the care, skill, and diligence of a diligent and prudent contractor familiar with the Work. Analogously, the expression "reasonably inferable" and similar terms in the Contract Documents shall be interpreted to mean reasonably inferable by a diligent and prudent contractor familiar with the Work.

1.1.22 Punch List

"Punch List" means the list of items, prepared in connection with the inspection(s) of the Project by the Owner's Representative or the Architect in connection with Substantial Completion of the Work or a portion of the Work, which the Owner's Representative or the Architect has designated as remaining to be performed, completed, or corrected before the Work will be accepted by the Owner.

1.1.23 Force Majeure

An event or circumstance that could not have been reasonably anticipated and is out of the control of both the Owner and the Contractor.

1.2 Specifications and Drawings

1.2.1 The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, construction system, standards and workmanship and performance of related services for the Work identified in the Contract for Construction. Specifications are separated into titled divisions for convenience of reference only. Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade. Such separation will not operate to make the Owner or the Architect an arbiter of labor disputes or work agreements.

1.2.2 The Drawings herein referred to, consist of drawings prepared by the Architect, and are enumerated in the Contract Documents.

1.2.3 Drawings are intended to show general arrangements, design, and dimensions of work and are partly diagrammatic. Dimensions shall not be determined by scale or rule. If figured dimensions are lacking, they shall be supplied by the Architect on the Contractor's written request to the Owner's Representative.

1.2.4 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complimentary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required only to the extent consistent with the Contract

Documents and reasonably inferable from them as being necessary to produce the intended results.

1.2.5 In the event of inconsistencies within or between parts of the Contract Documents, or between the Contract Documents and applicable standards, codes and ordinances, the Contractor shall (1) provide the better quality or greater quantity of Work or (2) comply with the more stringent requirement; either or both in accordance with the Owner's Representative's interpretation. On the Drawings, given dimensions shall take precedence over scaled measurements and large-scale drawings over small scale drawings. Before ordering any materials or doing any Work, the Contractor and each Subcontractor shall verify measurements at the Work site and shall be responsible for the correctness of such measurements. Any difference which may be found shall be submitted to the Owner's Representative and the Architect for resolution before proceeding with the Work. If a minor change in the Work is found necessary due to actual field conditions, the Contractor shall submit detailed drawings of such departure for the approval by the Owner's Representative and the Architect before making the change.

1.2.6 Data in the Contract Documents concerning lot size, ground elevations, present obstructions on or near the site, locations and depths of sewers, conduits, pipes, wires, etc., position of sidewalks, curbs, pavements, etc., and nature of ground and subsurface conditions have been obtained from sources the Architect believes reliable, but the Architect and the Owner do not represent or warrant that this information is accurate or complete. The Contractor shall verify such data to the extent possible through normal construction procedures, including but not limited to contacting utility owners and by prospecting.

1.2.7 Only Work included in the Contract Documents is authorized, and the Contractor shall do no work other than that described therein.

1.2.8 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become familiar with local conditions under which the Work is to be performed and correlated personal observations with requirements of the Contract Documents. The Contractor represents that it has performed its own investigation and examination of the Work site and its surroundings and satisfied itself before entering into this Contract as to:

- .1 conditions bearing upon transportation, disposal, handling, and storage of materials;
- .2 the availability of labor, materials, equipment, water, electrical power, utilities and roads;
- .3 uncertainties of weather, river stages, flooding and similar characteristics of the site;
- .4 conditions bearing upon security and protection of material, equipment, and Work in progress;
- .5 the form and nature of the Work site, including the surface and sub-surface conditions;

- .6 the extent and nature of Work and materials necessary for the execution of the Work and the remedying of any defects therein; and
- .7 the means of access to the site and the accommodations it may require and, in general, shall be deemed to have obtained all information as to risks, contingencies and other circumstances.
- .8 the ability to complete work without disruption to normal campus activities, except as specifically allowed in the Contract Documents.

The Owner assumes no responsibility or liability for the physical condition or safety of the Work site, or any improvements located on the Work site. The Contractor shall be solely responsible for providing a safe place for the performance of the Work. The Owner shall not be required to make any adjustment in either the Contract Sum or Contract Time concerning any failure by the Contractor or any Subcontractor to comply with the requirements of this Paragraph.

1.2.9 Drawings, specifications, and copies thereof furnished by the Owner are and shall remain the Owner's property. They are not to be used on another project and, with the exception of one contract set for each party to the Contract, shall be returned to the Owner's Representative on request, at the completion of the Work.

1.3 Required Provisions Deemed Inserted

Each and every provision of law and clause required by law to be inserted in this Contract shall be deemed to be inserted herein, and the Contract shall be read and enforced as though it were included herein; and if through mistake or otherwise any such provision is not inserted, or is not correctly inserted, then upon the written application of either party the Contract shall forthwith be physically amended to make such insertion or correction.

ARTICLE 2 OWNER

2.1 Information and Services Required of Owner

2.1.1 Permits and fees are the responsibility of the Contractor under the Contract Documents, unless specifically stated in the Contract Documents that the Owner will secure and pay for specific necessary approvals, easements, assessments, and charges required for construction, use or occupancy of permanent structures, or for permanent changes in existing facilities.

2.1.2 When requested in writing by the Contractor, information or services under the Owner's control, which are reasonably necessary to perform the Work, will be furnished by the Owner with reasonable promptness to avoid delay in the orderly progress of the Work.

2.2 Owner's Right to Stop the Work

2.2.1 If the Contractor fails to correct Work which is not in strict accordance with the requirements of the Contract

Documents or fails to carry out Work in strict accordance with the Contract Documents, the Owner's Representative may order the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work will not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity. The Owner's lifting of Stop Work Order shall not prejudice the Owner's right to enforce any provision of this Contract.

2.3 Owner's Right to Carry Out the Work

2.3.1 If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a seven (7) day period after receipt of a written notice from the Owner to correct such default or neglect, the Owner may, without prejudice to other remedies the Owner may have, correct such default or neglect. In such case, an appropriate Change Order shall be issued deducting from payments then or thereafter due the Contractor the cost of correcting such deficiencies, including compensation for the Architect's additional services and expenses made necessary by such default or neglect. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to Owner. However, such notice shall be waived in the event of an emergency with the potential for property damage or the endangerment of students, faculty, staff, the public or construction personnel, at the sole discretion of the Owner.

2.3.2 In the event the Contractor has not satisfactorily completed all items on the Punch List within thirty (30) days of its receipt, the Owner reserves the right to complete the Punch List without further notice to the Contractor or its surety. In such case, the Owner shall be entitled to deduct from payments then or thereafter due the Contractor the cost of completing the Punch List items, including compensation for the Architect's additional services. If payments then or thereafter due Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner.

2.4 Extent of Owner Rights

2.4.1 The rights stated in Article 2 and elsewhere in the Contract Documents are cumulative and not in limitation of any rights of the Owner (1) granted in the Contract Documents, (2) at law or (3) in equity.

2.4.2 In no event shall the Owner have control over, charge of, or any responsibility for construction means, methods, techniques, sequences or procedures or for safety precautions and programs in connection with the Work, notwithstanding any of the rights and authority granted the Owner in the Contract Documents.

ARTICLE 3 CONTRACTOR

3.1 Contractor's Warranty

3.1.1 The Contractor warrants all equipment and materials furnished, and work performed, under this Contract, against defective materials and workmanship for a period of twelve months after acceptance as provided in this Contract, unless a longer period is specified, regardless of whether the same were furnished or performed by the Contractor or any Subcontractors of any tier. Upon written notice from the Owner of any breach of warranty during the applicable warranty period due to defective material or workmanship, the affected part or parts thereof shall be repaired or replaced by the Contractor at no cost to the Owner. Should the Contractor fail or refuse to make the necessary repairs, replacements, and tests when requested by the Owner, the Owner may perform, or cause the necessary work and tests to be performed, at the Contractor's expense, or exercise the Owner's rights under Article 14.

3.1.2 Should one or more defects mentioned above appear within the specified period, the Owner shall have the right to continue to use or operate the defective part or apparatus until the Contractor makes repairs or replacements or until such time as it can be taken out of service without loss or inconvenience to the Owner.

3.1.3 The above warranties are not intended as a limitation but are in addition to all other express warranties set forth in this Contract and such other warranties as are implied by law, custom, and usage of trade. The Contractor, and its surety or sureties, if any, shall be liable for the satisfaction and full performance of the warranties set forth herein.

3.1.4 Neither the final payment nor any provision in the Contract Documents nor partial or entire occupancy of the premises by the Owner, nor expiration of warranty stated herein, will constitute an acceptance of Work not done in accordance with the Contract Documents or relieve the Contractor of liability in respect to any responsibility for non-conforming work. The Contractor shall immediately remedy any defects in the Work and pay for any damage to other Work resulting therefrom upon written notice from the Owner. Should the Contractor fail or refuse to remedy the non-conforming work, the Owner may perform, or cause to be performed all actions necessary to bring the Work into conformance with the Contract Documents at the Contractor's expense.

3.1.5 The Contractor agrees to defend, indemnify, and save harmless The Curators of the University of Missouri, their officers, agents, employees, and volunteers, from and against all loss or expense from any injury or damages to property of others suffered or incurred on account of any breach of the aforesaid obligations and covenants. The Contractor agrees to investigate, handle, respond to and provide defense for and defend against any such liability, claims, and demands at the sole expense of the Contractor, or at the option of the

University, agrees to pay to or reimburse the University for the defense costs incurred by the University in connection with any such liability claims, or demands. The parties hereto understand and agree that the University is relying on and does not waive or intend to waive by any provision of this Contract, any monetary limitations or any other rights, immunities, and protections provided by the State of Missouri, as from time to time amended, or otherwise available to the University, or its officers, employees, agents or volunteers.

3.2 Compliance with Laws, Regulations, Permits, Codes, and Inspections

3.2.1 The Contractor shall, without additional expense to the Owner, comply with all applicable laws, ordinances, rules, permit requirements, codes, statutes, and regulations (which may be collectively referred to as "laws").

3.2.2 Since the Owner is an instrumentality of the State of Missouri, municipal, or political subdivision, ordinances, zoning ordinances, and other like ordinances are not applicable to construction on the Owner's property, and the Contractor will not be required to submit plans and specifications to any municipal or political subdivision authority to obtain construction permits or any other licenses or permits from or submit to, inspection by any municipality or political subdivision relating to the construction on the Owner's property, unless required by the Owner in these Contract Documents or otherwise in writing.

3.2.3 All fees, permits, inspections, or licenses required by municipality or political subdivision for operation on property not belonging to the Owner, shall be obtained by and paid for by the Contractor. The Contractor, of its own expense, is responsible to ensure that all inspections required by said permits or licenses on property, easements, or utilities not belonging to the Owner are conducted as required therein. All connection charges, assessments or transportation fees as may be imposed by any utility company or others are included in the Contract Sum and shall be the Contractor's responsibility.

3.2.4 If the Contractor has knowledge that any Contract Documents are at variance with any laws, including Americans with Disabilities Act – Standards for Accessible Design, ordinances, rules, regulations, or codes applying to the Work, Contractor shall promptly notify the Architect and the Owner's Representative, in writing, and any necessary changes will be adjusted as provided in the Contract Documents. However, it is not the Contractor's primary responsibility to ascertain that the Contract Documents are in accordance with applicable laws, unless such laws bear upon performance of the Work.

3.3 Anti-Kickback

3.3.1 No member or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this Contract or to any benefit that may arise therefrom, but this provision shall not be construed to extend to this Contract if made with a corporation for its general benefit.

3.3.2 No official of the Owner who is authorized in such capacity and on behalf of the Owner to negotiate, make, accept or approve, or to take part in negotiating, making, accepting, or approving any architectural, engineering, inspection, construction, or material supply contract or any Subcontract of any tier in connection with the construction of the Work shall have a financial interest in this Contract or in any part thereof, any material supply contract, Subcontract of any tier, insurance contract, or any other contract pertaining to the Work.

3.4 Supervision and Construction Procedures

3.4.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences, and procedures and for coordinating all portions of the Work under the Contract. The Contractor shall supply sufficient and competent supervision and personnel, and sufficient material, plant, and equipment to prosecute the Work with diligence to ensure completion thereof within the time specified in the Contract Documents, and shall pay when due any laborer, Subcontractor of any tier, or supplier.

3.4.2 The Contractor, if an individual, shall give the Work an adequate amount of personal supervision, and if a partnership, corporation, or joint venture or other business entity, the Work shall be given an adequate amount of personal supervision by a partner or executive officer, as determined by the Owner's Representative.

3.4.3 The Contractor and each of its Subcontractors of any tier shall submit to the Owner such schedules of quantities and costs, progress schedules in accordance with 3.18 this document, payrolls, reports, estimates, records, and other data as the Owner may request concerning Work performed or to be performed under the Contract.

3.4.4 The Contractor shall be represented at the site by a competent superintendent from the beginning of the Work until its final acceptance, whenever Contract Work is being performed, unless otherwise permitted in writing by the Owner's Representative. The superintendent for the Contractor shall exercise general supervision over the Work and such superintendent shall have decision making authority of the Contractor. Communications given to the superintendent shall be binding as if given to the Contractor. The superintendent shall not be changed by the Contractor without approval from the Owner's Representative.

3.4.5 The Contractor shall establish and maintain a permanent benchmark to which access may be had during progress of the Work, and Contractor shall establish all lines

and levels, and shall be responsible for the correctness of such. The Contractor shall be fully responsible for all layout work for the proper location of Work in strict accordance with the Contract Documents.

3.4.6 The Contractor shall establish and be responsible for wall and partition locations. If applicable, separate contractors shall be entitled to rely upon these locations and for setting their sleeves, openings, or chases.

3.4.7 The Contractor's scheduled outage/tie-in plan, time, and date for any utilities is subject to approval by the Owner's Representative. Communication with the appropriate entity and planning for any scheduled outage/tie-in of utilities shall be the responsibility of the Contractor. Failure of the Contractor to comply with the provisions of this Paragraph shall cause the Contractor to forfeit any right to an adjustment of the Contract Sum or Contract Time for any postponement, rescheduling or other delays ordered by the Owner in connection with such Work. The Contractor shall follow the following procedures for all utility outages/tie-ins or disruption of any building system:

- .1** All shutting of valves, switches, etc., shall be by the Owner's personnel.
- .2** The Contractor shall submit its preliminary outage/tie-in schedule with its baseline schedule.
- .3** The Contractor shall request an outage/tie-in meeting at least two weeks before the outage/tie-in is required.
- .4** The Owner's Representative will schedule an outage/tie-in meeting at least one week prior to the outage/tie-in.

3.4.8 The Contractor shall coordinate all Work so there shall be no prolonged interruption of existing utilities, systems, and equipment of the Owner. Any existing plumbing, heating, ventilating, air conditioning, or electrical disconnection necessary, which affect portions of this construction or building or any other building, must be scheduled with the Owner's Representative to avoid any disruption of operation within the building under construction or other buildings or utilities. In no case shall utilities be left disconnected at the end of a workday or over a weekend. Any interruption of utilities, either intentionally or accidentally, shall not relieve the Contractor from repairing and restoring the utility to normal service. Repairs and restoration shall be made before the workers responsible for the repair and restoration leave the job.

3.4.9 The Contractor shall be responsible for repair of damage to property on or off the project occurring during construction of project, and all such repairs shall be made to meet code requirements or to the satisfaction of the Owner's Representative if code is not applicable.

3.4.10 The Contractor shall be responsible for all shoring required to protect the Work or adjacent property and shall pay for any damage caused by failure to shore or by improper shoring or by failure to give proper notice.

Shoring shall be removed only after completion of permanent supports.

3.4.11 The Contractor shall maintain at the Contractor's own cost and expense, adequate, safe and sufficient walkways, platforms, scaffolds, ladders, hoists and all necessary, proper, and adequate equipment, apparatus, and appliances useful in carrying on the Work and which are necessary to make the place of Work safe and free from avoidable danger for students, faculty, staff, the public and construction personnel, and as may be required by safety provisions of applicable laws, ordinances, rules regulations and building and construction codes.

3.4.12 During the performance of the Work, the Contractor shall be responsible for providing and maintaining warning signs, lights, signal devices, barricades, guard rails, fences, and other devices appropriately located on site which shall give proper and understandable warning to all persons of danger of entry onto land, structure, or equipment, within the limits of the Contractor's work area.

3.4.13 The Contractor shall pump, bail, or otherwise keep any general excavations free of water. The Contractor shall keep all areas free of water before, during and after concrete placement. The Contractor shall be responsible for protection, including weather protection, and proper maintenance of all equipment and materials installed, or to be installed by the Contractor.

3.4.14 The Contractor shall be responsible for care of the Work and must protect same from damage of defacement until acceptance by the Owner. All damaged or defaced Work shall be repaired or replaced to the Owner's satisfaction, without cost to the Owner.

3.4.15 When requested by the Owner's Representative, the Contractor, at no extra charge, shall provide scaffolds or ladders in place as may be required by the Architect or the Owner for examination or inspection of Work in progress or completed.

3.4.16 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors of any tier and their agents and employees, and any other entity or persons performing portions of the Work.

3.4.17 The Contractor shall not be relieved of its obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Owner's Representative or the Architect in their administration of the Contract, or by tests, inspections or approvals required or performed by persons other than the Contractor.

3.4.18 The Contractor shall be responsible for inspection of portions of the Work already performed under this Contract to determine that such portions are compliant and in proper condition to receive subsequent Work.

3.5 Use of Site

3.5.1 The Contractor shall limit operations and storage of material to the area within the Work limit lines shown on Drawings, except as necessary to connect to exiting utilities, shall not encroach on neighboring property, and shall exercise caution to prevent damage to existing structures.

3.5.2 Only materials and equipment, which are to be used directly in the Work, shall be brought to and stored on the Work site by the Contractor. After equipment is no longer required for the Work, it shall be promptly removed from the Work site. Protection of construction materials and equipment stored at the Work site from weather, theft, damage and all other adversity is solely the responsibility of the Contractor.

3.5.3 No project signs shall be erected without the written approval of the Owner's Representative.

3.5.4 The Contractor shall ensure that the Work is at all times performed in a manner that affords reasonable access, both vehicular and pedestrian, to the site of the Work and all adjacent areas. Particular attention shall be paid to access for emergency vehicles, including fire trucks. Wherever there is the possibility of interfering with normal emergency vehicle operations, the Contractor shall obtain permission from both campus and municipal emergency response entities prior to limiting any access. The Work shall be performed, to the fullest extent reasonably possible, in such a manner that public areas adjacent to the site of the Work shall be free from all debris, building materials and equipment likely to cause hazardous conditions. Without limitation of any other provision of the Contract Documents, the Contractor shall not interfere with the occupancy or beneficial use of (1) any areas and buildings adjacent to the site of the Work or (2) the Work in the event of partial occupancy. The Contractor shall assume full responsibility for any damage to the property comprising the Work or to the owner or occupant of any adjacent land or areas resulting from the performance of the Work.

3.5.5 The Contractor shall not permit any workers to use any existing facilities at the Work site, including, without limitation, lavatories, toilets, entrances, and parking areas other than those designated by Owner. The Contractor, Subcontractors of any tier, suppliers and employees shall comply with instructions or regulations of the Owner's Representative governing access to, operation of, and conduct while in or on the premises and shall perform all Work required under the Contract Documents in such a manner as not to unreasonably interrupt or interfere with the conduct of the Owner's operations. Any request for Work, a suspension of Work or any other request or directive received by the Contractor from occupants of existing buildings shall be referred to the Owner's Representative for determination.

3.5.6 The Contractor and the Subcontractor of any tier shall have its' name, acceptable abbreviation or recognizable logo and the name of the city and state of the mailing address of the principal office of the company, on each motor vehicle and motorized self-propelled piece of equipment which is used in connection with the project. The signs are required on such vehicles during the time the Contractor is working on the project.

3.6 Review of Contract Documents and Field Conditions by Contractor

3.6.1 The Contractor shall carefully study and compare the Contract Documents with each other and with information furnished by the Architect and the Owner and shall at once report in writing to the Architect and the Owner's Representative any errors, inconsistencies or omissions discovered. If the Contractor performs any construction activity which it knows or should have known involves a recognized error, inconsistency, or omission in the Contract Documents without such written notice to the Architect and the Owner's Representative, the Contractor shall assume appropriate responsibility for such performance and shall bear an appropriate amount of the attributable costs for correction.

3.6.2 The Contractor shall take field measurements and verify field conditions and shall carefully compare such field measurements and conditions and other information known to the Contractor with the Contract Documents before commencing activities. Errors, inconsistencies, or omissions discovered shall be reported in writing to the Architect and the Owner's Representative within twenty-four (24) hours. During the progress of the Work, the Contractor shall verify all field measurements prior to fabrication of building components or equipment and proceed with the fabrication to meet field conditions. The Contractor shall consult all Contract Documents to determine the exact location of all work and verify spatial relationships of all work. Any question concerning said location or spatial relationships shall be submitted to the Owner's Representative. Specific locations for equipment, pipelines, ductwork and other such items of work, where not dimensioned on plans, shall be determined in consultation with the Owner's Representative and the Architect. The Contractor shall be responsible for the proper fitting of the Work in place.

3.6.3 The Contractor shall provide, at the proper time, such material as required for support of the Work. If openings or chases are required, whether shown on Drawings or not, the Contractor shall see they are properly constructed. If required openings or chases are omitted, the Contractor shall cut them at the Contractor's own expense, but only as directed by the Architect, through the Owner's Representative.

3.6.4 Should the Contract Documents fail to particularly describe materials or goods to be used, it shall be the duty of the Contractor to inquire of the Architect and the Owner's Representative what is to be used and to supply it at the Contractor's expense, or else thereafter replace it to the Owner's Representative's satisfaction. At a minimum, the

Contractor shall provide the quality of materials as generally specified throughout the Contract Documents.

3.7 Cleaning and Removal

3.7.1 The Contractor shall keep the Work site and surrounding areas free from accumulation of waste materials, rubbish, debris, and dirt resulting from the Work and shall clean the Work site and surrounding areas as requested by the Architect and the Owner's Representative, including mowing of grass greater than six (6) inches high. The Contractor shall be responsible for the cost of clean up and removal of debris from premises. The building and premises shall be kept clean, safe, in a workmanlike manner, and in compliance with OSHA standards and code at all times. At completion of the Work, the Contractor shall remove from and about the Work site tools, construction equipment, machinery, fencing, and surplus materials. Further, at the completion of the Work, all dirt, stains, and smudges shall be removed from every part of the building, all glass in doors and windows shall be washed, and entire Work shall be left broom clean in a finished state ready for occupancy. The Contractor shall advise his Subcontractors of any tier of this provision, and the Contractor shall be fully responsible for leaving the premises in a finished state ready for use to the satisfaction of the Owner's Representative. If the Contractor fails to comply with the provisions of this Paragraph, the Owner may do so, and the cost thereof shall be charged to the Contractor.

3.8 Cutting and Patching

3.8.1 The Contractor shall be responsible for cutting, fitting, or patching required to complete the Work or to make its parts fit together properly.

3.8.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or separate contractors by cutting, patching, or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter such construction by the Owner or a separate contractor except with written consent of the Owner and of such separate contractor; such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the Owner or a separate contractor the Contractor's consent to cutting or otherwise altering the Work.

3.8.3 If the Work involves renovation and/or alteration of existing improvements, the Contractor acknowledges that cutting and patching of the Work is essential for the Work to be successfully completed. The Contractor shall perform any cutting, altering, patching, and/or fitting of the Work necessary for the Work and the existing improvements to be fully integrated and to present the visual appearance of an entire, completed, and unified project. In performing any Work which requires cutting or patching, the Contractor shall use its best efforts to protect and preserve the visual appearance and aesthetics of the

Work to the reasonable satisfaction of both the Owner's Representative and the Architect.

3.9 Indemnification

3.9.1 To the fullest extent permitted by law, the Contractor shall defend, indemnify, and hold harmless the Owner, the Architect, the Architect's consultants, and the agents, employees, representatives, insurers and re-insurers of any of the foregoing (hereafter collectively referred to as the "Indemnitees") from and against claims, damages (including loss of use of the Work itself), punitive damages, penalties and civil fines unless expressly prohibited by law, losses and expenses, including, but not limited to, attorneys' fees, arising out of or resulting from performance of the Work to the extent caused in whole or in part by negligent acts or omissions or other fault of the Contractor, a Subcontractor of any tier, or anyone directly or indirectly employed by them or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss, or expense is caused in part by the negligent acts or omissions or other fault of a party indemnified hereunder. The Contractor's obligations hereunder are in addition to and shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity that the Owner may possess. If one or more of the Indemnitees demand performance by the Contractor of obligations under this Paragraph or other provisions of the Contract Documents and if the Contractor refuses to assume or perform, or delays in assuming or performing the Contractor's obligations, Contractor shall pay each Indemnitee who has made such demand its respective attorneys' fees, costs, and other expenses incurred in enforcing this provision. The defense and indemnity required herein shall be a binding obligation upon the Contractor whether or not an Indemnitee has made such demand. Even if a defense is successful to a claim or demand for which the Contractor is obligated to indemnify the Indemnitees from under this Paragraph, the Contractor shall remain liable for all costs of defense.

3.9.2 The indemnity obligations of the Contractor under this Section 3.9 shall survive termination of this Contract or final payment thereunder. In the event of any claim or demand made against any party which is entitled to be indemnified hereunder, the Owner may in its sole discretion reserve, return or apply any monies due or to become due the Contractor under the Contract for the purpose of resolving such claims; provided, however, that the Owner may release such funds if the Contractor provides the Owner with reasonable assurance of protection of the Owner's interests. The Owner shall in its sole discretion determine if such assurances are reasonable. The Owner reserves the right to control the defense and settlement of any claim, action or proceeding which the Contractor has an obligation to indemnify the Indemnitees against.

3.9.3 In claims against any person or entity indemnified under this Section 3.9 by an employee of the Contractor, a Subcontractor of any tier, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, the indemnification obligation under this Section 3.9

shall not be limited by a limitation on amount or type of damages, compensation or benefits payable by or for the Contractor or a Subcontractor of any tier under workers' or workmen's compensation acts, disability benefit acts or other employee benefit acts.

3.9.4 The obligations of the Contractor under Paragraph 3.9.1 shall not extend to the liability of the Architect, the Architect's agents or employees, arising out of the preparation and approval of maps, drawings, opinions, reports, surveys, Change Orders, designs, or Specifications.

3.10 Patents

3.10.1 The Contractor shall hold and save harmless the Owner and its officers, agents, servants, and employees from liability of any nature or kind, including cost and expense, for, or on account of, any patented or otherwise protected invention, process, article, or appliance manufactured or used in the performance of the Contract, including its use by the Owner, unless otherwise specifically stipulated in the Contract Documents.

3.10.2 If the Contractor uses any design, device, or material covered by letters patent or copyright, the Contractor shall provide for such use by suitable agreement with the Owner of such patented or copyrighted design, device, or material. It is mutually agreed and understood, without exception, that the Contract Sum include, and the Contractor shall pay all royalties, license fees or costs arising from the use of such design, device, or material in any way involved in the Work. The Contractor and/or sureties shall indemnify and save harmless the Owner from any and all claims for infringement by reason of the use of such patented or copyrighted design, device, or material or any trademark or copyright in connection with Work agreed to be performed under this Contract and shall indemnify the Owner for any cost, expense, or damage it may be obligated to pay by reason of such infringement at any time during the prosecution of the Work or after completion of the Work.

3.11 Delegated Design

3.11.1 If the Contract Documents specify the Contractor is responsible for the design of any Work as part of the project, then the Contractor shall procure all design services and certifications necessary to complete the Work as specified, from a design professional licensed in the State of Missouri. The signature and seal of that design professional shall appear on all drawings, calculations, specifications, certifications, Shop Drawings, and other submittals related to the Work. The design professional shall maintain insurance as required per Article 11.

3.12 Materials, Labor, and Workmanship

3.12.1 Materials and equipment incorporated into the Work shall strictly conform to the Contract Documents and representations and approved Samples provided by Contractor and shall be of the most suitable grade of their respective kinds for their respective uses and shall be fit

and sufficient for the purpose intended, merchantable, of good new material and workmanship, and free from defect. Workmanship shall be in accordance with the highest standard in the industry and free from defect in strict accordance with the Contract Documents.

3.12.2 Materials and fixtures shall be new and of latest design unless otherwise specified and shall provide the most efficient operating and maintenance costs to the Owner. All Work shall be performed by competent workers and shall be of best quality.

3.12.3 The Contractor shall carefully examine the Contract Documents and shall be responsible for the proper fitting of his material, equipment, and apparatus into the building.

3.12.4 The Contractor shall base its bid only on the Contract Documents.

3.12.5 Materials and workmanship shall be subject to inspection, examination, and testing by the Architect and the Owner's Representative at any and all times during manufacture, installation, and construction of any of them, at places where such manufacture, installation, or construction is performed.

3.12.6 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Contract. The Contractor shall not permit employment of unfit persons or persons not skilled in tasks assigned to them.

3.12.7 Unless otherwise specifically noted, the Contractor shall provide and pay for supervision, labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for the proper execution and completion of the Work.

3.12.8 Substitutions

3.12.8.1 A substitution is a Contractor proposal of an alternate product or method in lieu of what has been specified or shown in the Contract Documents, which is not an "or equal" as set forth in Section 3.13.

3.12.8.2 The Contractor may make a proposal to the Architect and the Owner's Representative to use substitute products or methods as set forth herein, but the Architect's and the Owner's Representative's decision concerning acceptance of a substitute shall be final. The Contractor must do so in writing and setting forth the following:

- .1** Full explanation of the proposed substitution and submittal of all supporting data including technical information, catalog cuts, warranties, test results, installation instructions, operating procedures, and other like information necessary for a complete evaluation of the substitution.
- .2** Reasons the substitution is advantageous and necessary, including the benefits to the Owner and the Work in the event the substitution is acceptable.

- .3 The adjustment, if any, in the Contract Sum, in the event the substitution is acceptable.
- .4 The adjustment, if any, in the time of completion of the Contract and the construction schedule in the event the substitution is acceptable.
- .5 An affidavit stating that (a) the proposed substitution conforms to and meets all of the Contract Document requirements and is code compliant, except as specifically disclosed and set forth in the affidavit and (b) the Contractor accepts the warranty and correction obligations in connection with the proposed substitution as if originally specified by the Architect. Proposals for substitutions shall be submitted to the Architect and the Owner's Representative in sufficient time to allow the Architect and the Owner's Representative no less than ten (10) working days for review. No substitution will be considered or allowed without the Contractor's submittal of complete substantiating data and information as stated herein.

3.12.8.3 Substitutions may be rejected without explanation at the Owner's sole discretion and will be considered only under one or more of the following conditions:

- .1 Required for compliance with interpretation of code requirements or insurance regulations then existing;
- .2 Unavailability of specified products, through no fault of the Contractor;
- .3 Material delivered fails to comply with the Contract Documents;
- .4 Subsequent information discloses inability of specified products to perform properly or to fit in designated space;
- .5 Manufacturer/fabricator refuses to certify or guarantee performance of specified product as required; or
- .6 When in the judgment of the Owner or the Architect, a substitution would be substantially to the Owner's best interests, in terms of cost, time, or other considerations.

3.12.8.4 Whether or not any proposed substitution is accepted by the Owner or the Architect, the Contractor shall reimburse the Owner for any fees charged by the Architect or other consultants for evaluating each proposed substitution.

3.13 Approved Equal

3.13.1 Whenever in the Contract Documents any article, appliance, device, or material is designated by the name of a manufacturer, vendor, or by any proprietary or trade name, the words "or approved equal," shall automatically follow and shall be implied unless specifically indicated otherwise. The standard products of manufacturers other than those specified will be accepted when, prior to the ordering or use thereof, it is proven to the satisfaction of the Owner's Representative and the Architect they are equal in design, appearance, spare parts availability, strength, durability, usefulness, serviceability, operation cost, maintenance cost, and convenience for the purpose intended. Any general listings of approved manufacturers

in any Contract Document shall be for informational purposes only and it shall be the Contractor's sole responsibility to ensure that any proposed "or equal" complies with the requirements of the Contract Documents and is code compliant.

3.13.2 The Contractor shall submit to the Architect and the Owner's Representative a written and full description of the proposed "or equal" including all supporting data, including technical information, catalog cuts, warranties, test results, installation instructions, operating procedures, and similar information demonstrating that the proposed "or equal" strictly complies with the Contract Documents. The Architect or the Owner's Representative shall take appropriate action with respect to the submission of a proposed "or equal" item. If Contractor fails to submit proposed "or equals" as set forth herein, it shall waive any right to supply such items. The Contract Sum and Contract Time shall not be adjusted as a result of any failure by Contractor to submit proposed "or equals" as provided for herein. All documents submitted in connection with preparing an "or equal" shall be clearly and obviously marked as a proposed "or equal" submission.

3.13.3 No approvals or action taken by the Architect or Owner's Representative shall relieve the Contractor from its obligation to ensure that an "or equal" article, appliance, device, or material strictly complies with the requirements of the Contract Documents. The Contractor shall not propose "or equal" items in connection with Shop Drawings or other Submittals, and the Contractor acknowledges and agrees that no approvals or action taken by the Architect or Owner's Representative with respect to Shop Drawings or other Submittals shall constitute approval of any "or equal" item or relieve the Contractor from its sole and exclusive responsibility. Any changes required in the details and dimensions indicated in the Contract Documents for the incorporation or installation of any "or equal" item supplied by the Contractor shall be properly made and approved by the Architect at the expense of the Contractor. No "or equal" items will be permitted for components of or extensions to existing systems when, in the opinion of the Architect, the named manufacturer must be provided in order to ensure compatibility with the existing systems, including, but not limited to, mechanical systems, electrical systems, fire alarms, smoke detectors, etc. No action will be taken by the Architect with respect to proposed "or equal" items prior to receipt of bids, unless otherwise noted in the Special Conditions.

3.14 Shop Drawings, Product Data, Samples, and Coordination Drawings/BIM Models

3.14.1 Shop Drawings are drawings, diagrams, schedules, and other data specifically prepared for the Work by the Contractor or a Subcontractor, sub-subcontractor, manufacturer, supplier, or distributor to illustrate some portion of the Work.

3.14.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

3.14.3 Samples are physical samples which illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.

3.14.4 Coordination Drawings are drawings for the integration of the Work, including work first shown in detail on Shop Drawings or product data. Coordination Drawings show sequencing and relationship of separate units of work which must interface in a restricted manner to fit in the space provided, or function as indicated. Coordination Drawings are the responsibility of the Contractor and are submitted for informational purposes. The Special Conditions will state whether Coordination Drawings are required. BIM models may be used for coordination in lieu of Coordination Drawings at the Contractor's discretion, unless required in the Special Conditions. The final Coordination Drawings/BIM Model will not change the Contract Documents, unless approved by a fully executed Change Order describing the specific modifications that are being made to the Contract Documents.

3.14.5 Shop Drawings, Coordination Drawings/BIM Models, Product Data, Samples, and similar submittals (collectively referred to as "Submittals") are not Contract Documents. The purpose of their submittal is to demonstrate for those portions of the Work for which submittals are required the way the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents.

3.14.6 The Contractor shall schedule submittal of Shop Drawings and Product Data to the Architect so that no delays will result in delivery of materials and equipment, advising the Architect of priority for checking of Shop Drawings and Product Data, but a minimum of two weeks shall be provided for this purpose. Because time is of the essence in this Contract, unless noted otherwise in the Special Conditions or Technical Specifications, all Submittals, Shop Drawings and Samples must be submitted as required to maintain the Contractor's plan for proceeding but must be submitted within ninety (90) days of the Notice to Proceed. If the Contractor believes that this milestone is unreasonable for any submittal, the Contractor shall request an extension of this milestone, within sixty (60) days of Notice to Proceed, for each submittal that cannot meet the milestone. The request shall contain a reasonable explanation as to why the ninety (90)-day milestone is unrealistic and shall specify a date on which the submittal will be provided, for approval by the Owner's Representative. Failure of the Contractor to comply with this Section may result in delays in the submittal approval process and/or charges for expediting approval, both of which will be the responsibility of the Contractor.

3.14.7 The Contractor, at its own expense, shall submit Samples required by the Contract Documents with reasonable promptness as to cause no delay in the Work or the activities of separate contractors and no later than twenty

(20) days before materials are required to be ordered for scheduled delivery to the Work site. Samples shall be labeled to designate material or products represented, grade, place of origin, name of producer, name of the Contractor and the name and number of the Owner's project. Quantities of Samples shall be twice the number required for testing so that the Architect can return one set of the Samples. Materials delivered before receipt of Architect's approval may be rejected by the Architect and in such event, the Contractor shall immediately remove all such materials from the Work site. When requested by the Architect or the Owner's Representative, Samples of finished masonry and field applied paints and finishes shall be located as directed and shall include sample panels built at the site of approximately twenty (20) square feet each.

3.14.8 The Contractor shall perform no portion of the Work requiring submittal and review of Shop Drawings, Product Data, Samples, or similar submittals until the respective submittal has been approved by the Architect. Such Work shall be in accordance with approved Submittals.

3.14.9 By approving and submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor represents such Submittals strictly comply with the requirements of the Contract Documents and that the Contractor has determined and verified field measurements and field construction criteria related thereto, that materials are fit for their intended use and that the fabrication, shipping, handling, storage, assembly and installation of all materials, systems and equipment are in accordance with best practices in the industry and are in strict compliance with any applicable requirements of the Contract Documents. The Contractor shall also coordinate each Submittal with other Submittals.

3.14.10 The Contractor shall be responsible for the correctness and accuracy of the dimensions, measurements and other information contained in the Submittals.

3.14.11 Each Submittal will bear a stamp or specific indication that the Submittal complies with the Contract Documents and the Contractor has satisfied its obligations under the Contract Documents with respect to the Contractor's review and approval of that Submittal. Each Submittal shall bear the signature of the representative of the Contractor who approved the Submittal, together with the Contractor's name, Owner's name, number of the Project, and the item name and specification section number.

3.14.12 The Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples, or similar submittals. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples, or similar submittals by the Architect's approval thereof. Specifically, but not by way of limitation, the Contractor acknowledges that the Architect's approval of Shop Drawings shall not relieve the Contractor for responsibility for errors and omissions in the Shop Drawings since the Contractor is responsible for the correctness of dimensions, details and the design of adequate connections and details contained in the Shop Drawings.

3.14.13 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples or similar submittals, to revisions other than those requested by the Architect on previous Submittals.

3.14.14 The Contractor represents and warrants that all Shop Drawings shall be prepared by persons and entities possessing expertise and experience in the trade for which the Shop Drawing is prepared and, if required by the Architect or applicable laws, by a licensed engineer or other design professional.

3.15 Record Drawings

3.15.1 The Contractor shall maintain a set of Record Drawings on site in good condition and shall use colored pencils to mark up said set with "record information" in a legible manner to show: (1) bidding addendums, (2) executed Change Orders, (3) deviations from the Drawings made during construction; (4) details in the Work not previously shown; (5) changes to existing conditions or existing conditions found to differ from those shown on any existing drawings; (6) the actual installed position of equipment, piping, conduits, light switches, electric fixtures, circuiting, ducts, dampers, access panels, control valves, drains, openings, and stub-outs; and (7) such other information as either the Owner or the Architect may reasonably request. The prints for Record Drawing use will be a set of "blue line" prints provided by the Architect to the Contractor at the start of construction. Upon Substantial Completion of the Work, the Contractor shall deliver all Record Drawings to the Owner and the Architect for approval. If not approved, the Contractor shall make the revisions requested by the Architect or the Owner's Representative. Final payment and any retainage shall not be due and owing to the Contractor until the final Record Drawings marked by the Contractor as required above are delivered to the Owner.

3.16.1 Operating Instructions and Service Manuals

3.16.1 The Contractor shall submit four (4) volumes of operating instructions and service manuals to the Architect before completing 50% of the adjusted contract amount. Payments beyond 50% of the adjusted contract amount may be withheld until all operating instructions and service manuals are received. The operating instructions and service manuals shall contain:

- .1** Start-up and Shutdown Procedures: Provide a step-by-step write up of all major equipment. When manufacturer's printed start-up, trouble shooting and shut-down procedures are available, they may be incorporated into the operating manual for reference.
- .2** Operating Instructions: Written operating instructions shall be included for the efficient and safe operation of all equipment.
- .3** Equipment List: List of all major equipment as installed shall include model number, capacities, flow rate, and name-plate data.
- .4** Service Instructions: The Contractor shall be required to provide the following information for all pieces of equipment.

.4.1 Recommended spare parts including catalog number and name of local suppliers or factory representative.

.4.2 Belt sizes, types, and lengths.

.4.3 Wiring diagrams.

.5 Manufacturer's Certificate of Warranty: Manufacturer's certificates of warranty shall be obtained for all major equipment. Warranty shall be obtained for at least one year from the date of Substantial Completion. Where longer period is required by the Contract Documents, the longer period shall govern.

.6 Parts catalogs: For each piece of equipment furnished, a parts catalog or similar document shall be provided which identifies the components by number for replacement ordering.

3.16.2 Submission

.1 Manuals shall be bound into volumes of standard 8 1/2" x 11" hard binders. Large drawings too bulky to be folded into 8 1/2" x 11" shall be separately bound or folded and in brown envelopes, cross-referenced and indexed with the manuals.

.2 The manuals shall identify the Owner's project name, project number, and include the name and address of the Contractor and major Subcontractors of any tier who were involved with the activity described in that particular manual.

3.17 Taxes

3.17.1 The Contractor shall pay all applicable sales, consumer, use, and similar taxes for the Work which are legally enacted when the bids are received, whether or not yet effective or scheduled to go into effect. However, certain purchases by the Contractor of materials incorporated in or consumed in the Work are exempt from certain sales tax pursuant to Section 144.062, RSMo. The Contractor shall be issued a Project Tax Exemption Certificate for this Work to obtain the benefits of Section 144.062, RSMo.

3.17.2 The Contractor shall furnish this certificate to all Subcontractors, and any person or entity purchasing materials for the Work shall present such certificate to all material suppliers as authorization to purchase, on behalf of the Owner, all tangible personal property and materials to be incorporated into or consumed in the Work and no other on a tax-exempt basis. Such suppliers shall provide to the purchasing party invoices bearing the name of the exempt entity and the project identification number. Nothing in this Section shall be deemed to exempt from any sales or similar tax the purchase of any construction machinery, equipment or tools used in construction, repairing or remodeling facilities for the Owner. All invoices for all personal property and materials purchased under a Project Tax Exemption Certificate shall be retained by the Contractor for a period of five years and shall be subject to audit by the Director of Revenue.

3.17.3 Any excess resalable tangible personal property or materials which were purchased for the project under this Project Tax Exemption Certificate but which were not incorporated into or consumed in the Work shall either be returned to the supplier for credit or the appropriate sales or

use tax on such excess property or materials shall be reported on a return and paid by such purchasing party not later than the due date of the purchasing party's Missouri sales or use tax return following the month in which it was determined that the materials were not used in the Work.

3.17.4 If it is determined that sales tax is owed by the Contractor on property and materials due to the failure of the Owner to revise the certificate expiration date to cover the applicable date of purchase, the Owner shall be liable for the tax owed.

3.17.5 The Owner shall not be responsible for any tax liability due to the Contractor's neglect to make timely orders, payments, etc. or the Contractor's misuse of the Project Tax Exemption Certificate. The Contractor represents that the Project Tax Exemption Certificate shall be used in accordance with Section 144.062, RSMo and the terms of the Project Tax Exemption Certificate. The Contractor shall indemnify the Owner for any loss or expense, including but not limited to, reasonable attorneys' fees, arising out of the Contractor's use of the Project Tax Exemption Certificate.

3.18 Contractor's Construction Schedules

3.18.1 The Contractor, within fifteen (15) days after the issuance of the Notice to Proceed, shall prepare and submit for the Owner's and the Architect's information the Contractor's construction schedule for the Work and shall set forth interim dates for completion of various components of the Work and Work Milestone Dates as defined herein. The schedule shall not exceed time limits current under the Contract Documents, shall be revised on a monthly basis or as requested by the Owner's Representative as required by the conditions of the Work, and shall provide for expeditious and practicable execution of the Work. The Contractor shall conform to the most recent schedule.

3.18.2 The construction schedule shall be in a detailed format satisfactory to the Owner's Representative and the Architect and in accordance with the detailed schedule requirements set forth in this document and the Special Conditions. If the Owner's Representative or the Architect has a reasonable objection to the schedule submitted by Contractor, the construction schedule shall be promptly revised by the Contractor. The Contractor shall monitor the progress of the Work for conformance with the requirements of the construction schedule and shall promptly advise the Owner of any delays or potential delays.

3.18.3 As time is of the essence to this Contract, the University expects that the Contractor will take all necessary steps to ensure that the project construction schedule shall be prepared in accordance with the specific requirements of the Special Conditions to this Contract. At a minimum, the Contractor shall comply with the following:

.1 The schedule shall be prepared using Primavera P3, Oracle P6, Microsoft Project or other software acceptable to the Owner's Representative.

- .2** The schedule shall be prepared and maintained in CPM format, in accordance with Construction CPM Scheduling, published by the Associated General Contractors of American (AGC).
- .3** Prior to submittal to the Owner's Representative for review, the Contractor shall obtain full buy-in to the schedule from all major Subcontractors, in writing if so, requested by Owner's Representative.
- .4** Schedule shall be updated, in accordance with Construction CPM Scheduling, published by the AGC, on a monthly basis at minimum, prior to, and submitted with, the monthly pay application or as requested by the Owner's Representative.
- .5** Along with the update the Contractor shall submit a narrative report addressing all changes, delays and impacts, including weather to the schedule during the last month, and explain how the end date has been impacted by same.
- .6** The submission of the updated schedule certifies that all delays and impacts that have occurred on or to the project during the previous month have been factored into the update and are fully integrated into the schedule and the projected completion date.

Failure to comply with any of these requirements will be considered a material breach of this Contract. See Special Conditions for detailed scheduling requirements.

3.18.4 In the event the Owner's Representative or the Architect determines that the performance of the Work, as of a Milestone Date, has not progressed or reached the level of completion required by the Contract Documents, the Owner shall have the right to order the Contractor to take corrective measures necessary to expedite the progress of construction, including, without limitation, (1) working additional shifts or overtime, (2) supplying additional manpower, equipment, facilities, (3) expediting delivery of materials, and (4) other similar measures (hereinafter referred to collectively as "Extraordinary Measures"). Such Extraordinary Measures shall continue until the progress of the Work complies with the stage of completion required by the Contract Documents. The Owner's right to require Extraordinary Measures is solely for the purpose of ensuring the Contractor's compliance with the construction schedule. The Contractor shall not be entitled to an adjustment in the Contract Sum concerning Extraordinary Measures required by the Owner under or pursuant to this Paragraph. The Owner may exercise the rights furnished the Owner under or pursuant to this Paragraph as frequently as the Owner deems necessary to ensure that the Contractor's performance of the Work will comply with any Milestone Date or completion date set forth in the Contract Documents.

ARTICLE 4 ADMINISTRATION OF THE CONTRACT

4.1 Rights of the Owner

4.1.1 The Owner's Representative will administer the Construction Contract. The Architect will assist the Owner's

Representative with the administration of the Contract as indicated in these Contract Documents.

4.1.2 If, in the judgment of the Owner's Representative, it becomes necessary to accelerate the Work, the Contractor, when directed by the Owner's Representative in writing, shall cease work at any point and transfer its workers to such point or points and execute such portions of the Work as may be required to enable others to hasten and properly engage and carry out the Work, all as directed by the Owner's Representative. The additional cost of accelerating the Work, if any, will be borne by the Owner, unless the Contractor's work progress is behind schedule as shown on the most recent progress schedule.

4.1.3 If the Contractor refuses, for any reason, to proceed with what the Owner believes to be Contract Work, the Owner may issue a Construction Directive, directing the Contractor to proceed. The Contractor shall be obligated to promptly proceed with such work. If the Contractor feels that it is entitled to additional compensation as a result of a Construction Directive, it may file a claim for additional compensation and/or time, in accordance with 4.4 of this Contract.

4.1.4 The Owner's Representative may, by written notice, require the Contractor to remove from involvement with the Work, any of the Contractor's personnel or the personnel of its Subcontractors of any tier whom the Owner's Representative may deem abusive, incompetent, careless, or a hindrance to proper and timely execution of the Work. The Contractor shall comply with such notice promptly, but without detriment to the Work or its progress.

4.1.5 The Owner's Representative will schedule Work status meetings that shall be attended by representatives of the Contractor and appropriate Subcontractors of any tier. Material suppliers shall attend status meetings if required by the Owner's Representative. These meetings shall include preconstruction meetings.

4.1.6 The Owner does not allow smoking on University property.

4.2 Rights of the Architect

4.2.1 The Architect will interpret requirements of the Contract Documents with respect to the quality, quantity, and other technical requirements of the Work itself within a reasonable time after written request of the Contractor. The Contractor shall provide Owner's Representative a copy of such written request.

4.3 Review of the Work

4.3.1 The Architect, the Owner's Representative, and the Owner's Authorized Agent shall, at all times, have access to the Work; and the Contractor shall provide proper and safe facilities for such access.

4.3.2 The Owner's Representative shall have authority to reject Work that does not strictly comply with the requirements of the Contract Documents. Whenever the Owner's Representative considers it necessary or advisable for implementation of the intent of the Contract Documents, Owner's Representative shall have the authority to require additional inspection or testing of the Work, whether or not such Work is fabricated, installed, or completed.

4.3.3 The fact that the Architect or the Owner's Representative observed, or failed to observe, faulty Work, or Work done which is not in accordance with the Contract Documents, regardless of whether or not the Owner has released final payment, shall not relieve the Contractor from responsibility for all damages and additional costs of the Owner as a result of defective or faulty Work.

4.4 Claims

4.4.1 A Claim is a demand or assertion by the Contractor seeking, as a matter of right, adjustment or interpretation of Contract terms, payment of money, extension of time or any other relief with respect to the terms of the Contract. The term "Claim(s)" also includes demands and assertions of the Contractor arising out of or relating to the Contract Documents, including Claims based upon breach of contract, mistake, misrepresentation, or other cause for Contract Modification or rescission. Claims must be made by written notice. The Contractor shall have the responsibility to substantiate Claims.

4.4.2 Claims by the Contractor must be made promptly, and no later than within fourteen (14) days after occurrence of the event giving rise to such Claim. Claims must be made by written notice. Such notice shall include a detailed statement setting forth all reasons for the Claim and the amount of additional money and additional time claimed by the Contractor. The notice of Claims shall also strictly comply with all other provisions of the Contract Documents. The Contractor shall not be entitled to rely upon any grounds or basis for additional money on additional time not specifically set forth in the notice of Claim. All Claims not made in the manner provided herein shall be deemed waived and of no effect. The Contractor shall furnish the Owner and the Architect such timely written notice of any Claim provided for herein, including, without limitation, those in connection with alleged concealed or unknown conditions, and shall cooperate with the Owner and the Architect in any effort to mitigate the alleged or potential damages, delay or other adverse consequences arising out of the condition which is the cause of such a Claim.

4.4.3 Pending final resolution of a Claim, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments that are not in dispute in accordance with the Contract Documents.

4.5 Claims for Concealed or Unknown Conditions

4.5.1 If conditions are encountered at the site which are (1) subsurface or otherwise concealed physical conditions which differ materially from those indicated in the Contract Documents, or (2) unknown physical conditions of an unusual nature, which differ materially from those ordinarily found to

exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, then notice by the Contractor shall be given to the Owner's Representative promptly before conditions are disturbed, and in no event later than three (3) days after first observance of the conditions. The Owner's Representative will promptly investigate such conditions. If such conditions differ materially, as provided for above and cause an increase or decrease in the Contractor's cost, or time, required for performance of the Work, an equitable adjustment in the Contract Sum or Contract Time, or both, shall be made, subject to the provisions and restrictions set for herein. If the Owner's Representative determines that the conditions at the site are not materially different from those indicated in the Contract Documents, and that no change in the terms of the Contract is justified, the Owner's Representative will so notify the Contractor in writing. If the Contractor disputes the finding of the Owner's Representative that no change in the terms of the Contract terms is justified, the Contractor shall proceed with the Work, taking whatever steps are necessary to overcome or correct such conditions so that Contractor can proceed in a timely manner. The Contractor may have the right to file a Claim in accordance with the Contract Documents.

4.5.2 It is expressly agreed that no adjustment in the Contract Time or Contract Sum shall be permitted, however, in connection with a concealed or unknown condition which does not differ materially from those conditions disclosed or which reasonably should have been disclosed by the Contractor's (1) prior inspections, tests, reviews and preconstruction investigations for the Project, or (2) inspections, tests, reviews and preconstruction inspections which the Contractor had the opportunity to make or should have performed in connection with the Project.

4.6 Claim for Additional Cost

4.6.1 If the Contractor makes a Claim for an increase in the Contract Sum, written notice as provided herein shall be given before proceeding to execute the Work. In addition to all other requirements for notice of a Claim, said notice shall detail and itemize the amount of all Claims and shall contain sufficient data to permit evaluation of same by the Owner.

4.7 Claims for Additional Time

4.7.1 If the Contractor makes a Claim for an increase in the Contract Time, written notice as provided herein shall be given. In addition to other requirements for notice of a Claim, the Contractor shall include an estimate of the probable effect of delay upon the progress of the Work, utilizing a CPM Time Impact Schedule Analysis, (TIA) as defined in the AGC Scheduling Manual. In the case of a continuing delay, only one Claim is necessary.

.1 Time extensions will be considered for excusable delays only. That is, delays that are beyond the control and/or contractual responsibility of the Contractor.

4.7.2 If weather days are the basis for a Claim for additional time, such Claim shall be documented by the Contractor by data acceptable to the Owner's Representative substantiating that weather conditions for the period of time in question, had an adverse effect on the critical path of the scheduled construction. Weather days shall be defined as days on which critical path work cannot proceed due to weather conditions (including but not limited to rain, snow, etc.), in excess of the number of days shown on the anticipated weather day schedule in the Special Conditions. To be considered a weather day, at least four (4) working hours must be lost due to the weather conditions on a critical path scope item for that day. Weather days and anticipated weather days listed in the Special Conditions shall only apply to Monday through Friday. A weather day claim cannot be made for Saturdays, Sundays, New Year's Day, Martin Luther King Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the day after Thanksgiving Day and Christmas Day, unless that specific day was approved in writing for work by the Owner's Representative.

.1 The Contractor must have fulfilled its contractual obligations with respect to temporary facilities and protection of its work, and worker protection for hot and cold weather per OSHA guidelines.

.2 If the contractual obligations have been satisfied, the Owner will review requests for non-compensable time extensions for critical path activities as follows:

.2.1 If the Contractor cannot work on a critical path activity due to adverse weather, after implementing all reasonable temporary weather protection, the Contractor will so notify the Owner's Representative. Each week, the Contractor will notify the Owner's Representative of the number of adverse weather days that it believes it has experienced in the previous week. As provided in the Contract, until such time as the weather days acknowledged by the Owner's Representative exceed the number of days of adverse weather contemplated in the Special Conditions, no request for extension of the Contract Time will be considered.

.2.2 If the Contractor has accumulated in excess of the number of adverse weather days contemplated in the Special Conditions due to the stoppage of work on critical path activities due to adverse weather, the Owner will consider a time extension request from the Contractor that is submitted in accordance with the Contract requirements. The Owner will provide a Change Order extending the time for contract completion or direct an acceleration of the Work in accordance with the Contract terms and conditions to recover the time lost due to adverse weather in excess of the number of adverse weather working days contemplated in the Special Conditions.

4.7.3 A Force Majeure event or circumstance shall not be the basis of a claim by the Contractor seeking an adjustment in the Contract amount for costs or expenses of any type. With the exception of weather delays, which are administered under Article 4, and notwithstanding other requirements of the Contract, all Force Majeure events resulting in a delay to the critical path of the project shall be administered as provided in Article 8.

4.7.4 The Owner will consider and evaluate requests for time extensions due to changes or other events beyond the control of the Contractor on a monthly basis only, with the submission of the Contractor's updated schedule, in conjunction with the monthly application for payment.

4.8 Resolution of Claims and Disputes

4.8.1 The Owner's Representative will review Claims and take one or more of the following preliminary actions within ten days of receipt of a Claim: (1) request additional supporting data from the Contractor, (2) reject the Claim in whole or in part, (3) approve the Claim, or (4) suggest a compromise.

4.8.2 If a Claim has not been resolved, the Contractor shall, within ten (10) days after the Owner's Representative's preliminary response, take one or more of the following actions: (1) submit additional supporting data requested, (2) modify the initial Claim, or (3) notify the Owner's Representative that the initial Claim stands.

4.8.3 If a Claim has not been resolved after consideration of the foregoing and of further information presented by the Contractor, the Contractor has the right to seek administrative review as set forth in Section 4.9. However, Owner's Representative's decisions on matters relating to aesthetics will be final.

4.9 Administrative Review

4.9.1 Claims not resolved pursuant to the procedures set forth in the Contract Documents except with respect to Owner's Representative's decision on matters relating to aesthetic effect, and except for claims which have been waived by the making or acceptance of final payment, or the Contractor's acceptance of payments in full for changes in work may be submitted to administrative review as provided in this Section. All requests for administrative review shall be made in writing.

4.9.2 Upon written request from the Contractor, the Owner's Review Administrator authorized by the Campus Contracting Officer will convene a review meeting between the Contractor and Owner's Representative within fifteen (15) days of receipt of such written request. The Contractor and Owner's Representative will be allowed to present written documentation with respect to the Claim(s) before or during the meeting. The Contractor and Owner's Representative will be allowed to present the testimony of any knowledgeable person regarding the Claim at the review meeting. The Owner's Review Administrator will issue a written summary of the review meeting and decision to resolve the Claim within fifteen (15) days. If the Contractor is in agreement with the decision the Contractor shall notify the Owner's Review Administrator in writing within five (5) days, and appropriate documentation will be signed by the parties to resolve the Claim.

4.9.3 If the Contractor is not in agreement with the proposal of the Owner's Review Administrator as to the

resolution of the Claim, the Contractor may file a written appeal with the UM System Contracting Officer, [in care of the Executive Director of Facilities Planning and Development, University of Missouri, 130 General Services Building, University of Missouri, Columbia, Missouri 65211] within fifteen (15) days after receipt of the Owner's Review Administrator's proposal. The UM System Contracting Officer will call a meeting of the Contractor, the Owner's Representative, and the Owner's Review Administrator by written notice, within thirty (30) days after receipt of the Contractor's written appeal. The Owner's Review Administrator shall provide the UM System Contracting Officer with a copy of the written decision and summary of the review meeting, the Contractor's corrections, or comments regarding the summary of the review meeting, and any written documentation presented by the Contractor and the Owner's Representative at the initial review meeting. The parties may present further documentation and/or present the testimony of any knowledgeable person regarding the Claim at the meeting called by the UM System Contracting Officer.

4.9.4 The UM System Contracting Officer will issue a written decision to resolve the claim within fifteen (15) days after the meeting. If the Contractor is in agreement with the UM System Contracting Officer's proposal, the Contractor shall notify the UM System Contracting Officer in writing within five (5) days, and the Contractor and the Owner shall sign appropriate documents. The issuance of the UM System Contracting Officer's written proposal shall conclude the administrative review process even if the Contractor is not in agreement. However, proposals and any opinions expressed in such proposals issued under this Section will not be binding on the Contractor nor will the decisions or any opinions expressed be admissible in any legal actions arising from the Claim and will not be deemed to remove any right or remedy of the Contractor as may otherwise exist by virtue of Contract Documents or Law. The Contractor and the Owner agree that the Missouri Circuit Court for the County where the Work is located shall have exclusive jurisdiction to determine all issues between them. The Contractor agrees not to file any complaint, petition, lawsuit or legal proceeding against the Owner except with such Missouri Circuit Court.

ARTICLE 5 SUBCONTRACTORS

5.1 Award of Subcontracts

5.1.1 Pursuant to Article 9, the Contractor shall furnish the Owner and the Architect, in writing, with the name, and trade for each Subcontractor and the names of all persons or entities proposed as manufacturers of products, materials and equipment identified in the Contract Documents and where applicable, the name of the installing contractor. The Owner's Representative will reply to the Contractor in writing if the Owner has reasonable objection to any such proposed person or entity. The Contractor shall not contract with a proposed person or entity to whom the Owner has made reasonable and timely objection.

5.1.2 The Contractor may request to change a Subcontractor. Any such request shall be made in writing to the Owner's Representative. The Contractor shall not change a Subcontractor, person, or entity previously disclosed if the Owner makes reasonable objection to such change.

5.1.3 The Contractor shall be responsible to the Owner for acts, defaults, and omissions of its Subcontractors of any tier.

5.2 Subcontractual Relations

5.2.1 By appropriate agreement, written where legally required for validity, the Contractor shall require each Subcontractor of any tier, to the extent of the Work to be performed by the Subcontractor of any tier, to be bound to the Contractor by terms of the Contract Documents and to assume toward the Contractor all the obligations and responsibilities which the Contractor, by these Documents, assumes toward the Owner and the Architect. Each subcontract agreement of any tier shall preserve and protect the rights of the Owner and the Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor of any tier so that subcontracting thereof will not prejudice such rights and shall allow to the Subcontractor of any tier, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies, and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with its sub-subcontractors. The Contractor shall make available to each proposed Subcontractor of any tier, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor of any tier shall be bound. Subcontractors of any tier shall similarly make copies of applicable portions of such documents available to their respective proposed Subcontractors of any tier.

5.2.2 All agreements between the Contractor and a Subcontractor or supplier shall contain provisions whereby Subcontractor or supplier waives all rights against the Owner, Contractor, Owner's Representative, the Architect and all other Additional Insureds for all losses and damages caused by, arising out of, or resulting from any of the perils covered by property or builders risk insurance coverage required of the Contractor in the Contract Documents. If Contractor fails to include said provisions in all subcontracts, Contractor shall indemnify, defend and hold all the above entities harmless in the event of any legal action by Subcontractor or supplier. If insureds on any such policies require separate waiver forms to be signed by any Subcontractors of any tier or suppliers, Contractor shall obtain the same.

5.3 Contingent Assignment of Subcontract

5.3.1 No assignment by the Contractor of any amount or any part of the Contract or of the funds to be received thereunder will be recognized unless such assignment has

had the written approval of the Owner, and the surety has been given due notice of such assignment and has furnished written consent hereto. In addition to the usual recitals in assignment Contracts, the following language must be set forth: "It is agreed that the funds to be paid to the assignee under this assignment are subject to performance by the Contractor of the Contract and to claims and to liens for services rendered or materials supplied for the performance of the Work called for in said Contract in favor of all persons, firms or corporations rendering such services or supplying such materials."

ARTICLE 6 SEPARATE CONTRACTS AND COOPERATION

6.1 The Owner reserves the right to let other contracts in connection with the Work.

6.2 It shall be the duty of each Contractor to whom Work may be awarded, as well as all Subcontractors of any tier employed by them, to communicate immediately with each other in order to schedule Work, locate storage facilities, etc., in a manner that will permit all Contractors to work in harmony in order that Work may be completed in the manner and within the time specified in the Contract Documents.

6.3 No Contractor shall delay another Contractor by neglecting to perform the Contractor's work at the proper time. Each Contractor shall be required to coordinate the Contractor's work with other Contractors to afford others reasonable opportunity for execution of their work. Any costs caused by defective, non-compliant, or ill-timed work, including actual damages and liquidated damages for delay, if applicable, shall be borne by the Contractor responsible therefor.

6.4 Each Contractor shall be responsible for damage to the Owner's or another Contractor's property done by the Contractor or the Contractor's employees, through his or their fault or negligence. If any Contractor shall cause damage to any other Contractor, the Contractor causing such damage shall upon notice of any claim, settle with such Contractor.

6.5 The Contractor shall not claim from the Owner money damages or extra compensation under this Contract when delayed in initiating or completing his performance hereunder, when the delay is caused by labor disputes, acts of God, or the failure of any other Contractor to complete the Contractor's performance under any Contract with the Owner, where any such cause is beyond the Owner's reasonable control.

6.6 Progress schedule of the Contractor for the Work shall be submitted to other Contractors as necessary to permit coordinating their progress schedules.

6.7 If Contractors or Subcontractors of any tier refuse to cooperate with the instructions and reasonable requests of other contractors performing work for the Owner under separate contract, in the overall coordinating of the Work, the

Owner's Representative may take such appropriate action and issue such instructions as in his judgement may be required to avoid unnecessary and unwarranted delay.

ARTICLE 7 CHANGES IN THE WORK

7.1 CHANGE ORDERS

7.1.1 A Change Order is a written instrument prepared by the Owner and signed by the Owner and the Contractor formalizing their agreement on the following:

- .1** a change in the Work
- .2** the amount of an adjustment, if any, in the Contract amount
- .3** an adjustment, if any, in the Contract Time

7.1.2 The Owner may at any time, order additions, deletions, or revisions in the Work by a Change Order or a Construction Change Directive. Such Change Order or Construction Change Directive shall not invalidate the Contract and requires no notice to the surety. Upon receipt of any such document, or written authorization from the Owner's Representative directing the Contractor to proceed pending receipt of the document, the Contractor shall promptly proceed with the Work involved in accordance with the terms set forth therein.

7.1.3 Until such time as the Change Order is formalized and signed by both the Owner and the Contractor it shall be considered a Change Order Request.

7.1.4 The amount of adjustment in the Contract price for authorized Change Orders will be agreed upon before such Change Orders becomes effective and will be determined as follows:

- .1** By a lump sum proposal from the Contractor and the Subcontractors of any tier, including overhead and profit.
- .2** By a time and material basis with or without a specified maximum. The Contractor shall submit to the Owner's Representative itemized time and material sheets depicting labor, materials, equipment utilized in completing the Work on a daily basis for the Owner's Representative approval. If this pricing option is utilized, the Contractor may be required to submit weekly reports summarizing costs to date on time and material Change Order Requests not yet finalized.
- .3** By unit prices contained in the Contractor's original bid and incorporated in the Construction Contract or subsequently agreed upon. Such unit prices contained in the Contractor's original proposal are understood to include the Contractor's overhead and profit. If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are so changed in a proposed Change Order that application of such unit prices to quantities of the Work proposed will cause substantial inequity to the Owner or to the

Contractor, the applicable unit prices shall be equitably adjusted.

7.1.5 The Contractor shall submit all fully documented Change Order Requests with corresponding back-up documentation within the time requested by the Owner but no later than fourteen (14) working days following 1.) the Owner's request for pricing in the case of a lump sum; or 2.) the completion of unit price or time and material work.

7.1.6 The Contractor shall submit Change Order Requests in sufficient detail to allow evaluation by the Owner. Such requests shall be fully itemized by units of labor, material and equipment and overhead and profit. Such breakdowns shall be itemized as follows:

- .1** Labor: The Contractor's proposal shall include breakdowns by labor, by trade, indicating number of hours and cost per hour for each Subcontractor as applicable. Such breakdowns shall only include employees in the direct employ of the Contractor or Subcontractors in the performance of the Work. Such employees shall only include laborers at the site, mechanics, craftsmen and foremen. Payroll cost shall include base rate salaries and wages plus the cost of fringe benefits required by agreement or custom and social security contributions, unemployment, payroll taxes and workers' or workmen's compensation insurance and other customary and legally required taxes paid by the Contractor or Subcontractors. Any item or expense outside of these categories is not allowed. The expense of performing Work after regular working hours, on Saturdays, Sundays or legal holidays shall not be included in the above, unless approved in writing and in advance by Owner.
- .2** Material, supplies, consumables and equipment to be incorporated into the Work at actual invoice cost to the Contractor or Subcontractors; breakdowns showing all material, installed equipment and consumables fully itemized with number of units installed and cost per unit extended. Any singular item or items in aggregate greater than one thousand dollars (\$1,000) in cost shall be supported with supplier invoices at the request of the Owner's Representative. Normal hand tools are not compensable.
- .3** Equipment: Breakdown for required equipment shall itemize (at a minimum) delivery / pick-up charge, hourly rate and hours used. Operator hours and rate shall not be included in the equipment breakdown. Contractor must use the most cost-effective equipment available in the area and should not exceed the rates listed in the Rental Rate Blue Book for Construction Equipment (Blue Book). The Contractor shall submit documentation for the Blue Book to support the rate being requested.

7.2 Construction Change Directive

7.2.1 A construction change directive is a written order prepared and signed by the Owner, issued with supporting documents prepared by the Architect (if applicable), directing a change in the Work prior to agreement on adjustment of the Contract amount or Contract Time, or both. A Construction

Change Directive shall be used in the absence of complete agreement between the Owner and Contractor on the terms of a Change Order. If the Construction Change Directive allows an adjustment of the Contract amount or time, such adjustment amount shall be based on one of the following methods:

- .1 A lump sum agreement, properly itemized and supported by substantiating documents of sufficient detail to allow evaluation.
- .2 By unit prices contained in the Contractor's original proposal and incorporated in the Construction Contract or subsequently agreed upon.
- .3 A method agreed to by both the Owner and the Contractor with a mutually agreeable fee for overhead and profit.
- .4 In the absence of an agreement between the Owner and the Contractor on the method of establishing an adjustment of the Contract amount, the Owner, with the assistance of the Architect, shall determine the adjustment amount on the basis of expenditures by the Contractor for labor, materials, equipment, and other costs consistent with other provisions of the Contract. The Contractor shall keep and submit to the Owner an itemized accounting of all cost components, either expended or saved, while performing the Work covered under the Construction Change Directive.

7.2.2 Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Owner of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum, Contract Time, or both.

7.2.3 A Construction Change Directive signed by Contractor indicates the agreement of the Contractor therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

7.3 Overhead and Profit

7.3.1 Overhead and Profit on Change Orders shall be applied as follows:

- .1 The overhead and profit charged by the Contractor and Subcontractors shall be considered to include, but not limited to, job site office and clerical expense, normal hand tools, incidental job supervision, field supervision, payroll costs and other compensation for project manager, officers, executives, principals, general managers, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, time-keepers, and other personnel employed whether at the site or in principal or a branch office for general superintendent and administration of the Work.
- .2 The percentages for overhead and profit charged on Change Orders shall be negotiated and may vary according to the nature, extent, and complexity of the

Work involved but in no case shall exceed the following:

15%	To the Contractor or the Subcontractor of any tier for Work performed with their respective forces or materials purchased
5%	To the Contractor on Work performed by other than the Contractor's forces
5%	To first tier Subcontractor on Work performed by his Subcontractor

- .3 , extent, and complexity of The Contractor will be allowed to add 2% for the cost of bonding and insurance to their cost of work. This 2% shall be allowed on the total cost of the added work, including overhead and profit.
- .4 Not more than three mark-ups, not to exceed individual maximums shown above, shall be allowed regardless of the number of tier Subcontractors. Overhead and profit shall be shown separately for each Subcontractor of any tier and the Contractor.
- .5 On proposals covering both increases and decreases in the amount of the Contract, the application of overhead and profit shall be on the net change in direct cost for the Contractor or Subcontractor of any tier performing the Work.
- .6 The percentages for overhead and profit credit to the Owner on Change Orders that are strictly decreases in the quantity of work or materials shall be negotiated and may vary according to the nature the Work involved, but shall not be less than the following:

Overhead and Profit

7.5%	Credit to the Owner from the Contractor or Subcontractor of any tier for Work performed with their respective forces or materials purchased
2.5%	Credit to the Owner from the Contractor on Work performed by other than his forces
2.5%	Credit to the Owner from the first tier Subcontractor on Work performed by his Subcontractor of any tier

7.4 Extended General Conditions

7.4.1 The Contractor acknowledges that the percentage mark-up allowed on Change Orders for overhead and profit cover the Contractor's cost of administering and executing the Work, inclusive of Change Orders that increase the Contract Time. The Contractor further acknowledges that no compensation beyond the specified mark-up percentages for extended overhead shall be due or payable as a result of an increase in the Contract Time.

7.4.2 The Owner may reimburse the Contractor for extended overhead if an extension of the Contract Time is granted by the Owner, in accordance with 4.7.1 and the Owner determines that the extension of the Contract Time creates an inequitable condition for the Contractor. If these conditions are determined by the Owner to exist, the Contractor may be reimbursed by unit prices contained in the Contractor's original bid and incorporated in the Construction Contract or by unit prices subsequently agreed upon.

7.4.3 If unit prices are subsequently agreed upon, the Contractor's compensation shall be limited as follows:

- .1** For the portion of the direct payroll cost of the Contractor's project manager expended in completing the Work and the direct payroll cost of other onsite administrative staff not included in Article 7.3.1. Direct payroll cost shall include base rate salaries and wages plus the cost of fringe benefits required by agreement or custom and social security contributions, unemployment, payroll taxes and workers' or workmen's compensation insurance and other customary and legally required taxes paid by the Contractor;
- .2** Cost of the Contractor's temporary office, including temporary office utilities expense;
- .3** Cost of temporary utilities required in the performance of the Work;
- .4** Profit not to exceed 5% of the total extended overhead direct costs;

7.4.4 All costs not falling into one of these categories and costs of the Contractor's staff not employed onsite are not allowed.

7.5 Emergency Work

7.5.1 If, during the course of the Work, the Owner has need to engage the Contractor in emergency work, whether related to the Work or not, the Contractor shall immediately proceed with the emergency work as directed by the Owner under the applicable provisions of the Contract. In so doing, the Contractor agrees that all provisions of the Contract remain in full force and effect and the schedule for the Work is not impacted in any way unless explicitly agreed to in writing by the Owner.

ARTICLE 8 TIME

8.1 Progress and Completion

8.1.1 The Contractor acknowledges and agrees that time is of the essence of this Contract.

8.1.2 The Contract Time is the period of time set forth in the Contract for Construction required for Substantial Completion and Final Completion of the entire Work or portions of the Work as defined in the Contract Documents. Time limits stated in the Contract Documents are of the essence of the Contract. The Contract Time may only be changed by a Change Order. By executing the Contract, the Contractor confirms that the Contract Time is a sufficient period for performing the Work in its entirety.

8.1.3 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, prematurely commence operations on the site or elsewhere prior to the effective date of insurance and bonds required by Article 11 to be furnished by the Contractor.

8.1.4 The Contractor shall proceed expeditiously and diligently with adequate forces and shall achieve Substantial Completion and Final Completion within the time specified in the Contract Documents.

8.2 Delay in Completion

8.2.1 The Contractor shall be liable for all of the Owner's damages for delay in achieving Substantial Completion and/or Final Completion of the entire Work or portions of Work as set forth in the Contract Documents within the Contract Time unless liquidated damages are specifically provided for in the Contract Documents. If liquidated damages are specifically provided for in the Contract for Construction, the Contractor shall be liable for such liquidated damages as set forth in Section 8.3

8.2.2 All time limits stated in the Contract are of the essence of the Contract. However, if the Contractor is delayed at any time in the progress of the Work by any act or neglect of the Owner or by the Owner's Representative, by changes ordered in the Work, Force Majeure including but not limited to war, armed conflict, riot, civil commotion or disorder, act of terrorism or sabotage; epidemic, pandemic, outbreaks of infectious disease or any other public health crisis, including quarantine or other employee restrictions, compliance with any law or governmental order, rule, regulation or direction, curfew restriction, act of God or natural disaster such as earthquake, volcanic activity, landslide, tidal wave, tsunami, flood, damage or destruction by lightning, drought; explosion, fire, destruction of machines, equipment, prolonged break-down of transport, telecommunication or electric current; general labor disturbance such as but not limited to boycott, strike and lock-out, occupation of factories and premises, or any other causes beyond the Contractor's reasonable control which the Owner's Representative determines may justify delay then, upon submission of the Time Impact Schedule Analysis (TIA) justifying the delay called out in Section 4.7 of these General Conditions, the Contract Time may be extended for a reasonable time to the extent such delay will prevent the Contractor from achieving Substantial Completion and/or Final Completion within the Contract Time and if performance of the Work is not, was not or would not have been delayed by any other cause for which the Contractor is not entitled to an extension of the Contract Time under the Contract Documents. It shall be a condition precedent to any adjustment of the Contract Time that the Contractor provides the Owner's Representative with written notice of the cause of delay within seven (7) days from the occurrence of the event or condition which caused the claimed delay. If a Force Majeure is approved by the Owner as the basis for a delay claim, an adjustment in the Contract Time to the extent the Force Majeure impacts the schedule is the only remedy. No increase in the Contract Sum for any reason shall be allowed due to a Force Majeure.

8.2.3 The Contractor further acknowledges and agrees that adjustments in the Contract Time will be permitted for a delay only to the extent such delay (1) is not caused, or could not have been anticipated, by the Contractor, (2) could not be limited or

avoided by the Contractor's timely notice to the Owner of the delay, (3) prevents the Contractor from completing its Work by the Contract Time, and (4) is of a duration not less than one (1) day. Delays attributable to and within the control of a Subcontractor or supplier shall not justify an extension of the Contract Time.

8.2.4 Notwithstanding anything to the contrary in the Contract Documents, except as otherwise noted in these General Conditions, an extension in the Contract Time, to the extent permitted under this Article, shall be the sole remedy of the Contractor for any (1) delay in the commencement, prosecution or completion of the Work, (2) hindrance or obstruction in the performance of the Work, (3) loss of productivity, or (4) other claims due to or caused by any events beyond the control of both the Owner and the Contractor defined herein as Force Majeure. In no event shall the Contractor be entitled to any compensation or recovery of any damages or any portion of damages resulting from delays caused by or within the control of the Contractor or by acts or omissions of the Contractor or its Subcontractors of any tier or delays beyond the control of both the Owner and the Contractor. If the Contractor contends that delay, hindrance, obstruction or other adverse condition results from acts or omissions of the Owner, the Owner's Representative or the Architect, the Contractor shall provide written notice to the Owner within seven (7) calendar days of the event giving rise to such claim. The Contractor shall only be entitled to an adjustment in the Contract Sum to the extent that such acts or omissions continue after the Contractor's written notice to the Owner of such acts or omissions, but in no case shall Force Majeure be the basis of an increase in the Contract Sum. The Owner's exercise of any of its rights or remedies under the Contract Documents (including, without limitation, ordering changes in the Work, or directing suspension, rescheduling or correction of the Work) regardless of the extent or frequency of the Owner's exercise of such rights or remedies, shall not be the basis of any Claim for an increase in the Contract Sum or Contract Time. In the event Contractor is entitled to an adjustment in the Contract Sum for any delay, hindrance, obstruction or other adverse condition caused by the acts or omissions of the Owner, the Owner's Representative or the Architect, the Contractor shall only be entitled to its actual direct costs caused thereby and the Contractor shall not be entitled to and waives any right to special, indirect, or consequential damages including loss of profits, loss of savings or revenues, loss of anticipated profits, labor inefficiencies, idle equipment, home office overhead, and similar type of damages.

8.2.5 If the Contractor submits a progress report or any construction schedule indicating, or otherwise expressing an intention to achieve completion of the Work prior to any completion date required by the Contract Documents or expiration of the Contract Time, no liability of the Owner to the Contractor for any failure of the Contractor to so complete the Work shall be created or implied. Further, the Contractor acknowledges and agrees that even if the Contractor intends or is able to complete the Work prior to

the Contract Time, it shall assert no Claim and the Owner shall not be liable to the Contractor for any failure of the Contractor, regardless of the cause of the failure, to complete the Work prior to the Contract Time.

8.3 Liquidated Damages

8.3.1 If Liquidated Damages are prescribed on the Bid Form and Special Conditions in the Contract Documents, the Owner may deduct from the Contract Sum and retain as Liquidated Damages, and not as penalty or forfeiture, the sum stipulated in the Contract Documents for each calendar day after the date specified for completion of the Work that the entire Work is not substantially complete and/or finally complete.

8.3.2 The Owner's Representative shall establish the date of Substantial Completion and the date of Final Completion of the Work which shall be conclusive and binding on the Owner and the Contractor for the purpose of determining whether or not Liquidated Damages shall be assessed under terms hereof and the sum total amount due.

8.3.3 Liquidated Damages or any matter related thereto shall not relieve the Contractor or the Contractor's surety of any responsibility or obligation under this Contract.

ARTICLE 9 PAYMENTS AND COMPLETION

9.1 Commencement, Prosecution, and Completion

9.1.1 The Contractor shall commence Work within five (5) days upon the date of a "Notice to Proceed" from the Owner or the date fixed in the Notice to Proceed. The Contractor shall prosecute the Work with faithfulness and diligence, and the Contractor shall complete the Work within the Contract Time set forth in the Contract Documents.

9.1.2 The Owner will prepare and forward three (3) copies of the Contract and Performance Bond to the bidder to whom the Contract for the Work is awarded and such bidder shall return two (2) properly executed prescribed copies of the Contract and Bond to the Owner.

9.1.3 The construction period, when specified in consecutive calendar days, shall begin when the Contractor receives notice requesting the instruments listed in below. Before the Owner will issue Notice to Proceed to permit the Contractor to begin Work, the Owner shall have received the following instruments, properly executed as described in the Contract Documents. The documents below shall have been received by the Owner within fifteen (15) days after receipt of request for documents:

- .1** Contract
- .2** Bond (See Article 11)
- .3** Insurance (See Article 11)
- .4** List of Subcontractors of any tier

9.1.4 In the event the Contractor fails to provide the Owner such documents, the Contractor may not enter upon the site of the Work until such documents are provided. The date the

Contractor is required to commence and complete the Work shall not be affected by the Owner denying the Contractor access to the site as a result of the Contractor's failure to provide such documents and the Contractor shall not be entitled to an adjustment of the Contract Time or Contract Sum as a result of its failure to provide the Owner the required documents

9.1.5 Contracts executed by partnerships shall be signed by all general partners of the partnership. Contracts signed by corporations shall be signed by the President or Vice President and the Secretary or Assistant Secretary. In case the Assistant Secretary or Vice President signs, it shall be so indicated by writing the word "Asst." or "Vice" in front of the words "Secretary" and "President". The corporate seal of the corporation shall be affixed. For all other types of entities, the Contractor and the person signing the Contract on behalf of the Contractor represent and warrant that the person signing the Contract has the legal authority to bind the Contractor to the Contract.

9.1.6 Any successful bidder which is a corporation organized in a state other than Missouri or any bidder doing business in the State of Missouri under a fictitious name shall furnish, at no cost to the Owner, no later than the time at which the executed Contract for Construction, the Payment Bond, and the Performance Bond are returned, a properly certified copy of its current Certificate of Authority and License to do business in the State of Missouri. No contract will be executed by the Owner until such certificate is furnished by the bidder, unless there already is on file with the Owner a current certificate, in which event, no additional certificate will be required during the period of time for which such current certificate remains in effect.

9.1.7 Within fifteen (15) calendar days of the issuance of a Notice to Proceed, the Contractor shall submit one (1) signed copy of the following instruments. No payment will be processed until all of these instruments are received and approved by the Owner's Representative.

- .1** Reproducible progress and payment schedule
- .2** Contractor's Schedule of Values
- .3** List of material suppliers
- .4** Itemized breakdown of all labor rates for each classification. Overhead and profit shall not be included. Payroll cost shall include base rate salaries and wages plus the cost of fringe benefits required by agreement or custom and social security contributions, unemployment, payroll taxes and workers' or workmen's compensation insurance and other customary and legally required taxes paid by the Contractor or Subcontractors. Any item or expense outside of these categories is not allowed. The expense of performing Work after regular working hours, on Saturdays, Sundays or legal holidays shall not be included in the above, unless approved in writing and in advance by the Owner.
- .5** Itemized breakdown of anticipated equipment rates (breakout operator rate). Overhead and profit shall

not be included. Breakdown for required equipment shall itemize (at a minimum) delivery/ pick-up charge, hourly rate and hours used. Operator hours and rate shall not be included in the equipment breakdown. The Contractor must use the most cost-effective equipment available in the area and should not exceed the rates listed in the Rental Rate Blue Book for Construction Equipment (Blue Book). The Contractor shall submit documentation for the Blue Book to support the rate being requested.

9.1.8 The Contractor shall be paid electronically using the Owner's web-based payment program with a direct electronic transfer from the Owner's account into the Contractor's account. The Contractor must submit the following information to the Owner's Representative:

- .1** Bank Transit Number for the Contractor's bank into which the electronic deposit will be made.
- .2** Bank Account Number for the Contractor's account into which the electronic deposit will be made.
- .3** Contractor's E-Mail address so that formal notification of the deposit by the Owner can be provided.

9.2 Contract Sum

9.2.1 The Owner shall compensate the Contractor for all Work described herein, and in the Contract Documents the Contract Sum set forth in the Contract for Construction, subject to additions and deletions as provided hereunder.

9.3 Schedule of Values

9.3.1 Within fifteen (15) days after receipt of the Notice to Proceed, the Contractor shall submit to the Owner's Representative a schedule of values allocated to various portions of the Work, prepared in such form and supported by such data to substantiate its accuracy as the Owner's Representative may require. This schedule, unless objected to by the Owner's Representative, shall be used as a basis for reviewing the Contractor's Applications for Payment. The values set forth in such schedule may, at the Owner's option be used in any manner as fixing a basis for additions to or deletions from the Contract Sum.

9.3.2 The progress and payment schedule of values shall show the following:

- .1** Enough detail as necessary to adequately evaluate the actual percent complete of any line item on a monthly basis, as determined by the Owner's Representative.
- .2** Line items, when being performed by a Subcontractor or material supplier, shall correlate directly back to the subcontract or purchase order amount if requested by the Owner's Representative.

9.4 Applications for Payment

9.4.1 The Contractor shall submit monthly to the Owner's Representative and the Architect an itemized Application for Payment for operations completed in accordance with the Schedule of Values. Such application shall be supported by such data substantiating the Contractor's right to payment as the Owner's Representative or the Architect may require, such as

copies of requisitions from Subcontractors and material suppliers, and reflecting retainage as provided for herein.

9.4.2 Such applications shall not include requests for payment of amounts the Contractor does not intend to pay to a Subcontractor or material supplier

9.4.3 Progress payments shall be made on account of materials and equipment delivered to the site and incorporated in the Work. No payments will be made for materials and equipment stored at the Project site but not yet incorporated into the Work except as provided in Paragraph 9.4.4.

9.4.4 If approved in writing and in advance by the Owner, progress payments may be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. The Owner may in its sole discretion refuse to grant approval for payments for materials and equipment stored at the Project site but not yet incorporated in the Work. Any approval by the Owner for payment for materials and equipment delivered and suitably stored at the site, or stored offsite as noted below, for subsequent incorporation in the Work shall be conditioned upon Contractor's demonstrating that such materials and equipment are adequately protected from weather, damage, vandalism and theft and that such materials and equipment have been inventoried and stored in accordance with procedures established by or approved by the Owner. Nothing in this clause shall imply or create any liability on the part of the Owner for the Contractor's inventory and storage procedures or for any loss or damage to material, equipment or supplies stored on the site, whether incorporated into the Work or not. In the event any such loss or damage occurs, the Contractor remains solely responsible for all costs associated with replacement of the affected materials, supplies and equipment including labor and incidental costs, and shall have no claim against the Owner for such loss.

No allowance shall be made in the project pay requests for materials not delivered to the site of the Work and incorporated into the Work, except as noted below. For the purposes of this Contract, offsite is defined as any location not owned or leased by the Owner. The Contractor shall submit a list of materials that they are requesting payment for offsite storage within sixty (60) days of Notice to Proceed.

- .1** Items considered to be major items of considerable magnitude, if suitably stored, may be allowed in project pay requests on the basis of ninety percent (90%) of invoices
- .2** Determination of acceptable "major items of considerable magnitude" and "suitably stored" shall be made by the Owner's Representative.
- .3** Aggregate quantities of materials not considered unique to this project will not be considered for offsite storage payment.
- .4** The Contractor shall submit to the Owner's Representative a list of the material for which

application for payment for offsite storage is anticipated no less than forty-five days (45) prior to the submission of the applicable pay request. The list shall include a material description, applicable division, quantity, and discounts offered to the Owner for early payment. The Contractor shall also submit the location the material will be stored and the method of protection

- .5** The storage facility shall be subject to approval by the Owner's representative, shall be located within an acceptable distance of the project sites as established by the Owner's Representative and all materials for the Owner's project must be stored separately from all other items within the storage facility and shall be labeled and stored in the name of "The Curators of the University of Missouri."
- .6** The Owner's Representative shall be provided a minimum of two weeks' notice to visit the storage facility and inspect the stored material prior to submission of the pay request.
- .7** Upon favorable inspection by the Owner's Representative, the Contractor shall, at the Owner's option, submit a Bill of Sale on forms provided by the Owner's Representative, transferring title of the material or equipment to "The Curators of the University of Missouri."
- .8** An invoice provided by the supplier shall be included with the applicable pay request.
- .9** The Contractor shall remain fully responsible for all items, until acceptance of the project by the Owner.
- .10** The Contractor shall reimburse all costs incurred by the Owner in inspecting and verifying all material stored offsite, including mileage, airfare, meals, lodging and time, charged at a reasonable hourly rate.
- .11** The Contractor shall furnish and maintain insurance covering the replacement cost of the material stored offsite against all losses and shall furnish proof of coverage with the application for payment for material stored offsite.
- .12** The Contractor is responsible for all costs related to storage and handling of material stored offsite unless otherwise directed by the Owner's Representative.

9.4.5 The Application for Payment shall constitute a representation by the Contractor to the Owner that the Work has progressed to the point indicated; the quality of the Work covered by the Application for Payment is in accordance with the Contract Documents; and the Contractor is entitled to payment in the amount requested.

9.4.6 The Contractor will be reimbursed for ninety-five percent (95%) of the value of all labor furnished and material installed and computed in the same manner, less all previous payments made. On projects where a bond is not required, the Contractor will be reimbursed for ninety percent (90%) of the value of all labor furnished and material installed and computed in the same manner, less all previous payments made. The Owner shall hold the remaining five (5) or ten (10) percent, as applicable, as retainage until Substantial Completion of the work as set forth in 9.9.3 below.

9.5 Approval for Payment

9.5.1 The Owner's Representative will, within fifteen (15) days after receipt of the Contractor's Application for Payment, either approve Contractor's Application for Payment for such amount as the Owner's Representative determines is properly due or notify the Contractor of the Owner's Representative's reasons for withholding certification in whole or in part as provided in Section 9.6.

9.6 Decisions to Withhold Approval

9.6.1 The Owner's Representative may decide not to certify payment and may withhold approval in whole or in part, to the extent reasonably necessary to protect the Owner. If the Owner's Representative is unable to approve payment in the amount of the Application, the Owner's Representative will notify the Contractor as provided in Paragraph 9.5.1. If the Contractor and Owner's Representative cannot agree on a revised amount, the Owner's Representative will promptly issue approval for payment for the amount for which the Owner's Representative is able to determine is due to the Contractor. The Owner's Representative may also decide not to approve payment or, because of subsequently discovered evidence or subsequent observations, may nullify the whole or a part of approval for payment previously issued, to such extent as may be necessary in the Owner's Representative opinion to protect the Owner from loss because of:

- .1** defective or non-compliant Work not remedied, or damage to completed Work;
- .2** failure to supply sufficient skilled workers or suitable materials;
- .3** third party claims filed or reasonable evidence indicating probable filing of such claims;
- .4** failure of the Contractor to make payments properly to Subcontractors or for labor, materials or equipment, the Owner may, at its sole option issue joint checks to Subcontractors who have presented evidence that it has not been paid in accordance with the Contract;
- .5** reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
- .6** damage to the Owner or another contractor;
- .7** reasonable evidence that the Work will not be completed within the Contract Time or an unsatisfactory rate of progress made by the Contractor;
- .8** The Contractor's failure to comply with applicable laws;
- .9** The Contractor's or Subcontractor's failure to comply with applicable wage requirements; or
- .10** The Contractor's failure to carry out the Work in strict accordance with the Contract Documents.

9.6.2 When the above reasons for withholding approval are removed, approval will be made for amounts previously withheld.

9.7 Progress Payments

9.7.1 Based upon Applications for Payment submitted to the Owner by the Contractor and approvals issued by the Owner's Representative, the Owner shall make progress payments on account of the Contract Sum to the Contractor

as provided below and elsewhere in the Contract Documents.

9.7.2 The period covered by each Application for Payment shall be one (1) calendar month.

9.7.3 The Owner shall make payment to the Contractor for amounts due and approved by the Owner's Representative not later than thirty (30) days after the Owner approves a properly detailed Application for Payment which is in compliance with the Contract Documents. The Owner shall not have the obligation to process or pay such Application for Payment until it receives an Application for Payment satisfying such requirements.

9.7.4 Based on the Schedule of Values submitted by the Contractor, Applications for Payment submitted by the Contractor shall indicate the actual percentage of completion of each portion of the Contractor's Work as of the end of the period covered by the Application for Payment.

9.7.5 Within fifteen (15) days following receipt payment from the Owner, the Contractor shall pay each Subcontractor and supplier out of the amount paid to the Contractor on account of such Subcontractor's or supplier's portion of the Work, the amount to which said Subcontractor or supplier is entitled, reflecting percentages actually retained from payments to the Contractor on account of each Subcontractor's or supplier's portion of the Work, in full compliance with state statute. The Contractor shall, by appropriate agreement with each Subcontractor or supplier, require each Subcontractor or supplier to make payments to Sub-subcontractors in similar manner. If the Owner, the architect or engineer of record, and the Contractor all determine that a particular Subcontractor's portion of the Work has been satisfactorily completed, including corrective work and closeout requirements, payment equal to one hundred percent (100%) of the subcontract amount for that Subcontractor can be made to the Contractor prior to Substantial Completion. The Contractor shall request such adjustment as necessary to enable the Contractor to pay the Subcontractor in full. This does not relieve the Contractor of any responsibilities under the terms of the Contract and any deficiencies subsequently discovered shall be corrected at no cost to the Owner.

9.7.6 Neither the Owner nor the Architect shall have an obligation to pay or to see to the payment of money to a Subcontractor of any tier nor a laborer or employee of the Contractor except to the extent required by law. Retainage provided for by the Contract Documents are to be retained and held for the sole protection of the Owner, and no other person, firm or corporation shall have any claim or right whatsoever thereto.

9.7.7 An approval for payment by the Owner's Representative, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

9.8 Failure of Payment

9.8.1 If the Owner is entitled to reimbursement or payment from the Contractor under or pursuant to the Contract Documents, such payment by the Contractor shall be made promptly upon demand by the Owner. Notwithstanding anything contained in the Contract Documents to the contrary, if the Contractor fails to promptly make any payment due the Owner, or the Owner incurs any costs and expenses to cure any default of the Contractor or to correct defective Work, the Owner shall have an absolute right to offset such amount against the Contract Sum and may, in the Owner's sole discretion, elect either to: (1) deduct an amount equal to that to which the Owner is entitled from any payment then or thereafter due the Contractor from the Owner, or (2) issue a written notice to the Contractor reducing the Contract Sum by an amount equal to that to which the Owner is entitled.

9.9 Substantial Completion

9.9.1 Substantial Completion is the stage in the progress of the Work as defined in Paragraph 1.1.14 as certified by the Owner.

9.9.2 When the Contractor considers the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall notify the Owner and the Architect. The Owner's Representative will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Owner's Representative's inspection discloses any item which is not in accordance with the requirements of the Contract Documents, the Contractor shall complete or correct such item upon notification by the Owner's Representative. If the Owner's Representative determines the work is not substantially completed and accepted, then the Owner or the Owner's Representative shall provide a written explanation of why the work is not considered substantially completed and accepted within fourteen calendar days to the Contractor, who shall then provide such notice to the subcontractor or suppliers responsible for such work. The Contractor shall then submit a request for another inspection by the Owner's Representative to determine Substantial Completion. When the Work or designated portion thereof is substantially complete, the Owner will issue a Certificate of Substantial Completion. Substantial Completion shall transfer from the Contractor to the Owner responsibilities for security, maintenance, heat, utilities, damage to the Work and insurance. In no event shall the Contractor have more than thirty (30) days to complete all items on the Punch List and achieve Final Completion. Warranties required by the Contract Documents shall commence on the date of Substantial Completion or as agreed otherwise.

9.9.3 At the date of Substantial Completion, the Contractor may apply for, and if approved by Owner's Representative, the Owner, subject to the provisions herein, shall release the retainage, increasing the total payments to one hundred percent (100%) of the Contract Sum less one hundred fifty percent (150%) of the value of any incomplete

Work and unsettled claims, as determined by the Owner's Representative.

9.10 Partial Occupancy or Use

9.10.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and the Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, security, maintenance, heat, utilities, damage to the Work and insurance. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by the Owner's Representative.

9.10.2 Immediately before such partial occupancy or use, the Owner, and the Contractor shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work. Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

9.11 Final Completion and Final Payment

9.11.1 Upon receipt of written notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Owner's Representative and the Architect will promptly make such inspection and, when the Owner's Representative and the Architect find the Work acceptable under the Contract Documents and the Contract fully performed, the Owner's Representative will promptly issue a final approval for payment; otherwise, the Owner's Representative will return the Contractor's Final Application for Payment to the Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application. Submission of a Final Application for Payment shall constitute a further representation that conditions listed in Paragraph 9.11.2 as precedent to the Contractor being entitled to final payment have been fulfilled. All warranties and guarantees required under or pursuant to the Contract Documents shall be assembled and delivered by the Contractor to the Owner's Representative as part of the final Application for Payment. The final approval for payment will not be issued by the Owner's Representative until all warranties and guarantees have been received and accepted by the Owner.

9.11.2 The Owner will request the Contractor to submit the application for final payment along with a manually signed notarized letter on the Contractor's letterhead certifying that:

- .1** Labor costs, prevailing wage rates, fringe benefits and material costs have been paid.
- .2** Subcontractors of any tier and manufacturers furnishing materials and labor for the project have fully completed their Work and have been paid in full.
- .3** The project has been fully completed in accordance with the Contract Documents as modified by Change Orders.
- .4** The acceptance by the Contractor of its final payment, by check or electronic transfer, shall be and operate as a

release of all claims of the Contractor against the Owner for all things done or furnished or relating to the Work and for every act or alleged neglect of the Owner arising out of the Work.

9.11.3 Final payment constituting the entire unpaid balance due shall be paid by the Owner to the Contractor within thirty (30) days after the Owner's receipt of Contractor's Final Application for Payment which satisfies all the requirements of the Contract Documents and the Owner's receipt of all information and documents set forth in Section 9.11.

9.11.4 No payment under this Contract, including but not limited to final payment, shall constitute acceptance by the Owner of any Work or act not in accordance with the requirements of the Contract Documents.

9.11.5 No recourse shall be had against any member of the Board of Curators, or officer thereof, for any payment under the Contract or any claim based thereon.

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

10.1 Safety Precautions and Programs

10.1.1 The Contractor shall at all times conduct operations under this Contract in a manner to avoid the risk of bodily harm to persons or risk of damage to any property. The Contractor shall promptly take precautions which are necessary and adequate against conditions created during the progress of the Contractor's activities hereunder which involve a risk of bodily harm to persons or a risk of damage to property. The Contractor shall continuously inspect Work, materials, and equipment to discover and determine any such conditions and shall be solely responsible for discovery, determination, and correction of any such conditions. The Contractor shall comply with applicable safety laws, standards, codes, and regulations in the jurisdiction where the Work is being performed, specifically, but without limiting the generality of the foregoing, with rules, regulations, and standards adopted pursuant to the Williams-Steiger Occupational Safety and Health Act of 1970 and applicable amendments.

10.1.2 The Contractor and all Subcontractors to the Contract must require all on-site employees to complete the ten-hour construction safety training program required under Section 292.675, RSMo, unless they have previously completed the program and have documentation of having done so. The Contractor will forfeit a penalty to the Owner of \$2,500 plus an additional \$100 for each employee employed by the Contractor or Subcontractor, for each calendar day, or portion thereof, such employee is employed without the required training." (Section 292.675, RSMo).

10.1.3 In the event the Contractor encounters on the site, material reasonably believed to be asbestos,

polychlorinated biphenyl (PCB), lead, mercury, or other material known to be hazardous, which has not been rendered harmless, the Contractor shall immediately stop Work in the area affected and report the condition to the Owner's Representative and the Architect in writing. The Work in the affected area shall not thereafter be resumed except by written agreement of the Owner's Representative and the Contractor if in fact the material is asbestos or polychlorinated biphenyl (PCB) and has not been rendered harmless. The Work in the affected area shall be resumed in the absence of asbestos or polychlorinated biphenyl (PCB), or when it has been rendered harmless by written agreement of the Owner's Representative and the Contractor. "Rendered Harmless" shall mean that levels of such materials are less than any applicable exposure standards, including but limited to OSHA regulations.

10.2 Safety Of Persons and Property

10.2.1 The Contractor shall take reasonable precautions for safety of, and shall provide protection to prevent damage, injury, or loss to:

- .1** students, faculty, staff, the public, construction personnel, and other persons who may be affected thereby;
- .2** the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor or the Contractor's Subcontractors of any tier; and
- .3** other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

10.2.2 The Contractor shall give notices and comply with applicable laws, standards, codes, ordinances, rules, regulations, and lawful orders of public authorities bearing on safety of persons or property or their protection from damage, injury, or loss.

10.2.3 The Contractor shall erect and maintain, as required by existing conditions and performance of the Contract, safeguards for safety and protection, including, but not limited to, posting danger signs and other warnings against hazards, promulgating safety regulations, and notifying owners and users of adjacent sites and utilities.

10.2.4 When use or storage of explosives or other hazardous materials or equipment or unusual methods are necessary for execution of the Work, the Contractor shall exercise the highest degree of care and carry on such activities under supervision of properly qualified personnel.

10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property caused in whole or in part by the Contractor, a Subcontractor of any tier, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable, and for which the Contractor is responsible under Article 10, except damage or loss attributable solely to acts or omissions of the Owner or the Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either

of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's other obligations stated elsewhere in the Contract.

10.2.6 The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents, and the maintaining, enforcing and supervising of safety precautions and programs. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner's Representative and the Architect. The Contractor shall hold regularly scheduled safety meetings to instruct the Contractor's personnel on safety practices, accident avoidance and prevention, and the Project Safety Program. The Contractor shall furnish safety equipment and enforce the use of such equipment by its employees and its Subcontractors of any tier.

10.2.7 The Contractor shall not load or permit any part of the construction or site to be loaded so as to endanger its safety.

10.2.8 The Contractor shall promptly report in writing to the Owner all accidents arising out of or in connection with the Work which cause death, lost time injury, personal injury, or property damage, giving full details and statements of any witnesses. In addition, if death, serious personal injuries, or serious property damages are caused, the accident shall be reported immediately.

10.2.9 The Contractor shall promptly notify in writing to the Owner of any claims for injury or damage to personal property related to the Work, either by or against the Contractor.

ARTICLE 11 INSURANCE AND BONDS

11.1 Insurance

11.1.1 The Contractor shall secure from the date of the Contract for Construction and maintain for such periods of time as set forth below, insurance of such types and in such amounts specified below, to protect the Contractor, the Owner and others against all hazards or risks of loss described below. The form of such insurance together with carriers thereof, in each case, shall be approved by the Owner, but, regardless of such approval, it shall be the responsibility of the Contractor to maintain the insurance coverages set forth herein.

11.1.2 The Contractor shall not be allowed on the Owner's property without proof of the insurance coverages set forth herein

11.2 Commercial General Liability

11.2.1 The Contractor shall secure and maintain from the date of the Contract, and for a period of at least ten (10)

years from the date of Final Completion of the entire Work, Commercial General Liability insurance ("CGL") with a combined single limit of not less than \$2,000,000 per occurrence, \$5,000,000 general aggregate, \$5,000,000 products and completed operations aggregate, and \$1,000,000 personal injury and advertising injury. General Aggregate must apply per project. An umbrella policy may be used to satisfy these limits.

11.2.2 CGL insurance shall be written on a Commercial form CG 00 01 or an equivalent form providing the same coverages and shall cover claims and liability in connection with or resulting from the Contractor's operations and activities under the Contract, for personal injuries, occupational sickness, disease, death or damage to property of others, including loss of use resulting therefrom, arising out of any operations or activities of the Contractor, its agents, or any Subcontractors of any tier or by anyone directly or indirectly employed by either of them.

11.2.3 CGL insurance shall include premises, operations, independent contractors, products-completed operations, personal injury and advertising injury and liability assumed under an insured contract (including the tort liability of another assumed in a business contract) coverages. In particular, and not by way of any limitation, the CGL insurance shall cover the Contractor's indemnity obligations contained in the Contract Documents.

11.2.4 There shall be no endorsement or modification of the CGL policy limiting the scope of coverage for liability arising from blasting, explosion, collapse, or underground property damage.

11.2.5 The Contractor waives all rights against the Owner and its agents, officers, representatives, and employees for recovery of damages to the extent those damages are covered by the CGL policy required hereunder.

11.3 Licensed for Use Vehicle Liability

11.3.1 The Contractor shall secure and maintain from the date of the Contract for Construction until the date of Final Completion of the entire Work, insurance, to be on comprehensive form, which shall protect the Contractor against any and all claims for all injuries and all damage to property arising from the use of automobiles, trucks and motorized vehicles, in connection with the performance of Work under this Contract, and shall cover the operation on or off the site of the Work of all motor vehicles licensed for highway use whether they are owned, non-owned or hired. Such insurance shall include contractual liability coverage and shall provide coverage on the basis of the date of any accident. The liability limits under such policy shall not be less than \$2,000,000 combined single limit for bodily injury and property damage per accident.

11.3.2 The Contractor waives all rights against the Owner and its agents, officers, directors, and employees for recovery

of damages to the extent such damages are covered by the automobile liability insurance required hereunder.

11.4 Workers' Compensation Insurance

11.4.1 The Contractor shall purchase and maintain workers' compensation insurance and employers' liability insurance which shall protect the Contractor from claims for injury, sickness, disease or death of the Contractor's employees or statutory employees. The insurance policies required hereunder shall include an "all states" or "other states" endorsement. In case any Work is subcontracted, the Contractor shall require any Subcontractor of any tier to provide the insurance coverages required under this Paragraph.

11.4.2 The Contractor's workers' compensation insurance coverage shall be in compliance with all applicable laws, including the statutes of the State of Missouri. The Contractor's employers' liability coverage limits shall not be less than \$1,000,000 each accident for bodily injury by accident or \$1,000,000 each employee for bodily injury by disease.

11.5 General Insurance Requirements and Professional Liability

11.5.1 Any Consultant/Contractor providing professional design services as part of the Contract shall be required to provide and maintain, from the date of this Contract and for a period of ten (10) years after the date of Final Completion, Professional Liability insurance, in a claims made form, to cover any claims, including but not limited to errors, omissions, and negligence, which may arise from the design and related services performed by the Consultant. The minimum limits for such policy shall be \$1,000,000.00 per claim/\$1,000,000.00 aggregate.

11.5.2 "The officers, employees, and agents of The Curators of the University of Missouri" shall be added as Additional Insured with respect to the CGL, umbrella/excess and Automobile Liability policies required herein. A certificate of insurance evidencing all coverage required is to be provided at least ten (10) days prior to the inception date of the Contract between the Contractor and the University. The Contractor is required to maintain coverages as stated and required to notify the University of a carrier change or cancellation within two (2) business days. The University reserves the right to request a copy of the policy. The University reserves the right to require higher limits on any contract provided notice of such requirement is stated in the request for proposals for such contract. The Contractor shall request that its insurer(s) include the following disclaimer in any insurance policy, rider or endorsement issued pursuant to this Additional Insured requirement: "Neither the requirement for Additional Insured status nor any of the Contractor's action in compliance with such requirement, either direct or indirect, is intended to be and neither shall be construed as a waiver of any sovereign immunity, governmental immunity or any other type of immunity enjoyed by The Curators of the University of Missouri, the Board of

Curators of the University of Missouri, or any of its officers, employees or agents."

The Additional Insured status must be conveyed by using the ISO CG 20 10 (2004) edition or equivalent and the ISO CG 20 37 (2004) edition. The policy shall be endorsed to be primary coverage and any other insurance carried by the Owner shall be excess only and will not contribute with Contractors' insurance. To confirm, the Endorsement should accompany the insurance certificate.

11.5.3 All insurance coverages procured by the Contractor shall be provided by agencies and insurance companies acceptable to and approved by Owner. All insurance coverage shall be provided by insurance companies that are duly licensed to conduct business in the State of Missouri as an admitted carrier, except that the Professional Liability insurance required herein may be provided by any insurance company legally authorized to do business in the State of Missouri. The form and content of all insurance coverage provided by the Contractor are subject to the approval of the Owner. All required insurance coverages shall be obtained and paid for by the Contractor. Any approval of the form, content or insurance company by the Owner shall not relieve the Contractor from the obligation to provide the coverages required herein. All insurance coverage procured by the Contractor shall be provided by insurance companies having policyholder ratings no lower than "A-" and financial ratings not lower than "XI" in the Best's Insurance Guide, latest edition in effect as of the date of the Contract, and subsequently in effect at the time of renewal of any policies required by the Contract Documents. Insurance coverages required hereunder shall not be subject to a deductible amount on a per-claim basis of more than \$10,000.00 and shall not be subject to a per-occurrence deductible of more than \$25,000.00. Insurance procured by the Contractor covering the Additional Insureds shall be primary insurance and any insurance maintained by Owner shall be excess insurance.

11.5.4 All insurance required hereunder shall provide that the insurer's cost of providing the insureds a defense and appeal, including attorneys' fees, shall be supplementary and shall not be included as part of the policy limits but shall remain the insurer's separate responsibility. The Contractor shall cause its insurance carriers for all required coverages, except for workers' compensation, to waive all rights of subrogation against the Owner and its officers, employees and agents.

11.5.5 The Contractor shall furnish the Owner with certificates, Additional Insured endorsements, policies, or binders which indicate the Contractor and/or the Owner and other Contractors (where required) are covered by the required insurance showing type, amount, class of operations covered, effective dates and dates of expiration of policies prior to commencement of the Work. The Contractor is required to maintain coverages as stated and required to notify the University of a carrier change or cancellation within two (2) business days. The University reserves the right to request a copy of the policy. The Contractor fails to provide, procure, and deliver acceptable policies of insurance or satisfactory

certificates or other evidence thereof, the Owner may obtain such insurance at the cost and expense of the Contractor without notice to the Contractor.

11.5.6 With respect to all insurance coverages required to remain in force and affect after final payment, The Contractor shall provide the Owner additional certificates, policies and binders evidencing continuation of such insurance coverages along with the Contractor's application for final payment and shall provide certificates, policies and binders thereafter as requested by the Owner.

11.5.7 The maintenance in full current force and effect of such forms and amounts of insurance and bonds required by the Contract Documents shall be a condition precedent to the Contractor's exercise or enforcement of any rights under the Contract Documents.

11.5.8 Failure of the Owner to demand certificates, policies and binders evidencing insurance coverages required by the Contract Documents, approval by the Owner of such certificates, policies and binders or failure of the Owner to identify a deficiency from evidence that is provided by the Contractor shall not be construed as a waiver of the Contractor's obligations to maintain the insurance required by the Contract Documents.

11.5.9 The Owner shall have the right to terminate the Contract if the Contractor fails to maintain the insurance required by the Contract Documents.

11.5.10 If the Contractor fails to maintain the insurance required by the Contract Document, the Owner shall have the right, but not the obligation, to purchase said insurance at Contractor's expense. If the Owner is damaged by the Contractor's failure to maintain the insurance required by the Contract Documents, the Contractor shall bear all reasonable costs properly attributable to such failure.

11.5.11 By requiring the insurance set forth herein and in the Contract Documents, the Owner does not represent or warrant that coverage and limits will necessarily be adequate to protect the Contractor, and such coverages and limits shall not be deemed as a limitation on the Contractor's liability under the indemnities granted to the Owner in the Contract Documents. For those policies requiring the Owner to be added as an Additional Insured, as set forth herein, the Owner and all other indemnified parties shall be an Additional Insured for the full limits carried by the Contractor, not just the limits required herein.

11.5.12 If Contractor's liability policies do not contain a standard separation of insureds provision, such policies shall be endorsed to provide cross-liability coverage.

11.5.13 If a part of the Work hereunder is to be subcontracted, the Contractor shall: (1) cover any and all Subcontractors in its insurance policies; (2) require each Subcontractor to secure insurance which will protect said Subcontractor and supplier against all applicable hazards or

risks of loss designated in accordance with Article 11; and (3) require each Subcontractor or supplier to assist in every manner possible in the reporting and investigation of any accident, and upon request, to cooperate with any insurance carrier in the handling of any claim by securing and giving evidence and obtaining the attendance of witnesses as required by any claim or suit.

11.5.14 It is understood and agreed that the insurance coverages required by the provisions of this Contract are required in the public interest and that the Owner does not assume any liability for acts of the Contractor or Subcontractors of any tier or their employees in the performance of the Contract or Work.

11.6 Builder's Risk Insurance

11.6.1 The Contractor shall purchase and maintain, in a company or companies lawfully authorized to do business in the State of Missouri, as an admitted carrier, builder's risk insurance on the entire Work. Such insurance shall be written on a completed value form for the entire Work. The insurance shall apply on a replacement cost basis.

11.6.2 The insurance as required herein shall name as insureds the Owner, the Contractor, and all Subcontractors of any tier. The insurance policy shall contain a provision that the insurance will not be canceled, allowed to expire or materially changed until at least thirty (30) days prior written notice has been given to the Owner.

11.6.3 The insurance as required herein shall cover the entire Work, including reasonable compensation for Architect's services and expenses made necessary by an insured loss. Insured property shall include portions of the Work located away from the site (including all offsite stored materials) but intended for use at the site and shall also cover portions of the Work in transit. The policy shall include as insured property scaffolding, falsework, and temporary buildings located at the site. The policy shall cover the cost of removing debris, including demolition as may be made legally necessary by the operation of any law, ordinance, or regulation.

11.6.4 The insurance required herein shall be on an all risk form and shall be written to cover all risks of physical loss or damage to the insured party and shall insure at least against the perils of fire and extended coverage, theft, vandalism, malicious mischief, collapse, lightening, earthquake, flood, frost, water damage, windstorm and freezing.

11.6.5 If there are any deductibles applicable to the insurance required herein, the Contractor shall pay any part of any loss not covered because of the operation of such deductibles.

11.6.6 The insurance as required herein shall be maintained in effect until the earliest of the following dates:

- .1** the date which all persons and organization who are insureds under the policy agree in writing that it shall be terminated;

- .2 the date on which final payment of this Contract has been made by the Owner to the Contractor; or
- .3 the date on which the insurable interests in the property of all insureds other than the Owner have ceased.

11.6.7 The Owner and the Contractor waive all rights against (1) each other and any of their Subcontractors of any tier, suppliers, agents and employees, each of the other, (2) the Architect and Architect's consultants, and (3) separate contractors described in Article 6, if any, and any of their subcontractors of any tier, suppliers, agents and employees, for damages caused by fire or other perils to the extent covered by property insurance or other insurance applicable to the Work, except such rights as they have to proceeds of such insurance. The Owner or the Contractor, as appropriate, shall require of the Architect, Architect's consultants, separate contractors described in Article 6, if any, and the Subcontractors of any tier, suppliers, agents, and employees of any of them, by appropriate agreements, written where legally required for validity, similar waivers each in favor of other parties enumerated herein. The policies shall provide such waivers of subrogation by endorsement or otherwise. A waiver of subrogation shall be effective as to a person or entity even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, did not pay the insurance premium directly or indirectly, was at fault or was negligent in causing the loss and whether or not the person or entity had an interest in the property damaged.

11.6.8 A loss insured under the Contractor's property insurance shall be adjusted by the Owner in good faith and made payable to the Owner for the insureds, subject to requirements of the Contract Documents. The Contractor shall pay Subcontractors of any tier their just shares of insurance proceeds received by the Contractor, and by appropriate agreements, written where legally required for validity, shall require Subcontractors of any tier to make payments to their Sub-subcontractors in similar manner. The Contractor shall waive its rights to subrogation for any loss or damage to the Contractor's property or equipment coverage in favor of the Owner and other indemnified parties.

11.7 Bonds

11.7.1 When the Contract Sum exceeds Fifty Thousand Dollars (\$50,000), the Contractor shall procure and furnish a Performance Bond and a Payment Bond in the form prepared by the Owner, each in an amount equal to one hundred percent (100%) of the Contract Sum, as well as adjustments to the Contract Sum. The Performance Bond shall secure and guarantee the Contractor's faithful performance of this Contract, including but not limited to the Contractor's obligation to correct defects after final payment has been made as required by the Contract Documents. The Payment Bond shall secure and guarantee payment of all persons performing labor on the Project under this Contract and furnishing materials in connection with this Contract. These Bonds shall be in effect through

the duration of the Contract plus the Guaranty Period as required by the Contract Documents.

11.7.2 The bonds required hereunder shall be executed by a responsible surety licensed in the State of Missouri, with a Best's rating of no less than A-/XI. The Contractor shall require the attorney in fact who executes the required bonds on behalf of the surety to affix thereto a certified and current copy of this power of attorney indicating the monetary limit of such power.

11.7.3 If the surety of any bond furnished by the Contractor is declared bankrupt or becomes insolvent or its right to conduct business in the State of Missouri is terminated, or it ceases to meet the requirements of this Section, the Contractor shall within ten (10) days substitute another bond and surety, both of which must be acceptable to the Owner. If Contractor fails to make such substitution, the Owner may procure such required bonds on behalf of the Contractor at the Contractor's expense.

11.7.4 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds to such person or entity.

11.7.5 The Contractor shall keep the surety informed of the progress of the Work, and, where necessary, obtain the surety's consent to or waiver of: (1) notice of changes in the Work; (2) request for reduction or release of retention; (3) request for final payment; and (4) any other material required by the surety. The Owner shall be notified by the Contractor, in writing, of all communications with the surety, as it relates to items one through four. The Owner may, in the Owner's sole discretion, inform surety of the progress of the Work, any defects in the Work, or any defaults of the Contractor under the Contract Documents and obtain consents as necessary to protect the Owner's rights, interest, privileges and benefits under and pursuant to any bond issued in connection with the Work.

11.7.6 The Contractor shall indemnify and hold harmless the Owner and any agents, employees, representative or member of the Board of Curators from and against any claims, expenses, losses, costs, including reasonable attorneys' fees, as a result of any failure of the Contractor to procure the bonds required herein.

ARTICLE 12

UNCOVERING AND CORRECTION OF THE WORK

12.1 Uncovering of the Work

12.1.1 If a portion of the Work is covered contrary to the Architect's request or to requirements specifically expressed in the Contract Documents, it shall, if required in writing by the Architect or the Owner's Representative, be uncovered for the Architect's observation and be replaced at the Contractor's expense without change in the Contract Time.

12.1.2 If a portion of the Work has been covered which the Architect or the Owner's Representative has not specifically requested to observe, prior to its being covered, the Architect or the Owner's Representative may request to see such Work, and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, costs of uncovering and replacement shall, by appropriate Change Order, be charged to the Owner. If such Work is not in accordance with the Contract Documents, the Contractor shall pay such costs unless the condition was caused by the Owner or a separate contractor in which event the Owner will be responsible for payment of such costs.

12.2 Correction of the Work

12.2.1 The Architect or the Owner's Representative shall have the right to reject Work not in strict compliance with the requirements of the Contract Documents. The Contractor shall promptly correct Work rejected by the Architect or the Owner's Representative for failing to conform to the requirements of the Contract Documents, whether observed before or after final completion and whether or not fabricated, installed, or completed. If Work has been rejected by the Architect or the Owner's Representative, the Architect or the Owner's Representative shall have the right to require the Contractor to remove it from the Project site and replace it with Work that strictly conforms to the requirements of the Contract Documents regardless, if such removal and replacement results in "economic waste." The Contractor shall pay all claims, costs, losses and damages caused by or resulting from the correction, removal or replacement of defective, or non-compliant Work, including but not limited to, all costs of repair or replacement of Work of others. The Contractor shall bear costs of correcting, removing and replacing such rejected Work, including additional testing and inspections and compensation for the Architect's services and expenses made necessary thereby. If prior to the date of final payment, the Contractor, a Subcontractor, or anyone for whom either is responsible uses or damages any portion of the Work, including, without limitation, mechanical, electrical, plumbing, and other building systems, machinery, equipment or other mechanical device, the Contractor shall cause such item to be restored to "like new" condition at no expense to the Owner.

12.2.2 If, within twelve (12) months after the date of Final Completion of the Work or designated portion thereof, or after the date for commencement of warranties, or by terms of an applicable special warranty required by the Contract Documents, any of the Work is found not to be in strict accordance with the requirements of the Contract Documents, the Contractor shall correct or remove and replace such defective Work, at the Owner's discretion. Such twelve (12) month period is referred to as the "Guarantee Period." The obligations under this Paragraph shall cover any repairs, removal, and replacement to any part of the Work or other property caused by the defective Work.

12.2.3 The Contractor shall remove from the site portions of the Work which are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

12.2.4 If the Contractor fails to correct nonconforming Work within a reasonable time, the Owner may correct or remove it and replace such nonconforming Work. If the Contractor does not proceed with correction of such nonconforming Work within a reasonable time fixed by written notice from the Owner, the Owner may take action to correct or remove the nonconforming work at the Contractor's expense.

12.2.5 The Contractor shall bear the cost of correcting destroyed or damaged Work or property, whether completed or partially completed, of the Owner or of others caused by the Contractor's correction or removal of Work which is not in accordance with the requirements of the Contract Documents.

12.2.6 Nothing contained in Article 12 shall be construed to establish a period of limitation with respect to other obligations that the Contractor might have under the Contract Documents. Establishment of the twelve (12) month Guarantee Period as described in Article 12 relates only to the specific obligation of the Contractor to correct, remove or replace the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations under the Contract Documents. The requirements of Article 12 are in addition to and not in limitation of any of the other requirements of the Contract for warranties or conformance of the Work to the requirements of the Contract Documents.

12.3 Acceptance of Nonconforming Work

12.3.1 The Owner may accept Work which is not in accordance with the Contract Documents, instead of requiring its removal and correction, in its sole discretion. In such case, the Contract Sum will be adjusted as appropriate and equitable. Such adjustment shall be made whether or not final payment has been made. Nothing contained herein shall impose any obligation upon the Owner to accept nonconforming or defective Work.

ARTICLE 13 MISCELLANEOUS PROVISIONS

13.1 Written Notice

13.1.1 All notices required to be given by the Contractor under the terms of this Contract shall be made in writing. Written notice when served by the Owner will be deemed to have been duly served if delivered in person to the individual or a member of the firm or entity or to an office of the corporation for which it was intended, or if delivered at or sent to the last business address known to the party giving notice.

13.2 Rights and Remedies

13.2.1 Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights, and remedies otherwise imposed or available by law.

13.2.2 No action or failure to act by the Owner, the Architect, or the Owner's Representative will constitute a waiver of a right or duty afforded to the Owner under the Contract Documents, nor will such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed in writing.

13.2.3 The terms of this Contract and all representations, indemnifications, warranties and guarantees made in, required by, or given in accordance with the Contract Documents, as well as all continuing obligations indicated in the Contract Documents, will survive final payment, completion and acceptance of the Work and termination or completion of the Work and shall remain in effect so long as the Owner is entitled to protection of its rights under applicable law.

13.2.4 The Contractor shall carry out the Work and adhere to the current construction schedule during all disputes or disagreements with the Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements except as the Owner and the Contractor may otherwise agree to in writing.

13.3 Tests and Inspections

13.3.1 Tests, inspections, and approvals of portions of the Work required by the Contract Documents or by laws, ordinances, rules, codes, or regulations shall be made at an appropriate time. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections and approvals with an independent testing laboratory, the Owner's Authorized Agent, or entity acceptable to the Owner, and the Contractor shall bear related costs of tests, inspections, and approvals as required in the Contract Documents. The Contractor shall give the Architect, the Owner's Representative, and the Owner's Authorized Agent timely notice of when and where tests and inspections are to be made so the Architect, the Owner's Representative and/or the Owner's Authorized Agent may observe procedures or perform the necessary tests or inspections.

13.3.2 If the Architect, the Owner's Representative, or the Owner's Authorized Agent determine that portions of the Work require additional testing, inspection or approval not included in the Contract Documents, or required by law, the Architect, or the Owner's Representative will instruct the Contractor to make arrangements for such additional testing, inspection, or approval by an entity acceptable to the Owner's Representative and the Contractor shall give timely notice to the Architect, the Owner's Representative or the Owner's Authorized Agent, of when and where tests and inspections are to be made so

the Architect, the Owner's Representative and/or the Owner's Authorized Agent, may choose that the tests or inspections can be performed or observed. The Owner will bear such costs except as provided elsewhere in Article 13.

13.3.3 If such procedures for testing, inspection, or approval under Article 13 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, the Contractor shall bear all costs made necessary by such failure including those of repeated procedures and compensation for the Architect's and Owner's Authorized Agent's services and expenses.

13.3.4 Required certificates of testing, inspection, or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor, and promptly delivered to the Owner's Representative and the Architect.

13.3.5 The Contractor shall take all necessary actions to ensure that all tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

13.3.6 The Contractor shall arrange for and pay for all costs of all testing required by the Contract Documents or any applicable laws for materials to be tested or certified at or on the place or premises of the source of the material to be supplied. The Owner shall have the right to require testing of all materials at the place of the source of the material to be supplied if not required by the Contract Documents or any applicable laws. The Owner shall bear the costs of such tests and inspections not required by the Contract Documents or by applicable laws, unless prior defective Work provides the Architect or the Owner with a reasonable belief that additional defective Work may be found, in which case the Contractor shall be responsible for all costs of tests and inspections ordered by the Owner or the Architect, whether or not such tests or inspection reveals that Work is in compliance with the Contract Documents.

13.4 Nondiscrimination

13.4.1 In connection with the furnishing of equipment, supplies, and/or services under the Contract, the Contractor and all subcontractors shall not discriminate against any recipients of services, or employees or applicants for employment on the basis of race, color, national origin, ancestry, religion, sex, pregnancy, sexual orientation, gender identity, gender expression, age, disability, protected veteran status, or any other status protected by applicable state or federal law.

13.4.2 The University serves from time to time as a contractor for and/or receives grant funding from the United States government and/or State of Missouri. Accordingly, the Contractor shall comply with all applicable state and federal laws, rules, regulations and executive orders applicable to subcontractors of government contractors or to contractors of grant recipients, including those relating to equal employment of minorities, women, persons with disabilities, certain veterans and based on sexual orientation and gender identity, as each may be amended from time to time. Contract clauses required by the

United States government or State of Missouri in such circumstances are incorporated herein by reference.

13.5 MBE/WBE/SDVE Participation Goals

13.5.1 The Contractor shall provide participation of MBE/WBE/SDVE Firms in the Project, through self-performance, if a MBE/WBE/SDVE Firm, or by subcontracting with MBE/WBE/SDVE Firms as Subcontractors, suppliers or manufacturers, in an amount that is no less than the percent of the Contract Sum that was promised in the Contractor's bid and/or the amount accepted by the Owner.

13.5.2 If the Contractor must remove any MBE/WBE/SDVE Firm as a Subcontractor, supplier or manufacturer under the Contract, the Contractor shall replace the MBE/WBE/SDVE Firm with one or more MBE/WBE/SDVE Firms in an amount equal to the dollar value of the work awarded to the MBE/WBE/SDVE Firm that was removed. The Contractor shall immediately notify the Owner's Representative in writing of the Contractor's intent to remove any MBE/WBE/SDVE Firm as a Subcontractor, supplier or manufacturer, and the Contractor's plan to provide the promised amount of MBE/WBE/SDVE Participation. All changes of a MBE/WBE/SDVE Firm as a Subcontractor of any tier, supplier or manufacturer under the Contract shall be approved by the Executive Director of Facilities Planning and Development.

13.5.3 If the Contractor fails to meet or to maintain the promised amount of MBE/WBE/SDVE Participation, the Contractor shall immediately notify in writing the Owner's Representative and the Executive Director of Facilities Planning and Development. Such notice shall include a description of the Contractor's good faith effort to provide the promised MBE/WBE/SDVE Participation.

13.5.4 If the Executive Director of Facilities Planning and Development finds that the Contractor has failed to comply in good faith with the promised MBE/WBE/SDVE Participation the Executive Director may take appropriate action, including but not limited to, declaring the Contractor ineligible to participate in any contracts with the Owner for a period not to exceed six (6) months, and/or directing that the Contractor's actions be declared a material breach of the Contract and that the Contract be terminated.

13.5.5 In the enforcement of the non-discrimination requirements in Section 13.4 and 13.5, the Owner may use any reasonable procedures available, including but not limited to: requests, reports, site visits, and inspection of relevant documents of Contractors and Subcontractors of any tier. The Contractor shall submit a final Affidavit of MBE/WBE/SDVE Participation for each MBE/WBE/SDVE Firm at the end of the project stating the actual amount paid to the MBE/WBE/SDVE Firm.

13.6 Wage Rates (If the Contract amount is less than \$75,000, the requirements of this Section will not apply. Any adjustments that increase the Contract cost above \$75,000 will be subject to this Section, per Section 290.230, RSMo.)

13.6.1 The Contractor and its Subcontractors shall pay all workers performing work under the Contract not less than the prevailing hourly rate of wages or the public works contracting minimum wage, whichever is applicable, as set out in the Annual Wage Order that is attached to and made part of the specifications for work under the Contract, in accordance with Sections 290.210 to 290.340, RSMo (Missouri Prevailing Wage Law) and related regulations. The Annual Wage Order(s) published by the Missouri Department of Labor and Industrial Relations (MDLIR) for the location where the Work is performed is incorporated into the Contract by this reference. The Contractor shall use applicable MDLIR regulations, including, but not limited to, 8 CSR 30-3.010-3.060, in determining the appropriate occupational titles and rates for workers used in the execution of this Contract. All determinations and/or interpretations regarding wage rates and classification of workers will be made by the office of the University of Missouri Executive Director of Facilities Planning and Development.

13.6.2 If this Project is financed in whole or in part from Federal funds (as indicated in the bid or Contract Documents), then this Contract shall be subject to all applicable federal labor statutes, rules, and regulations, including provisions of the Davis-Bacon Act, 40 U.S.C. § 3141 et seq., and the "Federal Labor Standards Provisions." Where the Missouri Prevailing Wage Law and the Davis-Bacon Act require payment of different wages for work performed under this Contract, the Contractor and all Subcontractors shall pay the greater of the wages required under either law, on a classification-by-classification basis.

13.6.3 The Contractor will forfeit a penalty to the Owner of \$100 per day (or portion of a day) for each worker that is paid less than the specified rate for any work done under the Contract by the Contractor or by any Subcontractor. The Owner shall deduct from any unpaid amounts then or thereafter due the Contractor under the Contract all sums and amounts due and owing as a result of any violation of Sections 290.210 to 290.340, RSMo. (Section 290.250, RSMo) The Contractor agrees to abide by any decision made by the Owner regarding underpayment of wages to workers and amounts owed them as well as penalties for underpayment of wages.

13.6.4 The prevailing wage rate(s) and public works contracting minimum wage(s) included in the Annual Wage Order(s) include fringe benefits as set forth in Sections 290.219 and 290.257, RSMo. Fringe benefit payments may be made to the worker in cash, or irrevocably made by a Contractor or Subcontractor to a trustee or to a third person pursuant to a fund, plan or program, or pursuant to an enforceable commitment, or any combination thereof, to carry out a financially responsible plan or program which was communicated in writing to the workmen affected, for medical

or hospital care, pensions on retirement or death, compensation for injuries or illness resulting from occupational activity, or insurance to provide any of the foregoing, for unemployment benefits, life insurance, disability and sickness insurance, accident insurance, for vacation and holiday pay, for defraying costs of apprenticeship or other similar programs, or for other bona fide fringe benefits, but only where the Contractor or Subcontractor is not required by other federal or state law to provide any of the benefits as referenced in Section 290.210(5), RSMo.

13.6.5 The Contractor shall make full payment of the applicable required wages to workers in legal tender. Pay for travel, mileage, meals, bonuses, or other expenses are not fringe benefits and cannot be considered part of the workers wage rate. The Contractor shall not make any deductions for food, sleeping accommodations, transportation, use of small tools, uniforms, or anything of any kind or description, unless the Contractor and employee enter into an agreement in writing at the beginning of the worker's term of employment, and such agreement is approved by the Owner as fair and reasonable in accordance with Section 290.315, RSMo.

13.6.6 The Contractor shall submit to the Owner with the Contractor's periodic pay request, certified payroll records for labor performed by the Contractor and Subcontractors of any tier. The Contractor shall submit all required certified payroll information records electronically in pdf format using the Owner's web-based payment program. The certified payroll forms shall contain the name, address, personal identification number, and occupational title of the workers as well as the hours they work each day. Do not include personal social security numbers in payroll records. The Owner's acceptance of certified payroll records does not in any way relieve the Contractor of any responsibility for the payment of prevailing wages to workers on the project. The Contractor shall also maintain copies of the certified payroll records. The Owner may, at any time, request copies of, and/or inspect all of the Contractor's payroll records for the Work to verify compliance. The Contractor shall furnish the Owner copies of payroll records within ten (10) days of the Owner's written request. The Contractor shall provide copies of workers I-9 forms within twenty-four (24) hours of written notice. Such payroll records shall be maintained in accordance with Article 13.7.1 and shall be available for inspection for two (2) years after final completion of the Work. Falsification of the certified payroll records may result in the debarment of the Contractor or Subcontractor from future work with the University.

13.6.7 If applicable, the Contractor shall comply with the Copeland "Anti-Kick Act, 18 U.S.C. § 874, 40 U.S.C. § 3145, and the requirements of 29 C.F.R. pt. 3 as may be applicable, which are incorporated by reference into this contract.

13.6.8 The Contractor shall specifically incorporate the obligations of Section 13.6 into the subcontracts, supply agreements and purchase orders for the Work and require the same of any Subcontractors of any tier.

13.6.9 If Contractor fails to comply with the provisions of Section 13.6 of this Contract or with Sections 290.210 to 290.340, RSMo and related regulations, the Owner may, in its sole discretion, immediately terminate the Contract upon written notice. The rights and remedies of the Owner provided herein shall not be exclusive and are in addition to other rights and remedies provided by law or under this Contract.

13.6.10 The Contractor may pay entry-level workers or federally-registered apprentices fifty percent (50%) of the pay of a journeyman in their same occupational title, in accordance with Section 290.235, RSMo and 8 CSR 30-3.030. Per 8 CSR 30-3.030, an entry-level worker is "[a]ny worker who is not a journeyman and who is not otherwise enrolled in a federally-registered apprenticeship program but is participating in an on-the-job training program provided by the contractor for whom they perform work on a public construction project." The University of Missouri may require documentation showing, to the University's sole satisfaction, that an entry-level worker is participating in an on-the-job training program with the Contractor. The combined total of such entry-level workers and federally registered apprentices shall not exceed a one-to-one ratio with the number of journeyman workers in any occupational title on the project.

13.6.11 The Contractor shall post the wage rates for the Contract in a dry, accessible place at the field office on the project or, where there is no field office, at the Contractor's local office or batch plant so long as a copy is provided to workers upon request, as required by 8 CSR 30-3.050. The wage rates shall be kept in a clearly legible condition for the duration of the project.

13.6.12 Neither the Contractor, nor any Subcontractor of any tier, nor any person hired by them or acting on their behalf, shall request, demand or receive, either before or after such worker is engaged, that such worker pay back, return, donate, contribute, or give any part or all of said worker's wages, salary, or thing of value, to any person, upon the statement, representation, or understanding that failure to comply with such request or demand will prevent such worker from procuring or retaining employment, and no person shall, directly or indirectly, pay, request or authorize any other person to violate this Section as set forth in Section 290.305, RSMo, the exception being to an agent or representative of a duly constituted labor organization acting in the collection of dues or assessments of such organization. No Contractor or Subcontractor may directly or indirectly receive a wage subsidy, bid supplement, or rebate for employment on this project if such wage subsidy, bid supplement, or rebate has the effect of reducing the wage rate paid by the employer on a given occupational title below the applicable wage rate as provided in the Contract. In the event a wage subsidy, bid supplement, or rebate is provided or received, the entity receiving such subsidy, supplement, or rebate shall report the

date and amount of such subsidy, supplement, or rebate to the University within thirty days of receipt of payment. This disclosure report shall be a matter of public record.

13.6.13 The Contractor will pay workers overtime for all hours worked over ten (10) hours per day and forty (40) hours per week in accordance with Section 290.230, RSMo. For all overtime work performed, not less than one and one-half the prevailing hourly rate of wages for work of a similar character in the locality in which the Work is performed or the public works contracting minimum wage, whichever is applicable, shall be paid. For all work performed on a Sunday or holiday, not less than twice the prevailing hourly rate of pay or public works contracting minimum wage will apply in accordance with Section 290.230, RSMo. For purposes of this Section, holidays are as follows: January first, the last Monday in May, July fourth, the first Monday in September, November 11, the fourth Thursday in November, December twenty-fifth. If any holiday falls on a Sunday, the following Monday shall be considered a holiday.

13.7 Records

13.7.1 The Owner, or any parties it deems necessary, shall have access to and the right to examine any accounting or other records of the Contractor involving transactions and Work related to this Contract for five (5) years after final payment or five (5) years after the final resolution of any on going disputes at the time of final payment. All records shall be maintained in accordance with generally accepted accounting procedures, consistently applied. Subcontractors of any tier shall be required by Contractor to maintain records and to permit audits as required of Contractor herein.

13.8 Codes and Standards

13.8.1 The Work shall be performed to comply with the International Code Council (ICC) Codes, and the codes and standards noted below. The latest editions and supplements of these codes and standards in effect on the date of the execution of the Contract for Construction shall be applicable unless otherwise designated in the Contract Documents. Codes and standards required by accreditation agencies will also be used unless the ICC requirements are more stringent. In the event that special design features and/or construction systems are not covered in the ICC codes, the applicable edition of the National Fire Protection Association (NFPA) family of standards and/or the NFPA 101 Life Safety Code shall be used.

- .1** ICC International Building Code and reference standards
- .2** ICC International Plumbing Code
- .3** ICC International Mechanical Code
- .4** ICC International Fire Code
- .5** ICC International Fuel Gas Code
- .6** NFPA 70 National Electric Code (NEC)
- .7** Americans with Disabilities Act – Standards for Accessible Design.
- .8** American National Standard Safety Code for Elevators, Dumbwaiters, Escalators, and Moving

Walks as published by the American Society of Mechanical Engineers (ASME), American National Standards Institute (ANSI) A17.1

- .9** NFPA 101 Life Safety Code (as noted above)
- .10** American Concrete Institute (ACI)
- .11** American National Standards Institute (ANSI)
- .12** American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- .13** American Refrigeration Institute (ARI)
- .14** American Society for Testing and Materials (ASTM)
- .15** Missouri Standard Specification for Highway Construction, Missouri State Highway Commission
- .16** National Electrical Manufacturers Association (NEMA)
- .17** Underwriter's Laboratories, Inc. (UL), Federal Specifications
- .18** Williams Steiger Occupational Safety and Health Act of 1970 (OSHA)

13.9 General Provisions

13.9.1 Any specific requirement in this Contract that the responsibilities or obligations of the Contractor also apply to a Subcontractor is added for emphasis and are also hereby deemed to include a Subcontractor of any tier. The omission of a reference to a Subcontractor in connection with any of the Contractor's responsibilities or obligations shall not be construed to diminish, abrogate or limit any responsibilities or obligations of a Subcontractor of any tier under the Contract Documents or the applicable subcontract.

13.9.2 This Contract shall be interpreted, construed, enforced, and regulated under and by the laws of the State of Missouri. Whenever possible, each provision of this Contract shall be interpreted in a manner as to be effective and valid under applicable law. If, however, any provision of this Contract, or a portion thereof, is prohibited by law or found invalid under any law, only such provision or portion thereof shall be ineffective, without invalidating or affecting the remaining provisions of this Contract or valid portions of such provision, which are hereby deemed severable. The Contractor and the Owner further agree that in the event any provision of this Contract, or a portion thereof, is prohibited by law or found invalid under any law, this Contract shall be reformed to replace such prohibited or invalid provision or portion thereof with a valid and enforceable provision which comes as close as possible to expressing the intention of the prohibited or invalid provision.

13.9.3 The Contractor and the Owner each agree that the State of Missouri Circuit Court for the County where the Project is located shall have exclusive jurisdiction to resolve all Claims and any issue and disputes between the Contractor and the Owner. The Contractor agrees that it shall not file any petition, complaint, lawsuit or legal proceeding against the Owner in any other court other than the State of Missouri Circuit Court for the County where the Project is located.

13.9.4 The Owner's total liability to the Contractor and anyone claiming by, through, or under the Contractor for any Claim, cost, loss, expense, or damage caused in part by the fault of the Owner and in part by the fault of The Contractor or any other entity or individual shall not exceed the percentage share

that the Owner's fault bears to the total fault of the Owner, the Contractor and all other entities and individuals as determined on the basis of comparative fault principles.

13.9.5 The Contractor agrees that the Owner shall not be liable to the Contractor for any special, indirect, incidental, or consequential damage whatsoever, whether caused by the Owner's negligence, fault, errors or omissions, strict liability, breach of contract, breach of warranty or other cause or causes whatsoever. Such special, indirect, incidental or consequential damages include, but are not limited to loss of profits, loss of savings or revenue, loss of anticipated profits, labor inefficiencies, idle equipment, home office overhead, and similar types of damages.

13.9.6 Nothing contained in this Contract or the Contract Documents shall create any contractual relationship with or cause of action in favor of a third party against the Owner.

13.9.7 No member or officer of the Board of Curators of the University incurs or assumes any individual or personal liability under the Contract or by reason of the default of the Owner in the performance of any terms thereof. The Contractor releases and discharges all members or officers of the Board of Curators of the University from any liability as a condition of and as consideration for the award of the Contract to the Contractor.

13.9.8 The Contractor hereby binds itself, its partners, successors, assigns and legal representatives to the Owner in respect to covenants, agreements and obligations contained in the Contract Documents. The Contractor shall not assign the Contract or proceeds hereof without written consent of the Owner. If the Contractor attempts to make such an assignment without such consent, it shall be void and confer no rights on third parties, and the Contractor shall nevertheless remain legally responsible for all obligations under the Contract. The Owner's consent to any assignment is conditioned upon the Contractor entering into a written assignment which contains the following language: "It is agreed that the funds to be paid to the assignee under this assignment are subject to performance by the Contractor and to claims and to liens for services rendered or materials supplied for the performance of the Work required in said Contract in favor of all persons, firms, corporations rendering such services or supplying such materials."

13.10 Certifications

13.10.1 Suspension and Debarment

The Contractor certifies to the best of its knowledge and belief that it and its principals are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any department or agency in accordance with Federal Executive Orders 12549 (2/18/86) and 12689 (8/15/89).

13.10.2 Anti-Discrimination Against Israel Act

If this Contract is for \$100,000 or more, and if the Contractor is a company with ten (10) or more employees, then Contractor certifies that it, and any company affiliated with it,

does not boycott Israel, and will not boycott Israel during the term of this Contract. In this Paragraph, the terms "company" and "boycott Israel" shall have the meanings described in Section 34.600 of the Missouri Revised Statutes.

13.10.3 Byrd Anti-Lobbying Amendment

- .1** If this Contract exceeds \$100,000 and is funded by Federal funding, Contractor agrees to file the required certification, in compliance with 31 U.S.C. § 1352 (as amended).
- .2** Each tier certifies to the tier above that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, officer or employee of Congress, or an employee of a Member of Congress in connection with obtaining any Federal contract, grant, or any other award covered by 31 U.S.C. § 1352.
- .3** Each tier shall also disclose any lobbying with non-Federal funds that takes place in connection with obtaining any Federal award. Such disclosures are forwarded from tier to tier up to the recipient who in turn will forward the certification(s) to the awarding agency.

13.10.4 Work Authorization

The Contractor and all subcontractors performing work under this Contract shall enroll and participate in a federal work authorization program operated by the United States Department of Homeland Security, E-Verify or an equivalent federal work authorization program, to verify information of newly hired employees, under the Immigration Reform and Control Act of 1986 (IRCA), P.L.99-603. By executing a contract with The Curators of the University of Missouri, the Contractor shall affirm its enrollment and participation in a federal work authorization program with respect to the employees working in connection with the contracted service and affirm that it does not knowingly employ any person who is an unauthorized alien in connection with the contracted services. The Contractor shall maintain documentation of its participation in a federal work authorization program and make such documentation available to the University upon request.

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

14.1 Termination by Owner for Cause

14.1.1 In addition to other rights and remedies granted to the Owner under the Contract Documents and by law, the Owner may terminate the Contract if the Contractor:

- .1** refuses or fails to supply enough properly skilled workers, superintendents, foremen, or managers;
- .2** refuses or fails to supply sufficient or proper materials;
- .3** fails to make payment to Subcontractors for materials or labor in accordance with the respective agreements between the Contractor and the Subcontractors;
- .4** disregards laws, ordinances, rules, codes, regulations or orders of an authority having jurisdiction;

- .5 disregards the authority of the Owner's Representative, the Architect, or the Owner's Authorized Agent;
- .6 breaches any warranty or representations made by the Contractor under or pursuant to the Contract Documents;
- .7 fails to furnish the Owner with assurances satisfactory to the Owner evidencing the Contractor's ability to complete the Work in compliance with all the requirements of the Contract Documents;
- .8 fails after commencement of the Work to proceed continuously with the construction and completion of the Work for more than ten (10) days, except as permitted under the Contract Documents;
- .9 fails to maintain a satisfactory rate of progress with the Work or fails to comply with approved progress schedules; or
- .10 violates in any substantial way any provisions of the Contract Documents.

14.1.2 When any of the above reasons exist, the Owner may, without prejudice to any other rights or remedies of the Owner, terminate this Contract by delivering a written notice of termination to the Contractor and the Contractor's surety, and may:

- .1 take possession of the site and of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;
- .2 accept assignment of subcontracts pursuant to Section 5.3; and
- .3 finish the Work by whatever reasonable method the Owner may deem expedient, including turning the Work over to the surety.

14.1.3 The Contractor, in the event of a termination under Section 14.1, shall not be entitled to receive any further payments under the Contract until the Work is completed in its entirety. Then, if the unpaid balance under the Contract shall exceed all expenses of the Owner in finishing the Work, including additional compensation for the Architect's services and expenses made necessary thereby, such excess will be paid to the Contractor; but, if such expenses of the Owner to finish the Work shall exceed the unpaid balance, the Contractor and its surety shall be liable for, and shall pay the difference and any damages to the Owner. The obligation of the Contractor and its surety for payment of said amounts shall survive termination of the Contract.

14.1.4 In exercising the Owner's right to secure completion of the Work under any of the provisions hereof, the Owner shall have the right to exercise the Owner's sole discretion as to the manner, methods, and reasonableness of costs of completing the Work.

14.1.5 The rights of the Owner to terminate pursuant to Article 14.1 will be cumulative and not exclusive and shall be in addition to any other remedy provided by law or the Contract Documents.

14.1.6 Should the Contractor fail to achieve Final Completion of the Work within thirty (30) calendar days following the date of Substantial Completion, the Owner may exercise its rights under Section 14.1.

14.2 Suspension by the Owner for Convenience

14.2.1 The Owner may, without cause, order the Contractor in writing to suspend, delay, or interrupt the Work in whole or in part for such period of time as the Owner may determine.

14.2.2 An adjustment will be made to the Contract Sum for increases in the cost of performance of the Contract caused by suspension, delay or interruption. However, in the event of a suspension under Section 14.2, Contractor hereby waives and forfeits any claims for payment of any special, indirect, incidental or consequential damages such as lost profits, loss of savings or revenue, loss of anticipated profits, idle labor or equipment, home office overhead, and similar type damages. No adjustment will be made to the extent:

- .1 that performance is, was, or would have been so suspended, delayed or interrupted by another cause for which the Contractor in whole or in part is responsible, or
- .2 that an equitable adjustment is made or denied under another provision of this Contract.

14.3 Owner's Termination for Convenience

14.3.1 The Owner may, at any time, terminate the Contract in whole or in part for the Owner's convenience and without cause. Termination by the Owner under this Paragraph shall be by a notice of termination delivered to the Contractor specifying the extent of termination and the effective date.

14.3.2 Upon receipt of a notice of termination for convenience, the Contractor shall immediately, in accordance with instructions from the Owner, proceed with performance of the following duties regardless of delay in determining or adjusting amounts due under this Paragraph:

- .1 cease operation as specified in the notice;
- .2 place no further orders and enter into no further subcontracts for materials, labor, services or facilities except as necessary to complete Work not terminated;
- .3 terminate all subcontracts and orders to the extent they relate to the Work terminated;
- .4 proceed to complete the performance of Work not terminated; and
- .5 take actions that may be necessary, or that the Owner may direct, for the protection and preservation of the terminated Work.

14.3.3 Upon such termination, the Contractor shall recover as its sole remedy payment for Work properly performed in connection with the terminated portion of the Work prior to the effective date of termination and for items properly and timely fabricated off the Project site, delivered and stored in accordance with the Owner's instructions and for all Owner approved claims, costs, losses and damages incurred in settlement of terminated contracts with Subcontractors and suppliers. The Contractor hereby waives and forfeits all other claims for payment and damages, including, without limitation,

anticipated profits, consequential damages and other economic losses.

14.3.4 The Owner shall be credited for (1) payments previously made to the Contractor for the terminated portion of the Work, (2) claims which the Owner has against the Contractor under the Contract and (3) the value of the materials, supplies, equipment, or other items that are to be disposed of by the Contractor that are part of the Contract Sum.

14.3.5 Upon determination by a court that termination of Contractor or its successor in interest pursuant to Section 14.1 was wrongful, such termination will be deemed converted to a termination for convenience pursuant to Section 14.3, and Contractor's sole and exclusive remedy for wrongful termination is limited to recovery of the payments permitted for termination for convenience as set forth in ++

SECTION 1.E

SPECIAL CONDITIONS

1. DEFINITIONS

a. “Drawings”

Drawings referred to in and accompany Project Manual consist of Drawings prepared by and bearing the name of the below defined Architect, bearing Date of 9/17/2025 , entitled “CP231546 CHAMPIONS DRIVE SUBSTATION 69KV TRANSFORMER FOUNDATIONS”, project number CP231546.

a. Mechanical & Electrical Engineer:

JACOBS ENGINEERING GROUP, INC
777 MAIN STREET
FORT WORTH, TEXAS 76102
(T) 817-735-6000 (F) 817-735-6148

b. Structural Engineer

JACOBS ENGINEERING GROUP, INC
777 MAIN STREET
FORT WORTH, TEXAS 76102
(T) 817-735-6000 (F) 817-735-6148

c. Civil Engineer

SK DESIGN GROUP, INC
4600 COLLEGE BLVD, SUITE 100
OVERLAND PARK, KANSAS 66211
(T) 913-451-1818

2. SPECIAL SCHEDULING REQUIREMENTS

- a. The Contractor shall ensure the transformer pads are fully constructed, inspected, and ready to receive delivery of the transformers no later than February 27th , 2026.
- b. Owner furnished equipment includes two 69kV HICO transformers. Owner has purchased transportation, offloading, and installation of the transformers. Drawings of the transformers are included in Appendix B. The contractor shall be available for coordination of delivery and installation.

3. SCOPE OF WORK

- a. The Contractor shall furnish all labor, materials, tools, equipment necessary for, and incidental to, construction of this project as indicated on the Drawings and specified herein.
- b. Work shall include everything requisite and necessary to finish work properly, notwithstanding that every item of labor or materials or accessories required to make project complete may not be specifically mentioned.
- c. General Description of Work:
 - (1) Structural work shall consist of reinforced concrete foundations surrounded by containment pits. A PVC duct bank, encased in poured concrete, shall extend from the transformer pad, with a fiber optic duct bank integrated at its base. This duct bank will be routed to the control panel, which will be mounted on a dedicated concrete base. Additionally, two protective bollards shall be installed around the control panel for safety.
 - (2) Electrical work shall consist of the installation of two (2) transformers in accordance with the drawings provided. The scope also encompasses furnishing and installing all required conduit, cable trenches, duct banks, wiring, building electrical systems, and control panel connections as specified in the drawings.

4. LOCATION

- a. Work shall be performed under this Contract on the campus of the University of Missouri – Columbia, at 980 Champions Dr. Columbia MO 65211.

5. NUMBER OF CONSTRUCTION DOCUMENTS

- a. The Owner's Representative will furnish the Contractor a copy of the executed Contract and a complete set of Drawings and Specifications in PDF format.
- b. The contractor may obtain printed sets from the architect at cost of reproduction.
- c. The Owner will furnish explanatory and changed Drawings to the Contractor in PDF format as issued during project.
- d. The Owner will provide electronic data files to the Contractor for their convenience and use in progressing the Work and the preparation of shop drawings or other submittal requirements required for construction of the reference project. The electronic data files shall reflect Construction Documents and Bid Addenda only. These files will be transmitted subject to the following terms and conditions:

- (1) The Owner makes no representation as to the compatibility of these files with the Contractor's hardware or software.
- (2) Data contained on these electronic files shall not be used by the Contractor or anyone else for any purpose other than as a convenience in progressing the Work or in the preparation of shop drawings or other required submittals for the referenced project. Any other use or reuse by the Contractor or by others will be at their own sole risk and without liability or legal exposure to Owner. The Contractor agrees to make no claim and hereby waive, to the fullest extent permitted by law, any claim or cause of action of any nature against the Owner and its consultants, contractors, agents, employees, and representatives that may arise out of or in connection with the use of the electronic files transmitted.
- (3) Furthermore, the Contractor shall, to the fullest extent permitted by law, indemnify and hold harmless the Owner and its consultants, contractors, agents, employees, and representatives, against all damages, liabilities or costs, including reasonable attorney's fees and defense costs, arising out of or resulting from the use of these electronic files.
- (4) These electronic files are not contract documents. Differences may exist between these electronic files and corresponding hard-copy construction documents. The Owner makes no representation regarding the accuracy or completeness of the electronic files you receive. In the event that a conflict arises between the signed or sealed hard-copy construction documents prepared by the Consultant and the electronic files, the signed and sealed hard-copy construction documents shall govern. The Contractor is responsible for determining if any conflict exists. By use of these electronic files, the Contractor is not relieved of their duty to fully comply with the contract documents.
- (5) Because information presented on the electronic files can be modified, unintentionally or otherwise, the Owner reserves the right to remove all indications of ownership and/or involvement from each electronic display.
- (6) Under no circumstances shall delivery of the electronic files be deemed a sale by the Owner and no warranties are made, either expressed or implied, of merchantability and fitness for any particular purpose. In no event shall the Owner be liable for any loss of profit, or any consequential damages as a result of use or reuse of these electronic files.

6. SUBMITTALS

- a. The Contractor shall submit for approval to the Architect, equipment lists and Shop Drawings, as expediently as possible. Failure of the Contractor to submit Shop

Drawings in a timely manner will result in the Owner holding back Contractor payments. (See General Conditions)

- b. The material and equipment lists shall be submitted and approved before any material or equipment is purchased and shall be corrected to as-built conditions before the completion of the project.
- c. The Contractor shall submit electronic versions of all required Shop Drawings, material and equipment lists. The Contractor shall upload all Shop Drawings to a secure information sharing website determined by the Owner notifying the Owner and Consultant that these shop drawings are available for review. Each submittal shall have the General Contractors digital stamp affixed to the first page signifying their review and acceptance. Review comments, approvals, and rejections will be posted on this same site with notification to the contractor. Submittals requiring a professional seal shall be submitted hard copy with a manual seal affixed.
 - (1) The Contractor shall identify each submittal item with the following:
 - (a) Project Title and Locations
 - (b) Project Number
 - (c) Supplier's Name
 - (d) Manufacturer's Name
 - (e) Contract Specification Section and Article Number
 - (f) Contract Drawing Number
 - (g) Acrobat File Name: Spec Section_Times Submitted_Spec Title: 033000_01-Cast in Place Concrete.pdf
 - (2) Reference the accompanying Shop Drawing and Submittal Log at the end of this section (1.E.4) for the required submittal information.
- d. The Contractor shall submit to the Architect four (4) bound copies of all required Operating Instructions and Service Manuals for the Architect's and the Owner's sole use prior to completing 50% of the adjusted contract. Payments beyond 50% of the contract amount may be withheld until all Operating Instructions and Service Manuals are received as referenced in the accompanying Operating Instructions and Service Manual Log at the end of this section (1.E.5).
- e. The Contractor shall submit to the Owner's Representative all items referenced in the accompanying Closeout Log (1.E.6) within 30 days following substantial completion of the work. The Owner's Representative will maintain the closeout log and include as an agenda item at all coordination meetings.

7. USE OF PREMISES

- a. Access: Access to construction site shall be as indicated on the drawings and as directed by the Owner's Representative.
- b. Parking: Contractor shall be issued parking spots for **two (2)** service vehicles to

park in location directed by the Owner's Representative. Employee parking shall be on public streets or were directed by the Owner's Representative. The contractor parking lot (if available), may also be utilized for employee parking.

- b. Storage of materials: The Contractor shall store all materials within project limits. The Contractor shall confine apparatus, materials, and operation of workers to location established by the Owner's Representative. The Contractor shall not unreasonably encumber premises with materials. In addition, storage trailer locations may be available within 1-1/2 miles of project site as directed by the Owner's Representative. Storage trailer locations shall be subject to approval by the Owner's Representative and are available to the Contractor without cost.
- c. Utilities: Drinking water, water required to carry on work, and 120-volt electrical power required for small tool operation may be obtained without cost to the Contractor from existing utilities at locations designated by the Owner's Representative. Provisions for obtaining power, including temporary extensions, shall be furnished, and maintained by the Contractor. Upon completion of work such extensions shall be removed and any damage caused by use of such extensions shall be repaired to satisfaction of the Owner's Representative, at no cost to the Owner.
- d. Restroom: The Contractor shall provide and maintain, in a sanitary condition, chemical type portable toilet facilities at work site for use by his personnel. Toilets and toilet location shall be subject to approval by the Owner's Representative.
- e. Smoking is prohibited at the University of Missouri and all properties owned, operated, leased or controlled by the University of Missouri. Violation of the policy is defined as the use of any tobacco or marijuana products, including e-cigarettes, cigarettes, and vaping.
- f. Care of Project Work Site: The contractor shall be responsible for maintaining the construction site in a reasonably neat and orderly condition by regular cleaning and mowing of the premises as determined by the Owner's Representative.
- g. Discharge to Sewer Request: The University of Missouri's MS4 permit and NPDES Storm Water Discharge Permits along with the City of Columbia's POTW Operating Permit as well as local ordinances, and state and federal environmental regulations prohibit hazardous materials from being disposed into either the storm water or sanitary sewer systems. Unless specifically approved, all chemical products such as paints, dyes, lawn care products, maintenance products, and oil is prohibited from drain disposal. Any product, including contaminated water, being discarded into the storm water or sanitary sewer systems requires written approval from the Owner through a formal "Discharge to Sewer Request" form obtained at [Discharge to Sewer Request Form](#). The contractor should submit the form to the Owner's Representative, not to the Department of Environmental Health and Safety as the form indicates.

- h. All concrete waste material including washout water shall be totally contained and removed from the Owner's property.
- i. Artifacts Found During Construction: Contractor shall immediately notify the Owner's Representative when artifacts are uncovered or found during the demolition or construction process. Artifacts include, but are not limited to, tools, drawings (construction or other), photographs, books and other objects/devices which may hold historical importance/significance. Do not remove or disturb the object(s) in question. Artifacts are not considered part of demolished materials and shall remain the property of the University of Missouri.

k. **"Permit Required Confined Space" Entry Communication and Coordination**

(See OSHA 1926 subpart aa – Construction Confined Space for the definition of "permit required confined spaces" - Note: OSHA does not apply to the University. However, the University will provide a list of all known "permit required confined spaces")

There are no known "permit required confined spaces" within the project limits. Each contractor shall conduct a survey to confirm whether or not any confined spaces exist within the project limits. It is incumbent upon each contractor to list all "permit required spaces".

The Contractor shall notify the Owner's Representative if 1) conditions change resulting in a non-permit required confined space being reclassified to a "permit required confined space" after evaluation of the space by a competent person; 2) a space previously thought to be non-permit required space is classified as a "permit required confined space"; or 3) during the course of construction a "permit required confined space" is created after evaluation by a competent person.

The Contractor shall submit to the Owner's Representative a copy of the cancelled confined space entry permit and a written report summarizing the permit space program followed and all hazards confronted or created during entry operations. This information shall be submitted within one week of cancelling the permit.

8 PROTECTION OF OWNER'S PROPERTY

- a. The Contractor shall be responsible for repair of damage to building exterior and interior, drives, curbs, streets, walks, grass, shrubbery and trees, which was caused by workmen or equipment employed during progress of work. All such repairs shall be made to satisfaction of the Owner's Representative, at no cost to the Owner, or reimburse the Owner if the Owner elects to make repairs. For landscape damage, the Owners shall make such repairs. Compensation for these repairs shall be determined by the Owner's Representative using the "Valuation of Landscape Trees, Shrubs, and other Plants" as published by the International Society of Arboriculture, as last revised.

b. Construction Project Fencing:

- (1) Fencing will not be required as a part of work.
- (2) Using existing landmarks, lamp posts, trees or other Owner property for support of fencing is strictly prohibited unless a written waiver is obtained from Owner's Representative.
- (3) Use of ribbon, snow fence, chicken wire, rope, and wooden barricades as fencing is prohibited.
- (4) Fencing shall be maintained in an "as-installed" condition throughout the life of the project.
- (5) The Contractor may use used fencing provided it is in good condition and is satisfactory to the Owner's Representative.

c. Preserving and Protecting Existing Vegetation:

- (1) Protection and compensation for damages:
 - (a) Trees and shrubs within work area designated to remain shall be protected from damage during construction by fixed chain link fencing or armoring as indicated on Drawings or specified herein. Plant protection devices shall be installed before work has begun and shall be maintained for duration of work unless otherwise directed by Owner's Representative.
 - (b) In the event that damage(s) to the Owner's trees, shrubs or vegetation occurs as a result of the Contractor's unauthorized operations, the Contractor shall pay or allow to the Owner compensation for said damage(s). Compensation shall be determined by the Owner's Representative using the "Valuation of Landscape Trees, Shrubs, and other Plants" as published by the International Society of Arboriculture, as last revised.
- (2) Plants within work area designated for removal shall be removed by Contractor.
- (3) To prevent compaction of soil over tree roots, vehicles or equipment shall not at any time park or travel over, nor shall any materials be stored within drip line of trees designated to remain.

- (4) Owner's Representative will stop work immediately when proper measures are not being employed to protect trees and shrubs. Contractor will be notified to resume work after required protection measures are implemented.
- (5) Removal and/or pruning of select landscape materials shall be performed by MU Landscape Services department.

9. SUBSTITUTIONS AND EQUALS

- a. Substitutions and equals are defined in Article 3 of the General Conditions.
- b. Use of materials, products or equipment other than those named and described in the Contract Documents are substitutions and/or equal. Substitutions and/or equals of any item described in the Contract Documents will be allowed only prior to the receipt of bids provided that a request for approval has been received by both the Architect and the Owner at least ten calendar days prior to the date for receipt of Bids. To be considered, bidder's proposal shall include a complete description of the proposed substitution and/or equal and a comparison of significant qualities of the proposed substitution and/or equal with those specified including drawings, performance and test data, and other information necessary for an evaluation. The Architect's decision on the approval or disapproval of a proposed substitution and/or equal shall be final.
- c. If the Architect and Owner approve a proposed substitution prior to receipt of Bids, such approval will be set forth in an Addendum. Bidders shall not rely upon approval made in any other manner.

11. CODES AND STANDARDS

- a. The Contractor shall comply with applicable codes and standards as listed in the General Conditions. The following codes and standards shall also apply:
 - a. City of Columbia – Sewer Line Installation Standards – Department of Public Works

“All sanitary sewer construction shall be in accordance with the City of Columbia Specifications and Standards and in conformance with the rules and regulations of the Missouri Clean Water Commission.”

12. PERMITS

- a. The Owner will secure and pay for specific necessary approvals, easements, assessments, and charges required for construction, use or occupancy of permanent structures, or for permanent changes in existing facilities except as noted in Article 3.2 of the General Conditions.

- b. Before commencement of Boilers, Water Heaters or Pressure Vessels the Contractor must obtain an installation permit from the State of Missouri, Division of Fire Safety, Boiler and Pressure Unit as required by 11 CSR 40-2.010 through 11 CSR 30-2.065. Ther permit applications are available at <https://dfs.dps.mo.gov/programs/bpv/>.
- 13. SPECIALTIES
 - a. Area around the transformer and conduit shall be returned to existing conditions.
- 14. PRE-BID INSPECTION
 - a. All pre-bid inspections of work areas shall be scheduled with pre-bid inspection guide, telephone: (573) 882-6800.
- 15. ROOF CERTIFICATION AND WARRANTY REQUIREMENT (NOT USED)
- 15. MODIFICATION TO INFORMATION FOR BIDDERS: BIDDERS STATEMENT OF QUALIFICATIONS (NOT USED)
- 16. MODIFICATIONS TO GENERAL CONDITIONS
 - a. General Conditions
 - (1) Add to the Insurance Requirements in General Conditions Article 11, Pollution Liability Coverage, for specified hazardous waste disposal in the contract documents, in a limit no less than \$1,000,000 combined single limit, per occurrence and aggregate, for both bodily injury and property damage combined. The Owner will accept coverage from the Hazardous Waste Disposal Subcontractor and/or Hauler in lieu of the General Contractor subject to all requirements set forth in article 11.
 - (2) The Commercial General Liability policy or policies specified in Article 11 shall provide coverage for special hazards, where they exist, such as, but not limited to, the operation of material hoist, blasting or other use of explosives, and damage to underground property.
- 17. PROJECT SCHEDULING
 - a. Contractor Schedule – Contractor is responsible for the schedule, that may be provided with in-house personnel or hired a third-party scheduling consultant. See Contractor Schedule Requirements included in these documents.
 - b. Contractor Schedule Requirements

(1) GENERAL

(a) Time is of the essence for this contract. The time frames spelled out in this contract are essential to the success of this project. The University understands that effective schedule management, in accordance with the General Conditions and these Special Conditions is necessary to insure to that the critical milestone and end dates spelled out in the contract are achieved.

(b) Related Documents

(i) Drawings and general provisions of the Contract, including General Conditions' Article 3.18 shall apply to this Section.

(c) Stakeholders

(i) A Stake holder is anyone with a stake in the outcome of the Project, including the University, the University Department utilizing the facility, the Design Professionals, the Contractor and Subcontractor(s).

(d) Weather

(i) Contractor acknowledges that there will be days in which work cannot be completed on weather sensitive activities, due to the weather, and that a certain number of these lost days are to be expected under normal weather conditions in Missouri.

(ii) Rather than speculate as to what comprises "normal" weather at the location of the project, Contractor agrees that it will assume a total of 44 lost days, on weather sensitive activities of critical path work, due to weather over the course of a calendar year and include same in its as planned schedule. For projects of less than a calendar year, lost weather days should be prorated for the months of construction in accordance with the following schedule.

(iii) Anticipated weather days for allocation/proration only. For projects lasting 12 months or longer, the 44 days per year plus whatever additional months are included will constitute normal weather.

Jan – 5 days	Feb – 5 days	Mar – 4 days	Apr – 4 days

May – 3 days	Jun – 3 days	Jul – 2 days	Aug – 2 days
Sep – 3 days	Oct – 4 days	Nov – 4 days	Dec – 5 days

- (iv) The Contractor shall notify the Owner’s Representative via email on the same day a lost weather day occurs and shall maintain a log of weather days to be included in the Narrative described in 2.3.4 herein.

(2) SCHEDULING PROCESS

- (a) The intent of this section is to ensure that a well-conceived plan, that addresses the milestone and completion dates spelled out in these documents, is developed with input from all stakeholders in the project. Input is limited to all reasonable requests that are consistent with the requirements of the contract documents, and do not prejudice the Contractor’s ability to perform its work consistent with the contract documents. Further, the plan must be documented in an understandable format that allows for each stakeholder in the project to understand the plan for the construction and/or renovation contained in the Project.

(b) Contractor Requirements

(i) Schedule Development

Contractor shall prepare the Project Schedule using the latest version of Phoenix Project Management scheduling software or other software as approved by the Owner’s Representative prior to receipt of bids.

Contractor shall review each major subcontractor’s schedule with the sub and obtain the subcontractor’s concurrence with the schedule, prior to submitting to the University.

(ii) Schedule Updates

1. Schedule Updates will be conducted once a month, at a minimum. Actual Start and Finish dates should be recorded regularly during the month. Remaining Duration shall be updated as of the data date, just prior to Contractor’s submittal of the updated data.
2. Contractor will copy the previous months schedule and will input update information into the new monthly update version.

3. Contractor will meet with the Owner's Representative to review the draft of the updated schedule. At this meeting, Owner's Representative and Contractor will:
 - (a) Review out of sequence progress, making adjustments as necessary.
 - (b) Add any fragments necessary to describe changes or other impacts to the project schedule and
 - (c) Review the resultant critical and near critical paths to determine any impact of the occurrences encountered over the last month.

(iii) Schedule Narrative

After finalization of the update, the Contractor will prepare a Narrative that describes progress for the month, impacts to the schedule and an assessment as to the Contractor's entitlement to a time extension for occurrences beyond its control during the month and submit in accordance with this Section.

(c) Progress Meetings

- (i) Review the updated schedule at each monthly progress meeting. Payments to the Contractor may be suspended if the progress schedule is not adequately updated to reflect actual conditions.
- (ii) Submit progress schedules to subcontractors to permit coordinating their progress schedules to the general construction work. Include four (4) weeks look ahead schedules to allow subs to focus on critical upcoming work.

(2) CRITICAL PATH METHOD (CPM)

- (a) This Section includes administrative and procedural requirements for the critical path method (CPM) of scheduling and reporting progress of the Work.
- (b) Refer to the General and Special Conditions and the Agreement for definitions and specific dates of Contract Time.

- (c) Critical Path Method (CPM): A method of planning and scheduling a construction project where activities are arranged based on activity relationships and network calculations determine when activities can be performed and the critical path of the Project.
- (d) Critical Path: The longest continuous chain of activities through the network schedule that establishes the minimum overall project duration.
- (e) Network Diagram: A graphic diagram of a network schedule, showing the activities and activity relationships.
- (f) Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling, the construction project. Activities included in a construction schedule consume time and resources.
- (g) Critical activities are activities on the critical path.
- (h) Predecessor activity is an activity that must be completed before a given activity can be started.
- (i) Milestone: A key or critical point in time for reference or measurement.
- (j) Float or Slack Time: The measure of leeway in activity performance. Accumulative float time is not for the exclusive use or benefit of the Owner or Contractor but is a project resource available to both parties as needed to meet contract milestones and the completion date.
- (k) Total float is herein defined as the measure of leeway in starting or completing an activity without adversely affecting the planned project completion date.
- (l) Weather: Adverse weather that is normal for the area must be taken into account in the Contractor's Project Schedule. See 1.(d)(iii), above.
- (m) Force Majeure Event: Any event that delays the project but is beyond the control and/or contractual responsibility of either party.
- (n) Schedule shall include the following, in addition to Contractor's work.
 - (i) Phasing: Provide activity codes in the schedule to show how the sequence of the Work is affected by the following:

1. Requirements for phased completion and milestone dates.
2. Work by separate contractors.
3. Work by the Owner
4. Coordination with existing construction.
5. Limitations of continued occupancies.
6. Uninterruptible services.
7. Partial occupancy prior to Substantial Completion.
8. Area Separations: Use Activity Codes to identify each major area of construction for each major portion of the Work. For the purposes of the Article, a “major area” is a story of construction, a separate building, or a similar significant construction element.
9. Required delivery dates for Owner furnished equipment, if applicable
10. Post substantial completion activities and closeout
11. Floor or Level: Use separate activity codes to identify each floor or level.
12. Subcontractor: Use Activity Codes to identify each subcontractor’s work activities.
13. Type Work or Craft: Use Activity Codes to identify the type of work, or craft that will execute each activity.

(4) TIME EXTENSION REQUEST

- (a) Refer to General Conditions of the Contract for Construction, Article 4.7 Claims for Additional Time.
- (b) Changes or Other Impacts to the Contractor’s Work Plan. The Owner will consider and evaluate requests for time extensions due to changes or other events beyond the control of the Contractor on a monthly basis only, with the submission of the Contractor’s updated schedule, in conjunction with the monthly application for payment. The Update must include:
 - (i) An activity depicting the event(s) impacting the Contractors work plan shall be added to the CPM schedule, using the actual start date of the impact, along with actually required predecessors and successors.
 - (ii) After the addition of the impact activity(ies), the Contractor will identify subsequent activities on the critical path, with finish to start relationships that can be realistically adjusted to overlap using good, standard construction practice.

1. If the adjustments above result in a completion date beyond the contract completion date, the delay shall be deemed excusable, and the contract completion date shall be extended by the number of days indicated by the analysis.
 2. Contractor agrees to continue to utilize its best efforts to make up the time caused by the delays. However, the Contractor is not expected to expend costs not contemplated in its contract, in making those efforts.
- (c) Questions of compensability of any delays shall be held until the actual completion of the project. If the actual substantial completion date of the project based on excusable delays, excluding allocated weather delays, exceeds the original contract completion date, AND there are no delays that are the responsibility of the contractor to consider, the delays days may be considered for equitable adjustment. In review of time extension requests for compensable days, the Owner will consider the actual number of weather days incurred.
- (d) Home office expenditures and staff are NOT compensable.

18. PROJECT COORDINATION

- a. Coordinate construction operations included in various Sections of these Specifications to assure efficient and orderly installation of each part of the Work. Coordinate construction operations.
 - (1) Schedule construction operations in the sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - (2) Coordinate installation of different components to assure maximum accessibility for required maintenance, service, and repair.
 - (3) Make provisions to accommodate items scheduled for later installation.

19. PROJECT PARTNERING (NOT USED)

20. VALUE ENGINEERING (NOT USED)

21. BUILDING SYSTEM COMMISSIONING

- a. Contractor shall provide all personnel and equipment required to complete the commissioning activities referenced in the Commissioning Plan. The requirements of the commissioning plan shall be completed in their entirety before substantial

completion and submitted as referenced in the Closeout Log. Contractor shall use all MU forms for commissioning which can be found at <https://operations.missouri.edu/facilities/commissioning-forms>

- b. The contractor shall designate a competent person, separate from the superintendent or Project Manager, to act as the contractor's commissioning coordinator. The commissioning coordinator is responsible for planning, scheduling, coordinating, conducting and verifying all commissioning activities required by the commissioning plan and ensuring all building systems are complete, operable and ready for use by the Owner. At a minimum, building ventilation systems, chilled/hot water generation systems, hydronic distribution systems, power distributions systems and fire detection and alarm systems, as applicable.

22. MECHANICAL, ELECTRICAL, PLUMBING (MEP) PRE-INSTALLATION MEETING(S)

- a. Before the start of MEP installation, the Owner's Representative will convene an MEP pre-installation meeting. Meeting participants to include contractor (including MEP subcontractors), Owner's Representative and additional contractor and University operational staff invited by the Owner's Representative. Topics will include underground rough-ins, steam piping, chilled water piping, sprinkler piping, hot water piping, electrical system, duct, telephone/data wiring, control wiring. Additional meetings will be conducted as required for the review of coordination drawings and scope specific installations. Cross section drawings of corridor ceilings and other congested areas will be of highest priority and will be reviewed prior to the start of installations in the affected areas. Meeting minutes and sign-up sheet will be transcribed by contractor and distributed to attendees.
- b. Per article 3.14.4 of the General Conditions, coordination drawings are required prior to beginning MEP work. These drawings shall be reviewed and approved by the Consultant and the Owner's Representative.
- c. Per article 3.14.4 of the General Conditions, BIM drawings, in a format approved by the Owner's Representative, are required prior to beginning work and shall be updated to include as-built conditions. These BIM model(s) shall be reviewed collectively in a meeting with the Contractor, MEP subcontractor(s), Consultant, Owner's Representative, and other Owner staff. Additional review meetings shall be required as requested by the Owner's Representative until the BIM drawings are officially approved for construction.
- d. All serviceability clearances stated in manufacturer's equipment/product data shall be strictly provided.

23. COST BREAKOUT FOR OWNER'S ACCOUNTING PURPOSES / SPEND DOWN PURPOSES (NOT USED)

24. PROJECT MANAGEMENT/COMMUNICATION REQUIREMENTS (NOT USED)

25. SAFETY PRECAUTIONS AND PROGRAMS

- a. The Bidder's Statement of Qualifications includes a requirement that the Bidder provide its Worker's Compensation Experience Modification Rates (EMR) and Incidence Rates for the three recent years. The Bidder shall also include the EMR and Incidence Rates of listed major subcontractors on the Bid for Lump Sum Contract. If the EMR exceeds 1 or the Incidence Rate exceeds 13, the Contractor or major subcontractor shall take additional safety measures including, but not limited to, developing a site-specific safety plan and assigning a Safety Manager to the Project to perform inspections on a schedule as determined acceptable by the Owner with written reports to be submitted to the Owner. The Owner reserves the right to reject a Bidder or major subcontractor whose rates exceed these stated rates.
- b. The contractor shall provide Emergency Contact Information for the Contractor's on-site staff and home office management as well as contact information for all major subcontractor personnel. This information shall contain business and personal phone numbers for each individual for contact during or after hours in case of an emergency. This information shall be submitted within 15 days of the Notice to Proceed.

26. HOT WORK PERMITTING AND GENERAL REQUIREMENTS

- a. Hot work Requirements: The contractor shall comply with the following hot work requirements and the requirements of the International Fire Code and NFPA 51B.
 - (1) Hot work shall be defined as any work involving burning, welding, grinding, cutting, or similar operations that are capable of producing sparks, initiating fires or explosions.
 - (2) The Contractor shall utilize the hot work permit decision tree and procedures as outlined in NFPA 51B for all Hot Work operations.
 - (3) A University of Missouri Hot Work Permit (see Appendix 1.I) shall be used on all hot work performed outside a designated hot work area. The University of Missouri hot work permit shall be posted and clearly visible within proximity of the hot work area. The hot work permit authorizing individual (PAI) shall be as designated by the Contractor.
 - (4) Notify the Owner's Representative 24 hours prior to starting hot work in buildings with operational fire alarm or fire suppression systems. The Owner's Representative will coordinate the appropriate system outage with Campus Maintenance personnel.
 - (5) Unless otherwise instructed by the Owner's Representative, the Contractor shall post a copy of each completed hot work permit to the Owner's project management file system the following business day.

- (6) Hot Work personnel shall consist of the following three roles: the Permit Authorizing Individual (PAI), the Hot Work Operator (person doing the work), and the Fire Watch personnel. Hot Work Operators shall not be utilized to perform Fire Watch duties. Fire watch and monitoring duration shall be as required on the University of Missouri hot work permit.

27. GENERAL REQUIREMENTS FOR CRANE AND HOISTING OPERATIONS

- a. All crane and hoisting operations shall be performed in compliance with OSHA 29 CFR 1926. All Operators, riggers, and signal persons must have the proper qualifications and training necessary to perform the intended hoisting activities for this project.
- b. Only fully certified and evaluated Operators shall perform equipment operations. Operators in an “Operator in Training” status shall not be used.
- c. Submittal requirements:
 - (1) Submit copies of Operator certifications, licenses, and evaluations to the Owners Representative.
 - (2) Submit Rigger and Signal Person qualifications to the Owners Representative.
 - (3) Unless otherwise directed by the Owners Representative, submit a lift plan and conduct a lift coordination meeting for hoisting or crane operations for any lift greater than 2,000 pounds, or for any multi pick lift. Include protective measures for existing underground utilities, occupied buildings, pedestrian and vehicle pathways, adjacent buildings and overhead power lines. If the lift is to occur over an occupied building, provide a registered structural engineer’s review and verification that the building can resist the impact of a dropped load for the intended lift. If evacuation of an occupied building is necessary to conduct the lift, the decision for building evacuation or scheduling the lift for off-hours will be determined by the Owner.

28. CONSTRUCTION WASTE MANAGEMENT

- a. The goal of Construction Waste Management is to divert waste from the sanitary landfill. This shall be accomplished through reuse, recycling and/or salvage of non-hazardous construction and demolition debris to the greatest extent practical. Track and report all efforts related to reuse, recycling and/or salvage materials from the project (including clean fill material). Report all material types and weights, where material was diverted, type of diversion, documentation of diversion (waste or recycling tickets), and applicable dates. In order to calculate the diversion percentage, total weights of all non-hazardous landfill material must be reported. This information shall be updated monthly utilizing the [Construction Waste](#)

[Management Worksheet](#). Copies of all applicable receipts, tickets and tracking logs shall be uploaded to the Owner's information sharing website or reported as required by the Construction Project Manager.

- b. A summary worksheet is required prior to substantial completion.

29. WARRANTY WALKTHROUGH

- a. Contractor shall attend a walk-thru with the Owner at eleven (11) months after acceptance to review and document any warranty items to be addressed as part of the twelve (12) month warranty stated in article 3.1 of the General Conditions.

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SECTION 1.E.3

SHOP DRAWING AND SUBMITTAL LOG

Project: CP231546 CHAMPIONS DRIVE SUBSTATION 69KV TRANSFORMER FOUNDATIONS

Project Number: CP231546

Contractor:

<i>Section</i>	<i>Description</i>	<i>Contractor</i>	<i>Date Received</i>	<i>Date Returned</i>	<i>Comments</i>
031000	CONCRETE FORMING AND ACCESSORIES				
032000	CONCRETE REINFORCING				
033000	CAST-IN-PLACE CONCRETE				
051200	STRUCTURAL STEEL FRAMING				
260500	COMMON WORK RESULTS FOR ELECTRICAL				
260519	LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES				
260526	GROUNDING AND BOUNDING FOR ELECTRICAL SYSTEMS				
260529	HANGARS AND SUPPORTS FOR ELECTRICAL SYSTEMS				
260533	RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS				
260536	CABLE TRAYS FOR ELECTRICAL SYSTEMS				
260543	UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS				
262416	PANELBOARDS				
311000	SITE CLEARING				
312000	EARTH MOVING				
316329	DRILLED CONCRETE PIERS AND SHAFTS				

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SECTION 1.E.4

OPERATING INSTRUCTIONS AND SERVICE MANUAL LOG

Project: CP231546 CHAMPIONS DRIVE SUBSTATION 69KV TRANSFORMER FOUNDATIONS

Project Number: CP231546

Contractor:

Section	Description	Catalog Data	Wiring Diagrams	Installation Instructions	Service & Maintenance Instructions	Parts List & Availability	Performance Curves	Startup & Operating Instructions
260519	LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES							
260526	GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS							
260529	HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS							
260533	RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS							
260536	CABLE TRAYS FOR ELECTRICAL SYSTEMS							
260543	UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS							
262416	PANELBOARDS							
311000	SITE CLEARING							
312000	EARTH MOVING							
316329	DRILLED CONCRETE PIERS AND SHAFTS							
031000	CONCRETE FORMING AND ACCESSORIES							

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SECTION 1.E.5

CLOSEOUT LOG

Project: CP231546 CHAMPIONS DRIVE SUBSTATION 69KV TRANSFORMER FOUNDATIONS

Project Number: CP231546

Contractor:

<i>Section</i>	<i>Description</i>	<i>Contractor / Subcontractor</i>	<i>Date Rec'd</i>	<i># of Copies</i>	<i>CPM Initials</i>	<i>Remarks</i>
GC / 3.11	As-built drawings					
GC/13.5.6	Final Affidavit of MBE/WBE/SDVE Participation for each MBE/WBE/SDVE Firm					
SC/20	Executed commissioning plan w/ required documentation					
	List special warranties and guarantees for each section					
	List any required maintenance stock, spare parts, etc.					
	List any special tools, keys, etc.					

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SECTION 1.E.6

COMMISSIONING PLAN

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Construction Management Checklist for Energizing Utilities

(Contractor to initial each item upon completion and provide completed form to the Owner's Representative prior to energizing utility)

AM #1

Water – turned on to the first valve past Energy Management's last valve.

- ☐ Review all piping and equipment being turned on for proper installation and completed testing.
- ☐ Insulation installed (preferred but not required)
- ☐ Meter properly installed, working, and in readable location.
- ☐ Contractor has swabbed out with chlorine all piping from the backflow preventer to the source while installing.
- ☐ All bacteriological tests have been completed and passed.
- ☐ Backflow preventer installed and tested. (will need water pressure to test)
- ☐ Pressure test completed in piping being turned on.
- ☐ Contractor has method to communicate "Services On" to other contractor personnel and Owner's personnel.
- ☐ Consultant has signed off

Steam – turned on to the first valve past Energy Management's last valve.

- ☐ Review all piping, equipment, valves, reducing stations, relief valves, etc. for proper installation and complete testing.
- ☐ Piping protected from the weather.
- ☐ Insulation must be installed.
- ☐ All hangers and bolts have been installed.
- ☐ Meter installed, working and in readable location. (Don't need metasys to turn on.)
- ☐ All needed traps are installed and able to be tested as they are turned on.
- ☐ Condensate system is installed and operating including the pumping system.
- ☐ Pressure test completed in piping being turned on.
- ☐ Contractor has method to communicate "Services On" to other contractor personnel and Owner's personnel.
- ☐ Consultant has signed off

Condensate – turned on to the first valve past Energy Management's last valve.

- ☐ Review all piping and equipment being turned on for proper installation and completed testing.
- ☐ Piping protected from the weather.
- ☐ Insulation installed (preferred but not required)
- ☐ Pressure test completed in piping being turned on.
- ☐ Contractor has method to communicate "Services On" to other contractor personnel and Owner's personnel.
- ☐ Consultant has signed off

Electric – turned on to the first breaker past 13.8kV transformer.

- ☐ Review all wiring and equipment being turned on for proper installation and completed testing
- ☐ GFCI set and tested.
- ☐ Breakers set and tested.
- ☐ All needed permanent grounds are installed.
- ☐ Meter installed, working and in readable location.
- ☐ Main switchgear protected from the weather.
- ☐ Contractor has method to communicate "Services On" to other contractor personnel and Owner's personnel.
- ☐ Consultant has signed off

Chilled Water – turned on to the first valve inside of building.

- ☐ Review all piping and equipment being turned on for proper installation and completed testing.
- ☐ Pressure test completed in piping being turned on.
- ☐ Insulation must be installed.
- ☐ Meter installed, working and connected to Metasys.
- ☐ Building pump and automatic isolation/control valve must be installed and under control.
- ☐ If chillers are installed, automatic loop pump isolation must be installed.
- ☐ Control valves must be installed and automatically controlled on all loads.
- ☐ Contractor has method to communicate "Services On" to other contractor personnel and Owner's personnel.
- ☐ Consultant has signed off

CP231546 Champions Drive Substation 69Kv Xfrmr Fndtn Commissioning Check List

Verified by:

Commissioning Items by CSI Division	Name	Firm	Date compl	Coord Initial	Documentation Required	Owner Witness Required
1						
Building System Commissioning						
Commissioning Agent - Conduct pre-installation meetings per specifications.						☒
15713						
Temporary Erosion and Sediment Control						
Install and maintain. Inspect to ensure integrity.					Inspection Reports	☒
31000						
Concrete Forming and Accessories						
Hold Preinstallation Conference as specified					Meeting Minutes	☒
Perform Field Quality Control section of specifications					Test Report	☒
32000						
Concrete Reinforcing						
Hold Preinstallation Conference as specified					Meeting Minutes	☒
Perform Field Quality Control section of specifications					Test Report	☒
33000						
Cast-in-Place Concrete						
Hold Preinstallation Conference as specified					Meeting Minutes	☒

9/5/2025

COM 2

Commissioning Items by CSI Division		Verified by: Name	Firm	Date compl	Coord Initial	Documentation Required	Owner Witness Required
Perform Field Quality Control section of specifications						Test Report	☒
Provide a Copy Of Field Cured Concrete Cylinder Test Report to Owner's Rep Prior to Stripping Any Load Bearing Formwork						Test Report From Independent Testing Lab	☐
51200							
Structrual Steel Framing							
Hold Preinstallation Conference as specified						Meeting Minutes	☒
Perform Field Quality Control section of specifications						Test Report	☒
Provide welder qualification report for each welder on site						Welder Qualifications	☒
71326							
Self-Adhering Sheet Waterproofing							
Perform inspections as required.						test report	☒
311000							
Site Clearing							
Maintain dust control per contract documents							☐
312000							
Earth Moving							
Help with site compaction tests per contract documents						test report by 3rd party	☒

Commissioning Items by CSI Division		Verified by: Name	Firm	Date compl	Coord Initial	Documentation Required	Owner Witness Required
316329							
Drilled Concrete Piers and Shafts							
Help with Field Quality Control per contract documents						Test Report by 3rd party	☒
Hold PreInstallation meetings as specified						Meeting Minutes	☒
337100							
Main Electric Supply Station							
Perform Field Quality Control section of specifications						Test Report	☒

Please see following website for suggested commissioning forms:

<https://operations.missouri.edu/facilities/commissioning-forms>

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SECTION 1.F

INDEX OF DRAWINGS

Drawings referred to in and accompanying this Project Manual consist of the following sheets dated 9/17/2025 .

Sheet 1 of 16	G – 000 – COVER
Sheet 2 of 16	G – 002 - PROJECT INFORMATION/SHEET INDEX
Sheet 3 of 16	C – 100 - EROSION CONTROL PLAN
Sheet 4 of 16	C – 200 – SITE LAYOUT PLAN
Sheet 5 of 16	C – 300 – SITE DETAILS
Sheet 6 of 16	S – 001 – ABBREVIATIONS, GENERAL NOTES AND SYMBOLS
Sheet 7 of 16	S – 002 – GENERAL NOTES
Sheet 8 of 16	S – 200 – SUBSTATION TRANSFORMER FOUNDATION AND FRAMING PLANS
Sheet 9 of 16	S – 300 – TYPICAL CONCRETE DETAILS
Sheet 10 of 16	S – 310 – FOUNDATION SECTIONS AND DETAILS
Sheet 11 of 16	ES – 100 – OVERALL SITE PLAN
Sheet 12 of 16	EG – 101 – ENLARGED GROUNDING PLAN
Sheet 13 of 16	E – 508 – SUMP PUMP AND UNINSTRUT SUPPORT DETAILS
Sheet 14 of 16	E – 510 – DUCTBANK DETAILS
Sheet 15 of 16	E – 511 – DUCTBANK DETAILS
Sheet 16 of 16	E – 600 – PANEL SCHEDULES

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SECTION 1.G

PREVAILING WAGE RATES

1. The prevailing wage rates for Boone County as issued by the Missouri Division of Labor on the following pages.

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SECTION 1.I

UNIVERSITY OF MISSOURI HOT WORK PERMIT

University of Missouri HOT WORK PERMIT

Seek an alternative/safer method if possible

Before initiating hot work, ensure precautions are in place as required by NFPA 51B and ANSI Z49.1.
Make sure an appropriate fire extinguisher is readily available.

This Hot Work Permit is required for any operation involving open flame or producing heat and/or sparks. This work includes, but is not limited to, welding, brazing, cutting, grinding, soldering, thawing pipe, torch applied roofing, or chemical welding.

Date	Hot Work by: Employee ☐ Contractor ☐
Location / Building / Floor / Room #:	Name (Print) and Signature of person doing Hot Work
Work to be performed:	I verify that the above location has been examined, the precautions marked on the checklist below have been taken, and permission is granted for this work.
Time Started	
Time Completed	
Time Fire Watch Completed	
Name (print) and signature of permit-authorizing individual (PAI)	
Name (print) and signature of person performing Fire Watch	

THIS PERMIT IS GOOD FOR ONE DAY ONLY

Yes	N/A	
☐	☐	Available sprinklers, hose streams, and extinguishers are in service and operable.
☐	☐	Hot Work equipment is in good working condition in accordance with manufacturer's specifications.
☐	☐	Special permission obtained to conduct hot work on metal vessels or piping lined with rubber or plastic.
Requirements within 35 ft (11 m) of hot work		
☐	☐	Flammable liquid, dust, lint and oily deposits removed.
☐	☐	Explosive atmosphere in area eliminated.
☐	☐	Floors swept clean and trash removed.
☐	☐	Combustible floors wet down or covered with damp sand or fire-resistant / noncombustible materials or equivalent.
☐	☐	Personnel protected from electrical shock when floors are wet.
☐	☐	Other combustible storage material removed or covered with listed or approved materials (welding pads, blankets, curtains, fire-resistant tarpaulins), metal shields, or non-combustible material.
☐	☐	All wall and floor openings are covered.
☐	☐	Ducts and conveyors that might carry sparks to distant combustible material are covered, protected, or shut down.
Requirements for hot work on walls, ceilings or roofs		
☐	☐	Construction is noncombustible and without combustible coverings or insulation.
☐	☐	Combustible material on other side of walls, ceilings, or roofs is moved away.

Yes N/A

Requirements for hot work on enclosed equipment

- ☐ ☐ Enclosed equipment is cleaned of all combustibles.
- ☐ ☐ Containers are purged of flammable liquid / vapor.
- ☐ ☐ Pressurized vessels, piping, and equipment removed from service, isolated, and vented.

Requirements for hot work fire watch and fire monitoring

- ☐ ☐ Fire watch is provided with suitable extinguishers and, where practical, a charged fire hose.
- ☐ ☐ Fire watch is trained in use of equipment, sounding alarm, and notification of emergency contacts.
- ☐ ☐ Fire watch is required in adjoining areas, or above and below the work area.
- ☐ ☐ Per the PAI / fire watch, monitoring of hot work area is required, per the table below.

Construction Factors

	Noncombustible construction		Combustible construction without concealed cavities		Combustible Construction with unprotected concealed cavities	
Occupancy Factors	Fire Watch	Monitor	Fire Watch	Monitor	Fire Watch	Monitor
Noncombustible with any combustibles contained within closed equipment (e.g., ignitable liquid within piping)	30 minutes	0 hours	1 hour	3 hours	1 hour	5 hours
Office, retail or manufacturing with limited combustible loading	1 hour	1 hour	1 hour	3 hours	1 hour	5 hours

POST A COPY OF THIS PERMIT IN/NEAR THE HOT WORK AREA.

Admin: University employees shall file hot work permits in departmental safety file records.

Contract personnel shall file copies of permits in the University of Missouri Project Management File System.

END OF SECTION

APPENDICIES

GEOTECHNICAL REPORT

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GEOTECHNICAL ENGINEERING REPORT
FOR
UNIVERSITY OF MISSOURI

CP231541 GS – ELECTRICAL
INTERCONNECTION AND SUBSTATION
COLUMBIA, MISSOURI

AUGUST 19, 2025

Crockett GTL Project Number: G251201.1

1000 W Nifong Blvd. – Bldg 1 • Columbia, MO 65203

Phone: 573-447-0292

www.CrockettEngineering.com

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1000 W Nifong Blvd. - Building 1
Columbia, Missouri 65203
(573) 447-0292

August 19, 2025

University of Missouri
112 General Services Building
Columbia, MO 65211

Attn: Ashley Karpel, P.E.

Re: Geotechnical Engineering Report
CP231541 GS - Electrical Interconnection and Substation
Columbia, Missouri
Crockett GTL Project Number: G251201.1

Dear Ms. Karpel:

Crockett Geotechnical - Testing Lab (Crockett GTL) has completed the geotechnical engineering services for the referenced project. This report should be read in its entirety. This report presents the results of our field explorations, laboratory testing, and recommendations for design and construction of the referenced project. This report has been revised to address additional items requested by the structural engineer.

We appreciate the opportunity to be of service and look forward to working with you during the construction phase of this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,

A handwritten signature in blue ink that reads "Collin Walsh".

Collin Walsh, E.I.
Project Manager

A handwritten signature in blue ink that reads "Eric H. Lidholm".

Eric H. Lidholm, P.E.
Principal
Missouri: E-23265



Enclosures

cc: 1 - Client (.PDF)
1 - File

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APPENDIX

- Site Location Map
- Boring Location Plans
- Boring Logs
- Boring Log Legend and Nomenclature
- Rock Core Photo Log

Geotechnical Engineering Report
CP231541 GS - Electrical Interconnection and Substation
Columbia, Missouri
Crockett GTL Project Number: G251201.1
August 19, 2025

1 INTRODUCTION

Crockett Geotechnical - Testing Lab (CGTL) has conducted a geotechnical exploration for the proposed development. The purpose of our exploration was to:

- characterize and evaluate the subsurface conditions,
- provide design and construction recommendations for:
 - past site grading
 - uncontrolled fill
 - shrink/swell prone soils
 - earthwork
 - foundations
 - floor slab on-grade considerations
 - seismic considerations
 - lateral earth pressures
 - special inspection requirements

This revised report supersedes the previously submitted geotechnical engineering report dated July 31, 2025, project number G251201. This report has been revised to address additional items requested by the structural engineer.

2 SITE AND PROJECT INFORMATION

2.1 SITE LOCATION AND DESCRIPTION

Item	Description
Location	This project is located about 750 feet south and 150 feet east of the intersection of Champions Drive and East Stadium Boulevard in Columbia, Missouri A Site Location Map showing the approximate location of this site is included in the Appendix of this report

Item	Description
Approximate GPS Coordinates	38.933064, -92.326284
Existing improvements	Fenced, gravel-surfaced storage-lot

2.2 PROJECT DESCRIPTION

Item	Description
Proposed structures	The project will consist of a new building with a footprint of about 4,700 sq ft and new electrical substation equipment
Maximum loads (provided)	Electrical support structures: 10 kips Prefabricated E-house: 25 kips
Grading	We have assumed site grading to consist of less than about of 3 feet of cut or new structural fill
Cut and fill slopes	Final slopes are assumed to be no steeper than 3H:1V (Horizontal to Vertical)
Free-standing retaining walls	None
Below grade areas	Stem walls and basement walls

3 SUBSURFACE CONDITIONS

3.1 FIELD EXPLORATION AND LABORATORY TESTING

Five (5) borings were drilled for this project at the approximate locations indicated on the Boring Location Plan included in the Appendix of this report. Additional information follows:

Field Exploration	
Boring Locations ¹	Designated by the client and staked by a Crockett GTL project geologist
Boring Elevations ¹	Boring elevations were obtained using a site topographic diagram provided by Crockett Engineering The elevations were rounded to the nearest ½ foot
Drill Rig	Mobile B-57 track-mounted drill rig equipped with 4-inch solid stem augers
Sampling Methods ²	Representative samples were obtained using thin-walled tube sampling, split-barrel tube sampling and diamond bit rock coring techniques

Field Exploration

1. The location and elevation of the borings should be considered accurate only to the degree implied by the means and methods used to define them
2. An auto-hammer was used to advance the split-barrel sampler (hammer efficiency = 91.7%)

The samples were tagged for identification, sealed to reduce moisture loss and taken to our laboratory for further examination, testing and classification. Information provided on the boring logs attached to this report includes material descriptions, consistency evaluations, boring depths, sampling intervals and groundwater conditions. The borings were backfilled prior to the drill crew leaving the site.

The field logs were prepared by the drill crew. The final logs in this report reflect the engineer's interpretation of the field logs, incorporating modifications from laboratory tests and observations of the samples. Detailed information on material encountered, field sampling and laboratory testing results is provided on the boring logs in the Appendix of this report. The descriptions of the soil on the final boring logs are in general accordance with the Unified Soil Classification System which is included in the Appendix of this report.

3.2 ENCOUNTERED SUBSURFACE CONDITIONS

Detailed descriptions of the encountered materials are listed on the individual boring logs included in the Appendix of this report. Strata lines indicate the approximate location of changes in material types. The transition between material types may be gradual. A generalized summary of what was encountered in the borings follows:

All borings encountered about 2 to 3-inches of gravel at the ground surface. The thickness of the gravel may vary elsewhere on the site.

Underlying the gravel in all borings was uncontrolled fill consisting primarily of gravelly fat clay. Within the uncontrolled fill was also trace brick and asphalt, some wood debris, and occasional gravelly zones. A noticeable petroleum odor was detected in some of the retrieved soil samples; however, this is an incidental observation made during our geotechnical investigation and does not constitute an environmental assessment. Evaluation of potential environmental concerns, including the petroleum odor, is outside the scope of our geotechnical services and we recommend that a qualified environmental professional be engaged should further investigation be warranted. Uncontrolled fill is material that is variable in strength, density, moisture content and composition. The uncontrolled fill extended to depths ranging from about 3.0 to 23.4 feet in the borings.

Underlying the uncontrolled fill in borings B-1, B-3 and B-5 was fat clay. The fat clay extended to depths ranging from about 8.5 to 22.0 feet in these borings.

Underlying the uncontrolled fill in boring B-2 and underlying the fat clay in boring B-1 was gravelly weathered shale. The gravelly weathered shale extended to depths ranging from about 13.5 to 19.1 feet in these borings.

Underlying the gravelly weathered shale in borings B-1 and B-2, and underlying the fat clay in borings B-3 and B-5 was gravelly shale and shale. The shale contained cobbles and occasional boulders. Boulders were encountered within the shale in boring B-3 at a depth of about 22.0 feet and extended to approximately 23.5 feet. Split-spoon sampler refusal was achieved in the shale at various depths. The gravelly shale and shale extended to depths ranging from about 20.5 to 30.5 feet in these borings.

Underlying the uncontrolled fill in boring B-4 and underlying the gravelly shale and shale in the remaining borings was limestone. The upper surface of the limestone was variably weathered. The limestone was hard and caused auger refusal and split-spoon sampler refusal at depths ranging from 21.0 to 31.0 feet in the borings. Boring B-5 was advanced past split-spoon sampler refusal depths using NQ diamond bit rock coring techniques. The rock core extended into the limestone to a depth of 33.0 feet, at which the boring was terminated. Photographs of the rock core are included in the Appendix of this report.

3.3 GROUNDWATER

All boreholes were observed for the presence and level of groundwater while drilling, after completion of drilling and for the short duration the borings were allowed to remain open before they were backfilled. The groundwater levels observed are noted on the attached boring logs, and are summarized below:

Groundwater Levels ¹			
Boring Number	Depth to Groundwater (feet)		
	At Time of Drilling	At End of Drilling	After Completion of Drilling
B-2 ²	1.5 ²	3.0 ²	3.5 @ 0.25 hrs ²
B-4	23.5	23.5	23.5 @ 0.25 hrs
B-5 ²	8.0 ²	Not obtained due to coring	Not obtained due to coring
1. Groundwater was not encountered in any of the remaining borings during drilling, at the completion of drilling, or for the short duration the borings were allowed to remain open before they were backfilled 2. The drillers indicated the water appeared to be perched in the uncontrolled fill at this boring location			

Due to the low permeability of the clayey soils encountered in the borings, a relatively long period of time may be necessary for a groundwater level to develop and stabilize in a borehole in these materials. Long term observations in piezometers or observation wells sealed from the influence of surface water are often required to define groundwater levels in materials of this type.

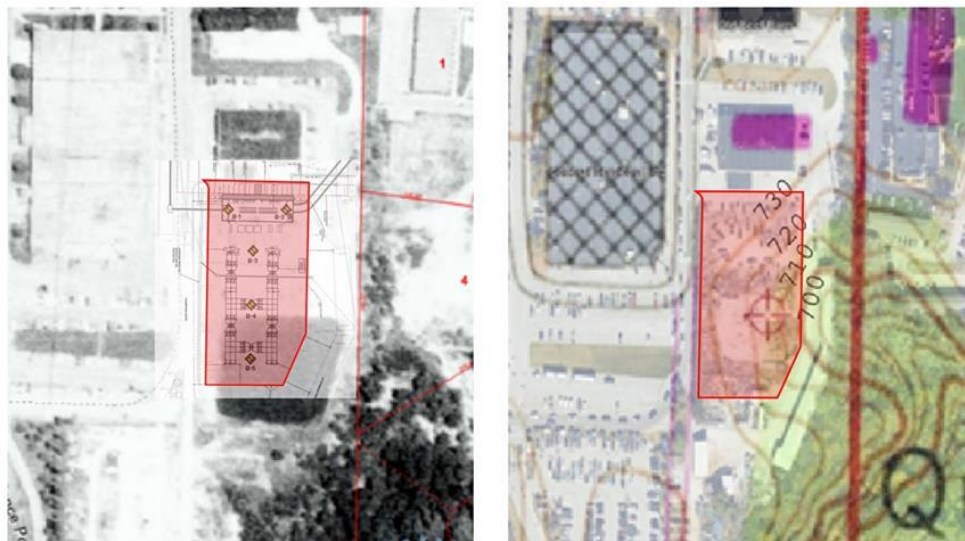
Perched groundwater can develop over low permeability soil or rock strata. This possibility should be considered when developing design and construction plans and specifications for the project. Groundwater levels depend on seasonal and climatic variations and may be present at different levels in the future.

The boreholes were backfilled prior to departing the project site. Groundwater records are indicated on the boring logs included in the Appendix of this report.

4 GEOTECHNICAL RECOMMENDATIONS

4.1 PAST SITE GRADING

Historical aerial photography (below left, circa 1977) and historical USGS topographic maps (below right, circa 1981) indicate this site once contained deeply incised gullies and a stormwater detention basin. The original contours were approximated on the adjacent drawing. The elevation differences between existing grade and historical contours indicate as much as 30 feet of fill was placed on this property. The area of deepest fill appears to be located at the south and east sides of the property. The fill on this property, as encountered in the borings, was classified as uncontrolled fill. This fill type is discussed in the following report sections.



4.2 UNCONTROLLED FILL

Uncontrolled fill was encountered in all borings to depths ranging from about 3.0 to 23.4 feet. Uncontrolled fill is material that is variable in strength, density, moisture content and composition. The uncontrolled fill thickness should be expected to vary between boring locations. The uncontrolled fill is not suitable for the support of shallow foundations unless improved using aggregate piers.

Based upon what was encountered in the borings, it is unclear as to whether the uncontrolled fill would be suitable for reuse as new structural fill if moisture conditioned and recompacted. We recommend the owner establish unit rates for complete removal and replacement of the uncontrolled fill. Determining if portions of the existing uncontrolled fill are suitable for reuse as new structural fill should be made during the excavation process.

4.2.1 Risk of Construction on Uncontrolled Fill

Owners sometimes choose to allow uncontrolled fill to remain on a project site in floor slab areas. Risk associated with construction on uncontrolled fill must be assumed by the owner.

In order to reduce, but not eliminate, the risk of supporting new floor slabs on uncontrolled fill, we recommend the subgrade be thoroughly evaluated after stripping and creation of all cut areas but prior to the start of fill operations. Additional evaluations may require the excavation of test pits. Risk can be also reduced by removing and replacing a portion of the uncontrolled fill with new structural fill. Additional reductions in risk could be achieved by removing and replacing a thicker portion of the uncontrolled fill with new structural fill. The risks associated with construction on uncontrolled fill can be eliminated by completely removing and replacing the uncontrolled fill with new structural fill.

4.3 SHRINK/SWELL PRONE SOILS

This report addresses the presence of soil that can shrink or swell due to changes in moisture. It offers recommendations to minimize the negative effects of soil shrinkage and expansion. However, even with these measures, some movement and minor cracking should be expected in the structure. If modifications to the site lead to excessive wetting or drying of the soil, the severity of cracking and cosmetic damage like uneven floor slabs may increase. Completely eliminating the risk of movement and cosmetic distress may not be possible, but utilizing more costly construction methods could further reduce the risk. We are available to discuss alternative construction options if desired.

While the recommended procedures in this report for constructing a low volume change (LVC) zone may not eliminate all subgrade volume change and floor slab movements, they should greatly reduce the likelihood of such changes. A thicker LVC zone could further decrease floor

slab movements. Soil within the top 24-inches under the building floor slab areas should meet LVC criteria, as defined in the Earthwork section of the report with additional details in the Floor Slab section of this report.

Effective drainage away from the building is crucial both during and after construction. Allowing water to accumulate near the building can lead to increased soil movement and compromised structural performance. It is advisable to verify final grades after construction and landscaping to ensure proper drainage. Regular inspections and adjustments of the grades around the structure should be included in the maintenance program.

4.3.1 Estimated Swell

Soil that is prone to volume change with variations in moisture content (shrink/swell prone soil) is present on this site. Because of this, two swell estimation techniques that use common index properties (liquid limit, plasticity index, dry density and moisture content) was utilized to evaluate the potential for swell at the lowest floor slab level. Based upon the results of these methods, the potential swell of the near surface soils is estimated to be on the order of 1.5% to 6.0%.

4.3.2 Swell Discussion

Based on geotechnical literature, swell potential is classified as follows:

Swell Potential Classification	
Swell, %	Classification
< 0.5	Low (non-critical)
0.5 – 1.5	Moderate
> 1.5	High (critical)

The estimated swell range of 1.5% to 6.0% indicate a moderate to high potential for volume change in the near-surface soils. This suggests that differential movement of lightly loaded, grade-supported structures, such as floor slabs, is likely without proper mitigation. To address this, we strongly recommend constructing a low volume change (LVC) zone beneath all at-grade floor slabs, as specified in the Earthwork and Floor Slab sections of this report. This LVC zone will reduce, but not eliminate, the risk of differential movement. Additional measures, such as enhanced drainage systems and deeper LVC zones, may further minimize movement but will increase construction costs. Regular monitoring and maintenance of site drainage are essential to prevent moisture-induced soil volume changes that could affect structural performance.

4.4 EARTHWORK

At the completion of stripping and grubbing, we recommend the exposed subgrade be thoroughly evaluated before the start of any fill operations, including placement of low volume change material. We recommend the geotechnical engineer be retained to evaluate the bearing material for the foundations and subgrade soils. Subsurface conditions, as identified by the field and laboratory testing programs have been reviewed and evaluated with respect to the proposed project plans known to us at this time.

4.4.1 Site Preparation

Uncontrolled fill is present on this site. Due to the volume of the uncontrolled fill, it is likely that it will remain on the project site. Soil stabilization recommendations are provided later in this report.

All unsuitable material should be removed from the construction areas prior to placing structural fill. After stripping and grubbing, the site should be proof-rolled to aid in locating loose or soft areas. Proof-rolling can be performed with a loaded tandem axle dump truck in areas of new construction and areas subjected to repetitive construction traffic. Soft, wet, dry and low-density soil should be removed or be moisture conditioned and recompacted in place as structural fill prior to placing new structural fill.

4.4.2 Structural Fill Requirements

Compacted structural fill should consist of approved materials free of organic matter and debris. Frozen material should not be used and fill should not be placed on a frozen subgrade. Native soil and uncontrolled fill that is approved for re-use, that is removed during basement excavation can be recompacted as new structural fill. A sample of each material type should be submitted for evaluation prior to use.

Structural Fill Material Requirements		
Material Type	Atterberg Limit Range	Acceptable Uses
Granular	Non-plastic	All locations
Low Plasticity Cohesive Soil	(LL<40)	All locations
Moderate Plasticity Cohesive Soil	(40<LL<50)	≥24 inches below slabs on grade unless PI<20
High Plasticity Cohesive Soil	(LL≥50+)	≥24 inches below slabs on grade

Structural Fill Material Requirements	
Low Volume Change Material ^{1,2}	<u>In climate-controlled areas:</u> 1-inch minus crushed limestone aggregate, limestone screenings, or granular material such as sand, gravel or crushed stone containing at least 18% low plasticity fines - Low plasticity cohesive soil or granular soil having at least 18% low plasticity fines <u>In both non-climate-controlled and climate-controlled areas:</u> - Soil treated with chemicals (hydrated lime, lime kiln dust, etc.) 1-inch minus crushed limestone aggregate base rock (e.g., Type 5 MoDOT)
- If limestone screenings are used as new structural fill, the contractor should be aware this material is extremely susceptible to degradation upon wetting which can result in deep-seated pumping and rutting - Limestone screenings that pump and rut are not acceptable for use as new structural fill or for low volume change (LVC) material and will need to be removed and replaced with suitable material.	

4.4.3 Structural Fill Compaction Requirements

Structural Fill Compaction Requirements	
Soil Fill Lift Thickness	9 inches or less when using heavy self-propelled compaction equipment 6-inches or less when using hand guided or light self-propelled equipment
Compaction Requirements ^{1,2}	95% of standard Proctor dry density (ASTM D-698) - Recommend testing engineered fill for moisture and density during placement. If in-place density tests show the specified limits are not met, rework and retest the affected area until requirements are met. - Follow ASTM D698, which is for soils with 30% or less material larger than 3/4". For materials with more than 30% aggregate retained on the 3/4"-sieve, use full-time proof-roll observation instead of moisture density testing.
Compaction Moisture Content Requirements	- Moderate to Highly Plastic Cohesive Soil - Low Plasticity Cohesive Soil - Granular Optimum moisture content (OMC) to 4% above the standard Proctor optimum moisture content 2% below to 3% above standard Proctor OMC Workable moisture content. Shall not pump when proof-rolled

4.4.4 Soil Stabilization

The potential for unstable subgrade soils exists on this project site. Unstable subgrade conditions could worsen during general construction operations, particularly if the soils are wetted or subjected to repetitive construction traffic. The use of remotely operated equipment, such as a backhoe, would be beneficial to perform cuts and reduce subgrade disturbance.

Should unstable subgrade conditions be encountered, stabilization measures will need to be employed and could consist of one of the methods outlined below. These methods should not be utilized below foundations.

Scarification and Recompaction: It may be feasible to scarify, dry and recompact the exposed soils. The success of this procedure would depend primarily upon favorable weather and sufficient time to dry the soils. Stable subgrades likely would not be achievable if the thickness of the unstable soil is greater than about 1 foot, or if construction is performed during a period of wet weather when drying is difficult.

Crushed Stone: The use of crushed stone or crushed gravel is the most common procedure to improve subgrade stability. Typical undercut depths in general fill areas would be expected to range from about 12 to 30 inches below finished subgrade elevation.

Geogrid: Geogrid could also be considered. Prior to placing the geogrid, all below grade construction, such as utility line installation, should be completed to avoid damaging the geogrid. Equipment should not be operated above the geogrid until one full lift of crushed stone fill is placed above it. The aggregate gradation requirements, as specified by the geogrid manufacturer, should be verified prior to material purchase and placement.

Clean Aggregate Stabilization: Subgrades can also be stabilized by placing a thin lift of 3-inch clean aggregate on top of the unsuitable soil and working it into the subgrade with appropriately sized equipment. This process should be repeated until the subgrade is stable enough to pass a proof roll. It should be recognized if multiple lifts are required, the initial elevation of the unsuitable subgrade will likely rise or swell due to the placement of the aggregate. This volume-change should be accounted for when planning for final grades.

Chemical Stabilization: Improvement of subgrades with Portland cement, lime kiln dust (LKD) or class C fly ash could be considered for improving unstable soils. Chemical modification should be performed by a pre-qualified contractor having experience with successfully stabilizing subgrades in the project area on similar sized projects with similar soil conditions. Results of chemical analysis of the additive materials should be provided to the geotechnical engineer prior to use. The hazards of chemicals blowing across the site or onto adjacent property should also

be considered. Additional testing would be needed for us to develop specific recommendations to improve subgrade stability by blending chemicals with the site soils.

Further evaluation of the need and recommendations for subgrade stabilization can be provided during construction as the geotechnical conditions are exposed on a broad scale; however, we recommend the owner budget for, and the contractor be prepared for, subgrade stabilization.

4.4.5 Grading and Drainage

Final surrounding grades should be sloped away from the structure on all sides to prevent ponding of water. Gutters and downspouts that drain water a minimum of 10 feet beyond the footprint of the proposed structure is recommended. This can be accomplished through the use of splash-blocks, downspout extensions, and flexible pipes designed to attach to the end of the downspout. Flexible pipe should only be used if it is daylighted in such a manner that it gravity-drains collected water. Splash-blocks should also be considered below hose bibs and water spigots.

4.4.6 Underground Utilities

With the exception of individual service lines to the building that intersect foundations perpendicularly, below grade utilities should not be located within the stress influence zone of the building foundations. Accordingly, below grade utilities should be located outside a zone extending 45-degrees downward and outward from the edge of the footings.

4.4.7 Earthwork Construction

In periods of dry weather, the surficial soils may be of sufficient strength to allow fill construction on the stripped and grubbed ground surface. However, unstable subgrade conditions could develop if the soils are wet or subjected to repetitive construction traffic. Should unstable subgrade conditions be encountered, stabilization measures will need to be employed.

Upon completion of filling and grading, care should be taken to maintain the subgrade moisture content prior to construction. Construction traffic over the completed subgrade should be avoided to the extent practical. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. If the subgrade should become frozen, desiccated, saturated, or disturbed, the affected material should be removed or these materials should be scarified, moisture conditioned, and recompacted prior construction.

The geotechnical engineer should be retained during the construction phase of the project to observe earthwork/fill placement and to perform necessary tests and observations during subgrade preparation; proof-rolling; placement and compaction of structural fills; backfilling of excavations into the completed subgrade, and just prior to construction.

4.4.8 Temporary Excavations

The Occupational Safety and Health Administration (OSHA) has developed regulations to provide for the safety of workers entering excavations. All excavation operations should be performed under the supervision of qualified site personnel in accordance with OSHA Excavation and Trench Safety Standards.

4.5 FOUNDATIONS

The subsurface data obtained from the borings was analyzed to evaluate potential foundation design alternatives. Based upon our analyses, it is our professional opinion that it would not be feasible to utilize shallow foundations at this site due to the presence of uncontrolled fill. However, two foundation alternatives appear suitable for use at this site:

1. High capacity conventional shallow foundations bearing on an aggregate pier reinforced subgrade appear to be an acceptable alternative and may potentially provide an economic benefit as compared to utilizing a deep foundation system.
2. Drilled pier foundation system

Aggregate pier supported shallow foundations or drilled piers (deep foundation) are required for all structural elements in areas underlain by uncontrolled fill.

4.5.1 Aggregate Pier Supported Shallow Foundation Design Recommendations

Aggregate piers can be used to support shallow foundations and possibly floor slabs (if needed) for the proposed structures. Aggregate pier foundation elements are usually part of the foundation contractor's design-build system. Therefore, the subsurface exploration information contained in this report should be provided to the foundation contractors for detailed analysis and design and cost information.

We anticipate an aggregate pier solution could be designed to strengthen and stiffen the existing clay to provide a substantially increased allowable bearing pressure, often between 4,000 psf to 8,000 psf, while reducing total and differential settlement by providing uniform support conditions for the footings.

4.5.2 Aggregate Pier Supported Shallow Foundation Construction Considerations

The base of all foundation excavations should be free of water and loose soil and rock prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Should the soils at bearing level become excessively dry, disturbed, saturated, or frozen the affected soil should be removed prior to placing concrete. Place a lean concrete mud-mat over the bearing soils if the excavations must remain open over night or for an

extended period of time. It is recommended the geotechnical engineer be retained to observe and test the soil foundation bearing materials.

Groundwater was encountered in some of the borings, apparently perched within the uncontrolled fill. Conditions may develop such that it may be encountered during foundation excavation. In addition, some surface and/or perched groundwater may enter foundation excavations during construction. It is anticipated any water entering foundation excavations from these sources can be removed using sump pumps or gravity drainage.

Quality assurance testing should be performed during installation. CGTL would be pleased to provide this service.

4.5.3 Shallow Foundation Design Recommendations

Design recommendations for aggregate pier-supported shallow foundations are as follows:

Shallow Foundation Design Recommendations	
Ultimate passive pressure (equivalent fluid pressure) 1. The sides of the spread footing foundation excavations must be nearly vertical and the concrete should be placed neat against the vertical faces for the passive earth pressure values to be valid 2. Passive resistance in the frost zone should be neglected 3. Some movement of the footing will be required to mobilize resistance from passive pressure and sliding friction	270 pcf
Ultimate coefficient of sliding friction	0.32
Minimum embedment below finished grade for frost protection	30-inches
Uplift Resistance - Soil Total Unit Weight - Concrete Total Unit Weight 1. Only the soil directly overlying the foundation should be used for uplift resistance 2. Unit weight values do not include factors of safety 3. Assumes foundations are drained and are constructed above the highest groundwater level	120 pcf 150 pcf

4.5.4 Drilled Pier Foundation Design Recommendations

As an alternative to the aggregate pier supported shallow foundation system, drilled piers can also be utilized at this site. The design parameters provided in the following table are based on the results of field and laboratory testing, published values, and our past experience with similar

soil and bedrock conditions. Based on the results of the borings, we have developed the following drilled pier LPILE design parameters:

Drilled Pier Design Parameters								
Material Type	Unit Weight (pcf) ²	Cohesion (psf)	Average Blow Count (N Value) Per Foot ³	Friction Angle, ϕ	Allowable End Bearing Pressure (psf) ⁴	Allowable Skin Friction (psf) ⁵	Lateral Subgrade Modulus (pci) ⁶	Strain ϵ_{50} (in/in) ⁶
0 - 3 feet	120	Ignore	Ignore	Ignore	Ignore	Ignore	Ignore	Ignore
Uncontrolled Fill	58	1,200	-	-	NR ⁷	240	350	0.010
Fat Clay	120	2,000	-	-	NR ⁷	400	650	0.007
Weathered Shale	135	4,000	66	-	NR ⁷	800	1,300	0.005
Shale	140	6,000	100+	-	18,000 ⁴	1,200	2,000	0.004
Limestone	150	10,000	-	-	30,000	2,000	3,000	0.0001
- CGTL should observe pier excavations to evaluate whether conditions are consistent with those encountered in our boring - Effective unit weight - Blow count listed in this table is averaged for the layers Detailed blow count information is listed on the boring log included in the Appendix of this report - Minimum pier length of 4 diameters required CGTL should be contacted if the pier length is less than four times the pier diameter as modifications to our design parameters may be warranted Allowable end bearing pressure based on a factor of safety of 3.0 <u>For piers bearing on rock</u> The skin friction values and cohesion values are based on a constant (rectangular) pressure distribution for cohesive soils and bedrock Allowable skin friction derived from NAVFAC Design Manual, DM 7.2 (1986) Allowable skin friction based on a factor of safety of 3.0 - Lateral subgrade modulus and strain values are to be utilized with LPILE software - NR = Not Recommended								

Drilled piers should have a minimum shaft diameter of 30 inches. The above-indicated cohesion and unit weight values are ultimate values without factors of safety. The end bearing, skin friction, and passive resistance are allowable parameters with factors of safety.

4.5.5 Drilled Pier Foundation Construction Considerations

Specialized drilling techniques may be required. The contractor should be prepared to handle wet drilling conditions. Temporary casing may be needed to advance drilled pier excavations.

For proper performance of the drilled pier foundation system, it is critical for the bottom of the pier excavation be cleaned of any water and loose material prior to placing reinforcing steel and concrete. Concrete should be placed soon after excavating to minimize bearing surface disturbance. Any water accumulating in the pier excavation should be pumped from the excavation or the water level should be allowed to stabilize and then concrete should be placed using the tremie method.

If concrete will be placed as the temporary casing is being removed, we recommend the concrete mixture be designed with a slump of about 5 to 7 inches to reduce the potential for arching when removing the casing. While removing the casing from a pier excavation during concrete placement, the concrete inside the casing should be maintained at a sufficient level to resist any earth and hydrostatic pressures outside the casing during the entire casing removal procedure.

We recommend a Crockett GTL engineer or their representative be present on a full-time basis during drilling activities to evaluate the materials removed from the drilled pier excavations to determine when adequate capacity has been developed, to observe the base of the drilled pier to determine that the cuttings have been adequately removed and also to observe the concreting techniques.

4.5.6 Pier Group Effect – Axially Loaded Piers

Piers should be spaced a minimum of 3 diameters center-to-center. Closer spacing may require a reduction in axial load capacity. Axial capacity reduction can be determined by comparing the allowable axial capacity determined from the sum of individual piers in a group versus the capacity calculated using the perimeter and base of the group acting as a unit. The lesser of the two capacities should be used in design. Pile caps and grade beams should extend at least 3 feet below grade for frost protection.

4.5.7 Pier Group Effect – Laterally Loaded Piers

Laterally loaded piers behave as a group when center to center spacing is less than 8 diameters in the direction of loading. Allowable passive resistance provided by a row of piers in line with the direction of the load should be reduced as determined by multiplying the individual lateral resistances of the piers by the number of piers in line and the appropriate reduction factor provided in the following table:

Pier Group Effect – Laterally Loaded Piers	
Pier Spacing D = Pier Diameter	Lateral Resistance Reduction Factor
8D	1.00
6D	0.7
4D	0.4
3D	0.25

Lateral loads acting perpendicular to a row of piers with center-to-center spacing of 3 diameters or less will cause the foundations to react essentially as a vertical wall. For this case, the lateral earth pressures provided in the lateral Earth Pressures section of this report should be used for the projected pier diameter. With spacing of greater than 3 diameters, the values provided in the previous table for individual piers may be used.

4.6 FLOOR SLABS

The following low volume change (LVC) thickness recommendations are based on lab tests, empirical swell estimation techniques, our knowledge of the site soil conditions and our experience with similar sites and structures. These recommendations will reduce, but not eliminate, the risk of movement and cosmetic distress. This risk could be further reduced if a thicker low volume change zone is developed or if significantly more expensive measures are used during construction.

Active soils that are prone to volume change with variations in moisture content are present near the anticipated at-grade floor slab subgrade level. Because of this, we recommend a low volume change zone be constructed beneath all at-grade floor slabs and equipment pads. Details follow:

Floor Slab Design Recommendations ^{1,2}	
Floor slab support	24-inch low volume change zone
Modulus of subgrade reaction For point loading conditions	100 (psi/in)
Aggregate base course/capillary break - Free draining granular material - Free-draining granular material should have less than 5 percent fines (material passing the #200 sieve)	4 to 6 inches Aggregate base course can be considered part of the low volume change zone

Floor Slab Design Recommendations ^{1,2}

1. Floor slabs should be structurally independent of any building footings or walls to reduce the possibility of floor slab cracking caused by differential movement between the slab and foundation. However, if floor slabs are tied to perimeter walls or turn-down slabs to meet structural or other construction objectives, our experience indicates that any differential movement between the walls and slabs will likely be observed in adjacent slab expansion joints or slab cracks that occur beyond the length of the structural dowels. The structural engineer should account for this potential differential settlement through use of sufficient control joints, appropriate reinforcing or other means
2. If the subgrade should become desiccated or saturated prior to construction of floor slabs, the affected material should be removed or the materials scarified, moistened, and recompact. Care should be taken to maintain the recommended subgrade moisture content and density until construction of the building floor slabs

Control joints should be utilized in the slab to help control the location and extent of cracking. For additional recommendations refer to the ACI Design Manual. Joints or any cracks that develop should be sealed with a water-proof, non-extruding compressible compound specifically recommended for heavy duty concrete pavement and wet environments.

The use of a vapor retarder should be considered beneath concrete slabs on grade that will be covered with wood, tile, carpet or other moisture sensitive or impervious coverings, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

4.7 SEISMIC CONSIDERATIONS

The International Building Code and ASCE 7 requires the average properties in the upper 100 feet of the subsurface profile be determined for seismic site classification. The drilling scope performed for this project had borings that extended to a maximum depth of 33.0 feet. As such, we provide the following seismic site classification:

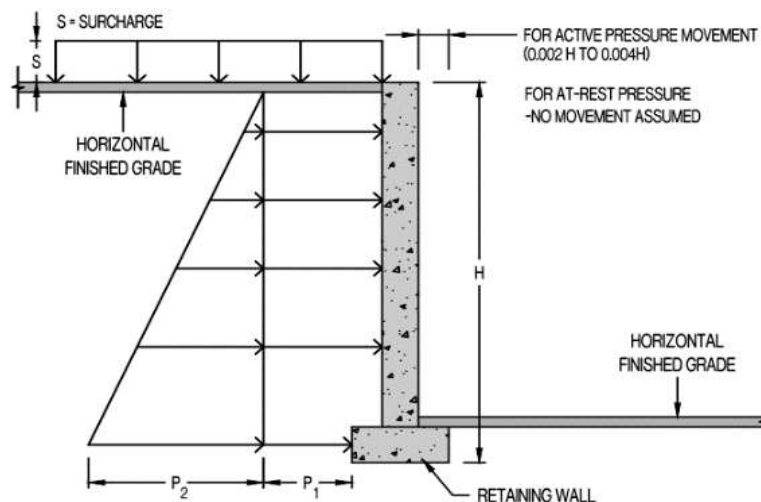
Seismic Site Classification	
Code Used	International Building Code (IBC) and ASCE 7
Site Classification	C

Additional exploration to greater depths could be considered to confirm the conditions below the current depth of exploration. Alternatively, a geophysical exploration could be utilized in order to attempt to justify a more favorable seismic site class.

4.8 LATERAL EARTH PRESSURES

The following lateral earth pressure recommendations are applicable to the design of rigid retaining walls subject to slight rotation, such as cantilever, or gravity type concrete walls. These recommendations are not applicable to the design of modular block - geogrid reinforced backfill walls. Recommendations covering these types of wall systems are beyond the scope of services for this assignment.

Reinforced concrete walls with unbalanced backfill levels may be utilized on this site. Walls should be designed using the earth pressures indicated on the following table. Earth pressures will be influenced by structural design of the walls, conditions of wall restraint, methods of construction and/or compaction and the strength of the materials being restrained. Two wall restraint conditions are shown. Active earth pressure is commonly used for design of free-standing cantilever retaining walls and assumes wall movement. The "at-rest" condition assumes no wall movement. The recommended design lateral earth pressures do not include a factor of safety and do not provide for possible hydrostatic pressure on the walls.



Earth Pressure Coefficients			
Backfill Type	Active (K_a)	At Rest (K_o)	Passive (K_p)
Equivalent Fluid Unit Weights			
Cohesive	50 pcf	70 pcf	280 pcf
Granular	40 pcf	60 pcf	360 pcf
Surcharge Pressure, P_1 (psf)			
Cohesive	(0.42) S	(0.58) S	---
Granular	(0.33) S	(0.46) S	---

Earth Pressure Coefficients			
Earth Pressure, P ₂ (psf)			
Cohesive	(50)H	(70)H	---
Granular	(40)H	(60)H	---
Sliding Resistance	0.32 (coefficient of friction)		
• The values are applicable when the surface of the backfill behind the wall is horizontal. Increased values will result with steeper than horizontal slopes • No safety factor included in soil parameters • Does not include loading from heavy compaction equipment • No hydrostatic pressures acting on wall • Backfill compacted to 95% standard Proctor dry density, or 80% relative density, as appropriate for material type • Soil backfill unit weight a maximum of 120 pcf • No dynamic loading • For active earth pressure, wall must rotate about base, with top lateral movements of about 0.002 H to 0.004 H, where H is wall height • For passive earth pressures to develop, the wall must move horizontally • Ignore passive pressure in the frost zone • For the granular values to be valid, the granular backfill must extend out from the base of the wall at an angle of at least 45 and 60 degrees from vertical for the active and passive cases, respectively • Exterior granular backfill should be capped with approximately 2 feet of cohesive soil to reduce the potential for surface water infiltration into the granular backfill • Uniform surcharge, where S is surcharge pressure			

We recommend all below-grade walls be provided with a drainage system. A minimum 4-inch diameter, perforated drainpipe should be placed at the foundation level. Granular drainage material, consisting of 1-inch clean crushed rock, classified as GP by ASTM D 2487, with less than 5 percent passing the No. 200 sieve, should be placed a minimum of 6 inches in all directions around the drainage pipe. Synthetic filter fabric, such as Mirafi 140N or equivalent, should encapsulate the drainpipe and granular drainage material.

The pipe should be sloped to drain by gravity or through weep holes located on approximately 10-foot centers for above-grade retaining walls, or to a sump with a pump for below-grade walls where positive drainage by gravity cannot be achieved. Any interior sumps must be isolated "watertight" from the interior subgrade to prevent the movement of moisture from the sump into the underlying soils.

4.9 SPECIAL INSPECTION REQUIREMENTS

The following items require special inspections in accordance with Chapter 17 of the International Building Code:

The contractor shall request special inspection of the items listed above prior to those items becoming inaccessible and unobservable due to the progression of work.

Schedule of Special Inspection Services ^{1,2}			
Material/Activity	Service	Applicable to this Project	
		Y/N	Extent
1705.6 Soil		Y	
Verify materials below shallow foundations are adequate to achieve the design bearing capacity	Field Inspection	Y	Periodic
Verify excavations are extended to proper depth and have reached proper material	Field Inspection	Y	Periodic
Perform classification and testing of controlled fill materials	Field Inspection	Y	Periodic
Verify use of proper material, densities, and lift thicknesses during placement and compaction of controlled fill	Field Inspection	Y	Continuous
Prior to placement of controlled fill, observe subgrade and verify site has been prepared properly	Field Inspection	Y	Periodic
1705.7 Driven Deep Foundations		N	
1705.8 Cast-In-Place Deep Foundations		Y	
Observe drilling operations and maintain complete and accurate records for each element	Field Inspection	Y	Continuous
Verify placement locations and plumbness, confirm element diameters, bell diameters (if applicable), lengths, embedment into bedrock (if applicable), and adequate end bearing strata capacity. Record concrete or grout volumes	Field Inspection	Y	Continuous
For concrete elements, perform additional inspections in accordance with section 1705.3	See section 1705.3	Y	See section 1705.3
Perform additional inspections and tests in accordance with the construction documents	Field Inspection and Testing	Y	In accordance with the construction documents
1705.9 Helical Pile Foundations		N	
1. Testing and inspections services shall be performed by an approved agency in general accordance with section 1703 of the International Building Code 2. This section references 2015 IBC. Other code years may have a differing section number for concrete elements			

5 GENERAL COMMENTS

The recommendations provided herein are for the exclusive use of our client. Our recommendations are specific only to the project described herein and are not meant to supersede more stringent requirements of local ordinances or codes. The recommendations are based on subsurface information obtained at our boring locations, sample locations, our understanding of the project as described in this report, and geotechnical engineering practice consistent with the current standard of care. No warranty is expressed or implied. CGTL should be contacted if conditions encountered are not consistent with those described.

CGTL should be provided with a set of final plans and specifications once they are available to review whether our recommendations have been understood and applied correctly and to assess the need for additional exploration or analysis. Failure to provide these documents to CGTL may nullify some or all of the recommendations provide herein. In addition, any changes in the planned project or changes in site conditions may require revised or additional recommendations on our part.

The final part of our geotechnical service should consist of direct observation during construction to observe that conditions actually encountered are consistent with those described in this report and to assess the appropriateness of the analyses and recommendations contained herein. CGTL cannot assume liability or responsibility for the adequacy of recommendations without being retained to observe construction.

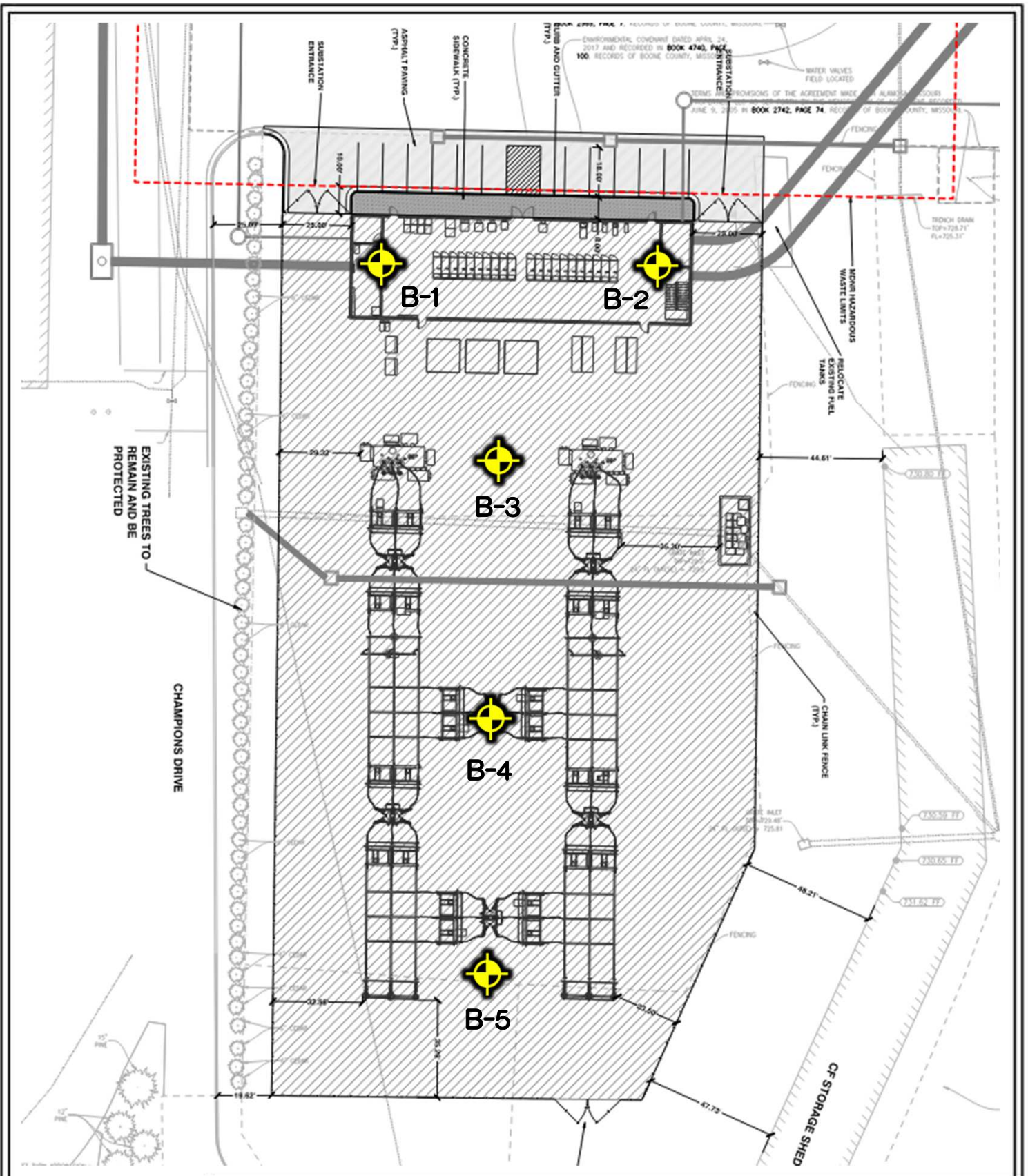
APPENDIX



SITE LOCATION MAP

CP231541 GS – ELECTRICAL
INTERCONNECTION AND SUBSTATION
COLUMBIA, MISSOURI

CROCKETT
GEOTECHNICAL - TESTING LAB
1000 W. Nifong Blvd, Building 1
Columbia, MO 65203
573-447-0292
www.CrockettEngineering.com



PROJECT NO.: G251201.1

BORING LOCATION PLAN

CP231541 GS - ELECTRICAL
INTERCONNECTION AND SUBSTATION
COLUMBIA, MISSOURI

Prepared By:

CROCKETT
GEOTECHNICAL - TESTING LAB
1000 W. Nifong Blvd, Building 1
Columbia, MO 65203
573-447-0292
www.CrockettEngineering.com

Crockett GTL
1000 W Nifong Blvd, Bldg 1
Columbia, MO 65203
Telephone: 573-447-0292



BORING NUMBER B-1

PAGE 1 OF 1

CLIENT	University of Missouri	PROJECT NAME	CP231541 GS - Electrical Interconnection & Substation
PROJECT NUMBER	G251201.1	PROJECT LOCATION	Columbia, Missouri
DATE STARTED	7/16/25	COMPLETED	7/16/25
GROUND ELEVATION	732 ft MSL	HOLE SIZE	4"
DRILLING CONTRACTOR	IPES	GROUND WATER LEVELS:	
DRILLING METHOD	4" SSA	AT TIME OF DRILLING	--- Not encountered
LOGGED BY	Walsh	CHECKED BY	Lidholm
AT END OF DRILLING	--- Not encountered		
NOTES	Borehole backfilled upon completion		
0.25hrs AFTER DRILLING	--- Not encountered		

SAMPLE LENGTH REPORT - LAT-LONG TEMPLATE.GDT - 8/18/25 09:45 - V:\PROJECTS\2025\G251201 - CP231541 GS - ELEC. INTERCONNECT & SUBSTATION\SUPPORTING DOCUMENTS\1\G251201.GPJ

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY LENGTH	BLOW COUNTS (N VALUE)	PENETROMETER (psf)	UNC. COMP. (psf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		
										LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
0												
0.2		GRAVEL (2-inches)										
		UNCONTROLLED FILL: Gravelly fat clay, brown, trace sand	ST 1	8		3600			17			
3.0		FAT CLAY: Reddish brown, trace gray	ST 2	17		4000	2700	99	24	79	21	58
5												
8.5		GRAVELLY WEATHERED SHALE: Tan	SPT 3	11	14-27-32 (59)	8000			14			
10												
13.5		GRAVELLY SHALE: Tan, petroleum odor	SPT 4	6	50/6"	12000			10			
15												
20		--: trace red	SPT 5	6	50/6"	12000			9			
25												
30		--: becomes gray	SPT 6	7	17-50/3"	12000			8			
30.5												
31.0		LIMESTONE: Hard	SPT 7	2	50/2"	12000			7			

Split spoon sampler refusal 14.0 feet, 19.0 feet, 24.3 feet and 28.7 feet.
Auger refusal at 31.0 feet.
Bottom of borehole at 31.0 feet.

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Telephone: 573-447-0292



CLIENT University of Missouri
PROJECT NAME CP231541 GS - Electrical Interconnection & Substation
PROJECT NUMBER G251201.1
PROJECT LOCATION Columbia, Missouri
DATE STARTED 7/17/25 **COMPLETED** 7/17/25
GROUND ELEVATION 732 ft MSL **HOLE SIZE** 4"
DRILLING CONTRACTOR IPES
GROUND WATER LEVELS:
DRILLING METHOD 4" SSA
▽ **AT TIME OF DRILLING** 1.50 ft / Elev 730.50 ft
LOGGED BY Walsh **CHECKED BY** Lidholm
▼ **AT END OF DRILLING** 3.00 ft / Elev 729.00 ft
NOTES Borehole backfilled upon completion
▼ **0.25hrs AFTER DRILLING** 3.50 ft / Elev 728.50 ft

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY LENGTH	BLOW COUNTS (N VALUE)	PENETROMETER (psf)	UNC. COMP. (psf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		
										LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
0												
0.3		GRAVEL (3-inches)										
		UNCONTROLLED FILL: Gravelly lean clay, gray and tan	X SPT 1	6	6-3-4 (7)	gravel			11			
5			X SPT 2	7	6-5-5 (10)	gravel			19			
10		--: becomes fat clay, tan trace gray, trace gravel, petroleum odor	X SPT 3	7	4-2-2 (4)	1000			52			
15		Sample SPT-4 consisted of wood debris	X SPT 4	6	12-11-10 (21)	wood debris						
18.5												
19.1		GRAVELLY WEATHERED SHALE: Tan, trace gray	X SPT 5	7	37-50/1"	crumbs			29			
20.5		GRAVELLY SHALE: Tan										
21.0		LIMESTONE: Hard										

Split spoon sampler refusal at 19.1 feet.
Auger refusal at 21.0 feet.
Bottom of borehole at 21.0 feet.

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Telephone: 573-447-0292



BORING NUMBER B-3

PAGE 1 OF 1

CLIENT	University of Missouri	PROJECT NAME	CP231541 GS - Electrical Interconnection & Substation
PROJECT NUMBER	G251201.1	PROJECT LOCATION	Columbia, Missouri
DATE STARTED	7/17/25	COMPLETED	7/17/25
GROUND ELEVATION	731 ft MSL	HOLE SIZE	4"
DRILLING CONTRACTOR	IPES	GROUND WATER LEVELS:	
DRILLING METHOD	4" SSA	AT TIME OF DRILLING	--- Not encountered
LOGGED BY	Walsh	CHECKED BY	Lidholm
AT END OF DRILLING	--- Not encountered		
NOTES	Borehole backfilled upon completion		
0.25hrs AFTER DRILLING	--- Not encountered		

SAMPLE LENGTH REPORT - LAT-LONG TEMPLATE.GDT - 8/18/25 09:45 - V:\PROJECTS\2025\G251201 - CP231541 GS - ELEC. INTERCONNECT & SUBSTATION\SUPPORTING DOCUMENTS\1\G251201.GPJ

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY LENGTH	BLOW COUNTS (N VALUE)	PENETROMETER (psf)	UNC. COMP. (psf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		
										LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
0												
0.3		GRAVEL (3-inches)										
		UNCONTROLLED FILL: Gravelly fat clay, brown, trace gray, trace sand, trace brick and asphalt	ST 1	9		7800		114	17			
			ST 2	8		6500			16			
5												
		--: petroleum odor	ST 3	13		3800			23			
10												
13.0			ST 4	17		6800	3368	92	33			
15		FAT CLAY: Brown, trace gray, trace lignite stains, trace sand and gravel, occasional sandy zones										
18.5												
		SHALE: Gray, trace gravel	SPT 5	3	50/3"	12000			13			
20												
22.0												
		BOULDER										
23.5												
		SHALE: Gray	SPT 6	2	50/2"	12000			5			
25												
28.5												
		WEATHERED LIMESTONE: Gray, hard	SPT 7	2	50/2"				5			
29.5												
30.0		LIMESTONE: Hard										

Split spoon sampler refusal at 18.8 feet, 23.7 feet and 28.7 feet.

Auger refusal at 30.0 feet.

Bottom of borehole at 30.0 feet.

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Columbia, MO 65203
Telephone: 573-447-0292



CLIENT University of Missouri
PROJECT NAME CP231541 GS - Electrical Interconnection & Substation
PROJECT NUMBER G251201.1
PROJECT LOCATION Columbia, Missouri
DATE STARTED 7/17/25 **COMPLETED** 7/17/25
GROUND ELEVATION 731 ft MSL **HOLE SIZE** 4"
DRILLING CONTRACTOR IPES
GROUND WATER LEVELS:
DRILLING METHOD 4" SSA
▽ **AT TIME OF DRILLING** 23.50 ft / Elev 707.50 ft
LOGGED BY Walsh **CHECKED BY** Lidholm
▼ **AT END OF DRILLING** 23.50 ft / Elev 707.50 ft
NOTES Borehole backfilled upon completion
▼ **0.25hrs AFTER DRILLING** 23.50 ft / Elev 707.50 ft

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY LENGTH	BLOW COUNTS (N VALUE)	PENETROMETER (psf)	UNC. COMP. (psf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		
										LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
0												
0.3		GRAVEL (3-inches)										
		UNCONTROLLED FILL: Gravelly fat clay, brown and gray, trace sand, trace brick and asphalt	X SPT 1	8	2-2-4 (6)	4500			21			
5			X SPT 2	8	2-1-2 (3)	3600			19			
10			X SPT 3	8	2-2-1 (3)	2500			17			
15		--: petroleum odor	X SPT 4	16	2-4-4 (8)	4000			22			
20			X SPT 5	10	2-4-5 (9)	1800			25			
23.4 23.5		LIMESTONE: Hard	SPT 6	0	50/0"							
		Split spoon sampler refusal at 23.5 feet. Auger refusal at 23.5 feet. Bottom of borehole at 23.5 feet.										

SAMPLE LENGTH REPORT - LAT-LONG TEMPLATE.GDT - 8/18/25 09:45 - V:\PROJECTS\G251201 - CP231541 GS - ELEC. INTERCONNECT & SUBSTATION\SUPPORTING DOCUMENTS\1\G251201.GPJ

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Columbia, MO 65203
Telephone: 573-447-0292



BORING NUMBER B-5

PAGE 1 OF 1

CLIENT	University of Missouri	PROJECT NAME	CP231541 GS - Electrical Interconnection & Substation
PROJECT NUMBER	G251201.1	PROJECT LOCATION	Columbia, Missouri
DATE STARTED	7/17/25	COMPLETED	7/17/25
GROUND ELEVATION	731 ft MSL	HOLE SIZE	4"
DRILLING CONTRACTOR	IPES	GROUND WATER LEVELS:	
DRILLING METHOD	4" SSA & NQ2 Diamond Bit	▽ AT TIME OF DRILLING	8.00 ft / Elev 723.00 ft
LOGGED BY	Walsh	CHECKED BY	Lidholm
AT END OF DRILLING	--- Not obtained due to coring		
NOTES	Borehole backfilled upon completion		
0.25hrs AFTER DRILLING	--- Not obtained due to coring		

SAMPLE LENGTH REPORT - LAT-LONG TEMPLATE.GDT - 8/18/25 09:45 - V:\PROJECTS\2025\G251201 - CP231541 GS - ELEC. INTERCONNECT & SUBSTATION\SUPPORTING DOCUMENTS\1\G251201.GPJ

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY LENGTH	BLOW COUNTS (N VALUE)	PENETROMETER (psf)	UNC. COMP. (psf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		
										LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
0												
0.3		GRAVEL (3-inches)										
		UNCONTROLLED FILL: Gravelly fat clay, dark brown, trace gray, trace rust stains, trace brick and asphalt	ST 1	16		4400	3733	105	22			
			ST 2	16		3000	1905	102	24			
5												
		▽										
10			ST 3	14		2000	1238	87	33			
15		--: trace sand and gravel	ST 4	18		2500	2063	98	27			
18.5												
		FAT CLAY: Light brown, trace gray, trace sand and gravel	SPT 5	16	3-5-6 (11)	5500			29	68	20	48
20												
22.0												
		SHALE: Tan, trace gravel										
23.5												
		LIMESTONE: Gray, hard, occasional shale seams	SPT 6	1	50/1"				10			
25			RC 7	44								
		RQD = 52%										
30			RC 8	41								
		RQD = 42%										
33.0												

Split spoon sampler refusal at 23.5 feet.
Bottom of borehole at 33.0 feet.

BORING LOG LEGEND AND NOMENCLATURE

Sample Type	Description
AU	Auger sample, disturbed, obtained from auger cuttings
NR	No recovery or lost sample
RC	Rock core, diamond core bit, nominal 2-inch diameter rock sample (ASTM D 2113)
ST	Thin walled (Shelby) tube sample, relatively undisturbed (ASTM D 1587)
SPT	Split spoon sample, disturbed (ASTM D 1586)
VA	Shear vane (ASTM D 2753)

Grain Size Terminology	
Boulders	Larger than 12-inches
Cobbles	3-inches to 12-inches
Gravel	Retained on #4 sieve to 3-inches
Sand	Retained on #200 sieve but passes #4 sieve
Silt or Clay	Passes #200 sieve

Descriptor	Relative Proportion of Sand and Gravel	Relative Proportion of Fines
Trace	Less than 15% by dry weight	Less than 5% by dry weight
With	15% to 30% by dry weight	5% to 12% by dry weight
Modifier	More than 30% by dry weight	More than 12% by dry weight

Relative Density of Coarse grained Soils	
Descriptive Term	SPT N-Value, Blows/Foot
Very Loose	0 – 3
Loose	4 – 9
Medium Dense	10 – 29
Dense	30 – 49
Very Dense	50+

Consistency of Fine Grained Soils		
Descriptive Term	SPT N-Value, Blows/Foot	Unconfined Compressive Strength, psf
Very Soft	0 – 1	0 – 500
Soft	2 – 3	501 – 1,000
Medium	4 – 9	1,001 – 2,000
Stiff	10 – 29	2,001 – 4,000
Very Stiff	30 – 49	4,001 – 8,000
Hard	50+	> 8,000

USCS Soil Classification System				
Major Divisions			Group Symbol	Group Name
coarse grained soils more than 50% retained on #200 sieve	gravel •50% of coarse fraction retained on #4 (4.75 mm) sieve	clean gravel •5% small than #200 sieve	GW	well-graded gravel, fine to coarse gravel
			GP	poorly graded gravel
		gravel with •12% fines	GM	silty gravel
			GC	clayey gravel
	sand •50% of coarse fraction passes #4 (4.75 mm) sieve	clean sand	SW	well-graded sand, fine to coarse sand
			SP	poorly graded sand
		sand with •12% fines	SM	silty sand
			SC	clayey sand
fine grained soils more than 50% passes #200 sieve	silt and clay liquid limit < 50	inorganic	ML	silt
			CL	clay
		organic	OL	organic silt, organic clay
	silt and clay liquid limit ≥ 50	inorganic	MH	silt of high plasticity, elastic silt
			CH	clay of high plasticity, fat clay
		organic	OH	organic clay, organic silt
highly organic soils			PT	peat

Weathering	Description of Rock Properties
Fresh	No discoloration. Not oxidized.
Slightly weathered	Discoloration or oxidation of most surfaces but or short distance from fractures
Moderately weathered	Discoloration or oxidation extends from fractures, usually throughout. All fractured surfaces are oxidized or discolored.
Severely weathered	Discoloration or oxidation throughout. All fractured surfaces are oxidized or discolored. Surfaces are friable.
Decomposed	Resembles a soil. Partial or complete remnant rock structure may be present.

Rock Quality Designator (RQD)	
RQD, %	Rock Quality
90 – 100	Excellent
75 – 90	Good
50 – 75	Fair
25 – 50	Poor
0 – 25	Very poor

Joint, Bedding, and Foliation Spacing in Rock		
Spacing	Joints	Bedding/Foliation
< 2-inches	Very close	Very thin
2-inches – 1-foot	Close	Thin
1-foot – 3-feet	Moderately Close	Medium
3-feet – 10-feet	Wide	Thick
>10-feet	Very Wide	Very thick

ROCK CORE PHOTO LOG

CP231541 GS - Electrical Interconnection and Substation - Columbia, Missouri
Crockett GTL Project Number: G251201.1



Boring B-5
RC-7 and RC-8
23.5'-33.0'

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APPENDICIES

HICO 69kV Transformer Shop Drawings

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Date Received: 6/12/24
Date Due: 7/14/24
Coordinator: G. Bick

Submittal Number: CP231541-003
(Provided by Jacobs)

TECHNICAL SUBMITTAL COVER SHEET

☒ Original ☐ Resubmittal If resubmitted, insert original submittal number here: CP231541-003
Submitted by: HICO America
General Description of Contents: 69kV transformer surge arrester drawing

List of Attached Documents (use additional pages as necessary)

	Action Code
1. General Arrangement Drawing	AAN
2. Foundation Drawing	A
3. Nameplate Drawing	A
4. Valve Nameplate Drawing	A
5.	
6.	
7.	

A	Approved. Where marked "Approved" that part of the work covered by the submittal may proceed provided it complies with requirements of the procurement documents. Final acceptance will depend upon that compliance.
AAN	Approved as Noted. When marked "Approved as Noted" that part of the work covered by the submittal may proceed provided that it complies with notations and corrections on the submittal and requirements of the procurement documents. Final acceptance will depend on that compliance.
NAR	Not Approved, Resubmit. The submittal is not acceptable and must be resubmitted. Do not proceed with the part of the work covered by the submittal, including purchasing, fabrication, delivery or other activities. Immediately upon receipt, the supplier shall contact the buyer to discuss the deficiencies and determine the schedule for resubmittal. Revise or prepare a new submittal in accordance with notations/discussions and resubmit to obtain a different action mark.
RNR	Received, No Action Required. Where a submittal is primarily for information or record purposes, special processing or other activity, the submittal will be returned.

☒ Discipline	Checked by	Date	☒ Discipline	Checked by	Date
☒ Structural	Jason Wallace		☒ Electrical	Mike Lewis	7/17/24
☐ Architectural			☐ C&I		
☐ Mechanical			☐ Aerodynamics		

Approved by: Greg Bick
Project Manager

7/26/24
Date

Review is for general conformance with the design concept and contract documents. This review does not relieve the contractor of the responsibility for any deviation from the contract documents.

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CABLE SPEC

1

FERRULING METHOD



WIRE

WIRE FERRULING

PLASTI-GRIP TERMINAL LUGS
(INSULATION)

WHITE-COLOR
BLACK-LETTER

NP	: NAMEPLATE		: MAGNETIC CONTACTOR CONTACT
71Q1	: OIL LEVEL GAUGE—MAIN		: NORMALLY OPEN CONTACT
71Q2	: OIL LEVEL GAUGE—OLTC		: NORMALLY CLOSED CONTACT
49W1	: WINDING TEMPERATURE(HV) THERMOMETER		: MOLDED CASE CIRCUIT BREAKER(MCCB)
49W2	: WINDING TEMPERATURE(XV) THERMOMETER		: TH—RELAY DEVICE
63PR1	: PRESSURE RELIEF DEVICE—MAIN		: FUSE
63PR2	: PRESSURE RELIEF DEVICE—OLTC		: OPERATING COIL
26Q	: OIL TEMPERATURE THERMOMETER—MAIN		: WIRING TERMINAL
74DB2	: DEHYDRATING BREATHER—OLTC		: TERMINAL BLOCK
63N	: N2 GAS SYSTEM		: SPACE HEATER
45M	: DGA		: THERMOSTAT
49T1	: TEMPERATURE CONTROLLER		: DOOR SWITCH
27—2	: UNDERVOLTAGE RELAY		
MDU	: MOTOR DRIVE UNIT		

	:	MAGNETIC CONTACTOR CONTACT
	:	NORMALLY OPEN CONTACT
	:	NORMALLY CLOSED CONTACT
	:	MOLDED CASE CIRCUIT BREAKER(MCCB)
	:	TH-RELAY DEVICE
	:	FUSE
	:	OPERATING COIL
	:	WIRING TERMINAL
	:	TERMINAL BLOCK
	:	SPACE HEATER
	:	THERMOSTAT
	:	DOOR SWITCH

The diagram illustrates a wiring configuration for a 10-core cable system. It is divided into two main sections: an internal connection (top) and an external connection (bottom).

Internal Connection (Top):

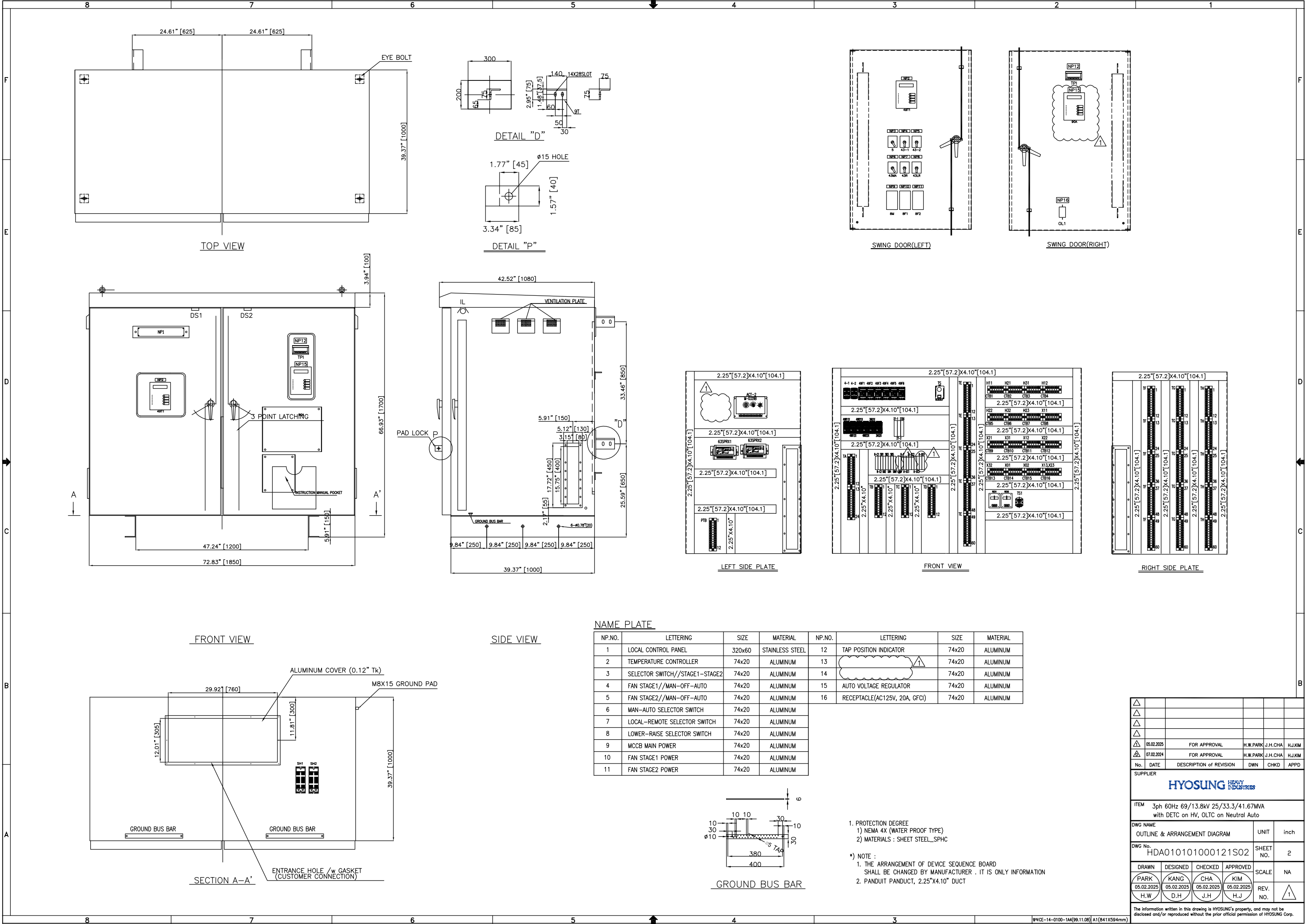
- A 10-core cable, labeled **S1**, is shown on the left. Its cores are numbered 31, 33, 43, 53, 63, 73, 32, 34, 54, 64, 74. It is connected to a ferrulling mark **W2** (top) and a ferrulling mark **W1** (bottom).
- A 10-core cable, labeled **X1**, is shown on the right. Its cores are numbered 73, 74, 75, 76, 77, 78, 79, 80, 81. It is connected to a ferrulling mark **W1** (top) and a ferrulling mark **W2** (bottom).
- The two cables are connected via an **INTERNAL CONNECTION** with a **MAX. NUMBER OF WIRE : 2**.
- A ground connection (**GND**) is shown, connected to the internal connection point.
- A *** START POINT** is indicated near the ground connection.

External Connection (Bottom):

- Three input lines are shown on the left, labeled **H1**, **H2**, and **H3**.
- Line **H3** is connected to a junction point labeled **H31**, which then splits into two lines labeled **1** and **2**.
- Line **1** is connected to a ferrulling mark **H31X1**.
- Line **2** is connected to a ferrulling mark **H31X1**.
- A ground connection (**GND**) is shown, connected to the internal connection point.
- A *** START POINT** is indicated near the ground connection.
- A 10-core cable, labeled **CTB1**, is shown on the right. Its cores are numbered 1, 2, 3, 4, 5, 6. It is connected to a ferrulling mark **H31X1** (top) and a ferrulling mark **H31X1** (bottom).

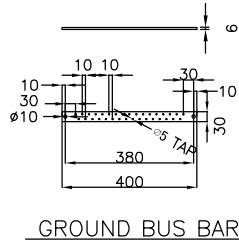
Missing from BOM:
71Q1, 71Q2, 49W1, 49W2, 26Q, 63N,
74DB2, 63PR1, 63PR2, 63SPR1, 63SPR2

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△									
△									
△									
△	05.02.2025	FOR APPROVAL	H.W.PARK	J.H.CHA	H.J.KIM				
△	07.02.2024	FOR APPROVAL	H.W.PARK	J.H.CHA	H.J.KIM				
No.	DATE	DESCRIPTION OF REVISION	DWN	CHKD	APPD				
SUPERIOR									
									
ITEM	3ph 60Hz 69/13.8kV 25/33.3/41.67MVA with DETC on HV, OLTC on LV								
DWG NAME	LEGEND & BILL OF MATERIALS DIAGRAM				UNIT	inch			
DWG No.	HDA010101000121S01				SHEET NO.	1			
DRAWN	DESIGNED	CHECKED	APPROVED		SCALE	NA			
PARK 05.02.2025	KANG 05.02.2025	CHA 05.02.2025	KIM 05.02.2025		REV.	△			
H.W.	D.H.	J.H.	H.J.		NO.	1			
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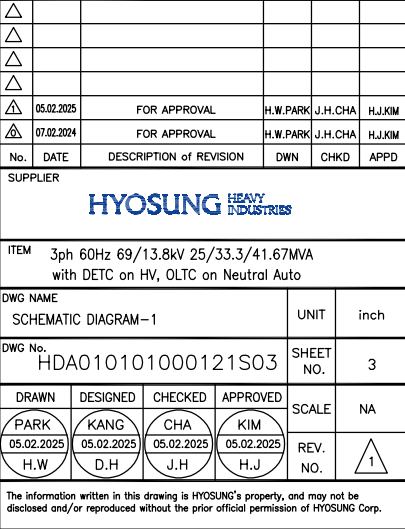
NAME PLATE

NP.NO.	LETTERING	SIZE	MATERIAL	NP.NO.	LETTERING	SIZE	MATERIAL
1	LOCAL CONTROL PANEL	320x60	STAINLESS STEEL	12	TAP POSITION INDICATOR	74x20	ALUMINUM
2	TEMPERATURE CONTROLLER	74x20	ALUMINUM	13		74x20	ALUMINUM
3	SELECTOR SWITCH//STAGE1-STAGE2	74x20	ALUMINUM	14		74x20	ALUMINUM
4	FAN STAGE1//MAN-OFF-AUTO	74x20	ALUMINUM	15	AUTO VOLTAGE REGULATOR	74x20	ALUMINUM
5	FAN STAGE2//MAN-OFF-AUTO	74x20	ALUMINUM	16	RECEPTACLE(AC125V, 20A, GFCI)	74x20	ALUMINUM
6	MAN-AUTO SELECTOR SWITCH	74x20	ALUMINUM				
7	LOCAL-REMOTE SELECTOR SWITCH	74x20	ALUMINUM				
8	LOWER-RAISE SELECTOR SWITCH	74x20	ALUMINUM				
9	MCCB MAIN POWER	74x20	ALUMINUM				
10	FAN STAGE1 POWER	74x20	ALUMINUM				
11	FAN STAGE2 POWER	74x20	ALUMINUM				



1. PROTECTION DEGREE
1) NEMA 4X (WATER PROOF TYPE)
2) MATERIALS : SHEET STEEL_SPHC
- *) NOTE :
1. THE ARRANGEMENT OF DEVICE SEQUENCE BOARD SHALL BE CHANGED BY MANUFACTURER . IT IS ONLY INFORMATION
2. PANDUIT PANDUCT, 2.25"X4.10" DUCT

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△	05.02.2025	FOR APPROVAL	H.W.PARK	J.H.CHA	H.J.KIM
△	07.02.2024	FOR APPROVAL	H.W.PARK	J.H.CHA	H.J.KIM
No.	DATE	DESCRIPTION of REVISION	DWN	CHKD	APPD
SUPPLIER					
HYOSUNG HEAVY INDUSTRIES					
ITEM	3ph 60Hz 69/13.8kV 25/33.3/41.67MVA with DETC on HV, OLTC on Neutral Auto				
DWG NAME	OUTLINE & ARRANGEMENT DIAGRAM	UNIT	inch		
DWG No.	HDA010101000121S02	SHEET NO.	2		
DRAWN	DESIGNED	CHECKED	APPROVED	SCALE	NA
PARK	KANG	CHA	KIM		
05.02.2025	05.02.2025	05.02.2025	05.02.2025		
H.W.	D.H.	J.H.	H.J.	REV. NO.	1
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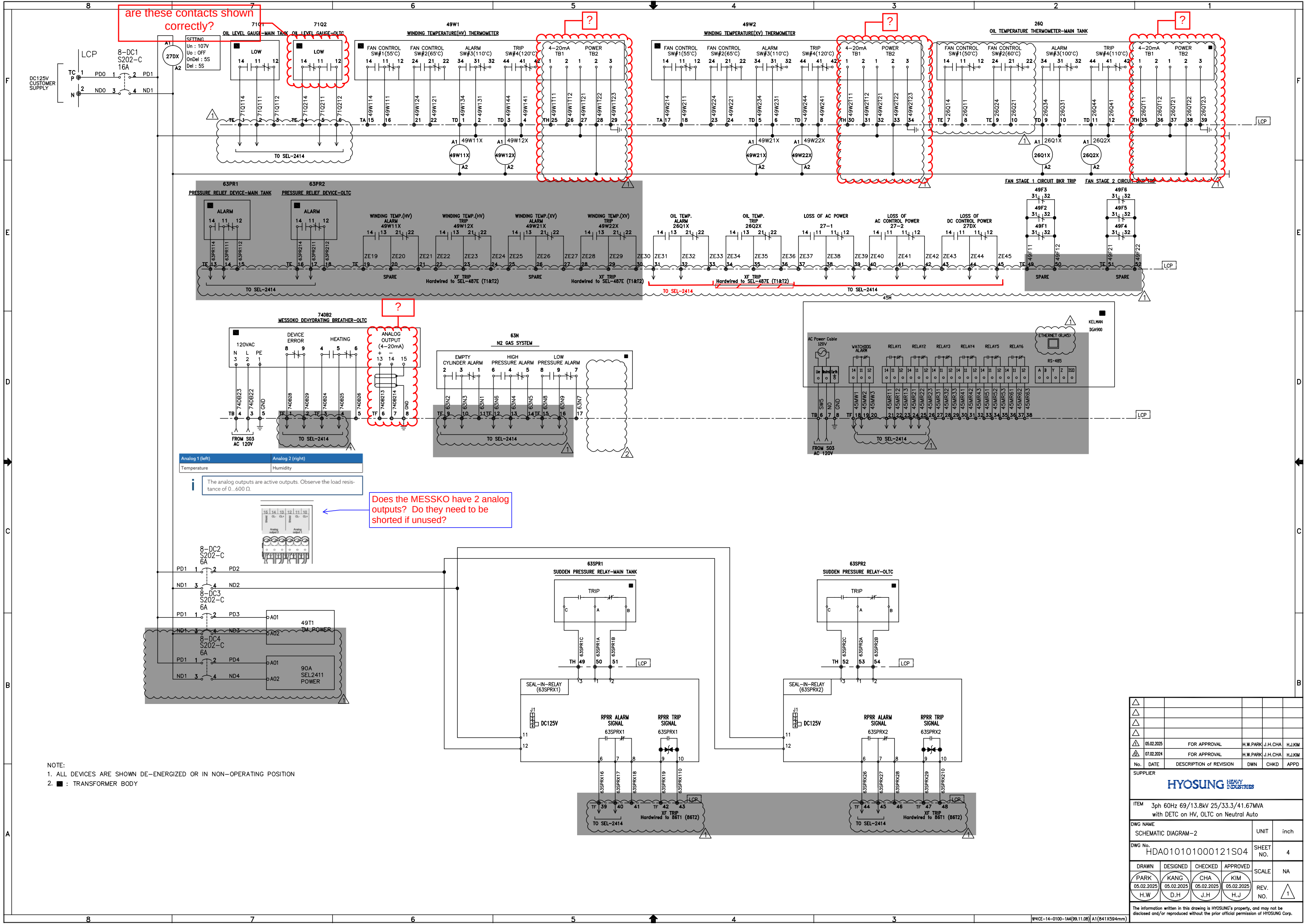


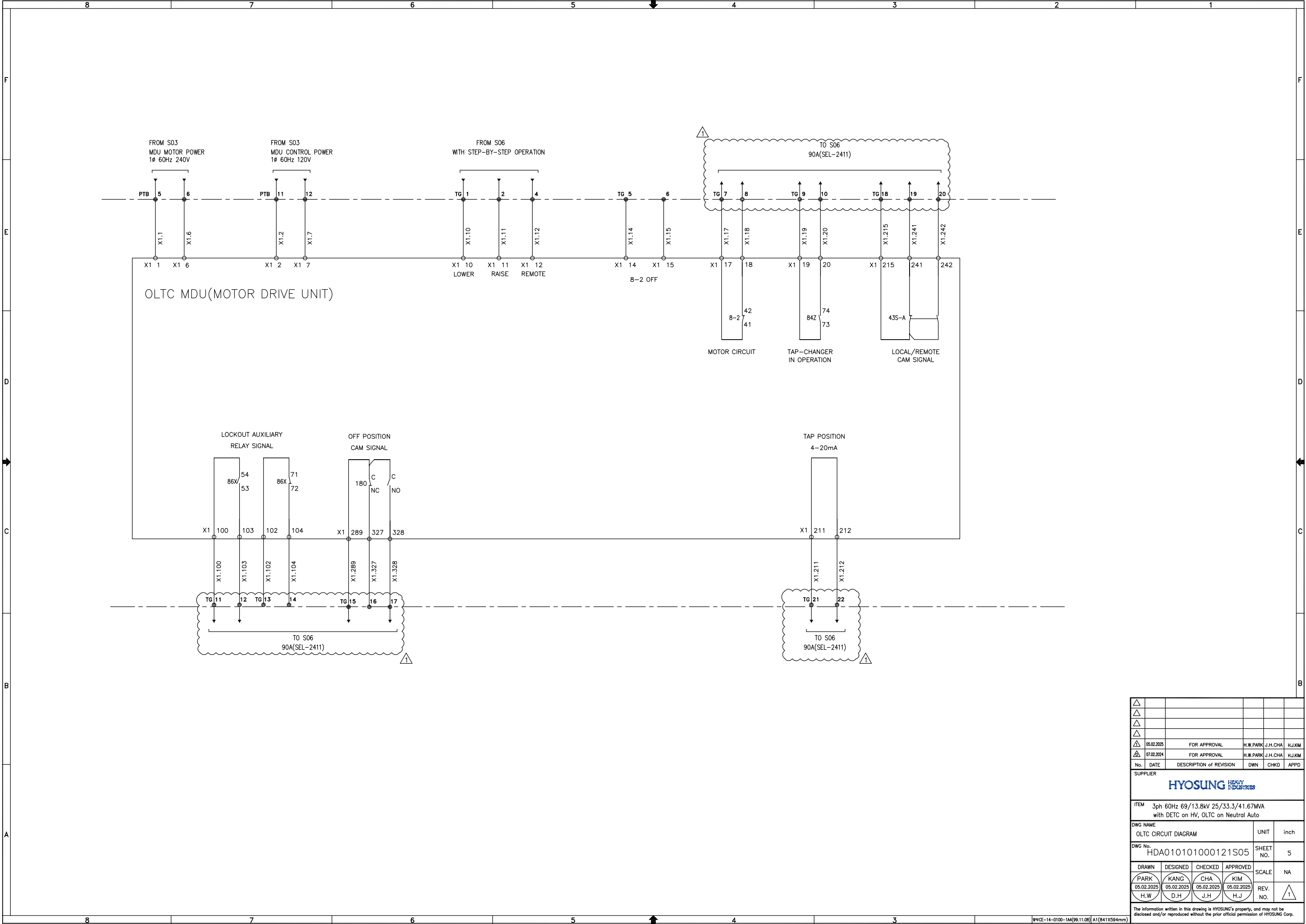
are these contacts shown correctly?

Does the MESSKO have 2 analog outputs? Do they need to be shorted if unused?

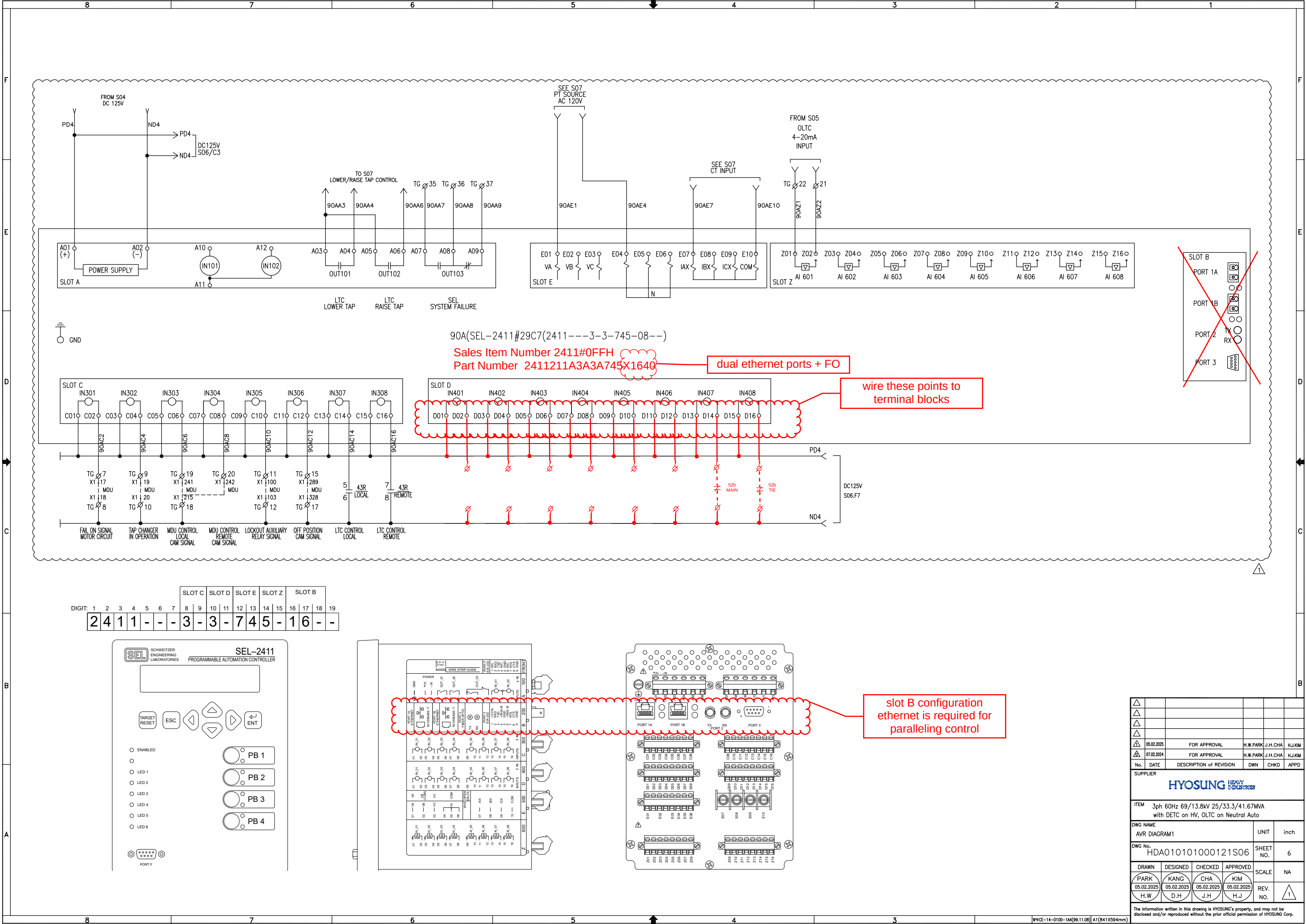
NOTE:
1. ALL DEVICES ARE SHOWN DE-ENERGIZED OR IN NON-OPERATING POSITION
2. ■ : TRANSFORMER BODY

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△	05.02.2025	FOR APPROVAL	H.W.PARK	J.H.CHA	H.J.KIM
△	07.02.2024	FOR APPROVAL	H.W.PARK	J.H.CHA	H.J.KIM
No.	DATE	DESCRIPTION OF REVISION	DWN	CHKD	APPD
SUPPLIER					
HYOSUNG HEAVY INDUSTRIES					
ITEM 3ph 60Hz 69/13.8kV 25/33.3/41.67MVA with DETC on HV, OLTC on Neutral Auto					
DWG NAME			UNIT inch		
SCHEMATIC DIAGRAM-2					
DWG No.			SHEET NO.		
HDA010101000121S04			4		
DRAWN	DESIGNED	CHECKED	APPROVED	SCALE NA	
PARK	KANG	CHA	KIM	REV. NO.	
05.02.2025	05.02.2025	05.02.2025	05.02.2025	1	
H.W	D.H	J.H	H.J		
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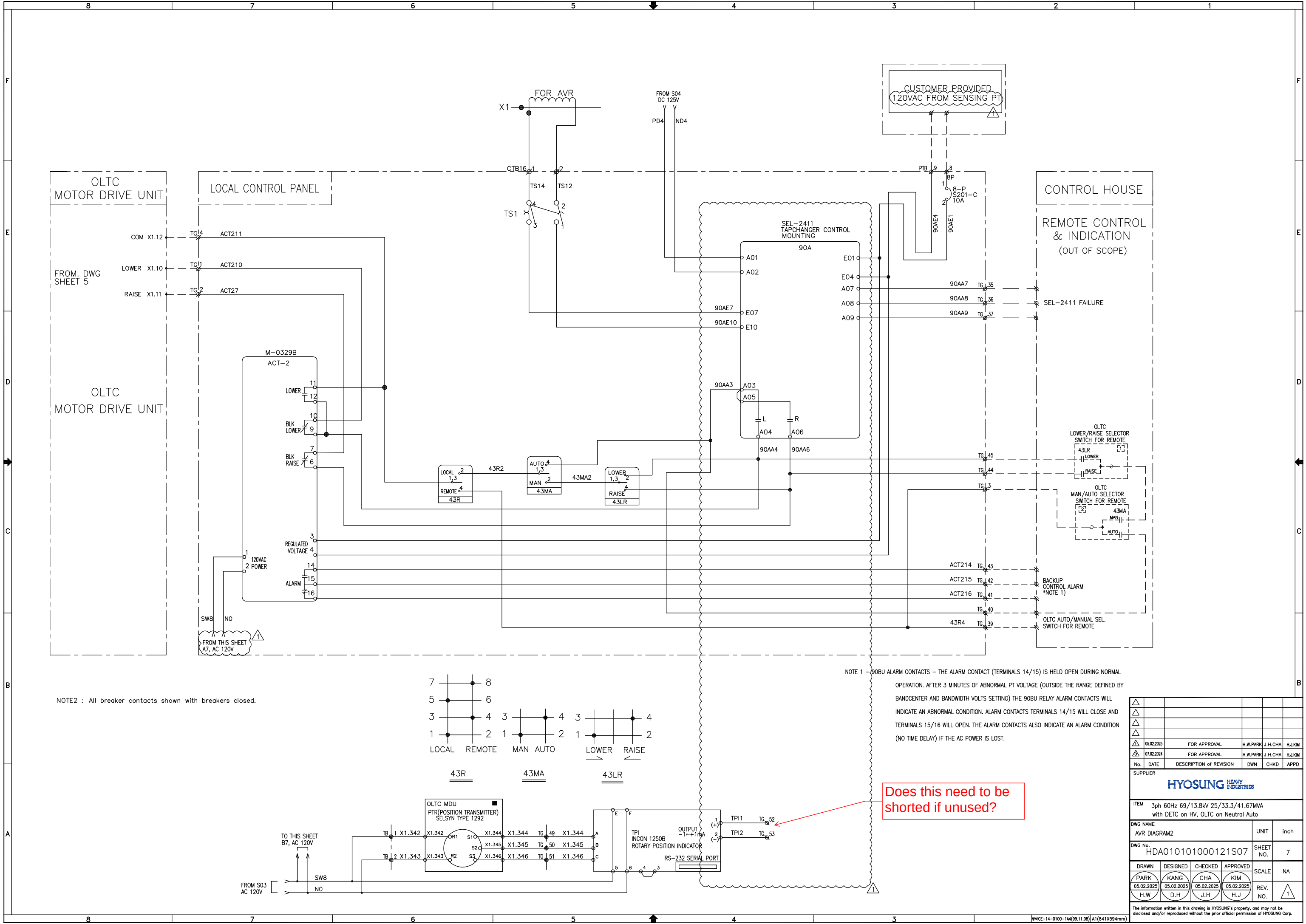




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△	05.02.2025	FOR APPROVAL	H.W.PARK	J.H.CHA	H.J.KIM
△	07.02.2024	FOR APPROVAL	H.W.PARK	J.H.CHA	H.J.KIM
No.	DATE	DESCRIPTION of REVISION	DWN	CHKD	APPD
SUPPLIER					
HYOSUNG HEAVY INDUSTRIES					
ITEM 3ph 60Hz 69/13.8kV 25/33.3/41.67MVA with DETC on HV, OLTC on Neutral Auto					
DWG NAME OLTC CIRCUIT DIAGRAM				UNIT	inch
DWG No. HDA010101000121S05				SHEET NO.	5
DRAWN	DESIGNED	CHECKED	APPROVED	SCALE	NA
PARK 05.02.2025 H.W.	KANG 05.02.2025 D.H.	CHA 05.02.2025 J.H.	KIM 05.02.2025 H.J.	REV. NO.	1
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△	05.02.2025	FOR APPROVAL	H.W.PARK	J.H.CHA	H.J.KIM	
△	07.02.2024	FOR APPROVAL	H.W.PARK	J.H.CHA	H.J.KIM	
No.	DATE	DESCRIPTION OF REVISION	DWN	CHKD	APPD	
SUPPLIER						
HYOSUNG HEAVY INDUSTRIES						
ITEM	3ph 60Hz 69/13.8kV 25/33.3/41.67MVA with DETC on HV, OLTC on Neutral Auto					
DWG NAME AVR DIAGRAM1			UNIT	inch		
DWG No. HDA010101000121S06			SHEET NO.	6		
DRAWN	DESIGNED	CHECKED	APPROVED	SCALE	NA	
PARK	KANG	CHA	KIM	REV. NO.	1	
05.02.2025	05.02.2025	05.02.2025	05.02.2025			
H.W.	D.H.	J.H.	H.J.			
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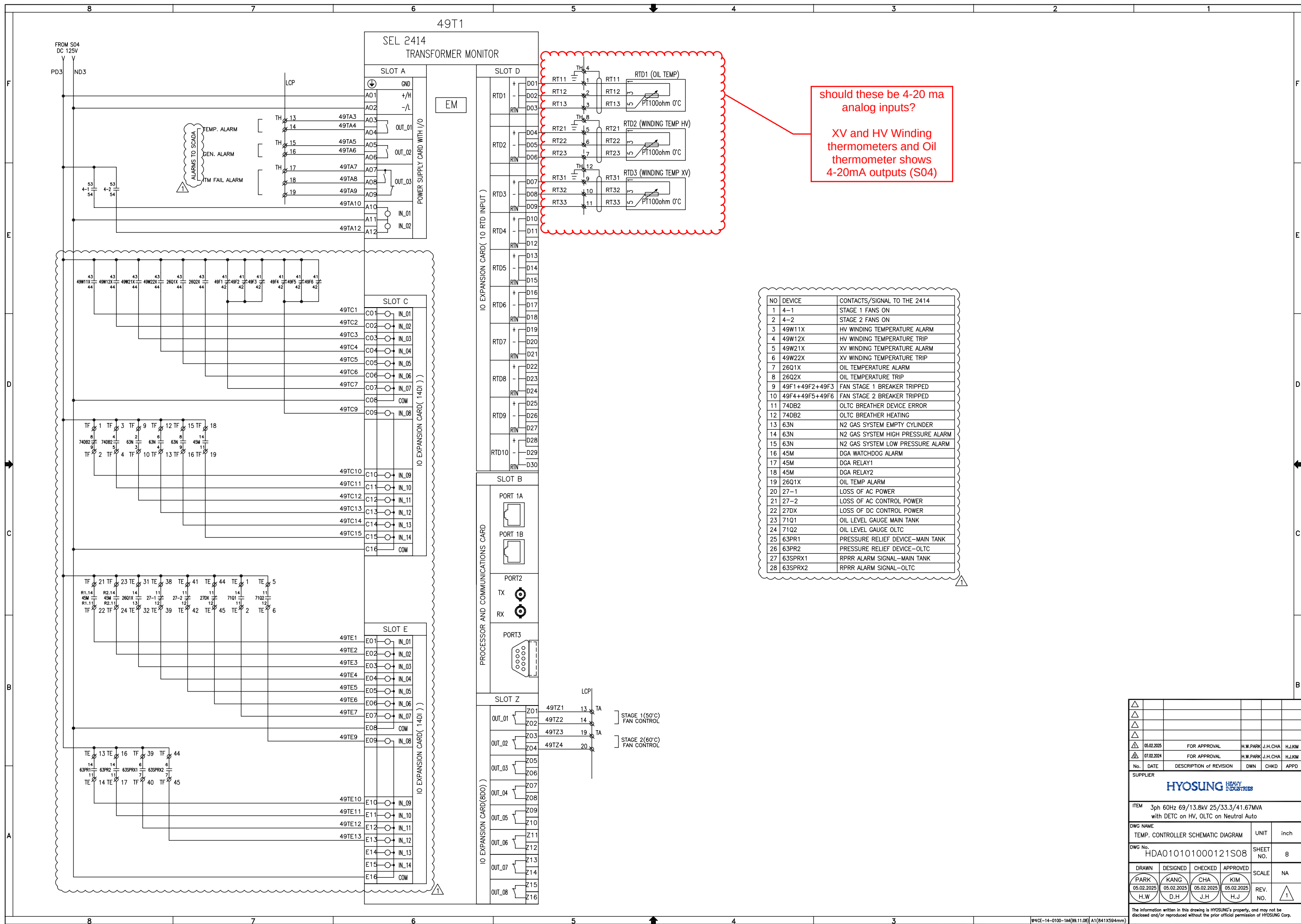


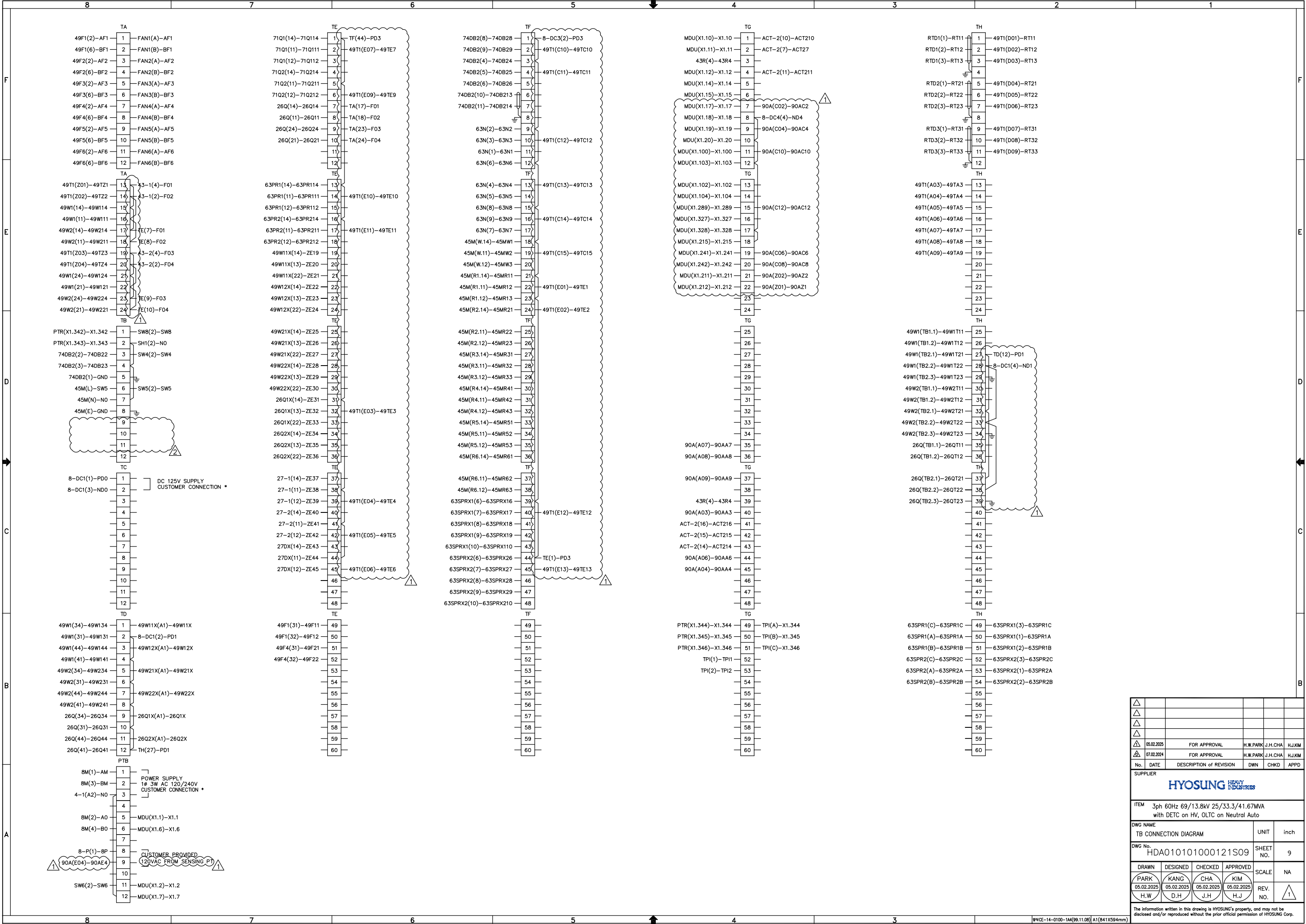
NOTE2 : All breaker contacts shown with breakers closed.

NOTE 1 - 90BU ALARM CONTACTS - THE ALARM CONTACT (TERMINALS 14/15) IS HELD OPEN DURING NORMAL OPERATION. AFTER 3 MINUTES OF ABNORMAL PT VOLTAGE (OUTSIDE THE RANGE DEFINED BY BANDCENTER AND BANDWIDTH VOLTS SETTING) THE 90BU RELAY ALARM CONTACTS WILL INDICATE AN ABNORMAL CONDITION. ALARM CONTACTS TERMINALS 14/15 WILL CLOSE AND TERMINALS 15/16 WILL OPEN. THE ALARM CONTACTS ALSO INDICATE AN ALARM CONDITION (NO TIME DELAY) IF THE AC POWER IS LOST.

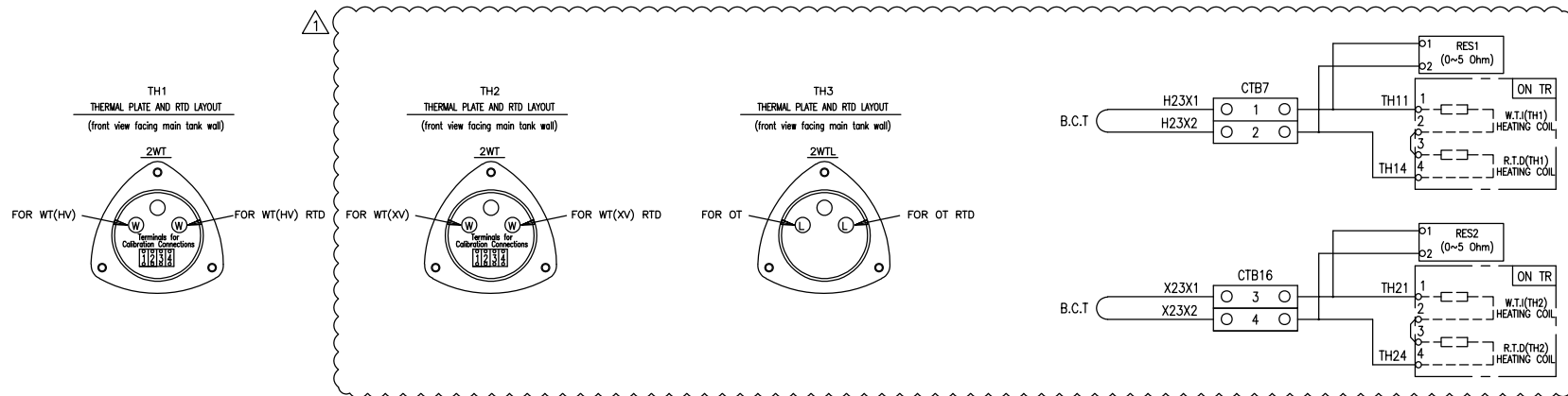
Does this need to be shorted if unused?

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△	05.02.2025	FOR APPROVAL	H.W.PARK	J.H.CHA	H.J.KIM
△	07.02.2024	FOR APPROVAL	H.W.PARK	J.H.CHA	H.J.KIM
No.	DATE	DESCRIPTION OF REVISION	DWN	CHKD	APPD
SUPPLIER					
HYOSUNG HEAVY INDUSTRIES					
ITEM 3ph 60Hz 69/13.8kV 25/33.3/41.67MVA with DETC on HV, OLTC on Neutral Auto					
DWC NAME AVR DIAGRAM2				UNIT	inch
DWC No. HDA010101000121S07				SHEET NO.	7
DRAWN	DESIGNED	CHECKED	APPROVED	SCALE	NA
PARK 05.02.2025 H.W.	KANG 05.02.2025 D.H.	CHA 05.02.2025 J.H.	KIM 05.02.2025 H.J.	REV. NO.	1
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△	05.02.2025	FOR APPROVAL	H.W.PARK	J.H.CHA	H.J.KIM
△	07.02.2024	FOR APPROVAL	H.W.PARK	J.H.CHA	H.J.KIM
No.	DATE	DESCRIPTION OF REVISION	DWN	CHKD	APPD
SUPPLIER					
HYOSUNG HEAVY INDUSTRIES					
ITEM 3ph 60Hz 69/13.8kV 25/33.3/41.67MVA with DETC on HV, OLTC on Neutral Auto					
DWG NAME TB CONNECTION DIAGRAM				UNIT	inch
DWG No. HDA010101000121S09				SHEET NO.	9
DRAWN	DESIGNED	CHECKED	APPROVED	SCALE	NA
PARK 05.02.2025 H.W.	KANG 05.02.2025 D.H.	CHA 05.02.2025 J.H.	KIM 05.02.2025 H.J.	REV. NO.	1
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양식CE-14-0100-1A4(99.11.08)	A1(841X594mm)

CABLE SPEC

1

FERRULING METHOD



WIRE

WIRE FERRULING

WHITE-COLOR
BLACK-LETTER

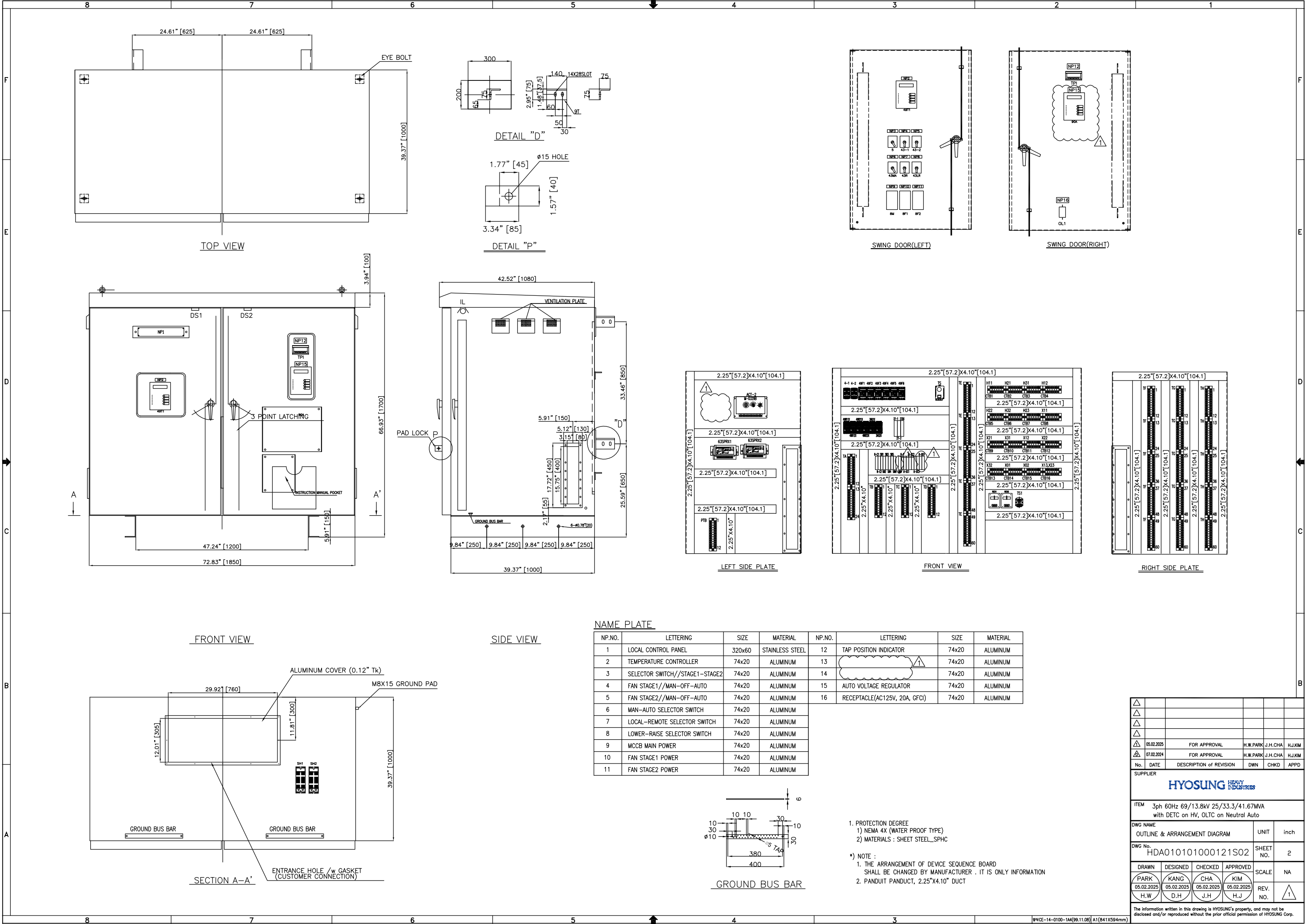
PLASTI-GRIP TERMINAL LUGS
(INSULATION)

NP	: NAMEPLATE		: MAGNETIC CONTACTOR CONTACT
71Q1	: OIL LEVEL GAUGE—MAIN		: NORMALLY OPEN CONTACT
71Q2	: OIL LEVEL GAUGE—OLTC		: NORMALLY CLOSED CONTACT
49W1	: WINDING TEMPERATURE(HV) THERMOMETER		: MOLDED CASE CIRCUIT BREAKER(MCCB)
49W2	: WINDING TEMPERATURE(XV) THERMOMETER		: TH—RELAY DEVICE
63PR1	: PRESSURE RELIEF DEVICE—MAIN		: FUSE
63PR2	: PRESSURE RELIEF DEVICE—OLTC		: OPERATING COIL
26Q	: OIL TEMPERATURE THERMOMETER—MAIN		: WIRING TERMINAL
74DB2	: DEHYDRATING BREATHER—OLTC		: TERMINAL BLOCK
63N	: N2 GAS SYSTEM		: SPACE HEATER
45M	: DGA		: THERMOSTAT
49T1	: TEMPERATURE CONTROLLER		: DOOR SWITCH
27—2	: UNDERVOLTAGE RELAY		
MDU	: MOTOR DRIVE UNIT		

	:	MAGNETIC CONTACTOR CONTACT
	:	NORMALLY OPEN CONTACT
	:	NORMALLY CLOSED CONTACT
	:	MOLDED CASE CIRCUIT BREAKER(MCCB)
	:	TH-RELAY DEVICE
	:	FUSE
	:	OPERATING COIL
	:	WIRING TERMINAL
	:	TERMINAL BLOCK
	:	SPACE HEATER
	:	THERMOSTAT
	:	DOOR SWITCH

Missing from BOM:
71Q1, 71Q2, 49W1, 49W2, 26Q, 63N,
74DB2, 63PR1, 63PR2, 63SPR1, 63SPR2

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△									
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△	05.02.2025	FOR APPROVAL	H.W.PARK	J.H.CHA	H.J.KIM				
△	07.02.2024	FOR APPROVAL	H.W.PARK	J.H.CHA	H.J.KIM				
No.	DATE	DESCRIPTION OF REVISION	DWN	CHKD	APPD				
SUPERIOR									
									
ITEM	3ph 60Hz 69/13.8kV 25/33.3/41.67MVA with DETC on HV, OLTC on LV								
DWG NAME	LEGEND & BILL OF MATERIALS DIAGRAM					UNIT	inch		
DWG No.	HDA010101000121S01					SHEET NO.	1		
DRAWN	DESIGNED	CHECKED	APPROVED		SCALE	NA			
PARK 05.02.2025	KANG 05.02.2025	CHA 05.02.2025	KIM 05.02.2025		REV.				
H.W	D.H	J.H	H.J		NO.				
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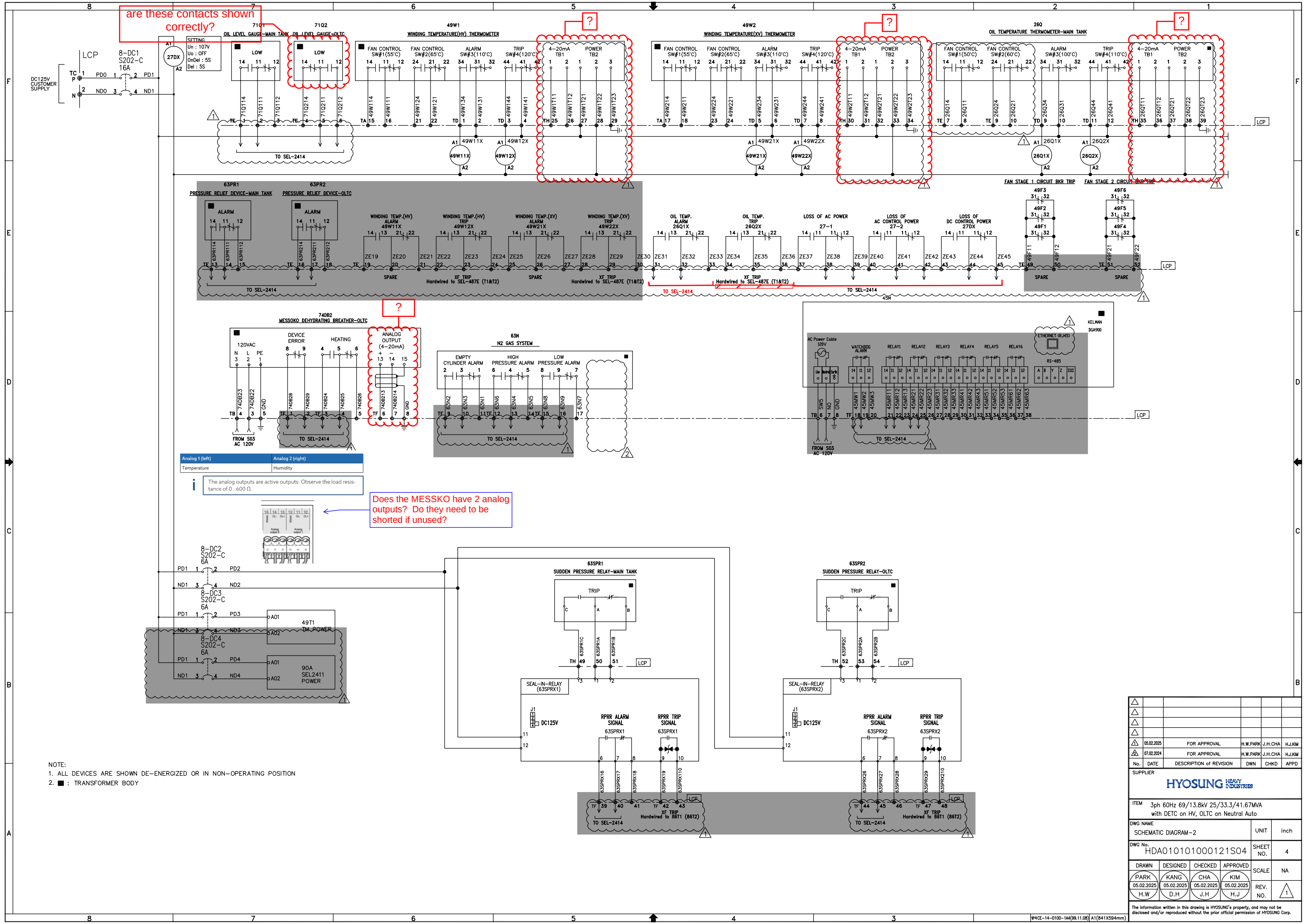
NAME PLATE

NP.NO.	LETTERING	SIZE	MATERIAL	NP.NO.	LETTERING	SIZE	MATERIAL
1	LOCAL CONTROL PANEL	320x60	STAINLESS STEEL	12	TAP POSITION INDICATOR	74x20	ALUMINUM
2	TEMPERATURE CONTROLLER	74x20	ALUMINUM	13		74x20	ALUMINUM
3	SELECTOR SWITCH//STAGE1-STAGE2	74x20	ALUMINUM	14		74x20	ALUMINUM
4	FAN STAGE1//MAN-OFF-AUTO	74x20	ALUMINUM	15	AUTO VOLTAGE REGULATOR	74x20	ALUMINUM
5	FAN STAGE2//MAN-OFF-AUTO	74x20	ALUMINUM	16	RECEPTACLE(AC125V, 20A, GFCI)	74x20	ALUMINUM
6	MAN-AUTO SELECTOR SWITCH	74x20	ALUMINUM				
7	LOCAL-REMOTE SELECTOR SWITCH	74x20	ALUMINUM				
8	LOWER-RAISE SELECTOR SWITCH	74x20	ALUMINUM				
9	MCCB MAIN POWER	74x20	ALUMINUM				
10	FAN STAGE1 POWER	74x20	ALUMINUM				
11	FAN STAGE2 POWER	74x20	ALUMINUM				

1. PROTECTION DEGREE
1) NEMA 4X (WATER PROOF TYPE)
2) MATERIALS : SHEET STEEL_SPHC
- *) NOTE :
1. THE ARRANGEMENT OF DEVICE SEQUENCE BOARD SHALL BE CHANGED BY MANUFACTURER . IT IS ONLY INFORMATION
2. PANDUIT PANDUCT, 2.25"X4.10" DUCT

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△	05.02.2025	FOR APPROVAL	H.W.PARK	J.H.CHA	H.J.KIM
△	07.02.2024	FOR APPROVAL	H.W.PARK	J.H.CHA	H.J.KIM
No.	DATE	DESCRIPTION of REVISION	DWN	CHKD	APPD
SUPPLIER					
HYOSUNG HEAVY INDUSTRIES					
ITEM	3ph 60Hz 69/13.8kV 25/33.3/41.67MVA with DETC on HV, OLTC on Neutral Auto				
DWG NAME	OUTLINE & ARRANGEMENT DIAGRAM		UNIT	inch	
DWG No.	HDA010101000121S02		SHEET NO.	2	
DRAWN	DESIGNED	CHECKED	APPROVED	SCALE	NA
PARK	KANG	CHA	KIM		
05.02.2025	05.02.2025	05.02.2025	05.02.2025		
H.W.	D.H.	J.H.	H.J.	REV. NO.	1
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are these contacts shown correctly?

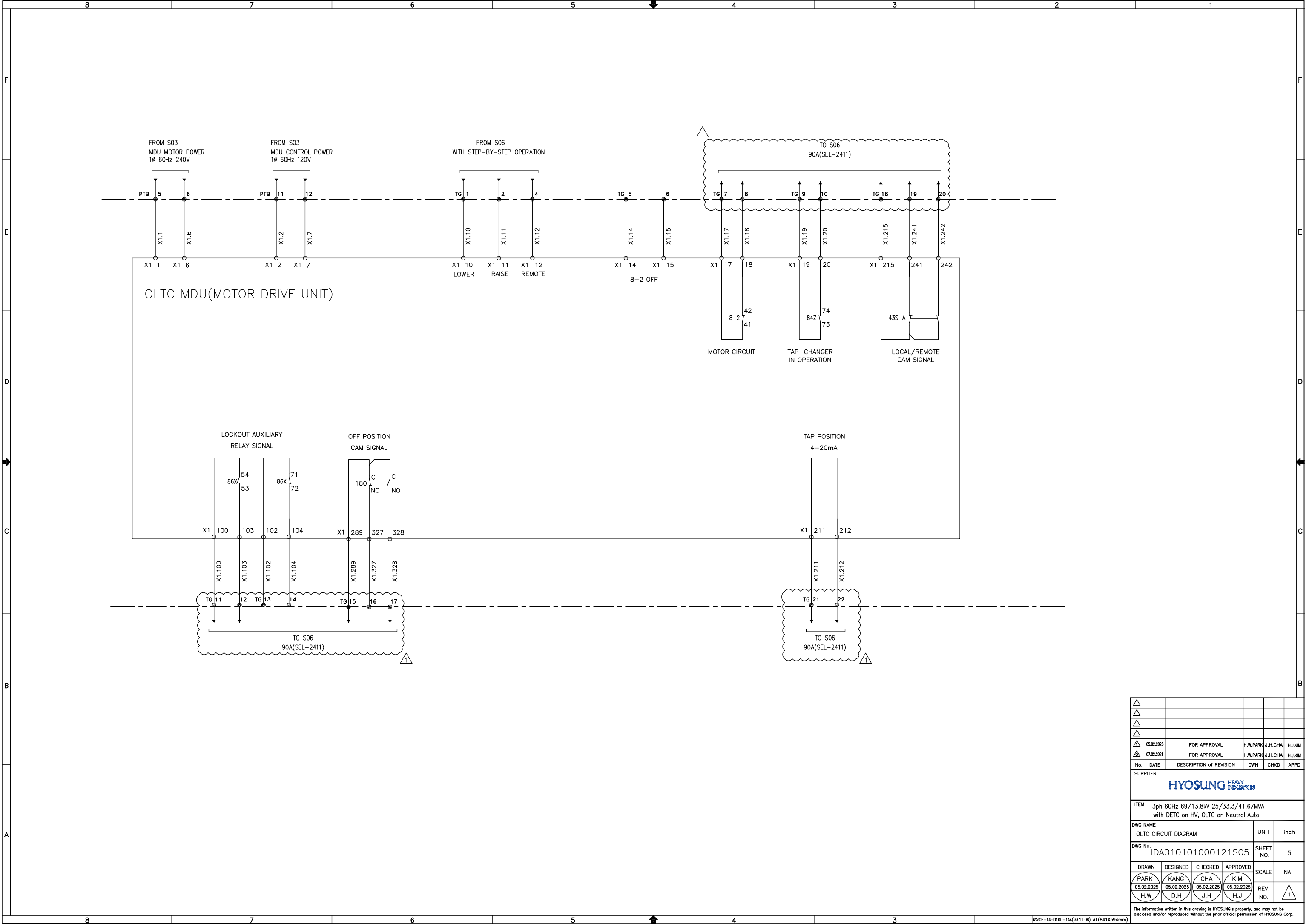


Analogue 1 (left)
Temperature
Analogue 2 (right)
Humidity
The analogue outputs are active outputs. Observe the load resistance of 0...600 Ω.

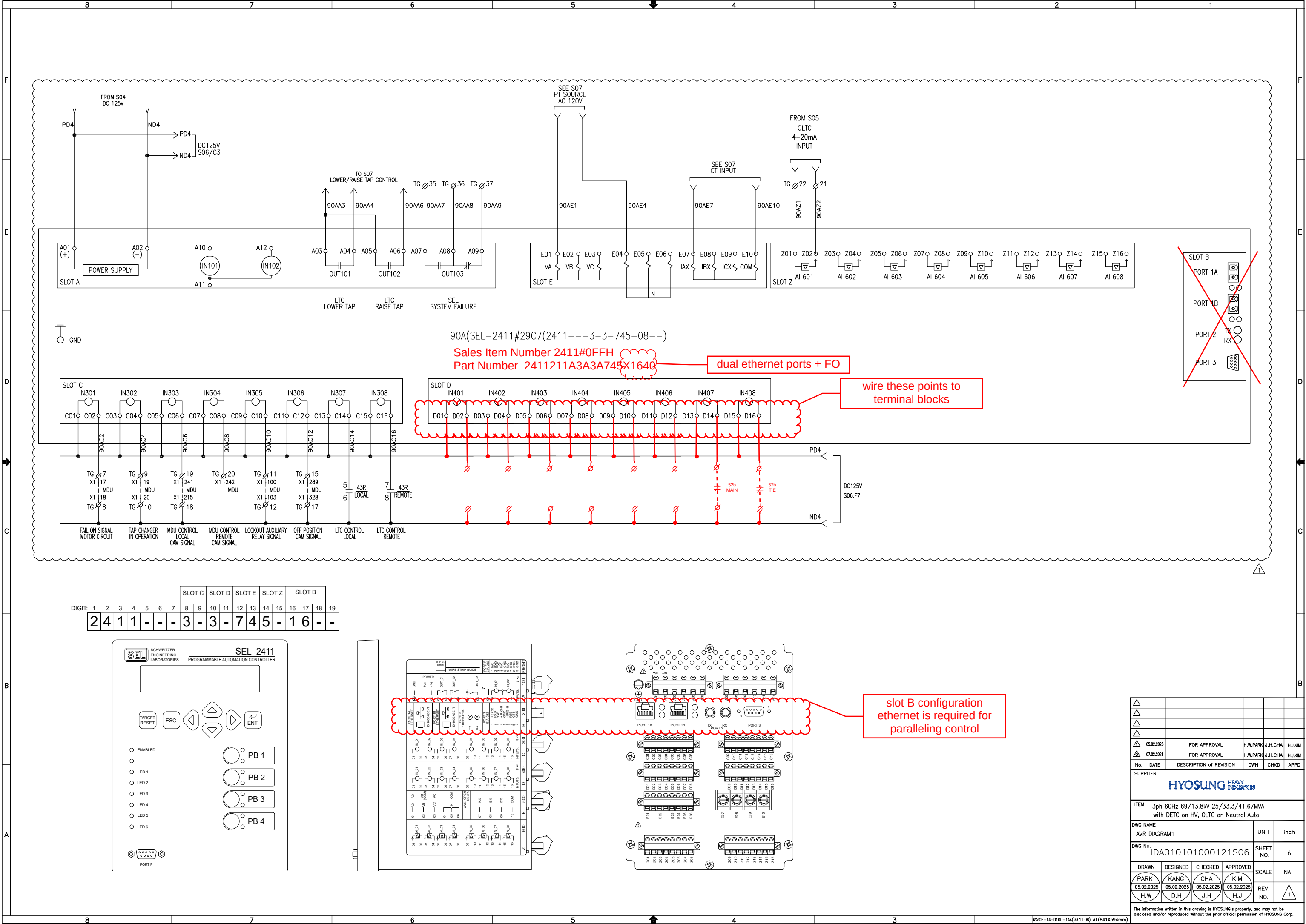
Does the MESSKO have 2 analog outputs? Do they need to be shorted if unused?

NOTE:
1. ALL DEVICES ARE SHOWN DE-ENERGIZED OR IN NON-OPERATING POSITION
2. ■ : TRANSFORMER BODY

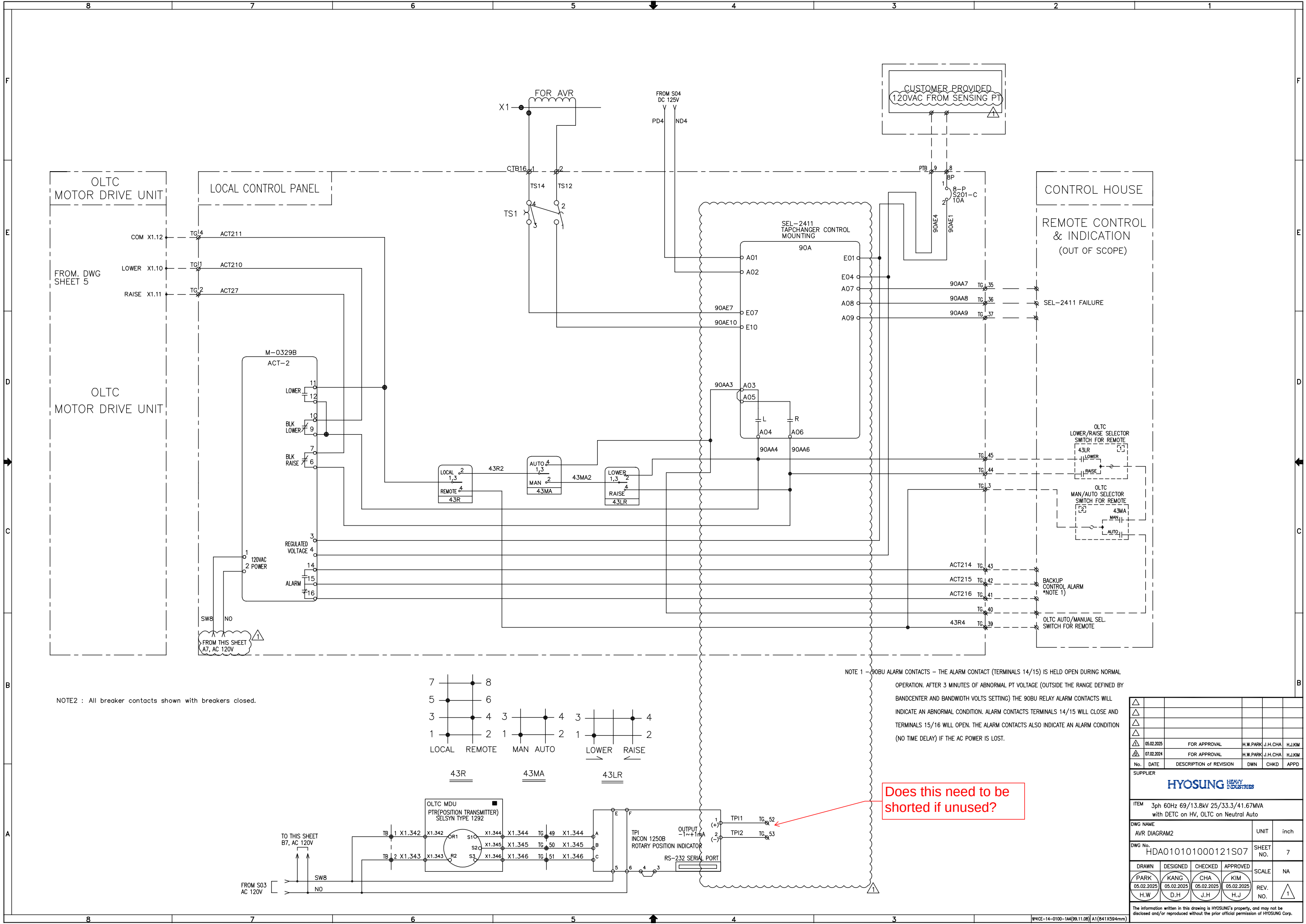
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△	05.02.2025	FOR APPROVAL	H.W.PARK	J.H.CHA	H.J.KIM
△	07.02.2024	FOR APPROVAL	H.W.PARK	J.H.CHA	H.J.KIM
No.	DATE	DESCRIPTION OF REVISION	DWN	CHKD	APPD
SUPPLIER					
HYOSUNG HEAVY INDUSTRIES					
ITEM 3ph 60Hz 69/13.8KV 25/33.3/41.67MVA with DETC on HV, OLTC on Neutral Auto					
DWG NAME			UNIT inch		
SCHEMATIC DIAGRAM-2					
DWG No. HDA010101000121S04			SHEET NO. 4		
DRAWN	DESIGNED	CHECKED	APPROVED	SCALE NA	
PARK	KANG	CHA	KIM	REV. NO. 1	
05.02.2025	05.02.2025	05.02.2025	05.02.2025		
H.W	D.H	J.H	H.J		
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△	07.02.2024	FOR APPROVAL	H.W.PARK	J.H.CHA	H.J.KIM
No.	DATE	DESCRIPTION of REVISION	DWN	CHKD	APPD
SUPPLIER					
HYOSUNG HEAVY INDUSTRIES					
ITEM 3ph 60Hz 69/13.8kV 25/33.3/41.67MVA with DETC on HV, OLTC on Neutral Auto					
DWG NAME OLTC CIRCUIT DIAGRAM				UNIT	inch
DWG No. HDA010101000121S05				SHEET NO.	5
DRAWN	DESIGNED	CHECKED	APPROVED	SCALE	NA
PARK 05.02.2025 H.W.	KANG 05.02.2025 D.H.	CHA 05.02.2025 J.H.	KIM 05.02.2025 H.J.	REV. NO.	1
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△	07.02.2024	FOR APPROVAL	H.W.PARK	J.H.CHA	H.J.KIM
No.	DATE	DESCRIPTION OF REVISION	DWN	CHKD	APPD
SUPPLIER					
HYOSUNG HEAVY INDUSTRIES					
ITEM	3ph 60Hz 69/13.8kV 25/33.3/41.67MVA with DETC on HV, OLTC on Neutral Auto				
DWG NAME	AVR DIAGRAM1		UNIT	inch	
DWG No.	HDA010101000121S06		SHEET NO.	6	
DRAWN	DESIGNED	CHECKED	APPROVED	SCALE	NA
PARK	KANG	CHA	KIM		
05.02.2025	05.02.2025	05.02.2025	05.02.2025	REV. NO.	1
H.W.	D.H.	J.H.	H.J.		
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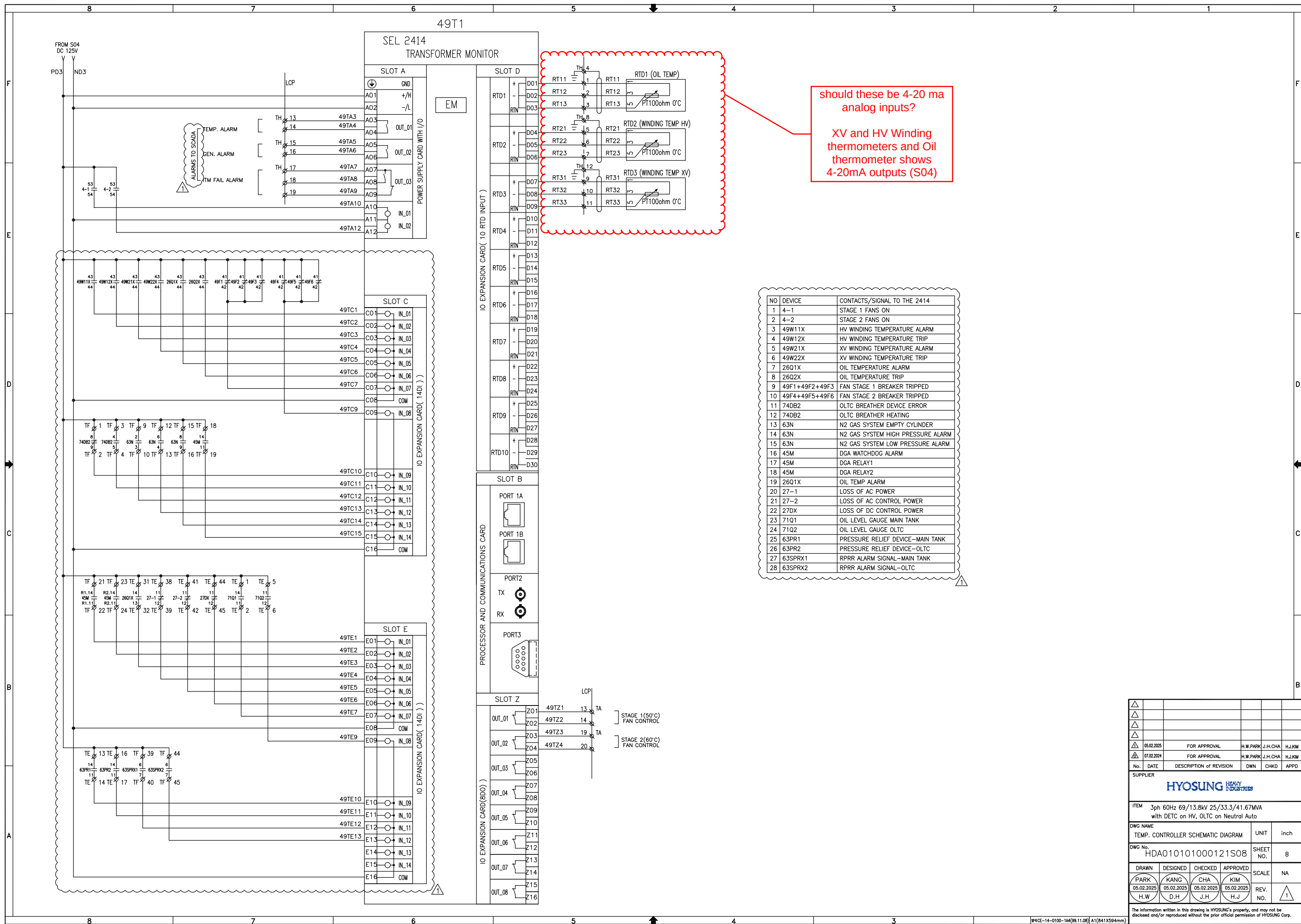


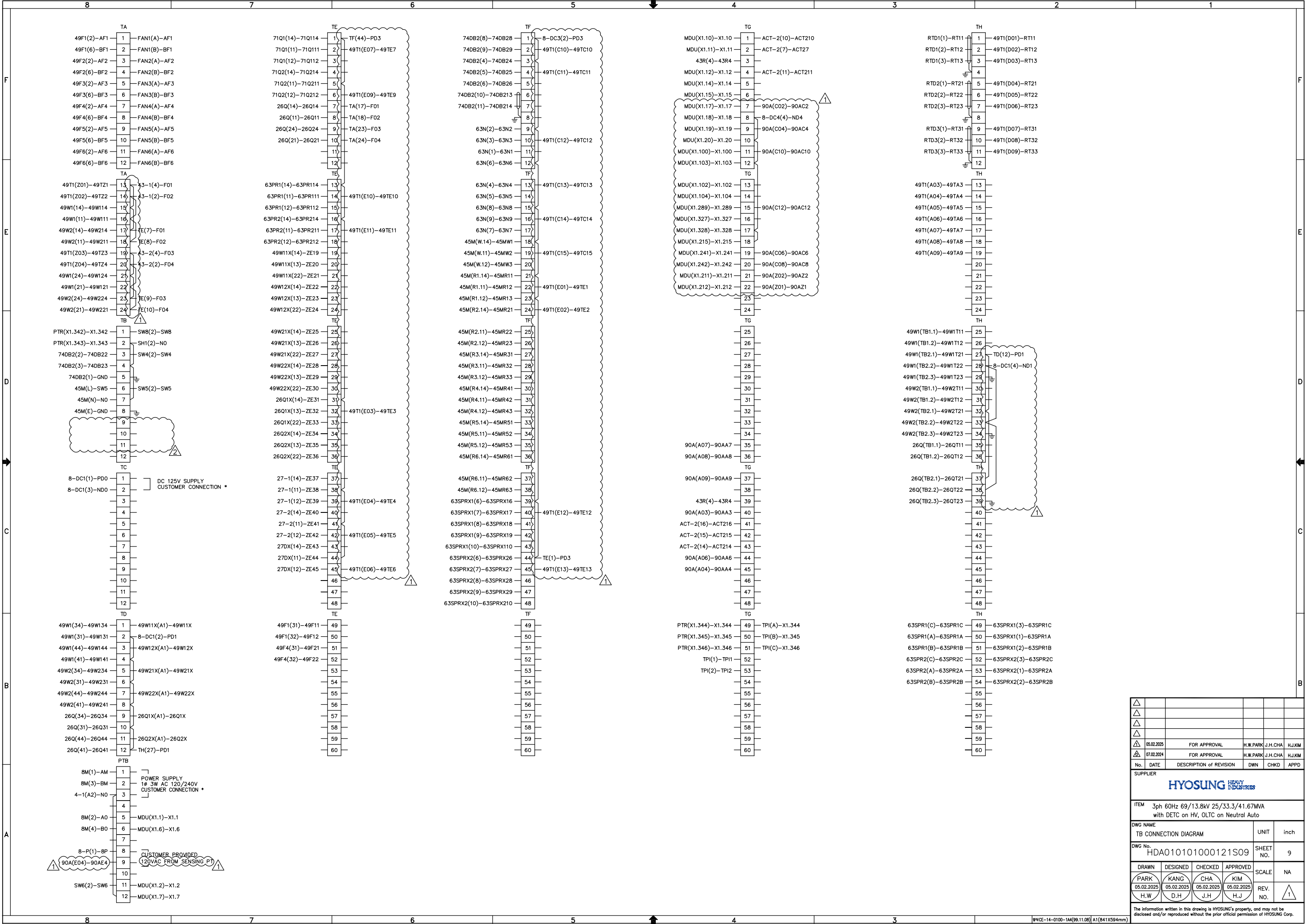
NOTE2 : All breaker contacts shown with breakers closed.

NOTE 1 - 90BU ALARM CONTACTS - THE ALARM CONTACT (TERMINALS 14/15) IS HELD OPEN DURING NORMAL OPERATION. AFTER 3 MINUTES OF ABNORMAL PT VOLTAGE (OUTSIDE THE RANGE DEFINED BY BANDCENTER AND BANDWIDTH VOLTS SETTING) THE 90BU RELAY ALARM CONTACTS WILL INDICATE AN ABNORMAL CONDITION. ALARM CONTACTS TERMINALS 14/15 WILL CLOSE AND TERMINALS 15/16 WILL OPEN. THE ALARM CONTACTS ALSO INDICATE AN ALARM CONDITION (NO TIME DELAY) IF THE AC POWER IS LOST.

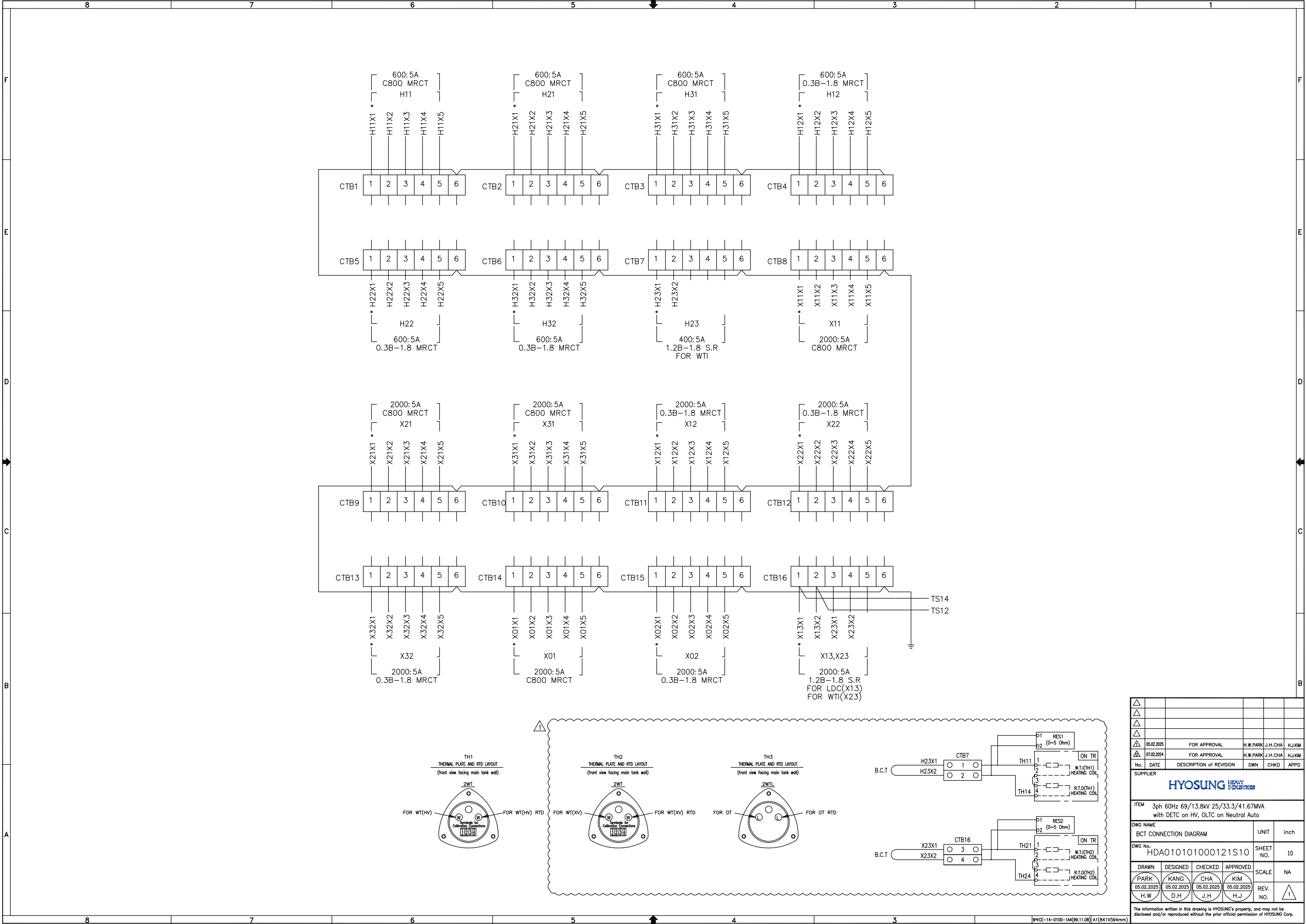
Does this need to be shorted if unused?

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△	05.02.2025	FOR APPROVAL	H.W.PARK	J.H.CHA	H.J.KIM
△	07.02.2024	FOR APPROVAL	H.W.PARK	J.H.CHA	H.J.KIM
No.	DATE	DESCRIPTION of REVISION	DWN	CHKD	APPD
SUPPLIER					
HYOSUNG HEAVY INDUSTRIES					
ITEM 3ph 60Hz 69/13.8kV 25/33.3/41.67MVA with DETC on HV, OLTC on Neutral Auto					
DWC NAME AVR DIAGRAM2			UNIT	inch	
DWC No. HDA010101000121S07			SHEET NO.	7	
DRAWN	DESIGNED	CHECKED	APPROVED	SCALE	NA
PARK 05.02.2025 H.W.	KANG 05.02.2025 D.H.	CHA 05.02.2025 J.H.	KIM 05.02.2025 H.J.	REV. NO.	1
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△	05.02.2025	FOR APPROVAL	H.W.PARK	J.H.CHA	H.J.KIM
△	07.02.2024	FOR APPROVAL	H.W.PARK	J.H.CHA	H.J.KIM
No.	DATE	DESCRIPTION OF REVISION	DWN	CHKD	APPD
SUPPLIER					
HYOSUNG HEAVY INDUSTRIES					
ITEM 3ph 60Hz 69/13.8kV 25/33.3/41.67MVA with DETC on HV, OLTC on Neutral Auto					
DWG NAME TB CONNECTION DIAGRAM				UNIT	inch
DWG No. HDA010101000121S09				SHEET NO.	9
DRAWN	DESIGNED	CHECKED	APPROVED	SCALE	NA
PARK 05.02.2025 H.W.	KANG 05.02.2025 D.H.	CHA 05.02.2025 J.H.	KIM 05.02.2025 H.J.	REV. NO.	1
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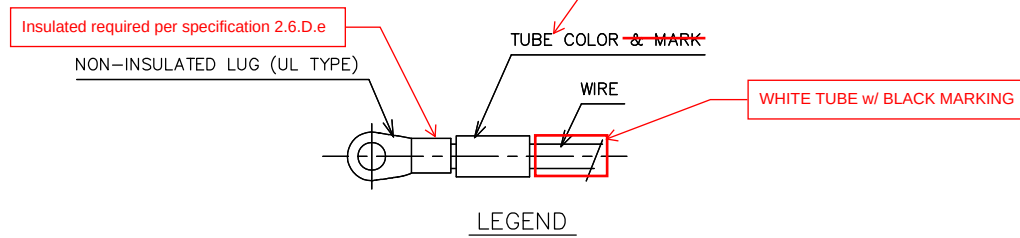


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△	05.02.2025	FOR APPROVAL	H.W.PARK	J.H.CHA	H.J.KIM
△	07.02.2024	FOR APPROVAL	H.W.PARK	J.H.CHA	H.J.KIM
No.	DATE	DESCRIPTION of REVISION	DWN	CHKD	APPD
SUPPLIER					
HYOSUNG HEAVY INDUSTRIES					
ITEM 3ph 60Hz 69/13.8kV 25/33.3/41.67MVA with DETC on HV, OLTC on Neutral Auto					
DWG NAME BCT CONNECTION DIAGRAM				UNIT	inch
DWG No. HDA010101000121S10				SHEET NO.	10
DRAWN	DESIGNED	CHECKED	APPROVED	SCALE	NA
PARK 05.02.2025 H.W.	KANG 05.02.2025 D.H.	CHA 05.02.2025 J.H.	KIM 05.02.2025 H.J.	REV. NO.	1
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BILL OF MATERIAL IN LOCAL CONTROL PANEL

NO.	DESCRIPTION	Q'TY	STYLE NO.	RATING	MANUFACTURER	REMARK(DWG SYM.)
1	M.C.C.B FOR MAIN POWER	1	XT1N 125	XT1N 125 TMF 50-500 3p F F UL/CSA	ABB	8M
2	M.C.C.B FOR MAIN POWER	2	XT1N 125	XT1N 125 TMF 20-450 3p F F UL/CSA	ABB	8F1, 8F2
3	M.C.C.B FOR FAN MOTOR POWER	6	MS116-1.6 TYPE	RATING 1~1.6A, W/HK1-02,2b	ABB	49F1~6
4	M.C.C.B FOR CONTROL CIRCUIT	1	S201-C	1P 10A	ABB	8-C1
5	M.C.C.B FOR CONTROL CIRCUIT	1	S201-C	1P 32A	ABB	8-C2
6	M.C.C.B FOR CONTROL CIRCUIT	1	S201-C	1P 20A	ABB	SW1
7	M.C.C.B FOR CONTROL CIRCUIT	2	S201-C	1P 4A	ABB	SW2,3
8	M.C.C.B FOR CONTROL CIRCUIT	5	S201-C	1P 10A	ABB	SW4,5,6,7, 8-P
9	SELECTOR SWITCH MAN-OFF-AUTO	2	CHR10 TYPE	CHR10 RK3103 6EG PR G251	KRAUS&NAIMER	43-1,2
10	SELECTOR SWITCH STAGE1-STAGE2	1	CHR10 TYPE	CHR10 RK2203 6EG PR G251	KRAUS&NAIMER	5
11	M.C.C.B FOR CONTROL CIRCUIT	1	S202-C	2P 16A	ABB	8-DC1
12	M.C.C.B FOR CONTROL CIRCUIT	2	S202-C	2P 6A	ABB	8-DC2,3
13	MAGNETIC S/W	2	AF26-30-00-13+CA4-10+CA4-01	100~250VAC/DC 1a1b	ABB	4-1,4-2
14	UNDERVOLTAGE RELAY	3	3UG4633-1AL30	17-275V AC/DC	SIEMENS	27-1~2,27DX
15	SPACE HEATER	2	RHPTC TYPE	RHPTC-100W AC 120V 100W	RUN	SH1,SH2
16	LED LAMP	1	RLB-UL TYPE	RLB-UL2-10W-F, AC100~240V 10W	RUN	IL
17	THERMOSTAT	1	RTM-H90N	-0~90 °C	RUN	TS
18	WIRING MATERIAL	1LOT	XHHW OR SIS, 600V	XHHW OR SIS, 600V	TMC or SHINKI	-----
19	LIMIT SWITCH	2	KLCA	KLCA12	KOINO	DS1,2
20	GROUND FAULT INTERRUPTER	1	GFR5362	AC125V, 2P,1P3W GROUNDING TYPE GFR5362	HUBBEL	OL1
21	AUX RELAY	6	NF22E-13	3a1b, 100-250VAC/DC	ABB	49W11X,49W12X,49W21X 49W22X,26Q1X,26Q2X
22	TERMINAL BLOCK	25	EB25B12C	12POLE	GE	DWG REF.
23	COMMON TERMINAL BLOCK(SHORT TYPE)	16	EB27B06SC	SHORT 6POLE	GE	DWG REF.
24	POWER TERMINAL BLOCK	1	EB25B12C	12POLE	GE	PTB
*25	SEAL-IN RELAY	2	909-300-01	DC125V	QUALITROL	63SPRX1, 63SPRX2
26	CT TEST TERMINAL	1	#202-C	-	STATES	TS1
*27	AUTO VOLTAGE REGULATOR	1	M-2001D W/M-2067B	-	BECKWITH	90A
*28	AUXILIARY CURRENT TRANSFORMER UNIT	1	M-0169A	-	BECKWITH	ACT-1
*29	LTC BACKUP CONTROL	1	M-0329B	-	BECKWITH	ACT-2
*30	PARALLEL BALANCING MODULE	1	M-0115A	-	BECKWITH	ACT-3
*31	AC CURRENT RELAY	1	M-0127A	-	BECKWITH	51-1
*32	CURRENT LOOP INTERFACE MODULE W/ RESISTOR	1	M-2025B w/ RESISTOR	-	BECKWITH	90C,R
*33	TAP POSITION INDICATOR	1	1250B	-	INCON	TPI
34	OLTC CONTROL SELECTOR SWITCH	3	CHR10 TYPE	-	KRAUS & NAIMER	43MA,43R,43LR
*35	TEMPERATURE CONTROLLER	1	SEL2414	-	SEL	49T1
*36	MATCHING RESISTOR FOR WTI	2	0~5ohm	0~5ohm	QUALITROL	RES1,2

KINDS OF WIRING				WIRE			MARKING & COLOR	
				SPEC.	COLOR	SIZE	TUBE COLOR	
INTERNAL	CONTROL	AC	A	XHHW	GRAY	14AWG (2.5 SQ)	BROWN	
			N	XHHW	GRAY	14AWG (2.5 SQ)	BLUE	
		DC	P	XHHW	GRAY	14AWG (2.5 SQ)	RED	
			N	XHHW	GRAY	14AWG (2.5 SQ)	WHITE	
	AC POWER SUPPLY	A	XHHW	GRAY	10AWG (6.0 SQ)	BROWN		
		B	XHHW	GRAY	10AWG (6.0 SQ)	BLACK		
N		XHHW	GRAY	10AWG (6.0 SQ)	BLUE			
EXTERNAL	ACCESSORY	ALARM	XHHW	GRAY	14AWG (2.5 SQ)	BLACK		
		TRIP	XHHW	GRAY	14AWG (2.5 SQ)	BLACK		
	B.C.T	H1,X1	XHHW	GRAY	10AWG (6.0 SQ)	BROWN		
		H2,X2	XHHW	GRAY	10AWG (6.0 SQ)	BLACK		
		H3,X3	XHHW	GRAY	10AWG (6.0 SQ)	GRAY		
		H0,X0	XHHW	GRAY	10AWG (6.0 SQ)	BLUE		
	FAN MOTORS	A	XHHW	GRAY	12AWG (4.0 SQ)	BROWN		
		B	XHHW	GRAY	12AWG (4.0 SQ)	BLACK		
	GROUND	GND	XHHW	GREEN	14AWG (2.5 SQ)	GREEN/YELLOW		



NP	: NAMEPLATE		: MAGNETIC CONTACTOR CONTACT
71Q1	: OIL LEVEL GAUGE—MAIN		: NORMALLY OPEN CONTACT
71Q2	: OIL LEVEL GAUGE—OLTC		: NORMALLY CLOSED CONTACT
49W1	: WINDING TEMPERATURE(HV) THERMOMETER		: MOLDED CASE CIRCUIT BREAKER(MCCB)
49W2	: WINDING TEMPERATURE(XV) THERMOMETER		: TH—RELAY DEVICE
63PR1	: PRESSURE RELIEF DEVICE—MAIN		: FUSE
63PR2	: PRESSURE RELIEF DEVICE—OLTC		: OPERATING COIL
26QB	: OIL TEMPERATURE THERMOMETER—MAIN		: WIRING TERMINAL
74DB2	: DEHYDRATING BREATHER—OLTC	T—	: TERMINAL BLOCK
63N	: N2 GAS SYSTEM		: SPACE HEATER
45M	: DGA		: THERMOSTAT
Provide complete legend?			: DOOR SWITCH

Provide complete legend?
49T1
27-1, 27-2
MDU

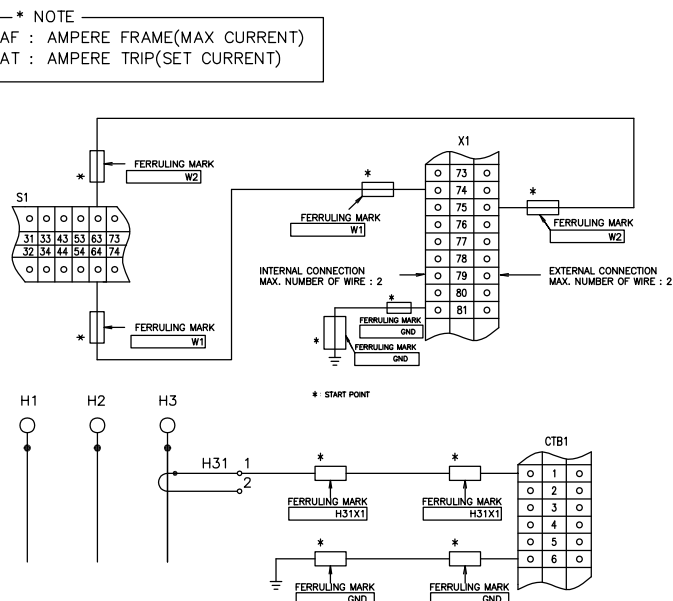
What are asterisks indicating?

Missing SEL-2411 required per specification 2.3.B.12
Provide full catalog number.

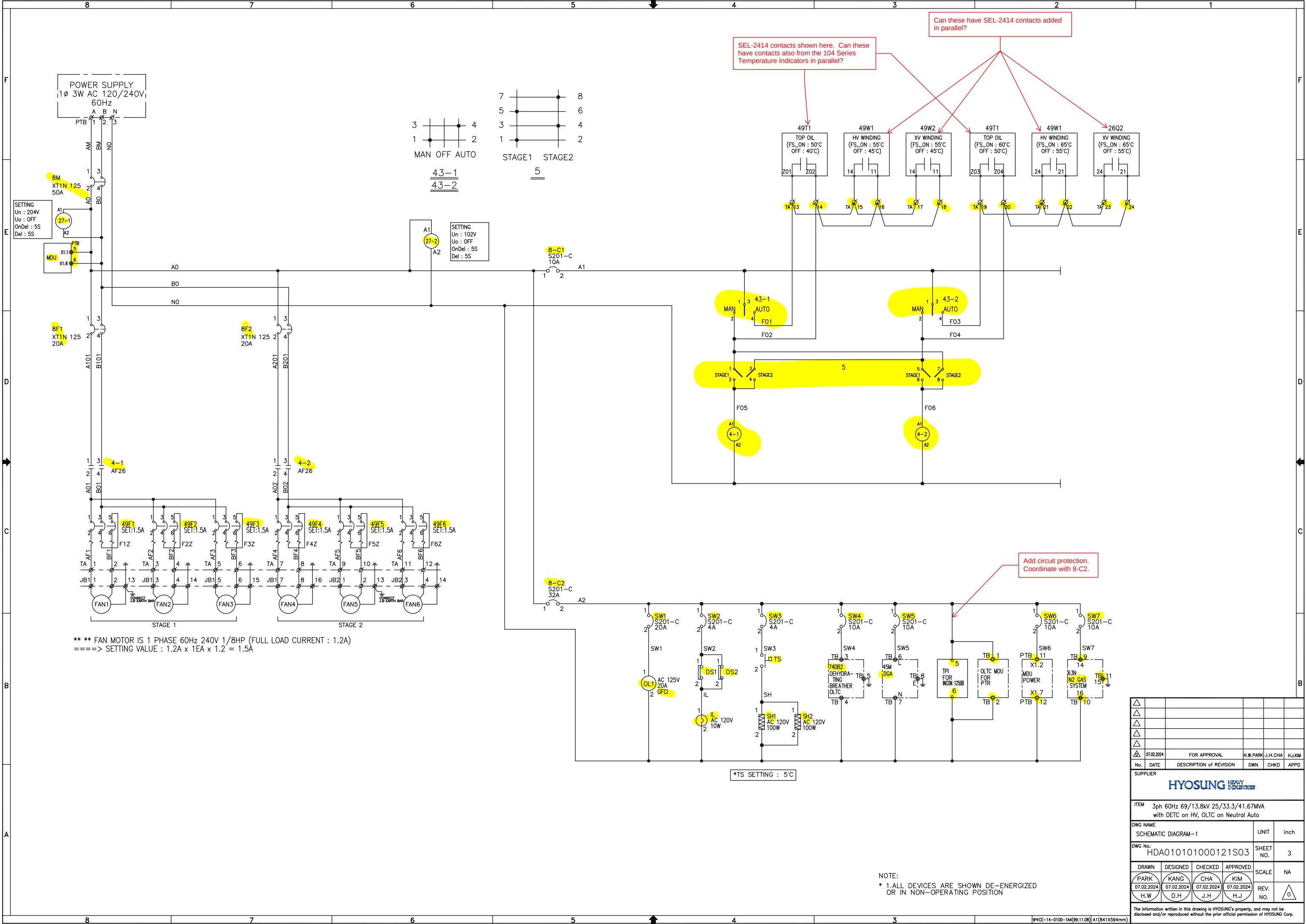
Provide full catalog number
for SEL-2414

Kelman Transfix (45M) DGA missing from BOM. Need full catalog number.

Missing from BOM:
71Q1, 71Q2, 49W1, 49W2, 26Q, 63N,
74DB2, 63PR1, 63PR2, 63SPR1, 63SPR2

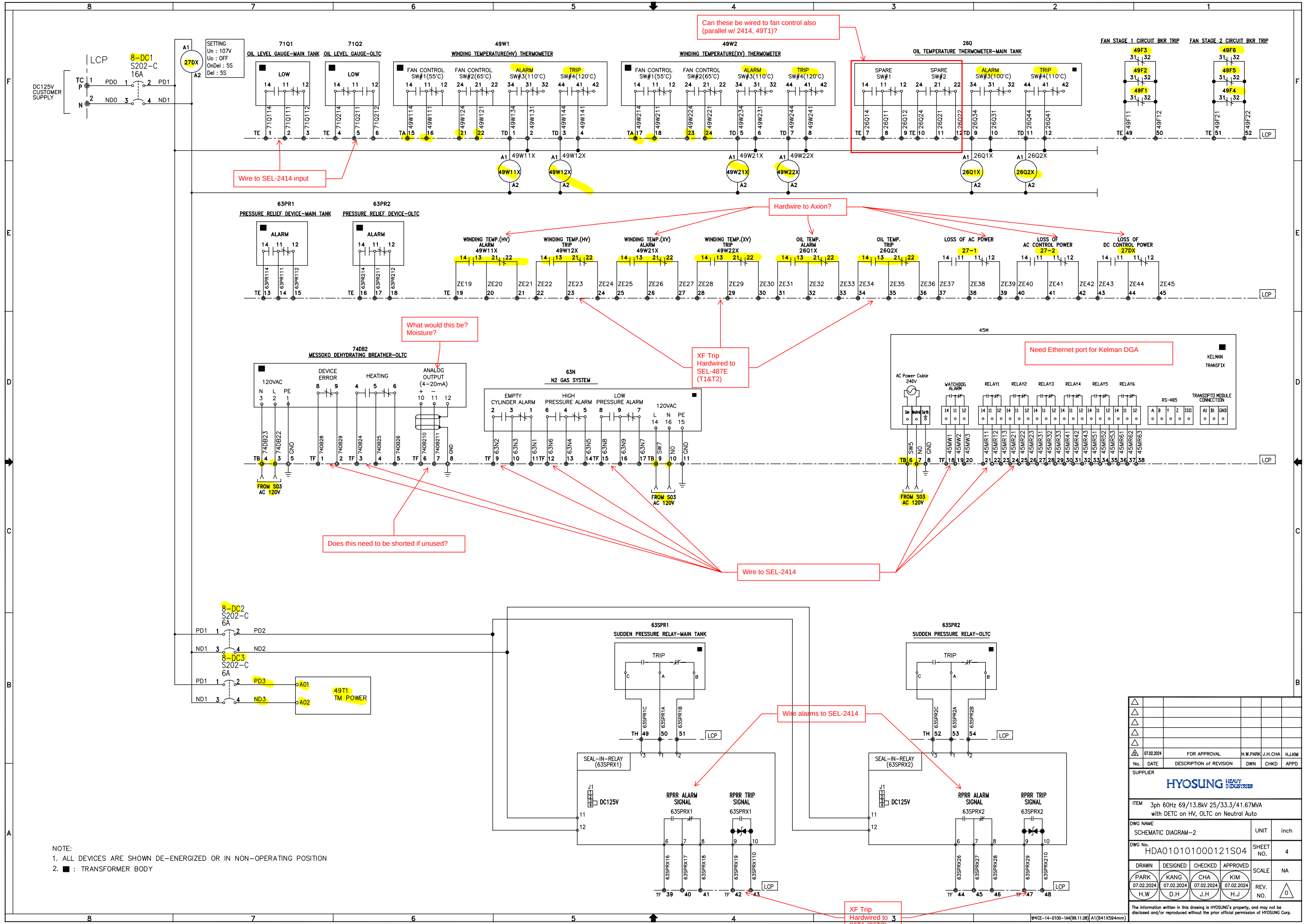


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△	07.02.2024	FOR APPROVAL	H.W.PARK	J.H.CHA	H.J.KIM				
No.	DATE	DESCRIPTION OF REVISION	DWN	CHKD	APPD				
SUPPLIER									
									
ITEM 3ph 60Hz 69/13.8KV 25/33.3/41.67MVA with DETC on HV, OLTC on LV									
DWG NAME						UNIT	inch		
DWG NAME & BILL OF MATERIALS DIAGRAM									
DWG No.						SHEET NO.	1		
HDA010101000121S01									
DRAWN	DESIGNED	CHECKED	APPROVED	SCALE		NA			
						REV. NO.			
H.W	D.H	J.H	H.J						
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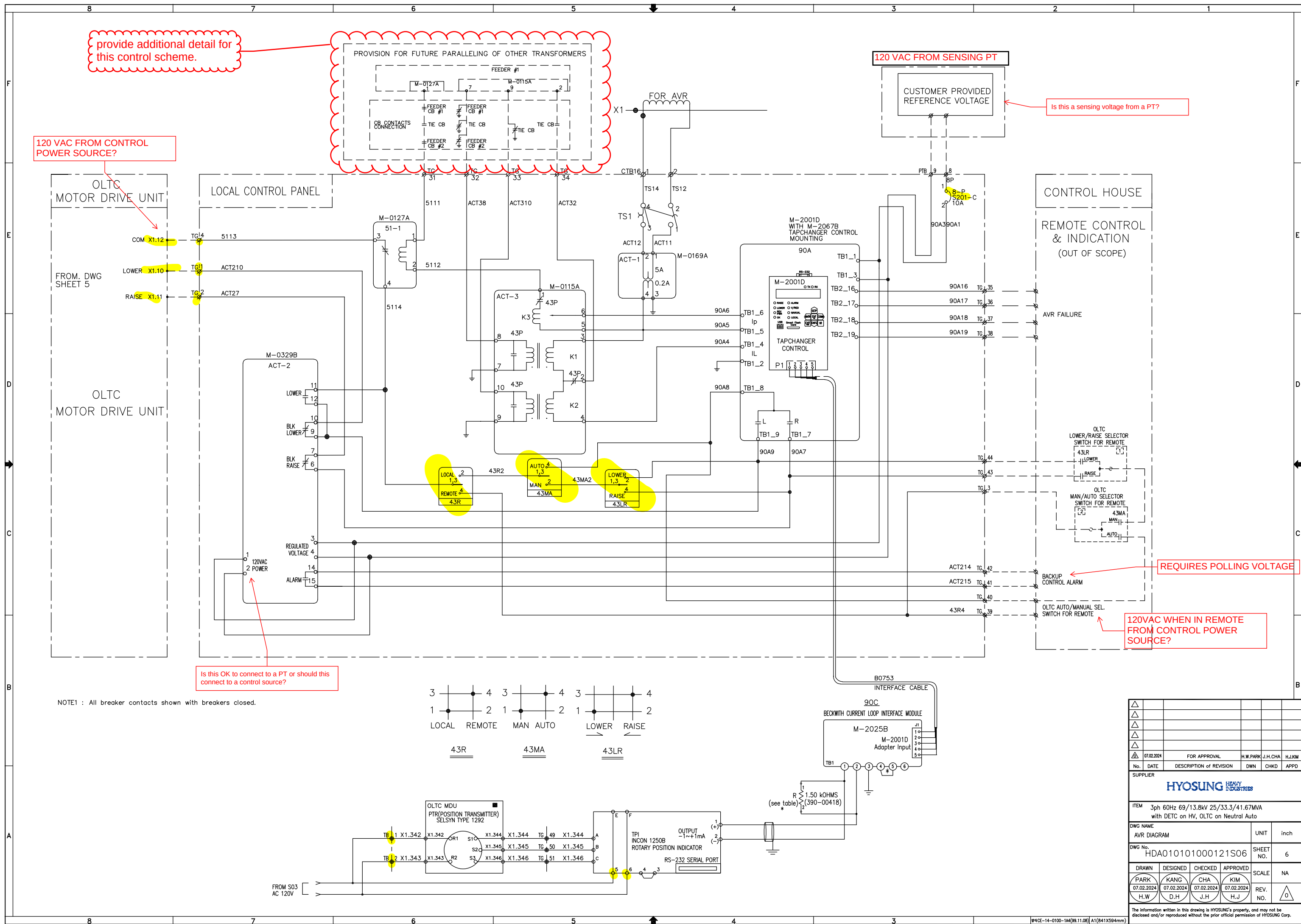
NOTE:
* 1.ALL DEVICES ARE SHOWN DE-ENERGIZED
OR IN NON-OPERATING POSITION

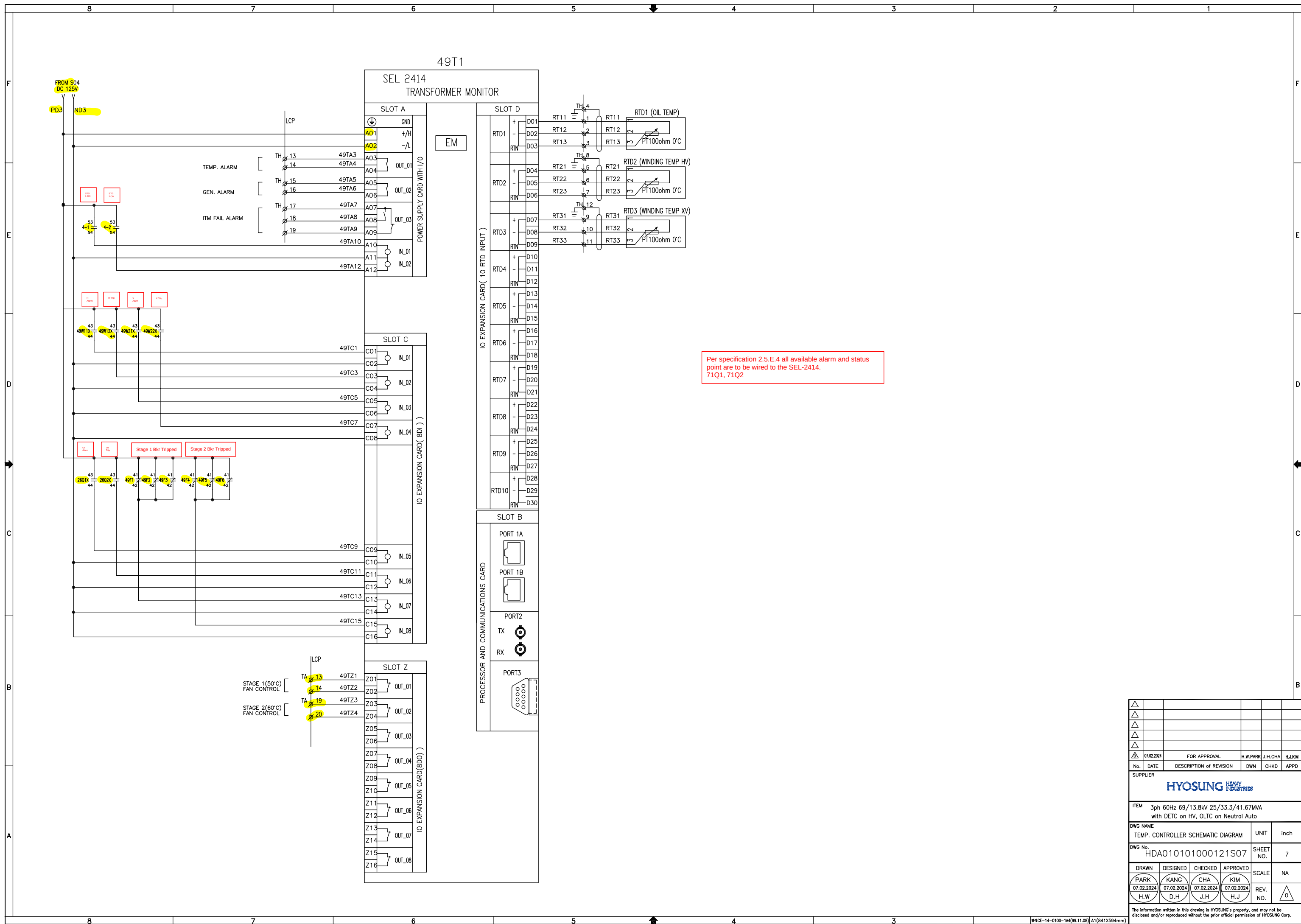
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△	07.02.2024	FOR APPROVAL	H.W.PARK	J.H.CHA	H.J.KIM
No.	DATE	DESCRIPTION OF REVISION	DWN	CHKD	APPD
SUPPLIER					
HYOSUNG HEAVY INDUSTRIES					
ITEM 3ph 60Hz 69/13.8kV 25/33.3/41.67MVA with DETC on HV, OLTC on Neutral Auto					
DWG NAME SCHEMATIC DIAGRAM-1				UNIT	inch
DWG No. HDA010101000121S03				SHEET NO.	3
DRAWN	DESIGNED	CHECKED	APPROVED	SCALE	NA
PARK 07.02.2024 H.W.	KANG 07.02.2024 D.H.	CHA 07.02.2024 J.H.	KIM 07.02.2024 H.J.	REV. NO.	0
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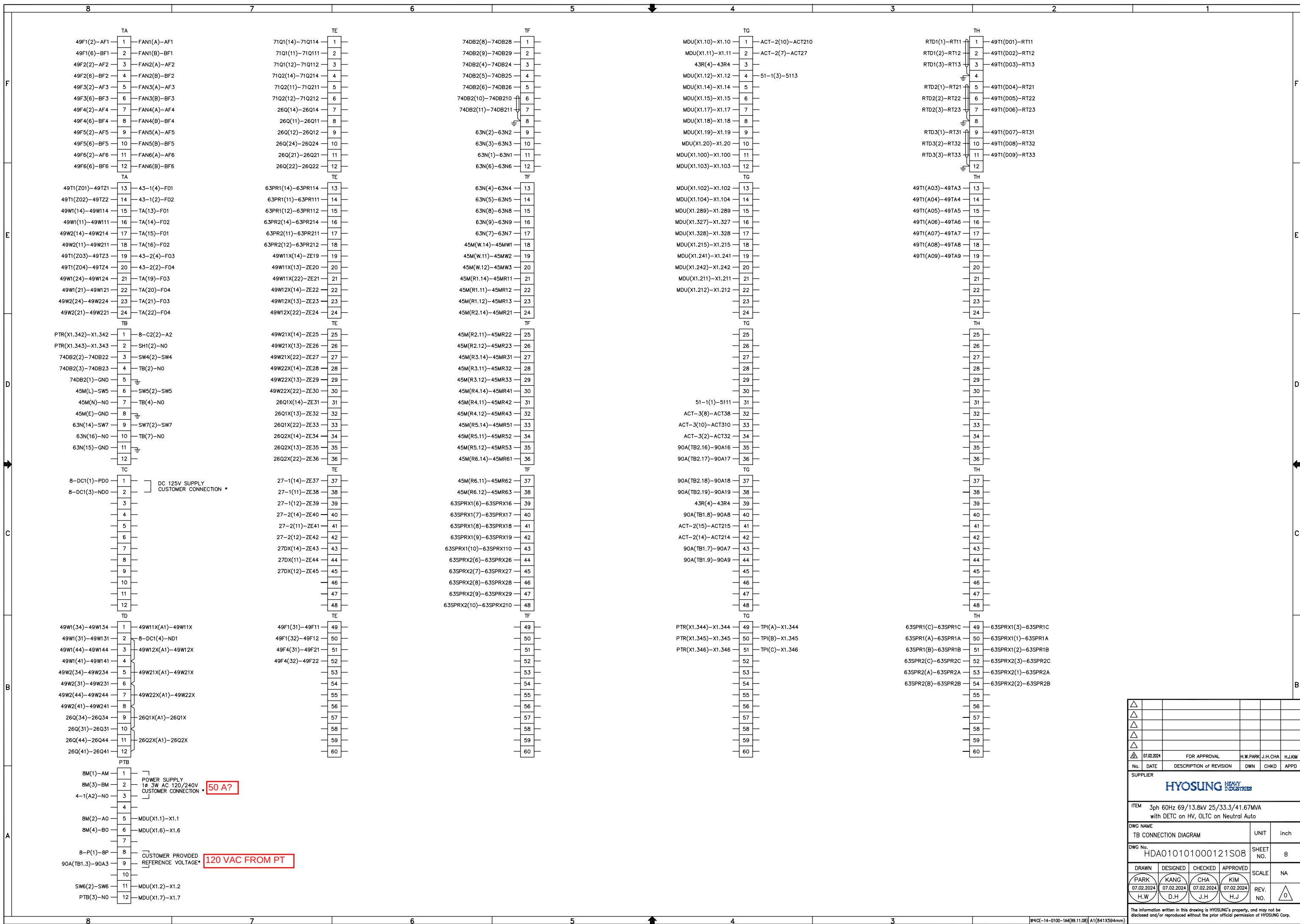


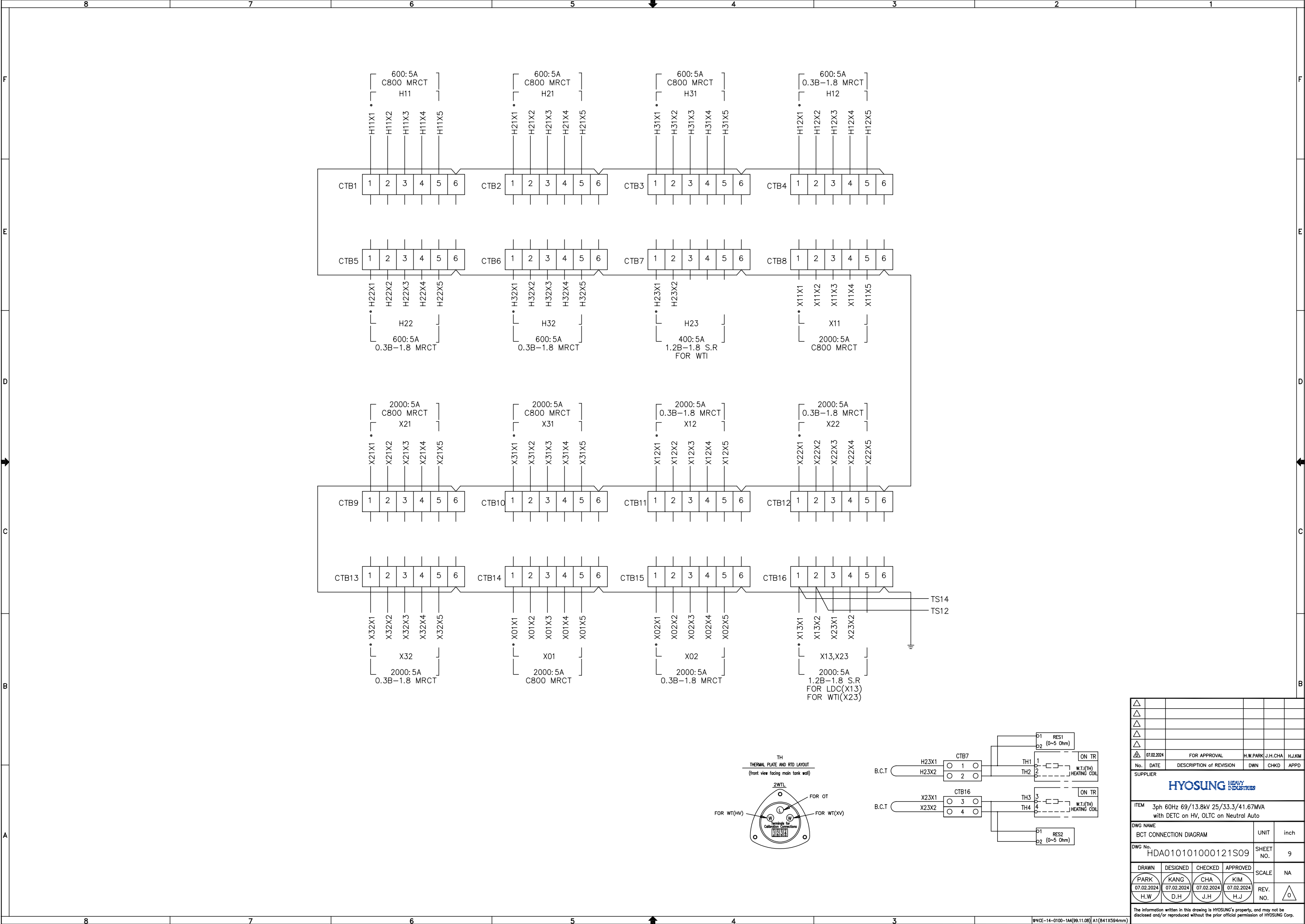
NOTE:
1. ALL DEVICES ARE SHOWN DE-ENERGIZED OR IN NON-OPERATING POSITION
2. ■ : TRANSFORMER BODY

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△	07.02.2024	FOR APPROVAL	H.W.PARK	J.H.CHA	H.J.KIM
No.	DATE	DESCRIPTION OF REVISION	DWN	CHKD	APPD
SUPPLIER					
HYOSUNG HEAVY INDUSTRIES					
ITEM	3ph 60Hz 69/13.8kV 25/33.3/41.67MVA with DETC on HV, OLTC on Neutral Auto				
DWG NAME			UNIT		inch
SCHEMATIC DIAGRAM-2					
DWG No.			SHEET NO.		4
HDA010101000121S04					
DRAWN	DESIGNED	CHECKED	APPROVED	SCALE	
PARK	KANG	CHA	KIM	NA	
07.02.2024	07.02.2024	07.02.2024	07.02.2024	REV. NO.	
H.W	D.H	J.H	H.J	0	
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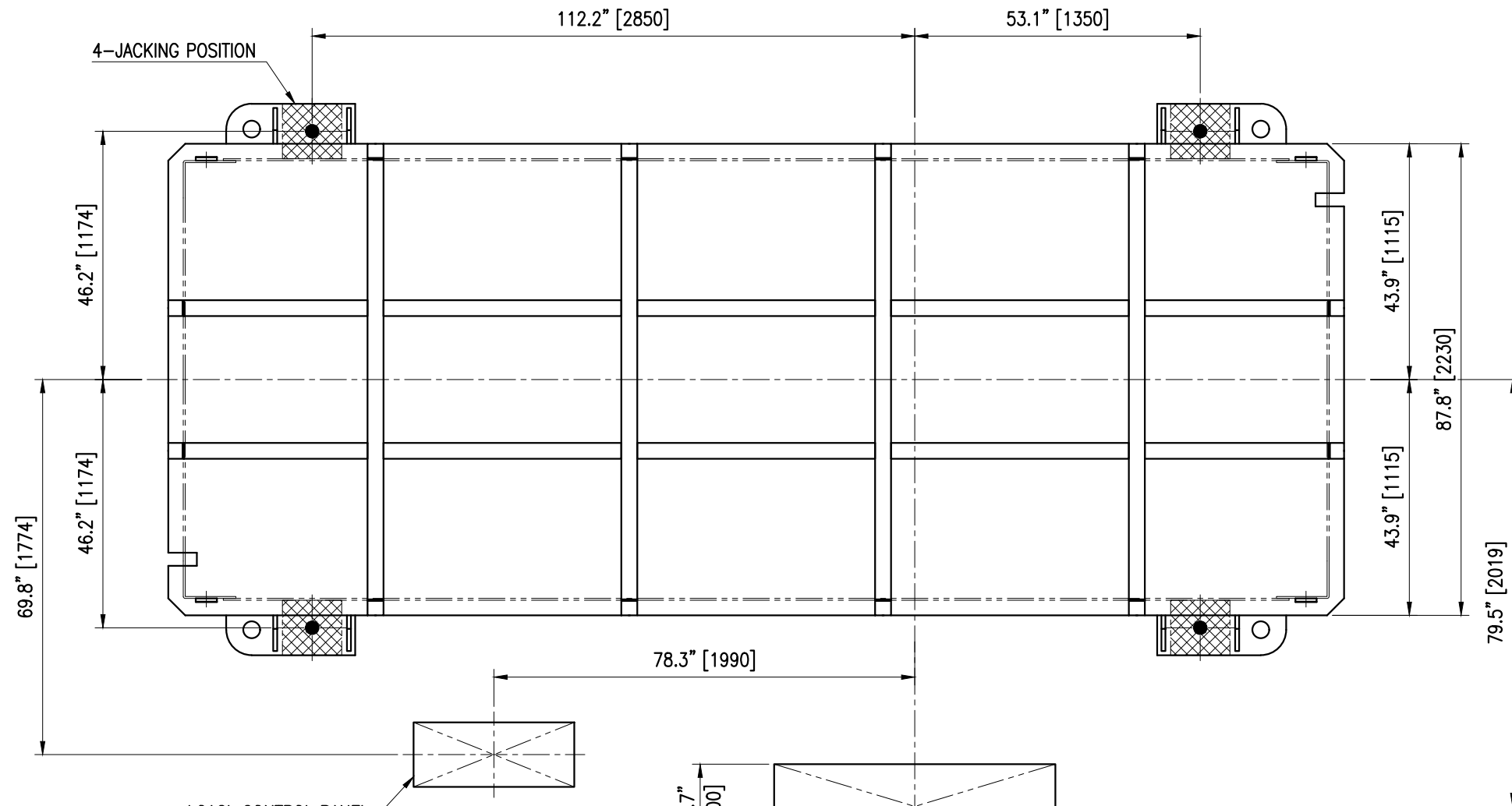






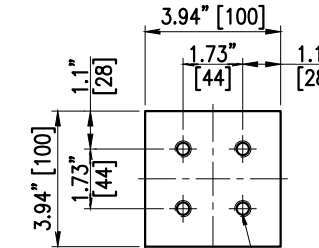
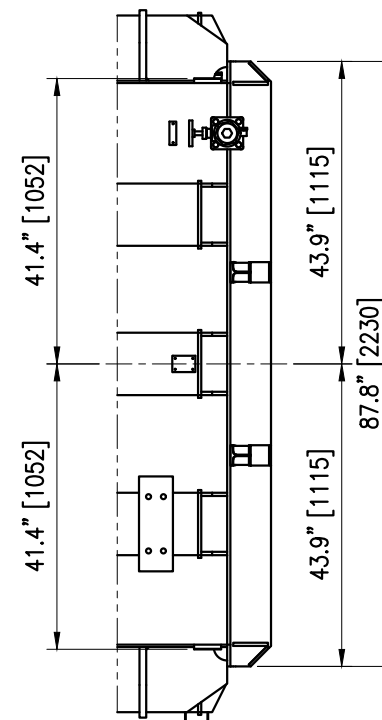
△					
△					
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△					
△	07.02.2024	FOR APPROVAL	H.W.PARK	J.H.CHA	H.J.KIM
No.	DATE	DESCRIPTION of REVISION	DWN	CHKD	APPD
SUPPLIER					
HYOSUNG HEAVY INDUSTRIES					
ITEM 3ph 60Hz 69/13.8kV 25/33.3/41.67MVA with DETC on HV, OLTC on Neutral Auto					
DWG NAME BCT CONNECTION DIAGRAM				UNIT	inch
DWG No. HDA010101000121S09				SHEET NO.	9
DRAWN	DESIGNED	CHECKED	APPROVED	SCALE	NA
PARK 07.02.2024 H.W.	KANG 07.02.2024 D.H.	CHA 07.02.2024 J.H.	KIM 07.02.2024 H.J.	REV. NO.	0
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APPROVED
7/26/2024

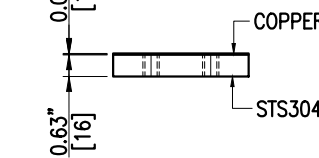


LOACL CONTROL PANEL
REMOVABLE PLATE

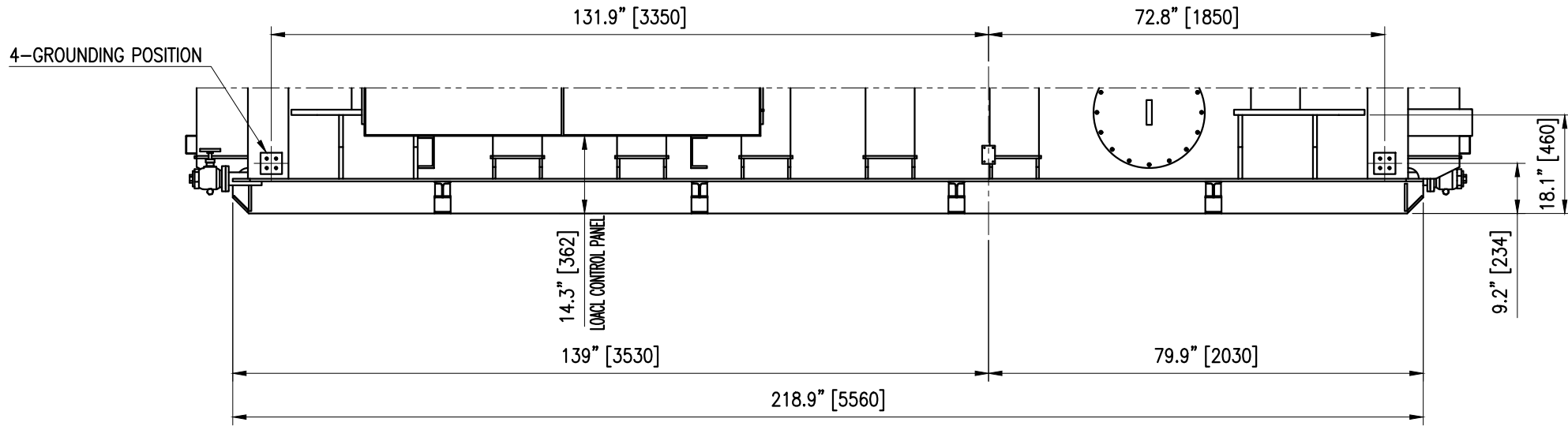
XV CHAMBER REMOVABLE PLATE
(STAINLESS STEEL 0.12" [3mm])



4-1/2"-13UNC TAPS



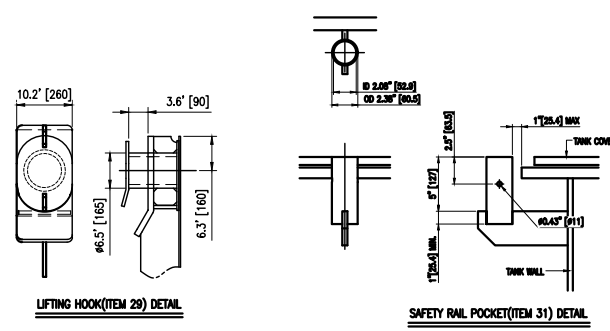
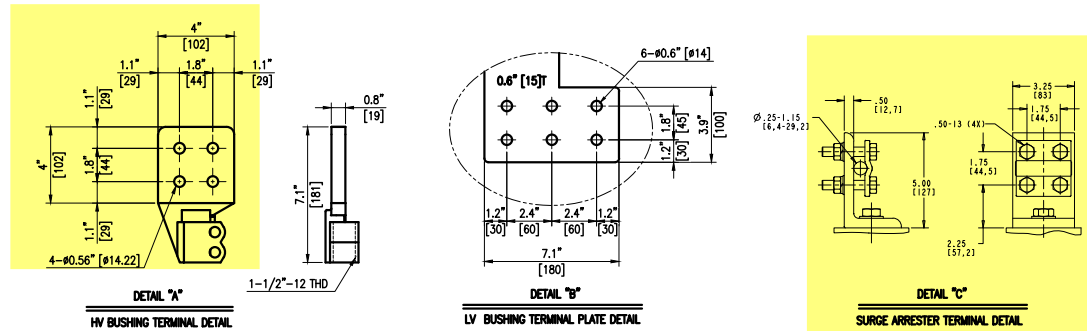
GROUNDING PAD DETAIL



4-GROUNDING POSITION

LOACL CONTROL PANEL

DWG NAME		FOUNDATION	
DWG No.		EJUZ1100051	
UNIT		mm	
SCALE		1:20	
No.	DATE	DESCRIPTION OF REVISION	
00	24-06-12	FOR APPROVAL	
DESIGNED	CHECKED	REVIEWED	APPROVED
I.H.SEO	D.H.KANG	B.C.LEE	H.J.KIM
24.06.12	24.06.12	24.06.12	24.06.12
REVISION No.		00	
THIRD ANGLE PROJECTION			
TYPE		TRANSFORMER	
REF. No.		-	

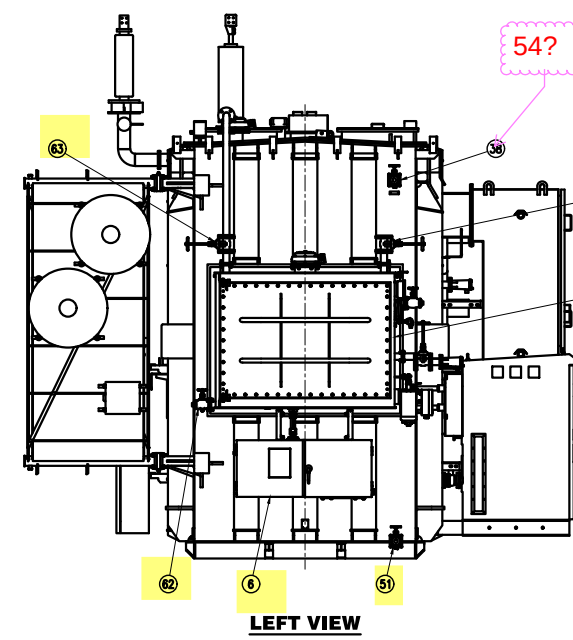
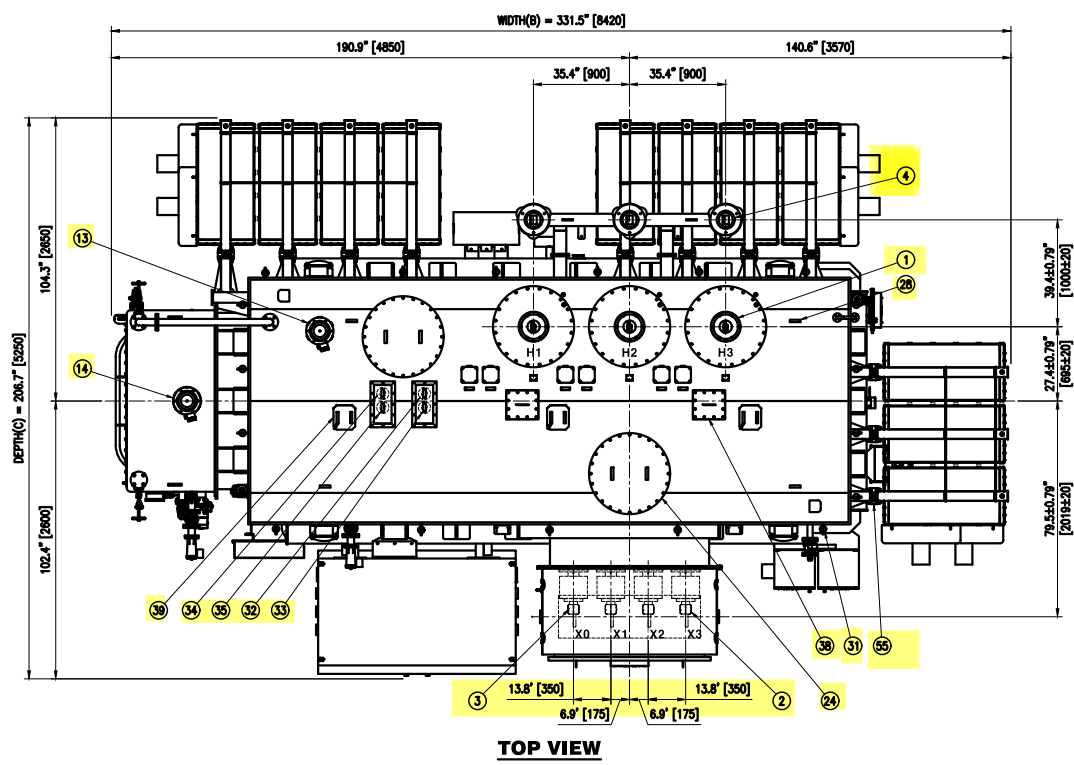


ITEM	DESCRIPTION	SPECIFICATION	Q'TY	ITEM	DESCRIPTION	SPECIFICATION	Q'TY
51	DRAIN VALVE FOR MAIN TANK	2" GLOBE, WITH 3/8" SAMPLING CAP (NPT)	2 EA	1	HV BUSHING (PCORE)	B-8593-70 (85KV, 350KV BIL, 1200A) BOTTOM CONNECTED	3 EA
52	AIR RELEASE VENT (SCREW TYPE) FOR RADIATOR	M16	11 EA	2	XV BUSHING (PCORE)	B-89131-70 (15KV, 110KV BIL, 3000A) BOTTOM CONNECTED	3 EA
53	DRAIN PLUG FOR RADIATOR	M16	11 EA	3	XVN BUSHING (PCORE)	B-89131-70 (15KV, 110KV BIL, 3000A) BOTTOM CONNECTED	1 EA
54	UPPER FILTER VALVE FOR MAIN TANK	2" GLOBE (NPT)	2 EA	4	HV ARRESTER (POLYMER TYPE) (ABB)	QD60SA048A, MOV 48KV, RATED 60KV	3 EA
55	VALVE FOR RADIATOR	3" BUTTERFLY (FLANGED)	22 EA	5	ON LOAD TAP CHANGER (MR)	RMV II-2500	1 EA
56	OIL INLET VALVE FOR GAS & MOISTURE MONITORING SYSTEM	1.5" BALL VALVE WITH 1/2" NPT COUPLING	1 EA	6	MOTOR DRIVE UNIT	MD-III	1 EA
57	OIL OUTLET VALVE FOR GAS & MOISTURE MONITORING SYSTEM	1.5" BALL VALVE WITH 1/2" NPT COUPLING	1 EA	7	DE ENERGIZED TAP CHANGER	A TYPE PAD LOCKABLE WITH 3/8" HASP	1 EA
58	CONNECTION VALVE FOR RPRR FOR MAIN TANK	2" GATE VALVE (FLANGED)	1 EA	8	LOCAL CONTROL PANEL	OUTDOOR/INDOOR TYPE	1 EA
59	CONNECTION VALVE FOR RPRR FOR OLTC	2" GATE VALVE (FLANGED)	1 EA	9	SURGE COUNTER	1HSA440000-D	1 EA
60	UFF VALVE FOR OLTC	2" GLOBE VALVE	1 EA	10	HCO MARK	STAINLESS STEEL	1 EA
61	FILLING VALVE FOR OLTC	2" GATE VALVE (FLANGED)	1 EA	11	MAIN NAMEPLATE	STAINLESS STEEL	1 EA
62	DRAIN VALVE FOR OLTC	2" GLOBE VALVE WITH SAMPLING DEVICE	1 EA	12	VALVE NAMEPLATE	STAINLESS STEEL	1 EA
63	EQUALIZING VALVE FOR OLTC	2" GATE VALVE (FLANGED)	1 EA	13	PRESSURE RELIEF DEVICE FOR MAIN TANK (QUALITROL)	QT208-60F	1 EA
64	GAS SPACE EXPANSION VALVE	1/2" BALL VALVE (PT)	1 EA	14	PRESSURE RELIEF DEVICE FOR OLTC (QUALITROL)	QT208-60F	1 EA

10255352_0001.2 (University of Missouri Units PJT) 3 PH, 60 Hz, 25/33.3/41.67MVA, 69, 13.8KV, Dyn1	
CORE & COIL	: 88,483 LBS
TANK & FITTING	: 66,869 LBS
INSULATING OIL	: 74,790 LBS (9,637 GAL)
TOTAL WEIGHT (WITH OIL)	: 230,142 LBS
TOTAL WEIGHT (WITHOUT OIL)	: 155,352 LBS
SHIPPING WEIGHT	: 137,035 LBS
SHIPPING DIMENSION	296.5" [7530] (W) x 159.5" [4050] (D) x 166.5" [4230] (H)

NOTE:
1. ALL DIMENSIONS ARE IN INCH (MILLIMETERS)
2. DIMENSION & WEIGHT TOLERANCE : ±3%
3. PHASE TO PHASE TOLERANCE : ±3%
4. DIMENSIONS AND WEIGHT MIGHT BE CHANGED SLIGHTLY AFTER DETAIL DESIGN.
5. Ⓞ MARK : CENTER OF GRAVITY FOR TOTAL UNIT

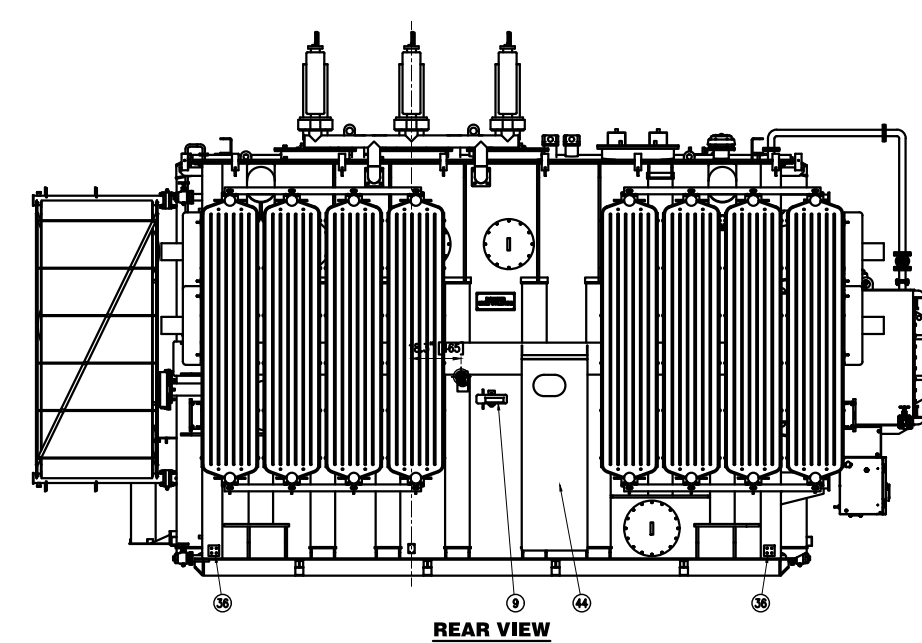
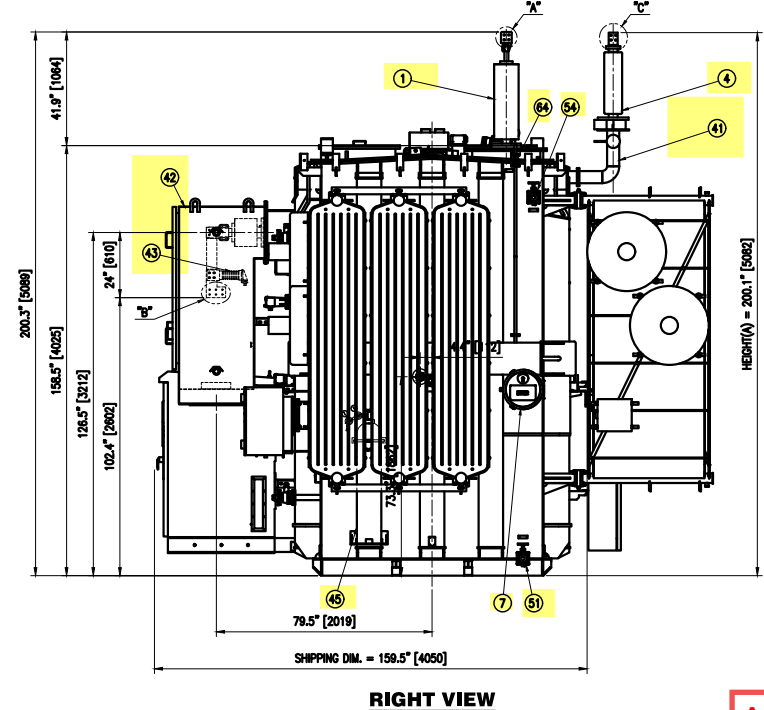
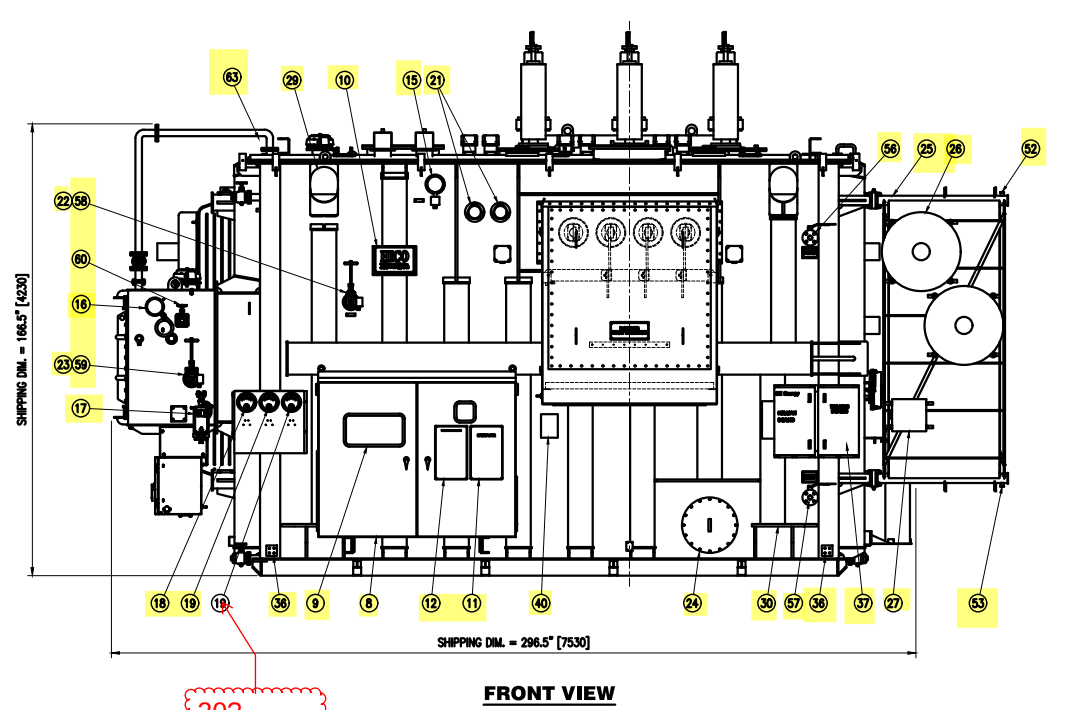
ITEM	DESCRIPTION	SPECIFICATION	Q'TY
15	OIL LEVEL GAUGE FOR MAIN TANK (QUALITROL)	DIAL TYPE : 042 SERIES	1 EA
16	OIL LEVEL GAUGE FOR RMV OLTC (MR)	—	1 EA
17	BREATHING FOR OLTC (MESSKO)	DB100RM-HT	1 EA
18	HV WINDING TEMPERATURE INDICATOR (QUALITROL)	104 SERIES	1 EA
19	LV WINDING TEMPERATURE INDICATOR (QUALITROL)	104 SERIES	1 EA
20	OIL TEMPERATURE INDICATOR (QUALITROL)	104 SERIES	1 EA
21	THERMAL PLATE	2WTL	2 EA
22	RAPID PRESSURE RISE RELAY FOR MAIN TANK (QUALITROL)	900-025-01	1 EA
23	RAPID PRESSURE RISE RELAY FOR RMV OLTC (QUALITROL)	900-025-01	1 EA
24	MANHOLE & HANDHOLE	—	1 LOT
25	COOLING RADIATORS	POWDER COATING	11 EA
26	FAN WITH MOTOR (KRENN-VENT)	F26K-A14712	6 EA
27	JUNCTION BOX FOR COOLING FANS	—	3 EA
28	LIFTING EYE FOR COVER	—	4 EA
29	LIFTING HOOK	—	4 EA
30	JACKING PAD	—	4 EA
31	SAFETY RAIL POCKET — SEE DETAIL	—	19 EA
32	GROUNDING BUSHING FOR MAIN END FRAME (TY Tech)	TBA01022	1 EA
33	GROUNDING BUSHING FOR MAIN CORE (TY Tech)	TBA01022	1 EA
34	GROUNDING BUSHING FOR REACTOR END FRAME (TY Tech)	TBA01022	1 EA
35	GROUNDING BUSHING FOR REACTOR CORE (TY Tech)	TBA01022	1 EA
36	GROUNDING PAD	NEW 4INX6 (STAINLESS STEEL WITH COPPER)	4 EA
37	DGA MONITORING SYSTEM	GE/KELMAN DGA900	1 EA
38	FIXING SUPPORTER FOR CORE & COIL ASS'Y	—	2 EA
39	PORTABLE FALL ARREST WELD — ON BASE (DBI SALA)	#B517412 WITH A TIE OFF ANCHOR	3 EA
40	IMPACT RECORDER-DIGITAL	—	1 EA
41	HV ARRESTER BRACKET	—	3 EA
42	XV TERMINAL CABLE BOX WITH: WOODEN CABLE SUPPORT	—	1 SET
43	INSULATOR	CH-901	3 EA
44	OIL PRESERVATION SYSTEM (ABB)	RND	1 EA
45	H2 GAS EQUIPMENT FOR SHIPPING	—	1 SET



wooden cable support?
from specification:

2. Provide bus work and adequate bracing supported by termination chamber adequate to support weight of 15kV conductors without straining bushings.

circuit will be 6 x 750 kcmil conductors



APPROVED AS NOTED 7/26/24

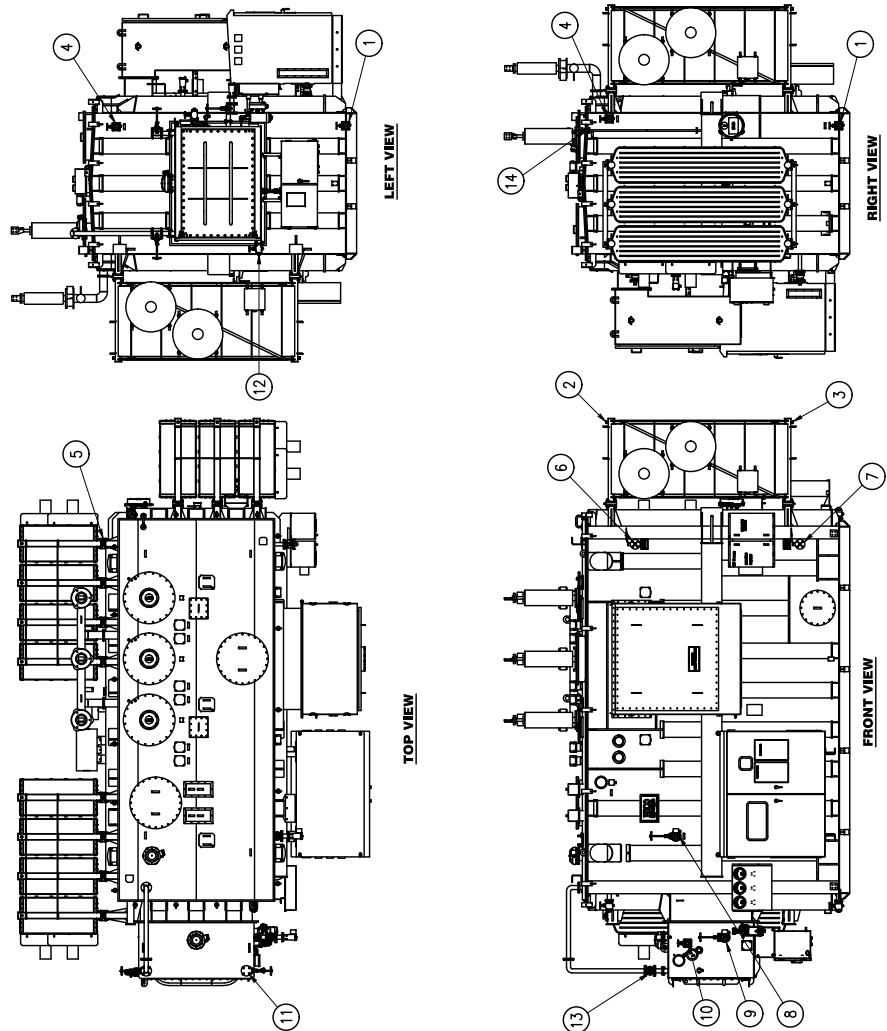
OUTLINE		EJUG1100012		UNIT	mm
00	24-06-12	FOR APPROVAL	DESIGNED	SCALE	1:35
No.	DATE	DESCRIPTION OF REVISION	CHECKED	REVIEWED	APPROVED
1	24.06.12	1. H.S.D.	24.06.12	B.C.L.E.	24.06.12
2	24.06.12	2. H.S.D.	24.06.12	H.J.K.M.	24.06.12
3	24.06.12	3. H.S.D.	24.06.12	H.J.K.M.	24.06.12
4	24.06.12	4. H.S.D.	24.06.12	H.J.K.M.	24.06.12
5	24.06.12	5. H.S.D.	24.06.12	H.J.K.M.	24.06.12
6	24.06.12	6. H.S.D.	24.06.12	H.J.K.M.	24.06.12
7	24.06.12	7. H.S.D.	24.06.12	H.J.K.M.	24.06.12
8	24.06.12	8. H.S.D.	24.06.12	H.J.K.M.	24.06.12
9	24.06.12	9. H.S.D.	24.06.12	H.J.K.M.	24.06.12
10	24.06.12	10. H.S.D.	24.06.12	H.J.K.M.	24.06.12
11	24.06.12	11. H.S.D.	24.06.12	H.J.K.M.	24.06.12
12	24.06.12	12. H.S.D.	24.06.12	H.J.K.M.	24.06.12
13	24.06.12	13. H.S.D.	24.06.12	H.J.K.M.	24.06.12
14	24.06.12	14. H.S.D.	24.06.12	H.J.K.M.	24.06.12
15	24.06.12	15. H.S.D.	24.06.12	H.J.K.M.	24.06.12
16	24.06.12	16. H.S.D.	24.06.12	H.J.K.M.	24.06.12
17	24.06.12	17. H.S.D.	24.06.12	H.J.K.M.	24.06.12
18	24.06.12	18. H.S.D.	24.06.12	H.J.K.M.	24.06.12
19	24.06.12	19. H.S.D.	24.06.12	H.J.K.M.	24.06.12
20	24.06.12	20. H.S.D.	24.06.12	H.J.K.M.	24.06.12
21	24.06.12	21. H.S.D.	24.06.12	H.J.K.M.	24.06.12
22	24.06.12	22. H.S.D.	24.06.12	H.J.K.M.	24.06.12
23	24.06.12	23. H.S.D.	24.06.12	H.J.K.M.	24.06.12
24	24.06.12	24. H.S.D.	24.06.12	H.J.K.M.	24.06.12
25	24.06.12	25. H.S.D.	24.06.12	H.J.K.M.	24.06.12
26	24.06.12	26. H.S.D.	24.06.12	H.J.K.M.	24.06.12
27	24.06.12	27. H.S.D.	24.06.12	H.J.K.M.	24.06.12
28	24.06.12	28. H.S.D.	24.06.12	H.J.K.M.	24.06.12
29	24.06.12	29. H.S.D.	24.06.12	H.J.K.M.	24.06.12
30	24.06.12	30. H.S.D.	24.06.12	H.J.K.M.	24.06.12
31	24.06.12	31. H.S.D.	24.06.12	H.J.K.M.	24.06.12
32	24.06.12	32. H.S.D.	24.06.12	H.J.K.M.	24.06.12
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52	24.06.12	52. H.S.D.	24.06.12	H.J.K.M.	24.06.12
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57	24.06.12	57. H.S.D.	24.06.12	H.J.K.M.	24.06.12
58	24.06.12	58. H.S.D.	24.06.12	H.J.K.M.	24.06.12
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60	24.06.12	60. H.S.D.	24.06.12	H.J.K.M.	24.06.12
61	24.06.12	61. H.S.D.	24.06.12	H.J.K.M.	24.06.12
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63	24.06.12	63. H.S.D.	24.06.12	H.J.K.M.	24.06.12
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66	24.06.12	66. H.S.D.	24.06.12	H.J.K.M.	24.06.12
67	24.06.12	67. H.S.D.	24.06.12	H.J.K.M.	24.06.12
68	24.06.12	68. H.S.D.	24.06.12	H.J.K.M.	24.06.12
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71	24.06.12	71. H.S.D.	24.06.12	H.J.K.M.	24.06.12
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73	24.06.12	73. H.S.D.	24.06.12	H.J.K.M.	24.06.12
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95	24.06.12	95. H.S.D.	24.06.12	H.J.K.M.	24.06.12
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97	24.06.12	97. H.S.D.	24.06.12	H.J.K.M.	24.06.12
98	24.06.12	98. H.S.D.	24.06.12	H.J.K.M.	24.06.12
99	24.06.12	99. H.S.D.	24.06.12	H.J.K.M.	24.06.12
100	24.06.12	100. H.S.D.	24.06.12	H.J.K.M.	24.06.12

APPROVED
7/26/2024

VALVE LOCATION

S.NO.	OUTLINE NO.	DISCRIPTION	SIZE & TYPE	TOTAL QTY	NORMAL CONDITION	VACUUM CONDITION
1	51	DRAIN VALVE FOR MAIN TANK	2" GLOBE, WITH 3/8" SAMPLING CAP(NIP)	2	CLOSED	OPEN
2	52	AIR RELEASE VENT (SCREW TYPE) FOR RADIATOR	M16	11	CLOSED	CLOSED
3	53	DRAIN PLUG FOR RADIATOR	M16	11	CLOSED	CLOSED
4	54	UPPER FILTER VALVE FOR MAIN TANK	2" GLOBE (NPT)	2	CLOSED	OPEN
5	55	VALVE FOR RADIATOR	3" BUTTERFLY (FLANGED)	22	OPEN	OPEN
6	56	OIL INLET VALVE FOR GAS & MOISTURE MONITORING SYSTEM	1.5" BALL VALVE WITH 1/2"NPT COUPLING	1	OPEN	CLOSED
7	57	OIL OUTLET VALVE FOR GAS & MOISTURE MONITORING SYSTEM	1.5" BALL VALVE WITH 1/2"NPT COUPLING	1	OPEN	CLOSED
8	58	CONNECTION VALVE FOR RPRR FOR MAIN TANK	2" GATE VALVE (FLANGED)	1	OPEN	CLOSED
9	59	CONNECTION VALVE FOR RPRR FOR OLTC	2" GATE VALVE (FLANGED)	1	OPEN	CLOSED
10	60	UFP VALVE FOR OLTC	2" GLOBE VALVE	1	CLOSED	CLOSED
11	61	FILLING VALVE FOR OLTC	2" GATE VALVE (FLANGED)	1	CLOSED	CLOSED
12	62	DRAIN VALVE FOR OLTC	2" GLOBE VALVE WITH SAMPLING DEVICE	1	CLOSED	CLOSED
13	63	EQUALIZING VALVE FOR OLTC	2" GATE VALVE (FLANGED)	1	CLOSED	OPEN
14	64	GAS SPACE EXPANSION VALVE	1/2" BALL VALVE (PT)	1	OPEN	OPEN

CAUTION : OPERATORS HAVE TO REFER TO THE MAINTENANCE INSTRUCTION MANUAL BEFORE APPLYING ANY VACUUM TREATMENT.



HICO
HYOSUNG HEAVY INDUSTRIES

MADE IN KOREA

0.39" [10]

19.69" [500]

0.39" [10]

0.39" [10]

11.81" [300]

0.39" [10]

4-Ø0.31" [Ø8]

#NOTE :

- ALL DIMENSIONS ARE IN INCHES [MILLIMETER].
- MATERIAL : STAINLESS STEEL.
- THICKNESS : 0.04 INCH [1mm]
- LETTER COLOR : BLACK

				DWG. NAME		VALVE NAMEPLATE			
				DWG. No.		EJXA1100341		UNIT	IN (mm)
00		24-06-12		FOR APPROVAL				SCALE	1:1
No.		DATE		DESCRIPTION OF REVISION		DESIGNED	CHECKED	REVIEWED	APPROVED
24-06-12		24-06-12				I.H.SEO	D.H.KANG	B.C.LEE	H.J.KIM
2024.12.20						24.06.12	24.06.12	24.06.12	24.06.12
FORM								REVISION No. 00	
CE-11-0100-44								THIRD ANGLE PROJECTION	
2024.12.20									
TYPE				TRANSFORMER		REF. No.		-	
								(A)	

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SECTION 003132 - GEOTECHNICAL DATA

1.1 GEOTECHNICAL DATA

- A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information. This Document and its attachments are not part of the Contract Documents.
- B. Because subsurface conditions indicated by the soil borings are a sampling in relation to the entire construction area, and for other reasons, the Owner, the Architect, the Architect's consultants, and the firm reporting the subsurface conditions do not warranty the conditions below the depths of the borings or that the strata logged from the borings are necessarily typical of the entire site. Any party using the information described in the soil borings and geotechnical report shall accept full responsibility for its use.
- C. A geotechnical investigation report for Project, prepared by Crockett Geotechnical – Testing Lab, dated August 19, 2025, is available for viewing as appended to this Document.
 - 1. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from the data.
 - 2. Any party using information described in the geotechnical report shall make additional test borings and conduct other exploratory operations that may be required to determine the character of subsurface materials that may be encountered.

END OF DOCUMENT 003132

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SECTION 031000 - CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Form-facing material for cast-in-place concrete.
 - 2. Shoring, bracing, and anchoring.
- B. Related Requirements:
 - 1. Section 321313 "Concrete Paving" for formwork related to concrete pavement and walks.

1.3 DEFINITIONS

- A. Form-Facing Material: Temporary structure or mold for the support of concrete while the concrete is setting and gaining sufficient strength to be self-supporting.
- B. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review the following:
 - a. Special inspection and testing and inspecting agency procedures for field quality control.
 - b. Construction, movement, contraction, and isolation joints
 - c. Forms and form-removal limitations.
 - d. Shoring and reshoring procedures.
 - e. Anchor rod and anchorage device installation tolerances.

1.5 ACTION SUBMITTALS

- A. Product Data: For each of the following:

1. Exposed surface form-facing material.
2. Concealed surface form-facing material.
3. Void forms.
4. Form ties.
5. Waterstops.
6. Form-release agent.

B. Shop Drawings: Prepared by, and signed and sealed by, a qualified professional engineer responsible for their preparation, detailing fabrication, assembly, and support of forms.

1. For exposed vertical concrete walls, indicate dimensions and form tie locations.
2. Indicate dimension and locations of construction and movement joints required to construct the structure in accordance with ACI 301.
 - a. Location of construction joints is subject to approval of the Architect.
3. Indicate location of waterstops.
4. Indicate proposed schedule and sequence of stripping of forms, shoring removal, and reshoring installation and removal.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing and inspection agency.
- B. Field quality-control reports.
- C. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

- A. Testing and Inspection Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.

1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
2. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of supports.
 - a. For architectural concrete specified in Section 033300 "Architectural Concrete," limit deflection of form-facing material, studs, and walers to 0.0025 times their respective clear spans (L/400).

2.2 FORM-FACING MATERIALS

A. As-Cast Surface Form-Facing Material:

1. Provide continuous, true, and smooth concrete surfaces.
2. Furnish in largest practicable sizes to minimize number of joints.
3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete, and as follows:
 - a. Plywood, metal, or other approved panel materials.
 - b. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - 1) APA HDO (high-density overlay).
 - 2) APA MDO (medium-density overlay); mill-release agent treated and edge sealed.
 - 3) APA Structural 1 Plyform, B-B or better; mill oiled and edge sealed.
 - 4) APA Plyform Class I, B-B or better; mill oiled and edge sealed.

B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.

1. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that produce surfaces not exceeding specified formwork surface class.

1. Provide forms with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

D. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

2.3 WATERSTOPS

A. Flexible PVC Waterstops: U.S. Army Corps of Engineers CRD-C 572, for embedding in concrete to prevent passage of fluids through joints, with factory fabricate corners, intersections, and directional changes.

1. Profile: Flat dumbbell without center bulb.
2. Dimensions: 4 inches by 3/16 inch thick; non tapered.

- B. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.
- C. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer-modified chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch.

2.4 RELATED MATERIALS

- A. Reglets: Fabricate reglets of not less than 0.022-inch-thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- B. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- C. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- D. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- E. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
 - 2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.
 - 3. Furnish ties with integral water-barrier plates to walls indicated to receive damp proofing or waterproofing.

PART 3 - EXECUTION

3.1 INSTALLATION OF FORMWORK

- A. Comply with ACI 301.
- B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 and to comply with the Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete" for as-cast finishes.
- C. Limit concrete surface irregularities as follows:
 - 1. Surface Finish-1.0: ACI 117 Class D, 1 inch.
 - 2. Surface Finish-2.0: ACI 117 Class B, 1/4 inch.
 - 3. Surface Finish-3.0: ACI 117 Class A, 1/8 inch.

- D. Construct forms tight enough to prevent loss of concrete mortar.
 - 1. Minimize joints.
 - 2. Exposed Concrete: Symmetrically align joints in forms.
- E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.
 - 1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
 - 2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 3. Install keyways, reglets, recesses, and other accessories, for easy removal.
- F. Do not use rust-stained, steel, form-facing material.
- G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.
 - 1. Provide and secure units to support screed strips
 - 2. Use strike-off templates or compacting-type screeds.
- H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.
 - 1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
 - 2. Locate temporary openings in forms at inconspicuous locations.
- I. Chamfer exterior corners and edges of permanently exposed concrete.
- J. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.
- K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.
 - 1. Determine sizes and locations from trades providing such items.
 - 2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.
- L. Construction and Movement Joints:
 - 1. Construct joints true to line with faces perpendicular to surface plane of concrete.
 - 2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 3. Place joints perpendicular to main reinforcement.
 - 4. Locate joints for beams, slabs, joists, and girders in the middle third of spans.
 - a. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 - 6. Space vertical joints in walls as indicated on Drawings.

- a. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
- M. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.
 - 1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
 - 2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.
- N. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- O. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- P. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.
 - 1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
 - 3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 - 4. Install dovetail anchor slots in concrete structures, as indicated on Drawings.
 - 5. Clean embedded items immediately prior to concrete placement.

3.3 INSTALLATION OF WATERSTOPS

- A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm.
 - 1. Install in longest lengths practicable.
 - 2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
 - 3. Allow clearance between waterstop and reinforcing steel of not less than 2 times the largest concrete aggregate size specified in Section 033000 "Cast-In-Place Concrete."
 - 4. Secure waterstops in correct position at 12 inches on center.
 - 5. Field fabricate joints in accordance with manufacturer's instructions using heat welding.
 - a. Miter corners, intersections, and directional changes in waterstops.
 - b. Align center bulbs.

6. Clean waterstops immediately prior to placement of concrete.
 7. Support and protect exposed waterstops during progress of the Work.
- B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated on Drawings, according to manufacturer's written instructions, by adhesive bonding, mechanically fastening, and firmly pressing into place.
1. Install in longest lengths practicable.
 2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
 3. Protect exposed waterstops during progress of the Work.

3.4 REMOVING AND REUSING FORMS

- A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.
1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work.
1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.
 2. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.
1. Align and secure joints to avoid offsets.
 2. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.5 SHORING AND RESHORING INSTALLATION

- A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.
1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
- B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.
- C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.6 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. Inspections:
 - 1. Inspect formwork for shape, location, and dimensions of the concrete member being formed.

END OF SECTION 031000

SECTION 032000 - CONCRETE REINFORCING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel reinforcement bars.
2. Welded-wire reinforcement.

B. Related Requirements:

1. Section 321313 "Concrete Paving" for reinforcing related to concrete pavement and walks.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review the following:
 - a. Special inspection and testing and inspecting agency procedures for field quality control.
 - b. Construction contraction and isolation joints.
 - c. Steel-reinforcement installation.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Each type of steel reinforcement.
2. Bar supports.
3. Mechanical splice couplers.

B. Shop Drawings: Comply with ACI SP-066:

1. Include placing drawings that detail fabrication, bending, and placement.
2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.

C. Construction Joint Layout: Indicate proposed construction joints required to build the structure.

1. Location of construction joints is subject to approval of Architect.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
 - 1. Reinforcement To Be Welded: Welding procedure specification in accordance with AWS D1.4/D1.4M.
- B. Material Test Reports: For the following, from a qualified testing agency:
 - 1. Steel Reinforcement:
 - a. For reinforcement to be welded, mill test analysis for chemical composition and carbon equivalent of the steel in accordance with ASTM A706/A706M.
 - 2. Mechanical splice couplers.
- C. Field quality-control reports.
- D. Minutes of preinstallation conference.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.
- B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4/D 1.4M.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
 - 1. Store reinforcement to avoid contact with earth.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.
- B. Low-Alloy Steel Reinforcing Bars: ASTM A706/A706M, deformed.
- C. Headed-Steel Reinforcing Bars: ASTM A970/A970M.
- D. Steel Bar Mats: ASTM A184/A184M, fabricated from ASTM A615/A615M, Grade 60, deformed bars, assembled with clips.

- E. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.
- F. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.
- G. Galvanized-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from galvanized-steel wire into flat sheets.

2.2 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A615/A615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.
 - 1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.
 - b. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.
 - c. For stainless steel reinforcement, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.
- C. Mechanical Splice Couplers: ACI 318 Type 2, same material of reinforcing bar being spliced; tension-compression type.
- D. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch in diameter.
 - 1. Finish: Plain.
- E. Stainless Steel Tie Wire: ASTM A1022/A1022M, not less than 0.0508 inch in diameter.

2.3 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protection of In-Place Conditions:
 - 1. Do not cut or puncture vapor retarder.

2. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.2 INSTALLATION OF STEEL REINFORCEMENT

- A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.
- B. Accurately position, support, and secure reinforcement against displacement.
1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
 2. Do not tack weld crossing reinforcing bars.
- C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.
- D. Provide concrete coverage in accordance with ACI 318.
- E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- F. Splices: Lap splices as indicated on Drawings.
1. Bars indicated to be continuous, and all vertical bars to be lapped not less than 36 bar diameters at splices, or 24 inches, whichever is greater.
 2. Stagger splices in accordance with ACI 318.
 3. Mechanical Splice Couplers: Install in accordance with manufacturer's instructions.
 4. Weld reinforcing bars in accordance with AWS D1.4/D 1.4M, where indicated on Drawings.
- G. Install welded-wire reinforcement in longest practicable lengths.
1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."
 - a. For reinforcement less than W4.0 or D4.0, continuous support spacing to not exceed 12 inches.
 2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches for plain wire and 8 inches for deformed wire.
 3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
 4. Lace overlaps with wire.

3.3 JOINTS

- A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
1. Place joints perpendicular to main reinforcement.
 2. Continue reinforcement across construction joints unless otherwise indicated.

3. Do not continue reinforcement through sides of strip placements of floors and slabs.

- B. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length, to prevent concrete bonding to one side of joint.

3.4 INSTALLATION TOLERANCES

- A. Comply with ACI 117.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. Inspections:
1. Steel-reinforcement placement.
 2. Steel-reinforcement mechanical splice couplers.
 3. Steel-reinforcement welding.

END OF SECTION 032000

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SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

B. Related Requirements:

1. Section 031000 "Concrete Forming and Accessories" for form-facing materials, form liners, insulating concrete forms, and waterstops.
2. Section 032000 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.
3. Section 312000 "Earth Moving" for drainage fill under slabs-on-ground.
4. Section 321313 "Concrete Paving" for concrete pavement and walks.

1.2 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
- B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete Subcontractor.
 - e. Special concrete finish Subcontractor.
2. Review the following:
 - a. Special inspection and testing and inspecting agency procedures for field quality control.
 - b. Construction joints, control joints, isolation joints, and joint-filler strips.
 - c. Semirigid joint fillers.

- d. Vapor-retarder installation.
- e. Anchor rod and anchorage device installation tolerances.
- f. Cold and hot weather concreting procedures.
- g. Concrete finishes and finishing.
- h. Curing procedures.
- i. Forms and form-removal limitations.
- j. Shoring and reshoring procedures.
- k. Methods for achieving specified floor and slab flatness and levelness.
- l. Floor and slab flatness and levelness measurements.
- m. Concrete repair procedures.
- n. Concrete protection.
- o. Initial curing and field curing of field test cylinders (ASTM C31/C31M.)
- p. Protection of field cured field test cylinders.

1.4 ACTION SUBMITTALS

A. Product Data: For each of the following.

- 1. Portland cement.
- 2. Fly ash.
- 3. Slag cement.
- 4. Blended hydraulic cement.
- 5. Silica fume.
- 6. Aggregates.
- 7. Admixtures:
 - a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.
- 8. Color pigments.
- 9. Fiber reinforcement.
- 10. Vapor retarders.
- 11. Floor and slab treatments.
- 12. Liquid floor treatments.
- 13. Curing materials.
 - a. Include documentation from color pigment manufacturer, indicating that proposed methods of curing are recommended by color pigment manufacturer.
- 14. Joint fillers.
- 15. Repair materials.

B. Design Mixtures: For each concrete mixture, include the following:

- 1. Mixture identification.
- 2. Minimum 28-day compressive strength.
- 3. Durability exposure class.
- 4. Maximum w/cm.

5. Slump limit.
6. Air content.
7. Nominal maximum aggregate size.
8. Synthetic micro-fiber content.
9. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
10. Include manufacturer's certification that permeability-reducing admixture is compatible with mix design.
11. Include certification that dosage rate for permeability-reducing admixture matches dosage rate used in performance compliance test.
12. Intended placement method.
13. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Shop Drawings:

1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - a. Location of construction joints is subject to approval of the Architect.

D. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:

1. Concrete Class designation.
2. Location within Project.
3. Exposure Class designation.
4. Formed Surface Finish designation and final finish.
5. Final finish for floors.
6. Curing process.
7. Floor treatment if any.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For the following:

1. Installer: Include copies of applicable ACI certificates.
2. Ready-mixed concrete manufacturer.
3. Testing agency: Include copies of applicable ACI certificates.

B. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Fiber reinforcement.
4. Curing compounds.
5. Floor and slab treatments.
6. Bonding agents.
7. Adhesives.
8. Vapor retarders.

9. Semirigid joint filler.
10. Joint-filler strips.
11. Repair materials.

C. Material Test Reports: For the following, from a qualified testing agency:

1. Portland cement.
2. Fly ash.
3. Slag cement.
4. Blended hydraulic cement.
5. Silica fume.
6. Aggregates.
7. Admixtures:

- a. Permeability-Reducing Admixture: Include independent test reports, indicating compliance with specified requirements, including dosage rate used in test.

D. Floor surface flatness and levelness measurements report, indicating compliance with specified tolerances.

E. Research Reports:

1. For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.
2. For sheet vapor retarder/termite barrier, showing compliance with ICC AC380.

F. Preconstruction Test Reports: For each mix design.

G. Field quality-control reports.

H. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs Project personnel qualified as an ACI-certified Flatwork Technician and Finisher and a supervisor who is a certified ACI Flatwork Concrete Finisher/Technician or an ACI Concrete Flatwork Technician.

1. Post-Installed Concrete Anchors Installers: ACI-certified Adhesive Anchor Installer.

B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated and employing an ACI-certified Concrete Quality Control Technical Manager.

1. Personnel performing laboratory tests to be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor to be an ACI-certified Concrete Laboratory Testing Technician, Grade II.
- D. Field Quality-Control Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.
1. Personnel conducting field tests to be qualified as an ACI Concrete Field-Testing Technician, Grade 1, in accordance with ACI CPP 610.1 or an equivalent certification program.

1.7 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Owner will engage a qualified testing agency to perform preconstruction testing on each concrete mixture.
1. Include the following information in each test report:
 - a. Admixture dosage rates.
 - b. Slump.
 - c. Air content.
 - d. Seven-day compressive strength.
 - e. 28-day compressive strength.
 - f. Permeability.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with ASTM C94/C94M and ACI 301.

1.9 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.
1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 2. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 3. Do not use frozen materials or materials containing ice or snow.
 4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.
 5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:

1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

1.10 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement sheet vapor retarder/termite barrier material and accessories for sheet vapor retarder/ termite barrier and accessories that do not comply with requirements or that fail to resist penetration by termites within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.

2.2 CONCRETE MATERIALS

- A. Source Limitations:

1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
3. Obtain aggregate from single source.
4. Obtain each type of admixture from single source from single manufacturer.

- B. Cementitious Materials:

1. Portland Cement: ASTM C150/C150M, Type as indicated on concrete material schedule.
2. Fly Ash: ASTM C618, Class C or F.
3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
4. Silica Fume: ASTM C1240 amorphous silica.

- C. Normal-Weight Aggregates: ASTM C33/C33M, Class as indicated on concrete material schedule coarse aggregate or better, graded. Provide aggregates from a single source.

1. Alkali-Silica Reaction: Comply with one of the following:

- a. Expansion Result of Aggregate: Not more than 0.04 percent at one-year when tested in accordance with ASTM C1293.
- b. Expansion Results of Aggregate and Cementitious Materials in Combination: Not more than 0.10 percent at an age of 16 days when tested in accordance with ASTM C1567.

- c. Alkali Content in Concrete: Not more than 4 lb./cu. yd. for moderately reactive aggregate or 3 lb./cu. yd. for highly reactive aggregate, when tested in accordance with ASTM C1293 and categorized in accordance with ASTM C1778, based on alkali content being calculated in accordance with ACI 301.
 - 2. Maximum Coarse-Aggregate Size: as indicated on Concrete material schedule.
 - 3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Air-Entraining Admixture: ASTM C260/C260M.
- E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
 - 2. Retarding Admixture: ASTM C494/C494M, Type B.
 - 3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
 - 5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
 - 6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.
 - 7. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C494/C494M, Type C.
 - 8. Retain "Non-Set-Accelerating Corrosion-Inhibiting Admixture" Subparagraph below if corrosion inhibitors that do not affect concrete setting time are required.
 - 9. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.
 - 10. Permeability-Reducing Admixture: ASTM C494/C494M, Type S, hydrophilic, permeability-reducing crystalline admixture, capable of reducing water absorption of concrete exposed to hydrostatic pressure (PRAH).
 - a. Permeability: No leakage when tested in accordance with U.S. Army Corps of Engineers CRD C48 at a hydraulic pressure of 200 psi for 14 days.
- F. Water and Water Used to Make Ice: ASTM C94/C94M, potable

2.3 FIBER REINFORCEMENT

- A. Synthetic Monofilament Micro-Fiber: Monofilament polypropylene micro-fibers engineered and designed for use in concrete, complying with ASTM C1116/C1116M, Type III, 1/2 to 1-1/2 inches long.

2.4 VAPOR RETARDERS

- A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A; not less than 10 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.

2.5 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

2.6 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.
 - 1. Color:
 - a. Ambient Temperature Below 50 deg F: Black.
 - b. Ambient Temperature between 50 deg F and 85 deg F: Any color.
 - c. Ambient Temperature Above 85 deg F: White.
- D. Curing Paper: 8-feet-wide paper, consisting of two layers of fibered kraft paper laminated with double coating of asphalt.
- E. Water: Potable or complying with ASTM C1602/C1602M.
- F. Clear, Waterborne, Membrane-Forming, Dissipating Curing Compound: ASTM C309, Type 1, Class B.
- G. Clear, Waterborne, Membrane-Forming, Nondissipating Curing Compound: ASTM C309, Type 1, Class B, certified by curing compound manufacturer to not interfere with bonding of floor covering.
- H. Clear, Waterborne, Membrane-Forming, Curing Compound: ASTM C309, Type 1, Class B, 18 to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
- I. Clear, Solvent-Borne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.
- J. Clear, Waterborne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.

2.7 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber or ASTM D1752, cork or self-expanding cork.

- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 in accordance with ASTM D2240.
- C. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade and class to suit requirements, and as follows:
 - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- E. Floor Slab Protective Covering: 8-feet-wide cellulose fabric.

2.8 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand, as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 5000 psi at 28 days when tested in accordance with ASTM C109/C109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
 - 4. Compressive Strength: Not less than 5000 psi at 28 days when tested in accordance with ASTM C109/C109M.

2.9 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.

1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
1. Fly Ash or Other Pozzolans: 25 percent by mass.
 2. Slag Cement: 50 percent by mass.
 3. Silica Fume: 10 percent by mass.
 4. Total of Fly Ash or Other Pozzolans, Slag Cement, and Silica Fume: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
 5. Total of Fly Ash or Other Pozzolans and Silica Fume: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
- C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.
1. Use water-reducing high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
 2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 3. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
 4. Use permeability-reducing admixture in concrete mixtures where indicated.
- D. Color Pigment: Add color pigment to concrete mixture in accordance with manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.10 CONCRETE MIXTURES

- A. As indicated on drawings.

2.11 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M and ASTM C1116/C1116M, and furnish batch ticket information.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete in accordance with ASTM C94/C94M. Mix concrete materials in appropriate drum-type batch machine mixer.
1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released.
 2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:

1. Daily access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.3 INSTALLATION OF EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.

1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.
3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

3.4 INSTALLATION OF VAPOR RETARDER

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.

1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
2. Face laps away from exposed direction of concrete pour.
3. Lap vapor retarder over footings and grade beams not less than 6 inches, sealing vapor retarder to concrete.
4. Lap joints 6 inches and seal with manufacturer's recommended tape.

5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
7. Protect vapor retarder during placement of reinforcement and concrete.
 - a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches on all sides, and sealing to vapor retarder.

- B. Bituminous Vapor Retarders: Place, protect, and repair bituminous vapor retarder in accordance with manufacturer's written instructions.

3.5 JOINTS

- A. Construct joints true to line, with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.
 1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
 2. Place joints perpendicular to main reinforcement.
 - a. Continue reinforcement across construction joints unless otherwise indicated.
 - b. Do not continue reinforcement through sides of strip placements of floors and slabs.
 3. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 4. Locate joints for beams, slabs, joists, and girders at third points of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 6. Space vertical joints in walls as indicated on Drawings. Unless otherwise indicated on Drawings, locate vertical joints beside piers integral with walls, near corners, and in concealed locations where possible.
 7. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 8. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:
 1. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 2. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.

- D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
 - 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface, where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
 - 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints:
 - 1. Install dowel bars and support assemblies at joints where indicated on Drawings.
 - 2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.
- F. Dowel Plates: Install dowel plates at joints where indicated on Drawings.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
 - 1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
 - 2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.
- B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.
- C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect in writing, but not to exceed the amount indicated on the concrete delivery ticket.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, but not to exceed the amount indicated on the concrete delivery ticket.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- E. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
 - 1. If a section cannot be placed continuously, provide construction joints as indicated.
 - 2. Deposit concrete to avoid segregation.

3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
 4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.
 - a. Do not use vibrators to transport concrete inside forms.
 - b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
 - c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
 - d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Do not place concrete floors and slabs in a checkerboard sequence.
 2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 3. Maintain reinforcement in position on chairs during concrete placement.
 4. Screed slab surfaces with a straightedge and strike off to correct elevations.
 5. Level concrete, cut high areas, and fill low areas.
 6. Slope surfaces uniformly to drains where required.
 7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
 8. Do not further disturb slab surfaces before starting finishing operations.

3.7 FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:

1. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.
 - a. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
 - b. Remove projections larger than 1 inch.
 - c. Tie holes do not require patching.
 - d. Surface Tolerance: ACI 117 Class D.
 - e. Apply to concrete surfaces not exposed to public view.
2. ACI 301 Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
 - a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
 - b. Remove projections larger than 1/4 inch.
 - c. Patch tie holes.
 - d. Surface Tolerance: ACI 117 Class B.
 - e. Locations: Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.

3. ACI 301 Surface Finish SF-3.0:

- a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
- b. Remove projections larger than 1/8 inch.
- c. Patch tie holes.
- d. Surface Tolerance: ACI 117 Class A.
- e. Locations: Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete Insert locations.

B. Rubbed Finish: Apply the following to as cast surface finishes where indicated on Drawings:

1. Smooth-Rubbed Finish:

- a. Perform no later than one day after form removal.
- b. Moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture.
- c. If sufficient cement paste cannot be drawn from the concrete by the rubbing process, use a grout made from the same cementitious materials used in the in-place concrete.
- d. Maintain required patterns or variances as shown on Drawings or to match design reference sample.

2. Grout-Cleaned Rubbed Finish:

- a. Clean concrete surfaces after contiguous surfaces are completed and accessible.
- b. Do not clean concrete surfaces as Work progresses.
- c. Mix 1 part portland cement to 1-1/2 parts fine sand, complying with ASTM C144 or ASTM C404, by volume, with sufficient water to produce a mixture with the consistency of thick paint. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces.
- d. Wet concrete surfaces.
- e. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap, and keep surface damp by fog spray for at least 36 hours.
- f. Maintain required patterns or variances as shown on Drawings or to match design reference sample.

3. Cork-Floated Finish:

- a. Mix 1 part portland cement to 1 part fine sand, complying with ASTM C144 or ASTM C404, by volume, with sufficient water to produce a mixture with the consistency of thick paint.
- b. Mix 1 part portland cement and 1 part fine sand with sufficient water to produce a mixture of stiff grout. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces.
- c. Wet concrete surfaces.
- d. Compress grout into voids by grinding surface.
- e. In a swirling motion, finish surface with a cork float.
- f. Maintain required patterns or variances as shown on Drawings or to match design reference sample.

4. Scrubbed Finish: After concrete has achieved a compressive strength of from 1000 to 1500 psi, apply scrubbed finish.
 - a. Wet concrete surfaces thoroughly and scrub with stiff fiber or wire brushes, using water freely, until top mortar surface is removed and aggregate is uniformly exposed.
 - b. Rinse scrubbed surfaces with clean water.
 - c. Maintain continuity of finish on each surface or area of Work.
 - d. Remove only enough concrete mortar from surfaces to match design reference sample.
- C. Abrasive-Blast Finish: Apply the following to as-cast surface finishes where indicated on Drawings:
1. Perform abrasive blasting after compressive strength of concrete exceeds 2000 psi.
 2. Coordinate with formwork removal to ensure that surfaces to be abrasive blasted are treated at the same age.
 3. Surface Continuity:
 - a. Perform abrasive-blast finishing as continuous operation, maintaining continuity of finish on each surface or area of Work.
 - b. Maintain required patterns or variances in depths of blast to match design reference sample.
 4. Abrasive Blasting:
 - a. Abrasive-blast corners and edges of patterns carefully, using backup boards to maintain uniform corner and edge lines.
 - b. Determine type of nozzle pressure and blasting techniques required to match field sample.
 - c. Depth of Cut: Use an abrasive grit of proper type and gradation to expose aggregate and surrounding matrix surfaces to match field sample, as follows:
 - 1) Brush Texture: Remove cement matrix to dull surface sheen and expose face of fine aggregate, with no significant reveal.
 - 2) Light Texture: Expose fine aggregate with occasional exposure of coarse aggregate and uniform color, with maximum reveal of 1/16 inch.
 - 3) Medium Texture: Generally, expose coarse aggregate with slight reveal and with a maximum reveal of 1/4 inch.
 - 4) Heavy Texture: Expose and reveal coarse aggregate to a maximum projection of one-third its diameter, with reveal range of 1/4 to 1/2 inch.
 - d. Maintain required patterns or variances in reveal projection to match design reference sample.
- D. High-Pressure Water-Jet Finish: Apply the following to as-cast surface finishes where indicated on Drawings:
1. Perform high-pressure water jetting on concrete that has achieved a minimum compressive strength of 4500 psi.

2. Coordinate with formwork removal to ensure that surfaces to be high-pressure water-jet finished are treated at same age for uniform results.
 3. Surface Continuity: Perform high-pressure water-jet finishing in as continuous an operation as possible, maintaining continuity of finish on each surface or area of Work.
 4. Maintain required patterns or variances in reveal projection to match design reference sample.
- E. Bushhammer Finish: Apply the following to as-cast surface finishes where indicated on Drawings:
1. Perform bushhammer finish to concrete that has achieved a minimum compressive strength of 4500 psi.
 2. Surface Continuity:
 - a. Perform bushhammer finishing in as continuous an operation as possible, maintaining continuity of finish on each surface or area of Work.
 3. Surface Cut:
 - a. Maintain required depth of cut and general aggregate exposure.
 - b. Use power tool with hammer attachments for large, flat surfaces, and use hand hammers for small areas, at corners and edges, and for restricted locations where power tools cannot reach.
 4. Remove impressions of formwork and form facings with exception of tie holes.
 5. Maintain required patterns or variances of cut as shown on Drawings or to match design reference sample.
 6. Maintain control of concrete chips, dust, and debris in each Work area, limiting migration of airborne materials and dust by use of tarpaulins, wind-breaks, or similar devices.
- F. Related Unformed Surfaces:
1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.
 2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.8 FINISHING FLOORS AND SLABS

- A. Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish:
1. While still plastic, texture concrete surface that has been screeded and bull-floated or darbied.
 2. Use stiff brushes, brooms, or rakes to produce a profile depth of 1/4 inch in one direction.
 3. Apply scratch finish to surfaces to receive concrete floor toppings or to receive mortar setting beds for bonded cementitious floor finishes.

C. Float Finish:

1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
2. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 tolerances for conventional concrete.
3. Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

D. Trowel Finish:

1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
2. Continue troweling passes and restraighen until surface is free of trowel marks and uniform in texture and appearance.
3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
4. Do not add water to concrete surface.
5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
6. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
7. Finish surfaces to the following tolerances, in accordance with ASTM E1155, for a randomly trafficked floor surface:
 - a. Slabs on Ground:
 - 1) Specified overall values of flatness, F_F 25; and of levelness, F_L 20; with minimum local values of flatness, F_F 17; and of levelness, F_L 15.
 - b. Suspended Slabs:
 - 1) Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/4 inch.

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated on drawings. While concrete is still plastic, slightly scarify surface with a fine broom perpendicular to main traffic route.

1. Coordinate required final finish with Architect before application.
2. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
2. Coordinate required final finish with Architect before application.

- G. Slip-Resistive Finish: Before final floating, apply slip-resistive aggregate finish to concrete stair treads, platforms, ramps as indicated on Drawings
 - 1. Apply in accordance with manufacturer's written instructions Retain Dry-Shake Floor Hardener Finish Paragraph below if pigmented or unpigmented dry-shake floor hardener finish is required.

3.9 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

- A. Filling In:
 - 1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
 - 2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
 - 3. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations:
 - 1. Coordinate sizes and locations of concrete bases with actual equipment provided.
 - 2. Construct concrete bases 4 inches - 6 inches high as indicated on Drawings, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.
 - 3. Minimum Compressive Strength: as indicated on concrete material schedule.
 - 4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 - 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
 - 6. Prior to pouring concrete, place and secure anchorage devices.
 - a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - b. Cast anchor-bolt insert into bases.
 - c. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.10 CONCRETE CURING

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
 - 1. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.
 - 2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
 - 3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h, calculated in accordance with ACI 305.1, before and during finishing operations.

B. Curing Formed Surfaces: Comply with ACI 308.1 as follows:

1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
2. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
3. If forms remain during curing period, moist cure after loosening forms.
4. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:
 - a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
 - b. Continuous Sprinkling: Maintain concrete surface continuously wet.
 - c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
 - d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
 - e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
 - 1) Recoat areas subject to heavy rainfall within three hours after initial application.
 - 2) Maintain continuity of coating and repair damage during curing period.

C. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:

1. Begin curing immediately after finishing concrete.
2. Interior Concrete Floors:
 - a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:
 - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12 inches.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
 - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - b) Cure for not less than seven days.

- 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.

- b. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:
 - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12 inches.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

 - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
 - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - b) Cure for not less than seven days.

 - 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.

- c. Floors to Receive Polished Finish: Contractor has option of the following:
 - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12 inches.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

 - 2) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.

d. Floors to Receive Chemical Stain:

- 1) As soon as concrete has sufficient set to permit application without marring concrete surface, install curing paper over entire area of floor.
- 2) Install curing paper square to building lines, without wrinkles, and in a single length without end joints.
- 3) Butt sides of curing paper tight; do not overlap sides of curing paper.
- 4) Leave curing paper in place for duration of curing period, but not less than 28 days.

e. Floors to Receive Urethane Flooring:

- 1) As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
- 2) Rewet absorptive cover, and cover immediately with polyethylene moisture-retaining cover with edges lapped 6 inches and sealed in place.
- 3) Secure polyethylene moisture-retaining cover in place to prohibit air from circulating under polyethylene moisture-retaining cover.
- 4) Leave absorptive cover and polyethylene moisture-retaining cover in place for duration of curing period, but not less than 28 days.

f. Floors to Receive Curing Compound:

- 1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
- 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
- 3) Maintain continuity of coating, and repair damage during curing period.
- 4) Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

g. Floors to Receive Curing and Sealing Compound:

- 1) Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller in accordance with manufacturer's written instructions.
- 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
- 3) Repeat process 24 hours later, and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

3.11 TOLERANCES

- A. Conform to ACI 117.

3.12 APPLICATION OF LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment in accordance with manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
 2. Do not apply to concrete that is less than seven days' old.
 3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing.
 4. Rinse with water; remove excess material until surface is dry.
 5. Apply a second coat in a similar manner if surface is rough or porous.
- B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller in accordance with manufacturer's written instructions.

3.13 JOINT FILLING

- A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.
1. Defer joint filling until concrete has aged at least one month.
 2. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints.
- D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.14 CONCRETE SURFACE REPAIRS

- A. Defective Concrete:
1. Repair and patch defective areas when approved by Architect.
 2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.
 - a. Limit cut depth to 3/4 inch.
 - b. Make edges of cuts perpendicular to concrete surface.
 - c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
 - d. Fill and compact with patching mortar before bonding agent has dried.
 - e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.
 - a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
 - b. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces:

1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
 - a. Correct low and high areas.
 - b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
3. After concrete has cured at least 14 days, correct high areas by grinding.
4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.
 - a. Finish repaired areas to blend into adjacent concrete.
5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.
 - a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 - b. Feather edges to match adjacent floor elevations.
6. Correct other low areas scheduled to remain exposed with repair topping.
 - a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations.
 - b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
7. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.
 - a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
 - b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.

- c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
 - d. Place, compact, and finish to blend with adjacent finished concrete.
 - e. Cure in same manner as adjacent concrete.
8. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.
- a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
 - b. Dampen cleaned concrete surfaces and apply bonding agent.
 - c. Place patching mortar before bonding agent has dried.
 - d. Compact patching mortar and finish to match adjacent concrete.
 - e. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.15 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
 - 1. Testing agency to be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
 - 2. Testing agency to immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
 - 3. Testing agency to report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
 - a. Test reports to include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:
 - 1) Project name.
 - 2) Name of testing agency.
 - 3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
 - 4) Name of concrete manufacturer.
 - 5) Date and time of inspection, sampling, and field testing.
 - 6) Date and time of concrete placement.
 - 7) Location in Work of concrete represented by samples.
 - 8) Date and time sample was obtained.
 - 9) Truck and batch ticket numbers.
 - 10) Design compressive strength at 28 days.

- 11) Concrete mixture designation, proportions, and materials.
 - 12) Field test results.
 - 13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
 - 14) Type of fracture and compressive break strengths at seven days and 28 days.
- C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.
- D. Inspections:
1. Headed bolts and studs.
 2. Verification of use of required design mixture.
 3. Concrete placement, including conveying and depositing.
 4. Curing procedures and maintenance of curing temperature.
 5. Verification of concrete strength before removal of shores and forms from beams and slabs.
 6. Batch Plant Inspections: On a random basis, as determined by Architect.
- E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M to be performed in accordance with the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C143/C143M:
 - a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - b. Perform additional tests when concrete consistency appears to change.
 3. Slump Flow: ASTM C1611/C1611M:
 - a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - b. Perform additional tests when concrete consistency appears to change.
 4. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete;.
 - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 5. Concrete Temperature: ASTM C1064/C1064M:

- a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
 6. Compression Test Specimens: ASTM C31/C31M:
 - a. Cast and laboratory cure three sets of three 6-inch by 12-inch or 4-inch by 8-inch cylinder specimens for each composite sample.
 7. Compressive-Strength Tests: ASTM C39/C39M.
 - a. Test one set of three laboratory-cured specimens at seven days and one set of three specimens at 28 days and hold the other set in reserve. The reserve set may be discarded if the 28 day specimens are found to pass all required testing.
 - b. A compressive-strength test to be the average compressive strength from a set of three specimens obtained from same composite sample and tested at age indicated.
 8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor to evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
 9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
 10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
 11. Additional Tests:
 - a. Testing and inspecting agency to make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
 - b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.
 - 1) Acceptance criteria for concrete strength to be in accordance with ACI 301, Section 1.6.6.3.
 12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- F. Measure floor and slab flatness and levelness in accordance with ASTM E1155 within 48 hours of completion of floor finishing and promptly report test results to Architect.

3.16 PROTECTION

A. Protect concrete surfaces as follows:

1. Protect from petroleum stains.
2. Diaper hydraulic equipment used over concrete surfaces.
3. Prohibit vehicles from interior concrete slabs.
4. Prohibit use of pipe-cutting machinery over concrete surfaces.
5. Prohibit placement of steel items on concrete surfaces.
6. Prohibit use of acids or acidic detergents over concrete surfaces.
7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.
8. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using Floor Slab Protective Covering.

END OF SECTION 033000

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural-steel materials.
2. Shrinkage-resistant grout.
3. Prefabricated building columns.
4. Shear stud connectors.

B. Related Requirements:

1. Section 053100 "Steel Decking" for field installation of shear stud connectors through deck.
2. Section 055000 "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame and miscellaneous steel fabrications and other steel items not defined as structural steel.
3. Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" for painting requirements.

1.2 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.
- B. Demand-Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the seismic-load-resisting system and which are indicated as "demand critical" or "seismic critical" on Drawings.

1.3 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data:

1. Structural-steel materials.
2. High-strength, bolt-nut-washer assemblies.
3. Shear stud connectors.
4. Anchor rods.
5. Threaded rods.
6. Prefabricated building columns.
7. Shop primer.
8. Galvanized repair paint.
9. Shrinkage-resistant grout.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
5. Identify members not to be shop primed.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and fabricator.

B. Welding certificates.

C. Mill test reports for structural-steel materials, including chemical and physical properties.

D. Product Test Reports: For the following:

1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
2. Direct-tension indicators.
3. Tension-control, high-strength, bolt-nut-washer assemblies.
4. Shear stud connectors.

E. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).

B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.

- C. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
 - 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with applicable provisions of the following specifications and documents:
 - 1. ANSI/AISC 303.
 - 2. ANSI/AISC 360.
 - 3. RCSC's "Specification for Structural Joints Using High-Strength Bolts."
- B. Connection Design Information:
 - 1. Option 1: Connection designs have been completed and connections indicated on the Drawings.

2.2 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A992/A992M.
- B. Channels, Angles, M-Shapes: ASTM A36/A36M.
- C. Channels, Angles, S-Shapes: ASTM A36/A36M.
- D. Plate and Bar: ASTM A36/A36M or ASTM A572/A572M, Grade 50 where indicated on drawings.

- E. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade C structural tubing.
- F. Steel Pipe: ASTM A53/A53M, Type E or Type S, Grade B.
- G. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS AND CONNECTORS

- A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
 - 1. Direct-Tension Indicators: ASTM F959/F959M, Type 325-1, compressible-washer type with plain finish.
- B. High-Strength A490 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A490, Type 1, heavy-hex steel structural bolts or Grade F2280 tension-control, bolt-nut-washer assemblies with splined ends; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
 - 1. Direct-Tension Indicators: ASTM F959/F959M, Type 490-1, compressible-washer type with plain finish.
- C. Zinc-Coated High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
 - 1. Finish: Hot-dip or mechanically deposited zinc coating.
 - 2. Direct-Tension Indicators: ASTM F959/F959M, Type 325-1, compressible-washer type with mechanically deposited zinc coating finish.
- D. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

2.4 RODS

- A. Unheaded Anchor Rods: ASTM F1554, Grade as indicated on drawings.
 - 1. Configuration: Straight.
 - 2. Nuts: ASTM A563 heavy-hex carbon steel.
 - 3. Plate Washers: ASTM A36/A36M carbon steel.
 - 4. Washers: ASTM F436, Type 1, hardened carbon steel.
 - 5. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C.
- B. Headed Anchor Rods: ASTM F1554, Grade as indicated on drawings, straight.
 - 1. Nuts: ASTM A563 heavy-hex carbon steel.
 - 2. Plate Washers: ASTM A36/A36M carbon steel.
 - 3. Washers: ASTM F436, Type 1, hardened carbon steel.

4. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C.

C. Threaded Rods: ASTM A36/A36M.

1. Nuts: ASTM A63 heavy-hex carbon steel.
2. Washers: ASTM F436, Type 1, hardened carbon steel.
3. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C.

2.5 PRIMER

A. Steel Primer:

1. Comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

2.6 SHRINKAGE-RESISTANT GROUT

- A. Metallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.
- B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.7 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.
 1. Camber structural-steel members where indicated.
 2. Fabricate beams with rolling camber up.
 3. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until structural-steel framing has been erected.
 4. Mark and match-mark materials for field assembly.
 5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted in accordance with SSPC-SP 3.

- F. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using automatic end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.
- G. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural-steel frame. Straighten as required to provide uniform, square, and true members in completed wall framing. Build up welded framing, weld exposed joints continuously, and grind smooth.
- H. Welded-Steel Door Frames: Build up welded-steel doorframes attached to structural-steel frame. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk machine screws, uniformly spaced not more than 10 inches o.c. unless otherwise indicated on Drawings.
- I. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
 - 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 - 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.8 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: As indicated on drawings.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

2.9 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123/A123M.
 - 1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
 - 2. Galvanize lintels shelf angles and welded door frames attached to structural-steel frame and located in exterior walls.

2.10 SHOP PRIMING

- A. Shop prime steel surfaces, except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 - 2. Surfaces to be field welded.
 - 3. Surfaces of high-strength bolted, slip-critical connections.
 - 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
 - 5. Galvanized surfaces unless indicated to be painted.
 - 6. Corrosion-resisting (weathering) steel surfaces.
 - 7. Surfaces enclosed in interior construction.
- B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:
 - 1. SSPC-SP 2.
 - 2. SSPC-SP 3.
 - 3. SSPC-SP 7 (WAB)/NACE WAB-4.
 - 4. SSPC-SP 14 (WAB)/NACE WAB-8.
 - 5. SSPC-SP 11.
 - 6. SSPC-SP 6 (WAB)/NACE WAB-3.
 - 7. SSPC-SP 10 (WAB)/NACE WAB-2.
 - 8. SSPC-SP 5 (WAB)/NACE WAB-1.
 - 9. SSPC-SP 8.
- C. Surface Preparation of Galvanized Steel: Prepare galvanized-steel surfaces for shop priming by thoroughly cleaning steel of grease, dirt, oil, flux, and other foreign matter, and treating with etching cleaner or in accordance with SSPC-SP 16.
- D. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 - 2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.11 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform shop tests and inspections.
 - 1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
 - 2. Bolted Connections: Inspect and test shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 - 3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

- a. Liquid Penetrant Inspection: ASTM E165/E165M.
 - b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - c. Ultrasonic Inspection: ASTM E164.
 - d. Radiographic Inspection: ASTM E94/E94M.
- 4. In addition to visual inspection, test and inspect shop-welded shear stud connectors in accordance with requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear stud connector.
 - b. Conduct tests in accordance with requirements in AWS D1.1/D1.1M on additional shear stud connectors if weld fracture occurs on shear stud connectors already tested.
- 5. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 - 1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated on Drawings.
 - 1. Do not remove temporary shoring supporting composite deck construction and structural-steel framing until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.

- B. Baseplates, Bearing Plates, and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of baseplate.
 - 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - 4. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for grouting.
- C. Maintain erection tolerances of structural steel within ANSI/AISC 303.
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.
 - 1. Joint Type: As indicated on drawings.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 - 2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
 - 3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

- C. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

3.5 INSTALLATION OF PREFABRICATED BUILDING COLUMNS

- A. Install prefabricated building columns to comply with ANSI/AISC 360, manufacturer's written recommendations, and requirements of testing and inspecting agency that apply to the fire-resistance rating indicated.

3.6 REPAIR

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780/A780M.
- B. Touchup Painting:
 - 1. Immediately after erection, clean exposed areas where primer is damaged or missing, and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
 - 2. Cleaning and touchup painting are specified in Section 099113 "Exterior Painting." Section 099123 "Interior Painting."
- C. Touchup Priming: Cleaning and touchup priming are specified in Section 099600 "High-Performance Coatings."

3.7 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:
 - 1. Verify structural-steel materials and inspect steel frame joint details.
 - 2. Verify weld materials and inspect welds.
 - 3. Verify connection materials and inspect high-strength bolted connections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
 - 1. Bolted Connections: Inspect and test bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 - 2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.
 - a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

- 1) Liquid Penetrant Inspection: ASTM E165/E165M.
 - 2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - 3) Ultrasonic Inspection: ASTM E164.
 - 4) Radiographic Inspection: ASTM E94/E94M.
3. Shear Stud Connectors: In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
- a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 - b. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

END OF SECTION 051200

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SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to all Division 26 specifications.

1.2 SUMMARY

- A. Section Includes:
 1. Electrical equipment coordination and installation.
 2. Common electrical installation requirements specified under Division 26.

1.3 QUALITY ASSURANCE

- A. Warrant electrical work against faulty material or Workmanship in accordance with Division 1. If the project is occupied or systems are placed in operation in phases at the request of the Owner's Representative, then the warranty of each system or piece of equipment, shall begin on the date each system or component was placed in operation as designed and accepted as such, in writing, by the Owner's Representative. The use of equipment for temporary service and testing does not constitute the beginning of the warranty.
- B. Equipment and materials provided and installed under this Division shall periodically be inspected and serviced by competent mechanics or technicians. This function becomes the responsibility of the Owner's Representative when the system is accepted, in writing, by the Owner's Representative. The material and Workmanship warranty is not intended to supplant normal inspection or service and shall not be construed to mean the Contractor shall provide free service for normal maintenance items such as periodic lubrication and adjustment due to normal use, nor to correct, without charge, breakage, maladjustment, and other trouble caused by improper maintenance.
- C. Upon completion of contract and progressively as work proceeds, clean up dirt, debris and scrap materials. Maintain premises neat and clean throughout. Protect and preserve access to energized equipment at all times. Clean items with factory finishes. Touch up minor damage to surfaces; refinish entire piece of equipment in the event of major damage as determined by Owner's Representative. Use only factory supplied paints of matching color and formula. Schedule an off-hour shutdown of all electrical equipment during the 2-week period preceding substantial completion. During this shutdown, clean all busses and insulators inside switchgear, switchboards, bus ducts, collector busses and panel boards located inside or adjacent to the project limits.

1.4 STANDARDS

- A. Perform all work specified in Division 26 in strict accordance with the following codes and standards, latest edition, adopted by the authority having jurisdiction. Where these specifications are more stringent than the AHJ, these specifications shall take precedence.
 - 1. National Electric Code NFPA 70 (NEC).
 - 2. NESC-National Electric Safety Code
 - 3. Association of Edison Illuminating Companies (AEIC).
 - 4. American National Standards Institute (ANSI).
 - 5. American Society for Testing Materials (ASTM).
 - 6. Certified Ballast Manufacturers (CBM).
 - 7. Electrical Testing Laboratories (ETL).
 - 8. Insulated Cable Engineers Association (ICEA).
 - 9. Institute of Electrical and Electronic Engineers (IEEE).
 - 10. National Electrical Contractors Association (NECA)
 - 11. National Electrical Manufacturer's Association (NEMA)
 - 12. Underwriters Laboratories, Inc. (UL)
 - 13. All applicable OSHA Publications.

1.5 SUBMITTALS

- A. Comply with provisions in accordance with Division 01.
- B. Submit all data specified in Division 26.

1.6 OPERATION AND MAINTENANCE MANUALS

- A. Comply with provisions of Division 01
- B. In addition to required submittals, manuals shall include copies of all test reports specified in Division 26.
- C. Provide completed warranty certificates for systems and equipment.

1.7 RECORD DRAWINGS

- A. Comply with provisions of Division 01.

1.8 WARRANTY

- A. Provide a minimum one-year warranty on all electrical workmanship and labor. Warranty period shall begin when substantial completion of the contract is issued unless specified otherwise. Contractor shall provide written notification to Owner's Representative prior to this warranty start date.

- B. Equipment Warranties shall be covered under related Division 26 section and as required by Division 01.

PART 2 - PRODUCTS

2.1 PRODUCTS:

- A. Unless indicated otherwise, all equipment and material shall be new, undamaged and meet the requirements of Underwriters Laboratories, Inc. (UL). Where UL requirements are not applicable, equipment and material shall be identified as such by Contractor and approved by Owner before purchase and installation.

2.2 ELECTRONIC EQUIPMENT COMPLIANCE

- A. Contractor warrants that all equipment, devices, items, systems, software, hardware, or firmware provided shall properly, appropriately, and consistently function and accurately process date and time data (including without limitation: calculating, comparing, and sequencing). This warranty supersedes anything in the Specifications or other Contract Documents which might be construed inconsistently. This warranty is applicable whether the equipment, device, item, system, software, hardware, or firmware is specified with or without reference to a manufacturer's name, make, or model number.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Contractor is responsible for verification of all existing conditions and dimensions by field measurements.
- C. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- D. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- E. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- F. Right of Way: Give to piping systems installed at a required slope.

3.2 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. To connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate all items which will affect the installation of the work of this Division. This coordination shall include, but not be limited to, voltage, ampacity, capacity, connections, space requirements, sequence of construction, building requirements and special conditions.
- C. Examine specifications and drawings for all equipment and systems that require electrical connections and coordination.
- D. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- E. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed.
- F. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- G. Electrical drawings are diagrammatic only and shall not be scaled for exact sizes.
- H. Coordinate all work with other trades prior to beginning work.
- I. By submitting shop drawings on the project, it is to be understood that the contractor is indicating that all necessary coordination has been completed and that the systems, products and equipment submitted can be installed and will operate as specified and intended, in full coordination with all other trades.

END OF SECTION 26 05 00

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Qualification Data: For testing agency.
- C. Field quality-control test reports.

1.3 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Insulated Wire Corp.; a Leviton Company.
 2. Okonite.
 3. Southwire Company.

- B. Substitutions: As specified in Section 016000 - Product Requirements.
- C. Copper Conductors: Comply with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- D. Conductor Insulation:
 - 1. Type THHN and THWN-2 shall comply with UL 83.
 - 2. Type XHHW-2 shall comply with UL 44.
 - 3. Minimum insulation temperature rating shall be 90°C.
 - 4. Outer cable jacket shall be color coded in accordance with the associated phase it is connected to. Refer to Section 26 05 53.
- E. No aluminum conductors shall be used.
- F. Pre-wired systems such as type AC (armored cable) and type NM (nonmetallic-sheathed cable) shall not be used.

2.2 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hubbell Power Systems, Inc.
 - 2. O-Z/Gedney; Emerson Electric Company.
 - 3. 3M; Electrical Products Division.
 - 4. TE Connectivity.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- C. Minimum allowed conductor size is No. 12 AWG.

3.2 CONDUCTOR INSULATION AND WIRING METHODS

- A. Exposed Feeders: Type THHN or THWN-2, single conductors in raceway.
- B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway.

- C. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- D. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.
- E. Class 1 Control Circuits: Type THHN/THWN-2, single conductors in raceway.
- F. Class 2 Control Circuits: Type THHN/THWN-2, single conductors in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls and ceilings, unless otherwise indicated.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Division 26 Section 26 05 29 "Hangers and Supports for Electrical Systems."
- F. Identify and color-code conductors and cables according to Division 26 Section 26 05 53 "Identification for Electrical Systems."
- G. Conductor ratings:
 - 1. For circuits 100 amps or less, copper conductor shall be rated in accordance with the NFPA 70 60°C table.
 - 2. For circuits 100 amps or more, copper conductor shall be rated in accordance with NFPA 70 75°C table.
- H. Dedicated neutral conductors shall be used for all single-phase loads unless approved in writing by the Owner.
- I. All neutral conductors shall be a minimum of full size, unless oversized neutral conductors are specified on the Contract Drawings.

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

3.5 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified third-party testing agency to perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test for compliance with requirements.
 - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- C. Test Reports: Prepare a written report to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Grounding and bonding conductors.
2. Grounding and bonding clamps.
3. Grounding and bonding bushings.
4. Grounding and bonding hubs.
5. Grounding and bonding connectors.
6. Intersystem bonding bridge grounding connector.
7. Grounding and bonding busbars.
8. Signal reference grids.
9. Grounding (earthing) electrodes.
10. Grounding electrode enclosures.

B. Related Requirements:

1. Section 264113 "Lightning Protection for Structures" specifies bonding of lightning protection grounding electrodes to facility grounding electrodes.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Plans showing dimensioned locations of grounding features described in "Field Quality Control for Grounding and Bonding of Electrical Power" Article, including the following:

1. Grounding electrode access enclosures.
2. Grounding electrodes.
3. Grounding arrangements and connections for separately derived systems.

C. Field quality-control reports.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. Provide the following:
 - a. Plans showing locations of grounding features described in "Field Quality Control for Grounding and Bonding of Electrical Power" Article, including the following:

- 1) Grounding electrode access enclosures.
 - 2) Grounding electrodes.
 - 3) Grounding arrangements and connections for separately derived systems.
- b. Instructions for periodic testing and inspection of grounding features at test wells based on NETA MTS.
- 1) Tests must determine if ground-resistance or impedance values remain within specified maximums, and instructions must recommend corrective action if values do not.
 - 2) Include recommended testing intervals.

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

A. Equipment Grounding Conductor:

1. General Characteristics: 600 V, THWN-2, copper wire or cable, green color, in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Isolated Equipment Grounding Conductor:

1. General Characteristics: 600 V, THWN-2, copper wire or cable, green color with one or more yellow stripes, in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
 - a. Isolated grounding conductors shall be identified by the use of a spirally applied set of two (2) orange stripes over the green insulation. Each orange stripe shall be 1/16 inch minimum width.

C. ASTM - Bare Copper Grounding and Bonding Conductor:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Insulated Wire Corp.; a Leviton Company.
 - b. Okonite.
 - c. Southwire Company.
2. Substitutions: As specified in Section 016000 - Product Requirements.
3. Referenced Standards: Complying with one or more of the following:
 - a. Soft or Annealed Copper Wire: ASTM B3.
 - b. Concentric-Lay Stranded Copper Conductor: ASTM B8.
 - c. Tin-Coated Soft or Annealed Copper Wire: ASTM B33.
 - d. 19-Wire Combination Unilay-Stranded Copper Conductor: ASTM B787/B787M.

2.2 GROUNDING AND BONDING CLAMPS

- A. Description: Clamps suitable for attachment of grounding and bonding conductors to grounding electrodes, pipes, tubing, and rebar. Grounding and bonding clamps specified in this article are also suitable for use with communications applications.
- B. Source Limitations: Obtain products from single manufacturer.
- C. Performance Criteria:
 - 1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application.
 - 2. Listing Criteria:
 - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
 - b. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.
- D. UL KDER and KDSH - Hex-Fitting-Type Pipe and Rod Grounding and Bonding Clamp
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Business
 - b. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - c. AFL Dossert
 - d. SEFCOR Inc.
 - 2. Substitutions: As specified in Section 016000 - Product Requirements.
 - 3. General Characteristics:
 - a. Two pieces with zinc-plated bolts.
 - b. Clamp Material: Brass
 - c. Listed for outdoor use.
- E. UL KDER and KDSH - U-Bolt-Type Pipe and Rod Grounding and Bonding Clamp:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Business
 - b. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - c. AFL Dossert
 - d. SEFCOR Inc.
 - 2. Substitutions: As specified in Section 016000 - Product Requirements.
 - 3. General Characteristics:

- a. Clamp Material: Brass.
- b. Listed for outdoor use.

F. UL KDER - Exothermically Welded Connection.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Business
 - b. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated
- 2. Substitutions: As specified in Section 016000 - Product Requirements.
- 3. General Characteristics: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING AND BONDING BUSHINGS

- A. Description: Bonding bushings connect conduit fittings, tubing fittings, threaded metal conduit, and unthreaded metal conduit to metal boxes and equipment enclosures and have one or more bonding screws intended to provide electrical continuity between bushing and enclosure. Grounding bushings have provision for connection of bonding or grounding conductor and may or may not also have bonding screws.
- B. Source Limitations: Obtain products from single manufacturer.
- C. Performance Criteria:
 - 1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application.
 - 2. Listing Criteria:
 - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
- D. UL KDER - Bonding Bushing:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Business
 - b. Eaton
 - c. Appleton Emerson
 - 2. Substitutions: As specified in Section 016000 - Product Requirements.
 - 3. General Characteristics: Threaded bushing with insulated throat.
- E. UL KDER - Grounding Bushing:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Business
 - b. Eaton
 - c. Appleton Emerson
2. Substitutions: As specified in Section 016000 - Product Requirements.
3. General Characteristics: Threaded bushing with insulated throat and mechanical-type wire terminal.

2.4 GROUNDING AND BONDING HUBS

- A. Description: Hubs with certified grounding or bonding locknut.
- B. Source Limitations: Obtain products from single manufacturer.
- C. Performance Criteria:
 1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application.
 2. Listing Criteria:
 - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
- D. UL KDER - Grounding and Bonding Hub:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Business
 - b. Eaton
 - c. Appleton Emerson
 2. Substitutions: As specified in Section 016000 - Product Requirements.
 3. General Characteristics: Insulated, gasketed, watertight hub with mechanical-type wire terminal.

2.5 GROUNDING AND BONDING CONNECTORS

- A. Source Limitations: Obtain products from single manufacturer.
- B. Performance Criteria:
 1. Regulatory Requirements:

- a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application.
- 2. Listing Criteria:
 - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
 - b. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.

2.6 GROUNDING AND BONDING BUSBARS

- A. Description: Miscellaneous grounding and bonding devices that serve as common connection for multiple grounding and bonding conductors.
- B. Source Limitations: Obtain products from single manufacturer.
- C. Performance Criteria:
 - 1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application.
 - 2. Listing Criteria:
 - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
- D. UL KDER - Equipment Room Grounding and Bonding Busbar:
 - 1. General Characteristics:
 - a. Bus: Rectangular bar of annealed copper.
 - b. Mounting Stand-Off Insulators: Lexan or PVC.
 - 1) Comply with UL 891 for use in 600 V switchboards, impulse tested at 5000 V.
 - 2. Options:
 - a. Dimensions: 1/4 by 4 inch in cross section; length as indicated on Drawings.
 - b. Predrilled Hole Pattern: 9/32-inch holes spaced 1-1/8 inch apart.
 - c. Mounting Hardware: Stand-off brackets that provide 2-inch clearance to access rear of bus. Brackets and bolts must be stainless steel.
 - 3. General Characteristics:
 - a. Bus: Rectangular bar of hard-drawn solid copper.
 - b. Horizontal Mounting Dimensions: Designed for mounting in 19-inch-wide equipment racks or cabinets.
 - c. Vertical Mounting Dimensions: Designed for mounting in 72-inch-high equipment racks or cabinets.

- d. Predrilled Hole Pattern: Accepts connectors for grounding and bonding conductor sizes 14 AWG to 2/0 AWG.
- e. Mounting Hardware: Stainless steel or copper-plated, for attachment to rack.

2.7 GROUNDING (EARTHING) ELECTRODES

- A. Source Limitations: Obtain products from single manufacturer.
- B. Performance Criteria:
 - 1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application.
 - 2. Listing Criteria:
 - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
- C. UL KDER - Rod Electrode:
 - 1. General Characteristics: Copper-clad; 3/4 inch by 10 ft.

2.8 GROUNDING ELECTRODE ENCLOSURES

- A. Description: Enclosures designed to protect grounding electrodes from damage while providing access for inspection and testing of the grounding system.
- B. Grounding Electrode Access Well Enclosure:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Harger Inc.
 - 2. Substitutions: As specified in Section 016000 - Product Requirements.
 - 3. Source Limitations: Obtain products from single manufacturer.
 - 4. Product Characteristics:
 - a. Well Material: Concrete.
 - b. Cover Material: Cast iron or Concrete.
 - c. Cover Strength: Sidewalk or turf use.
 - 5. Required Product Options:
 - a. Round:
 - 1) Nominal Diameter: 10 inches.
 - 2) Nominal Height: 36 inches.

- 3) Slotted sides for installation after grounding connections made.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine facility's grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of electrical system.
- B. Inspect test results of grounding system measured at point of electrical service equipment connection.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with connection of electrical service equipment only after unsatisfactory conditions have been corrected.

3.2 SELECTION OF GROUNDING AND BONDING PRODUCTS

- A. Grounding and Bonding Conductors:
 1. Provide solid conductor for 8 AWG and smaller, and stranded conductors for 6 AWG and larger unless otherwise indicated.
 2. Custom-Length Insulated Equipment Bonding Jumpers: 6 AWG, 19-strand, Type THHN.
 3. Bonding Cable: 28 kcmil, 14 strands of 17 AWG conductor, 1/4 inch in diameter.
 4. Bonding Conductor: 4 AWG or 6 AWG, stranded conductor.
 5. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch wide and 1/16 inch thick.
 6. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch wide and 1/16 inch thick.
 7. Underground Grounding Conductors: Install bare copper conductor, 2/0 AWG minimum, sized per drawings.
- B. Grounding and Bonding Connectors:
 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 4. Connections to Structural Steel: Welded connectors.
 - a. Building steel shall not be used as a grounding path.
- C. Grounding and Bonding Busbars: Provide in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated on Drawings.

3.3 INSTALLATION OF GROUNDING AND BONDING

- A. Comply with manufacturer's published instructions.
- B. Reference Standards:
 - 1. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor and install in conduit.
 - 2. Consult Architect for resolution of conflicting requirements.
- C. Special Techniques:
 - 1. Grounding and Bonding Conductors:
 - a. Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
 - b. Underground Grounding Conductors:
 - 1) Bury at least 30 inches below grade.
 - 2) Duct-Bank Grounding Conductor: Bury 12 inch above duct bank when indicated as part of duct-bank installation.
 - 2. Grounding and Bonding Connectors: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
 - a. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
 - b. Make connections with clean, bare metal at points of contact.
 - c. Make aluminum-to-steel connections with stainless steel separators and mechanical clamps.
 - d. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
 - e. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
 - f. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 - 1) Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate adjacent parts.
 - 2) Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 - 3) Use exothermic-welded connectors for outdoor locations; if disconnect-type connection is required, use bolted clamp.

- g. Grounding and Bonding for Piping:
 - 1) Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use bolted clamp connector or bolt lug-type connector to pipe flange by using one of lug bolts of flange. Where dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2) Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with bolted connector.
 - 3) Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
 - h. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.
3. Grounding and Bonding Busbars:
- a. Install busbar horizontally, on insulated spacers 2 inch minimum from wall, 6 inch above finished floor unless otherwise indicated.
 - b. Where busbars are indicated on both sides of doorways, route bonding conductor up to top of door frame, across top of doorway, and down; connect to continuation of horizontal busbar.
4. Electrodes:
- a. Ground Rods: Drive rods until tops are 18 inch below final grade unless otherwise indicated.
 - 1) Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 - 2) Use exothermic welds for below-grade connections.
5. Grounding at Service:
- a. Equipment grounding conductors and grounding electrode conductors must be connected to ground busbar. Install main bonding jumper between neutral and ground buses.
6. Grounding Separately Derived Systems:
7. Grounding Underground Distribution System Components:
- a. Duct-Bank Grounding Conductor: Bury 12 inch above duct bank when indicated as part of duct-bank installation.
 - b. Comply with IEEE C2 grounding requirements.

- c. Grounding Manholes and Handholes: Install driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inch will extend above finished floor. If necessary, install ground rod before manhole is placed and provide 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inch above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.
- d. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors' level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields in accordance with manufacturer's published instructions with splicing and termination kits.
- e. Pad-Mounted Transformers and Switches: Install two ground rods and ring electrode around pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than 2 AWG for ring electrode and for taps to equipment grounding terminals. Bury ring electrode not less than 6 inches from foundation.

8. Equipment Grounding and Bonding:

- a. Install insulated equipment grounding conductors with feeders and branch circuits.
- b. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1) Feeders and branch circuits.
 - 2) Lighting circuits.
 - 3) Receptacle circuits.
 - 4) Single-phase motor and appliance branch circuits.
 - 5) Three-phase motor and appliance branch circuits.
 - 6) Flexible raceway runs.
 - 7) Armored and metal-clad cable runs.
 - 8) Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
- c. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- d. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- e. Isolated Grounding Receptacle Circuits: Install insulated equipment grounding conductor connected to receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of applicable derived system or service unless otherwise indicated.
- f. Isolated Equipment Enclosure Circuits: For designated equipment supplied by branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Hangers, supports and anchorage for electrical equipment and systems.

1.2 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. RMC: Rigid metal conduit.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports and equipment anchorage for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.
- C. Structural Performance: Hangers, supports and anchorage for electrical raceways and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel slotted support systems, hardware, and accessories.
 - 2. Nonmetallic slotted support systems, hardware and accessories.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze hangers. Include Product Data for components.
 - 2. Steel slotted channel systems. Include Product Data for components.
 - 3. Nonmetallic slotted channel systems. Include Product Data for components.
 - 4. Equipment supports.

- C. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

1.6 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 9/16 inch diameter holes at a maximum of 8 inches on center in at least one surface. Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Atkore Allied Tube & Conduit.
 - b. Atkore Unistrut.
 - c. ABB Installation Products (formerly Thomas & Betts Corporation).
 - d. Cooper B-Line, Inc.; a division of Cooper Industries.
 - e. nVent ERICO (formerly ERICO International Corporation).
 - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 - 4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 - 5. Channel Dimensions: Selected for applicable load criteria.
- B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch-diameter holes at a maximum of 8 inches on center in at least one surface. Comply with MFMA-4, factory-fabricated components for field assembly.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Atkore Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. Fabco Plastics Wholesale Limited.
 - d. Seasafe, Inc.
 2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
 3. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
 4. Rated Strength: Selected to suit applicable load criteria.
- C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A36M, steel plates, shapes, and bars; black and galvanized.
- G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated stainless steel, for use in hardened Portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
 2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A325.

5. Toggle Bolts: All-steel springhead type.
6. Hanger Rods: Threaded steel.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 1. To Wood: Fasten with lag screws or through bolts.
 2. To New Concrete: Bolt to concrete inserts.
 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 4. To Existing Concrete: Expansion anchor fasteners.
 5. Powder-actuated fasteners shall not be utilized in any circumstance.
 6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts or beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.

7. To Light Steel: Sheet metal screws.
 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks independent of structures unless approved by Engineer.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touchup: Comply with requirements in Division 09 for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

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SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes conduit and tubing, surface raceways, wireways, outlet boxes, pull and junction boxes, and handholes.
- B. Related Sections:
 - 1. Section 260583 - Wiring Connections.
 - 2. Section 260526 - Grounding and Bonding for Electrical Systems.
 - 3. Section 260529 - Hangers and Supports for Electrical Systems.
 - 4. Section 260533.16 - Boxes for Electrical Systems.
 - 5. Section 260536 - Cable Trays for Electrical Systems.
 - 6. Section 260539 - Underfloor Raceways for Electrical Systems.
 - 7. Section 260553 - Identification for Electrical Systems.
 - 8. Section 262716 - Electrical Cabinets and Enclosures.
 - 9. Section 262723 - Indoor Service Poles.
 - 10. Section 262726 - Wiring Devices.
 - 11. Section 270533 - Conduits and Backboxes for Communications Systems.
 - 12. Section 270536 - Cable Trays for Communications Systems.
 - 13. Section 280528.33 - Conduits and Backboxes for Electronic Safety and Security.
 - 14. Section 280528.36 - Cable Trays for Electronic Safety and Security.
 - 15. Section 337119 - Electrical Underground Ducts, Ductbanks, and Manholes.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
 - 2. ANSI C80.3 - Specification for Electrical Metallic Tubing, Zinc Coated.
 - 3. ANSI C80.5 - Aluminum Rigid Conduit - (ARC).
- B. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
 - 3. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - 4. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - 5. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 - 6. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
 - 7. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.3 SYSTEM DESCRIPTION

- A. Raceway and boxes located as indicated on Drawings, and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.
- B. Underground Greater Than 5 feet outside Foundation Wall: Provide rigid steel conduit with anti-corrosion tape wrap or thickwall nonmetallic conduit. Provide cast metal boxes and handhole.
- C. Underground Within 5 feet from Foundation Wall: Provide rigid steel conduit with anti-corrosion tape wrap or plastic-coated rigid steel conduit. Provide cast metal and boxes.
- D. In or Under Slab on Grade: Provide rigid steel conduit with anti-corrosion tape wrap or thickwall nonmetallic conduit. Provide cast metal boxes.
 - 1. No conduit shall be embedded in a concrete slab unless otherwise noted. All conduit below a slab shall be a minimum of 12" below the concrete slab.
- E. Outdoor Locations, Above Grade: Provide rigid steel conduit. Provide cast metal outlet, pull, and junction boxes.
- F. In Slab Above Grade: Provide rigid steel conduit with anti-corrosion tape wrap or thickwall nonmetallic conduit.
 - 1. Provide Schedule 80 PVC conduit anywhere underground conduit emerges from concrete.
 - 2. No conduit shall be embedded in a concrete slab unless otherwise noted.
- G. Wet and Damp Locations: Provide rigid steel conduit. Provide cast metal or nonmetallic outlet, junction, and pull boxes. Provide flush mounting outlet box in finished areas.
- H. Concealed Dry Locations: Provide electrical metallic tubing. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.
- I. Exposed Dry Locations: Provide rigid steel conduit below 7' above finished floor, electrical metallic tubing 7' above finished floor. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.

1.4 DESIGN REQUIREMENTS

- A. Minimum Raceway Size: 1 inch 3/4 inch for branch circuits unless otherwise specified.

1.5 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit for the following:
 - 1. Flexible metal conduit.
 - 2. Liquidtight flexible metal conduit.

3. Nonmetallic conduit.
4. Flexible nonmetallic conduit.
5. Nonmetallic tubing.
6. Raceway fittings.
7. Conduit bodies.
8. Surface raceway.
9. Wireway.
10. Pull and junction boxes.
11. Handholes.

- C. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.6 CLOSEOUT SUBMITTALS

- A. Section 017000 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents:
 1. Record actual routing of conduits larger than 2 inches
 2. Record actual locations and mounting heights of outlet, pull, and junction boxes.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Product storage and handling requirements.
- B. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- C. Protect PVC conduit from sunlight.

1.8 COORDINATION

- A. Section 013000 - Administrative Requirements: Coordination and project conditions.
- B. Coordinate installation of outlet boxes for equipment connected under Section 260583.
- C. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backslashes.

PART 2 - PRODUCTS

2.1 METAL CONDUIT

- A. Manufacturers:

1. ABB, Electrification Business.
2. Allied Tube & Conduit; Atkore International.
3. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
4. Republic Conduit; Nucor Corporation, Nucor Tubular Products.
5. Western Tube; Zekelman Industries.
6. Wheatland Tube; Zekelman Industries.

B. Substitutions: As specified in Section 016000 - Product Requirements.

C. Rigid Steel Conduit: ANSI C80.1.

D. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit.

2.2 PVC COATED METAL CONDUIT

A. Manufacturers:

1. ABB, Electrification Business.
2. Plasti-Bond; Robroy Industries.

B. Substitutions: As specified in Section 016000 - Product Requirements.

C. Product Description: NEMA RN 1; rigid steel conduit with external PVC coating, 20 mil thick.

D. Fittings and Conduit Bodies: NEMA FB 1; steel fittings with external PVC coating to match conduit.

2.3 FLEXIBLE METAL CONDUIT

A. Manufacturers:

1. AFC Cable Systems; Atkore International.
2. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
3. Southwire Company, LLC.

B. Substitutions: As specified in Section 016000 - Product Requirements.

C. Product Description: Interlocked steel or aluminum construction.

D. Fittings: NEMA FB 1.

2.4 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

A. Manufacturers:

1. ABB, Electrification Business.
2. AFC Cable Systems; Atkore International.
3. Anaconda Sealtite; Anamet Electrical, Inc.
4. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
5. Southwire Company, LLC.

- B. Substitutions: As specified in Section 016000 - Product Requirements.
- C. Product Description: Interlocked steel construction with PVC jacket.
- D. Fittings: NEMA FB 1.

2.5 ELECTRICAL METALLIC TUBING (EMT)

- A. Manufacturers:
 - 1. ABB, Electrification Business.
 - 2. Republic Conduit; Nucor Corporation, Nucor Tubular Products.
 - 3. Rosemount Inc.; Emerson Electric Company.
 - 4. Western Tube; Zekelman Industries.
 - 5. Wheatland Tube; Zekelman Industries.
- B. Substitutions: As specified in Section 016000 - Product Requirements.
- C. Product Description: ANSI C80.3; galvanized tubing.
- D. Fittings and Conduit Bodies: NEMA FB 1; steel compression type.

2.6 NONMETALLIC CONDUIT

- A. Manufacturers:
 - 1. ABB, Electrification Business.
 - 2. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
- B. Substitutions: As specified in Section 016000 - Product Requirements.
- C. Product Description: NEMA TC 2; Schedule [40] [80] PVC.
- D. Fittings and Conduit Bodies: NEMA TC 3.

2.7 NONMETALLIC TUBING

- A. Manufacturers:
 - 1. ABB, Electrification Business.
- B. Substitutions: As specified in Section 016000 - Product Requirements.
- C. Product Description: NEMA TC 2.
- D. Fittings and Conduit Bodies: NEMA TC 3.

2.8 SURFACE METAL RACEWAY

- A. Manufacturers:
 - 1. Niedax Inc.
 - 2. Panduit Corp.
 - 3. Wiremold; Legrand North America, LLC.
- B. Substitutions: As specified in Section 016000 - Product Requirements.
- C. Product Description: Sheet metal channel with fitted cover, suitable for use as surface metal raceway.
- D. Finish: Gray enamel.
- E. Fittings, Boxes, and Extension Rings: Furnish manufacturer's standard accessories; match finish on raceway.

2.9 WIREWAY

- A. Manufacturers:
 - 1. ABB, Electrification Business.
 - 2. AMP; American Midwest Power.
 - 3. Cooper B-line; brand of Eaton, Electrical Sector.
 - 4. Hammond Mfg. Co. Inc.
 - 5. Hoffman; brand of nVent Electrical plc.
 - 6. Panduit Corp.
 - 7. Square D; Schneider Electric USA.
 - 8. Stahlin Non-Metallic Enclosures.
 - 9. Wiremold; Legrand North America, LLC.
- B. Substitutions: As specified in Section 016000 - Product Requirements.
- C. Product Description: General purpose type wireway.
- D. Knockouts: Manufacturer's standard.
- E. Size: 4 by 4 inchlength as indicated on Drawings.
- F. Cover: Hinged cover.
- G. Connector: Slip-in.
- H. Fittings: Lay-in type with.
- I. Finish: Rust inhibiting primer coating with gray enamel finish.

2.10 OUTLET BOXES

- A. Manufacturers:
 - 1. ABB, Electrification Business.
 - 2. Allied Moulded Products, Inc.
 - 3. Emerson Electric Co.
 - 4. Racal Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
- B. Substitutions: As specified in Section 016000 - Product Requirements.
- C. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
 - 1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch male fixture studs where required.
 - 2. Concrete Ceiling Boxes: Concrete type.
- D. Cast Boxes: NEMA FB 1, Type FD, aluminum or cast ferrous alloy. Furnish gasketed cover by box manufacturer. Furnish threaded hubs.
- E. Wall Plates for Finished Areas: As specified in Section 262726.
- F. Wall Plates for Unfinished Areas: Furnish gasketed cover.

2.11 PULL AND JUNCTION BOXES

- A. Manufacturers:
 - 1. Hoffman; brand of nVent Electrical plc.
 - 2. Kraloy Fittings.
 - 3. Racal Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - 4. Rosemount Inc.; Emerson Electric Company.
- B. Substitutions: As specified in Section 016000 - Product Requirements.
- C. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
- D. Hinged Enclosures: As specified in Section 262716.
- E. Surface Mounted Cast Metal Box: NEMA 250, Type 4; flat-flanged, surface mounted junction box:
 - 1. Material: Galvanized cast iron or Cast aluminum.
 - 2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.
- F. In-Ground Cast Metal Box: NEMA 250, Type 6, flanged, recessed cover box for flush mounting:
 - 1. Material: Galvanized cast iron.
 - 2. Cover: Nonskid cover with neoprene gasket and stainless steel cover screws.
 - 3. Cover Legend: ELECTRIC.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 013000 - Administrative Requirements: Coordination and project conditions.
- B. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

3.2 EXISTING WORK

- A. Remove exposed abandoned raceway. Cut raceway flush with walls and floors, and patch surfaces.
- B. Remove concealed abandoned raceway to its source.
- C. Disconnect abandoned outlets and remove devices. Remove abandoned outlets when raceway is abandoned and removed. Install blank cover for abandoned outlets not removed.
- D. Maintain access to existing boxes and other installations remaining active and requiring access. Modify installation or provide access panel.
- E. Extend existing raceway and box installations using materials and methods compatible with existing electrical installations, or as specified.
- F. Clean and repair existing raceway and boxes to remain or to be reinstalled.

3.3 INSTALLATION

- A. Ground and bond raceway and boxes in accordance with Section 260526.
- B. Fasten raceway and box supports to structure and finishes in accordance with Section 260529.
- C. Identify raceway and boxes in accordance with Section 260553.
- D. Arrange raceway and boxes to maintain headroom and present neat appearance.

3.4 INSTALLATION - RACEWAY

- A. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.
- B. Arrange raceway supports to prevent misalignment during wiring installation.
- C. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

- D. Group related raceway; support using conduit rack. Construct rack using steel channel specified in Section 260529 ; provide space on each for 25 percent additional raceways.
- E. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports
- F. Do not attach raceway to ceiling support wires or other piping systems.
- G. Construct wireway supports from steel channel specified in Section 260529.
- H. Route exposed raceway parallel and perpendicular to walls.
- I. Route raceway installed above accessible ceilings parallel and perpendicular to walls.
- J. Route conduit under slab from point-to-point.
- K. Maintain clearance between raceway and piping for maintenance purposes.
- L. Maintain 12 inch clearance between raceway and surfaces with temperatures exceeding 104 degrees F.
- M. Cut conduit square using saw or pipe cutter; de-burr cut ends.
- N. Bring conduit to shoulder of fittings; fasten securely.
- O. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for minimum 20 minutes.
- P. Install conduit hubs to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.
- Q. Install no more than equivalent of three 90 degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Install factory elbows for bends in metal conduit larger than 2 inch size.
- R. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.
- S. Install fittings to accommodate expansion and deflection where raceway crosses seismic, control and expansion joints.
- T. Install suitable pull string or cord in each empty raceway except sleeves and nipples.
- U. Install suitable caps to protect installed conduit against entrance of dirt and moisture.
- V. Surface Raceway: Install flat-head screws, clips, and straps to fasten raceway channel to surfaces; mount plumb and level. Install insulating bushings and inserts at connections to outlets and corner fittings.
- W. Close ends and unused openings in wireway.
- X. All metallic fittings shall be compression type rated for ground connection.

- Y. All exposed conduit installed in a finished space shall be painted to match the background.
- Z. Elbows for rigid metal conduit, 3" and larger, shall be either plastic coated or anti-corrosion tapped to prevent damage from pulling ropes.
 - 1. Apply anti-corrosion tape per manufacturer directions.

3.5 INSTALLATION - BOXES

- A. Install wall mounted boxes at elevations to accommodate mounting heights as indicated on Drawings.
- B. Adjust box location up to 10 feet prior to rough-in to accommodate intended purpose.
- C. Orient boxes to accommodate wiring devices oriented as specified in Section 262726.
- D. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- E. In Accessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.
- F. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- G. Do not install flush mounting box back-to-back in walls; install with minimum 6 inches separation. Install with minimum 24 inches separation in acoustic rated walls.
- H. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- I. Install stamped steel bridges to fasten flush mounting outlet box between studs.
- J. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- K. Install adjustable steel channel fasteners for hung ceiling outlet box.
- L. Do not fasten boxes to ceiling support wires or other piping systems.
- M. Support boxes independently of conduit.
- N. Install gang box where more than one device is mounted together. Do not use sectional box.
- O. Install gang box with plaster ring for single device outlets.

3.6 INTERFACE WITH OTHER PRODUCTS

- A. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket. Coordinate location with roofing installation specified in Section 077100.
- B. Locate outlet boxes to allow luminaires positioned as indicated on Drawings.

- C. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

3.7 ADJUSTING

- A. Section 017000 - Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Adjust flush-mounting outlets to make front flush with finished wall material.
- C. Install knockout closures in unused openings in boxes.

3.8 CLEANING

- A. Section 017000 - Execution and Closeout Requirements: Final cleaning.
- B. Clean interior of boxes to remove dust, debris, and other material.
- C. Clean exposed surfaces and restore finish.

END OF SECTION 260533

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SECTION 260536 - CABLE TRAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal cable trays.
2. Cable tray accessories.

B. Products Installed, but Not Furnished, under This Section:

1. Section 260526 "Grounding and Bonding for Electrical Systems" specifies grounding and bonding products installed under this Section.
2. Section 260553 "Identification for Electrical Systems" specifies electrical equipment labels and warning signs installed by this Section.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Metal cable trays.
2. Cable tray accessories.

B. Shop Drawings:

1. Cable tray fabrication drawings, diagrams, and supporting documents.

C. Field quality-control reports.

1.3 INFORMATIONAL SUBMITTALS

A. Manufacturers' published instructions.

B. Field Reports:

1. Factory test reports.
2. Manufacturer's field reports for field quality-control support.

PART 2 - PRODUCTS

2.1 METAL CABLE TRAYS

- A. Description: This product category covers metal cable trays and metal cable tray systems intended for field assembly and for use in accordance with Article 392 of NFPA 70.
- B. Performance Criteria:
 - 1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 - 2. Listing Criteria: UL CCN CYNW; including NEMA VE 1 and suitability for use as equipment grounding conductors in accordance with Sections 392.60(A) and 392.60(B) of NFPA 70.
- C. UL CYNW - Ladder Cable Tray:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper B-line
 - b. MP Huskey
 - c. Hubbell
 - 2. Substitutions: As specified in Section 016000 - Product Requirements.
 - 3. Retain "Source Limitations" Subparagraph below to limit sources for this product type.
 - 4. Source Limitations: Obtain products from single manufacturer.
 - 5. General Characteristics:
 - a. Configuration: Two longitudinal side rails with transverse rungs swaged or welded to side rails, complying with NEMA VE 1.
 - b. Radius-Fitting Rung Spacing: 9 inch at center of tray's width.
 - c. Minimum Cable-Bearing Surface for Rungs: 7/8 inch width with radius edges.
 - d. No portion of the rungs must protrude below the bottom plane of side rails.
 - e. Structural Performance of Each Rung: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200 lb. concentrated load, when tested in accordance with NEMA VE 1.
 - f. Splicing Assemblies: Bolted type using serrated flange locknuts.
 - g. Splice-Plate Capacity: Splices located within support span must not diminish rated loading capacity of cable tray.
 - 6. Materials and Finishes (Aluminum):
 - a. Materials: Alloy 6063-T6 in accordance with ANSI H35.1/H 35.1M for extruded components, and Alloy 5052-H32 or Alloy 6061-T6 in accordance with ANSI H35.1/H 35.1M for fabricated parts.

- b. Hardware: Chromium-zinc-plated steel, ASTM F1136
- c. Hardware for Aluminum Cable Tray Used Outdoors: Stainless steel, Type 316, ASTM F593 and ASTM F594.

7. Options:

- a. Width: as indicated on Drawings.
- b. Minimum Usable Load Depth: 6 inch.
- c. Straight Section Lengths: 10 ft, except where shorter lengths are required to facilitate tray assembly.
- d. Rung Spacing: 9 inch on center.
- e. Fitting Minimum Radius: 24 inch.
- f. Class Designation: Comply with NEMA VE 1, Class 10E.

D. UL CYNW - Wire-Mesh Cable Tray:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper B-line
 - b. MP Huskey
 - c. Hubbell
2. Substitutions: As specified in Section 016000 - Product Requirements.
3. Source Limitations: Obtain products from single manufacturer.
4. General Characteristics:
 - a. Configuration: Galvanized-steel wire mesh, complying with NEMA VE 1.
 - b. Structural Performance: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200 lb. concentrated load, when tested in accordance with NEMA VE 1.
 - c. Splicing Assemblies: Bolted type using serrated flange locknuts.
 - d. Splice-Plate Capacity: Splices located within support span must not diminish rated loading capacity of cable tray.
5. Materials and Finishes (Steel):
 - a. Straight Sections and Fittings: Steel complies with the minimum mechanical properties of ASTM A1008/A1008M, Grade 33, Type 2.
 - b. Steel Tray Splice Plates: ASTM A1011/A1011M, HSLAS, Grade 50, Class 1.
 - c. Fasteners: Steel complies with the minimum mechanical properties of ASTM A510/A510M, Grade 1008.
 - d. Finish:
 - 1) Hot-dip galvanized after fabrication, complying with ASTM A123/A123M, Class B2, with galvanized, ASTM B633 hardware.
6. Options:
 - a. Width: as indicated on Drawings.
 - b. Minimum Usable Load Depth: 4 inch.

- c. Straight Section Lengths: 10 ft, except where shorter lengths are required to facilitate tray assembly.
- d. Class Designation: Comply with NEMA VE 1, Class 10A .

2.2 CABLE TRAY ACCESSORIES

- A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.
- B. Barrier Strips: Same materials and finishes as for cable tray.
- C. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.3 SOURCE QUALITY CONTROL

- A. Product Data: Prepare and submit catalog cuts, brochures, diagrams, and performance data illustrating size, physical appearance, and other characteristics of product.
 - 1. Include data indicating dimensions and finishes for each type of cable tray indicated.
- B. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.
- C. Factory Tests:
 - 1. Testing Adminstrant: Engage qualified electrical testing agency to evaluate cable trays.
 - 2. Factory Tests and Inspections: Perform the following tests and inspections on cable trays, by, or under supervision of, qualified electrical testing laboratory recognized by authorities having jurisdiction before delivering to site. Affix label with name and date of manufacturer's certification of system compliance.
 - a. Test and inspect cable trays in accordance with NEMA VE 1.
 - 3. Nonconforming Work:
 - a. Equipment that does not pass tests and inspections will be considered defective.
 - 4. Factory Test Reports: Prepare and submit factory test and inspection reports.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Shop Drawings: Prepare and submit the following for each cable tray system:
 - 1. Cable Tray Fabrication Drawings, Diagrams, and Supporting Documents:

- a. Show fabrication and installation details of cable trays, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.
- b. Include load calculations to show that dead and live loads do not exceed manufacturer's rating for tray and its support elements.
- c. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
 - 1) Vertical and horizontal offsets and transitions.
 - 2) Clearances for access above and to sides of cable trays.
 - 3) Vertical elevation of cable trays above the floor or bottom of ceiling structure.

3.2 INSTALLATION OF CABLE TRAYS

- A. Install cable tray and support systems in accordance with NEMA VE 2.
- B. Install cable tray as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.
- C. Install cable tray, so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.
- D. Remove burrs and sharp edges from cable trays.
- E. Join aluminum cable tray with splice plates; use four square-neck carriage bolts and locknuts.
 - 1. Provide heavy duty splice plates where required by manufacturer.
- F. Fasten cable tray supports to building structure.
- G. Design fasteners and supports to carry cable tray, cables, and a concentrated load of 200 lb. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems."
- H. Place supports as instructed by manufacturer, so that spans do not exceed maximum spans indicated by manufacturer, and so that splices are within manufacturer recommended distances to splice plates. Install intermediate supports when cable weight exceeds the load-carrying capacity of tray rungs.
- I. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
- J. Support assembly to prevent twisting from eccentric loading.
- K. Do not install more than one cable tray splice between supports.
- L. Support wire-basket cable trays with trapeze hangers.

- M. Support trapeze hangers for wire-basket trays with 3/8 inch diameter rods.
- N. Make connections to equipment with flanged fittings fastened to cable trays and to equipment. Support cable trays independent of fittings. Do not carry weight of cable trays on equipment enclosure.
- O. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed recommended dimensions. Space connectors and set gaps in accordance with applicable standard.
- P. Make changes in direction and elevation using manufacturer's recommended fittings.
- Q. Make cable tray connections using manufacturer's recommended fittings.
- R. Seal penetrations through fire and smoke barriers.
- S. Install cable trays with enough workspace to permit access for installing cables.
- T. Install barriers to separate cables of different systems, such as power, communications, and data processing, or of different insulation levels, such as 600, 5000, and 15 000 V.
- U. Install warning signs in visible locations on or near cable trays after cable tray installation.

3.3 CABLE TRAY GROUNDING

- A. Ground cable trays in accordance with NFPA 70 unless additional grounding is specified.
- B. Cable trays with electrical power conductors must be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.
- C. Cable trays with single-conductor power conductors must be bonded together with a grounding conductor run in the tray along with the power conductors and bonded to the tray at 72 inch intervals. The grounding conductor must be sized in accordance with Article 250 and Article 392 of NFPA 70.
- D. Bond cable trays to power source for cables contained within with bonding conductors sized in accordance with Article 250 of NFPA 70.

3.4 INSTALLATION OF CABLES

- A. Install cables only when each cable tray run has been completed and inspected.
- B. Fasten cables on horizontal runs with cable clamps or cable ties. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.
- C. Fasten cables on vertical runs to cable trays every 18 inch.
- D. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and support cables

independent of the enclosure. The cable length between cable trays or between cable tray and enclosure must be no more than 72 inch.

3.5 FABRICATION OF CONNECTION POINTS

- A. Remove paint from all connection points before making connections. Repair paint after the connections are completed.
- B. Connect raceways to cable trays in accordance with requirements in NEMA VE 2.

3.6 INSTALLATION OF CABLE TRAY MARKINGS AND SIGNS

- A. Trays Containing Cables Operating Over 600 V: Provide hazard markings in accordance with Section 392.18 of NFPA 70 and with NEMA Z535.4.
 - 1. Legend: "DANGER - HIGH VOLTAGE - KEEP AWAY."
- B. Ladder Cable Trays: Provide warning signs to prevent use as personnel ladder.
 - 1. Lettering: 1-1/2 inch high.
 - 2. Legend: "WARNING! NOT TO BE USED AS WALKWAY, LADDER, OR SUPPORT FOR LADDERS OR PERSONNEL."

3.7 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.
 - 2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.
 - 3. Verify that the number, size, and voltage of cables in cable trays do not exceed that permitted by NFPA 70. Verify that communications or data-processing circuits are separated from power circuits by barriers or are installed in separate cable trays.
 - 4. Verify that there are no intruding items, such as pipes, hangers, or other equipment, in the cable tray.
 - 5. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.
 - 6. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorquing in suspect areas.
 - 7. Check for improperly sized or installed bonding jumpers.
 - 8. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
 - 9. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable trays. Test entire cable tray system for continuity. Maximum allowable resistance is 1 Ω .

B. Nonconforming Work:

1. Cable tray will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

C. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.

3.8 PROTECTION

A. Protect installed cable trays and cables.

1. Install temporary protection for cables in open trays to safeguard exposed cables against falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials and must remain in place until the risk of damage is over.
2. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
3. Repair damage to paint finishes with matching touchup coating recommended by cable tray manufacturer.

END OF SECTION 260536

SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Type ERMC-S raceways, elbows, couplings, and nipples.
2. Type IMC raceways.
3. Type PVC raceways and fittings.
4. Type RTRC-BG raceways and fittings.
5. Fittings for conduit, tubing, and cable.
6. Electrically conductive corrosion-resistant compounds for threaded conduit.
7. Solvent cements.
8. Duct accessories.
9. Handholes and boxes for exterior underground wiring.
10. Manholes for exterior underground wiring.
11. Utility structure accessories.
12. Duct sealing.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" specifies additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" specifies seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
3. Section 013100 "Project Management and Coordination" preinstallation conference procedures.
4. Section 260519 "Low-Voltage for Electrical Power Conductors and Cables" specifies nonmetallic underground conduit with conductors (Type NUCC).
5. Section 260553 "Identification for Electrical Systems" specifies underground-line warning tape and concrete cable routing markers (warning planks).

1.2 ALLOWANCES

- A. See Section 012100 "Allowances" for description of allowances affecting items specified in this Section.

1.3 UNIT PRICES

- A. See Section 012200 "Unit Prices" for description of unit prices affecting items specified in this Section.

1.4 ALTERNATES

- A. See Section 012300 "Alternates" for description of alternates affecting items specified in this Section.

1.5 DEFINITIONS

- A. Duct: A single raceway or multiple raceways, installed singly or as components of a duct bank.
- B. Duct Bank: Two or more ducts installed in parallel, direct buried or with additional casing materials such as concrete.
- C. Handhole: An underground chamber containing electrical cables, sized such that personnel are not required to enter in order to access the cables.
- D. Manhole: An underground chamber containing electrical cables and equipment, sized to provide access with working space clearances.
- E. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

1.6 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
- B. Preinstallation Coordination Meeting(s): For underground ducts and raceways. Conduct meeting(s) as videoconference or at Project site before proceeding with work.
 - 1. Attendees: Installers, fabricators, representatives of manufacturers, and administrators for field tests and inspections. Notify Architect, and Owner's Rep of scheduled meeting dates.

1.7 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For concrete and steel used in precast concrete manholes and handholes, also include product certificates as required by ASTM C858.
- B. Shop Drawings:
 - 1. Electric Utility Duct Banks and Structures:
 - a. Include plans, elevations, sections, and details, including attachments to other Work.
 - b. Indicate locations of private property boundaries and utility easements.
 - c. Include information required for approval by electric utility and for obtaining public space utility work permits.
 - 2. Precast or Factory-Fabricated Concrete Structures:
 - a. Include plans, elevations, sections, and details, including attachments to other Work.

- b. Include duct entry provisions, including locations and duct sizes, and methods and materials for waterproofing duct entry locations.
 - c. Include reinforcement details.
 - d. Include frame and cover design and manhole chimneys.
 - e. Include grounding details.
 - f. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, sumps, and other accessories.
 - g. Include joint details.
- 3. Factory-Fabricated Handholes and Boxes Other Than Precast Concrete:
 - a. Include dimensioned plans, sections, and elevations, and fabrication and installation details.
 - b. Include duct entry provisions, including locations and duct sizes, and methods and materials for waterproofing duct entry locations.
 - c. Include cover design.
 - d. Include grounding details.
 - e. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, and other accessories.

C. Field quality-control reports.

1.8 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.
- B. Field Reports:
 - 1. Factory Test Reports: For handholes and boxes.
 - 2. Manufacturer's field reports for field quality-control support.

1.9 MAINTENANCE MATERIAL SUBMITTALS

- A. Spare Parts: Furnish to Owner spare parts necessary for repairing or adding more cables to manholes or handholes that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Cable-Support Stanchions, Arms, and Associated Fasteners: Five percent of quantity of each item installed.
 - 2. Insulators: Five percent of quantity of each item installed.

PART 2 - PRODUCTS

2.1 TYPE ERM-C-S RACEWAYS, ELBOWS, COUPLINGS, AND NIPPLES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 6 and UL CCN DYIX.

B. Galvanized-Steel Electrical Rigid Metal Conduit (ERMC-S-G), Elbows, Couplings, and Nipples:

1. Exterior Coating: Zinc.
2. Options:
 - a. Interior Coating: Zinc.
 - b. Minimum Trade Size: 2 inch.

C. PVC-Coated-Steel Electrical Rigid Metal Conduit (ERMC-S-PVC), Elbows, Couplings, and Nipples:

1. Additional Characteristics:
2. Fittings for PVC-Coated Conduit:
 - a. Minimum coating thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
 - b. Conduit bodies must be Form 8 with effective seal and positive placement feature to ease and assure proper installation. Certified results confirming seal performance at 15 psig (positive) and 25-inch Hg (vacuum) for 72 hours must be available. Conduit bodies must be supplied with plastic-encapsulated stainless steel cover screws.
 - c. Form 2 inch long or one pipe diameter long, whichever is less, PVC sleeve at openings of female fittings, except unions. Inside sleeve diameter must be matched to outside diameter of metal conduit.
 - d. PVC coating on outside of conduit couplings must be protected from tool damage during installation.
 - e. Female threads on fittings and couplings must be protected by urethane coating.
 - f. Fittings must be from same manufacturer as conduit.
 - g. Beam clamps and U bolts must be formed and sized to fit outside diameter of coated conduit. Plastic-encapsulated nuts must cover exposed portions of threads.
3. Options:
 - a. Exterior Coating: PVC complying with NEMA RN 1.
 - b. Interior Coating: Zinc.
 - c. Minimum Trade Size: 2 inch.
 - d. Colors: As indicated on Drawings.
 - e. Conduit Fittings for Hazardous (Classified) Locations: UL 1203.
 - f. Expansion and Deflection Fittings: UL 651 with flexible external bonding jumper.

2.2 TYPE PVC RACEWAYS AND FITTINGS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 651, UL CCN DZYR, NEMA TC-6, and ASTM F-512.

B. Schedule 40 Rigid PVC Conduit (PVC-40) and Fittings:

1. Dimensional Specifications: Schedule 40.
2. Options:
 - a. Minimum Trade Size: 2 inch.
 - b. Conduit shall be rated for 90 degrees C cable.

2.3 TYPE RTRC-BG RACEWAYS AND FITTINGS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 2420 and UL CCN DZKT, for Type BG.

B. Low-Halogen, Belowground Reinforced Thermosetting Resin Conduit (RTRC-BG) and Fittings:

1. Options:
 - a. Minimum Trade Size: 2 inch.

2.4 FITTINGS FOR CONDUIT, TUBING, AND CABLE

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.

B. Metallic Fittings for Type ERM, Type PVC, and Type RTRC Raceways:

1. General Characteristics: UL 514B and UL CCN DWTT.
2. Options:
 - a. Material: Steel.
 - b. Coupling Method: Compression coupling.
 - c. Conduit Fittings for Hazardous (Classified) Locations: UL 1203.
 - d. Expansion and Deflection Fittings: UL 651 with flexible external bonding jumper.

2.5 ELECTRICALLY CONDUCTIVE CORROSION-RESISTANT COMPOUNDS FOR THREADED CONDUIT

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL Subject 2419 and UL CCN FOIZ.

2.6 SOLVENT CEMENTS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: As recommended by conduit manufacturer in accordance with UL 514B and UL CCN DWTT.

2.7 DUCT ACCESSORIES

- ### A. Duct Spacers: Factory-fabricated, rigid, PVC interlocking spacers; sized for type and size of duct with which used and selected to provide minimum duct spacing indicated while supporting duct during concreting or backfilling.

2.8 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics:
 - a. ASTM C858 for design and manufacturing processes.
 - b. SCTE 77.

B. Precast Concrete Handholes and Boxes:

1. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover must form top of enclosure and must have load rating consistent with that of handhole or box.
2. Configuration: Units must be designed for flush burial and have open bottom unless otherwise indicated.
3. Frame and Cover:
 - a. Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
 - b. Weatherproof steel frame, with steel cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
 - c. Weatherproof steel frame, with concealed-hinge steel access door assembly; tamper-resistant, captive, cover-securing bolts; hold-open ratchet assembly; and recessed cover handle.

- d. Weatherproof aluminum frame, with concealed-hinge aluminum access door assembly; tamper-resistant, captive, cover-securing bolts; hold-open ratchet assembly; and recessed cover handle.
 - e. Cover Finish: Nonskid finish must have minimum coefficient of friction of 0.50.
 - f. Cover Legend: Molded lettering, "ELECTRIC".
- 4. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.
 - a. Extension must provide increased depth of 12 inch.
 - b. Slab: Same dimensions as bottom of enclosure and arranged to provide closure.
- 5. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at installation location with ground-water level at grade.
- 6. Knockout Panels: Precast openings in walls, arranged to match dimensions and elevations of approaching duct, plus additional 12 inch vertically and horizontally to accommodate alignment variations.
 - a. Center window location.
 - b. Knockout panels must be located no less than 6 inch from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.
 - c. Knockout panel opening must have cast-in-place, welded-wire fabric reinforcement for field cutting and bending to tie into concrete envelopes of duct.
 - d. Knockout panels must be framed with at least two additional No. 3 steel reinforcing bars in concrete around each opening.
 - e. Knockout panels must be 1-1/2 to 2 inch thick.
- 7. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
 - a. Type and size: Match fittings to duct to be terminated.
 - b. Fittings must align with elevations of approaching duct and be located near interior corners of handholes to facilitate racking of cable.
- 8. Handholes 12 inch wide by 24 inch long and larger must have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.9 MANHOLES FOR EXTERIOR UNDERGROUND WIRING

A. Performance Criteria:

- 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
- 2. General Characteristics:
 - a. ASTM C858 for design and manufacturing processes.
 - b. SCTE 77.

B. Precast Concrete Manholes:

1. Description: One-piece units and units with interlocking mating sections, complete with accessories, hardware, and features.
2. Knockout Panels: Precast openings in walls, arranged to match dimensions and elevations of approaching duct, plus additional 12 inch vertically and horizontally to accommodate alignment variations.
 - a. Center window location.
 - b. Knockout panels must be located no less than 6 inch from interior surfaces of walls, floors, or roofs of manholes, but close enough to corners to facilitate racking of cables on walls.
 - c. Knockout panel opening must have cast-in-place, welded-wire fabric reinforcement for field cutting and bending to tie into concrete envelopes of duct.
 - d. Knockout panel must be framed with at least two additional No. 3 steel reinforcing bars in concrete around each opening.
 - e. Knockout panels must be 1-1/2 to 2 inch thick.
3. Duct Entrances in Manhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
 - a. Type and size: Match fittings to duct to be terminated.
 - b. Fittings must align with elevations of approaching duct and be located near interior corners of manholes to facilitate racking of cable.
 - c. Provide minimum of one cast end-bell or duct-terminating fitting of each size provided in each wall.
4. Ground Rod Sleeve: Provide 3 inch PVC sleeve in manhole floors 2 inch from wall adjacent to, but not underneath, duct entering structure.
5. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at installation location with ground-water level at grade.
6. Source Quality Control: Test and inspect in accordance with ASTM C1037.

C. Cast-in-Place Concrete Manholes:

1. Description: Underground utility structures, constructed in place, complete with accessories, hardware, and features. Include concrete knockout panels for duct entrance and sleeve for ground rod.
2. Additional Criteria: Comply with Section 033000 "Cast-in-Place Concrete."

2.10 UTILITY STRUCTURE ACCESSORIES

- A. Description: Utility equipment and accessory items used for utility structure access and utility support, listed and labeled for intended use and application.
- B. Manhole Frames, Covers, and Chimney Components: Comply with structural design loading specified for manhole.

1. Frame and Cover: Weatherproof, gray cast iron complying with ASTM A48/A48M, Class 30B with milled cover-to-frame bearing surfaces; diameter, 29 inch.
 - a. Cover Finish: Nonskid finish must have minimum coefficient of friction of 0.50.
 - b. Special Covers: Recess in face of cover designed to accept finish material in paved areas.
 2. Cover Legend: Cast in; selected to suit system.
 - a. Legend:
 - 1) "ELECTRIC-LV" for duct systems with power wires and cables for systems operating at 600 V and less.
 - 2) "ELECTRIC-HV" for duct systems with medium-voltage cables.
 3. Manhole Chimney Components: Precast concrete rings with dimensions matched to those of roof opening.
 - a. Mortar for Chimney Ring and Frame and Cover Joints: Comply with ASTM C270, Type M, except for quantities less than 2.0 cu. ft where packaged mix complying with ASTM C387/C387M, Type M, may be used.
 - b. Seal joints watertight using preformed plastic or rubber complying with ASTM C990. Install sealing material in accordance with sealant manufacturers' published instructions.
- C. Manhole Sump Frame and Grate: ASTM A48/A48M, Class 30B, gray cast iron.
- D. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 2 inch diameter eye, and 1-by-4 inch bolt.
1. Working Load Embedded in 6 inch (150 mm), 4000 psi (27.6 MPa) Concrete: 13,000 lbf minimum tension.
- E. Pulling Eyes in Nonconcrete Walls: Eyebolt with reinforced fastening, 1-1/4 inch diameter eye, rated 2500 lbf minimum tension.
- F. Pulling-in and Lifting Irons in Concrete Floors: 7/8 inch diameter, hot-dip galvanized, bent steel rod; stress relieved after forming; fastened to reinforcing rod; and with exposed triangular opening.
1. Ultimate Yield Strength: 40,000 lbf shear and 60,000 lbf tension.
- G. Bolting Inserts for Concrete Utility Structure Cable Racks and Other Attachments: Flared, threaded inserts of noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2 inch ID by 2-3/4 inch deep, flared to 1-1/4 inch minimum at base.
1. Tested Ultimate Pullout Strength: 12,000 lbf minimum.
- H. Ground Rod Sleeve: 3 inch PVC sleeve in manhole floors 2 inch from wall adjacent to, but not underneath, ducts routed from facility.

- I. Expansion Anchors for Installation after Concrete Is Cast: Zinc-plated, carbon-steel-wedge type with stainless steel expander clip with 1/2 inch bolt, 5300 lbf rated pullout strength, and minimum 6800 lbf rated shear strength.
- J. Nonmetallic Cable Rack Assembly: Components fabricated from nonconductive, fiberglass-reinforced polymer.
 - 1. Stanchions: Nominal 36 inch high by 4 inch wide, with provisions to connect to other sections to form continuous unit, with minimum of nine holes for arm attachment.
 - 2. Arms: Arranged for secure, drop-in attachment in horizontal position at locations on cable stanchions, and capable of being locked in position. Arms must be available in lengths ranging from 3 inch with 450 lb minimum capacity to 20 inch with 250 lb minimum capacity. Top of arm must be nominally 4 inch wide, and arm must have slots along full length for cable ties.

2.11 DUCT SEALING

- A. Duct-Sealing Compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F. Compound must be capable of withstanding temperature of 300 deg F without slump and adhering to clean surfaces of plastic ducts, metallic conduit, conduit and duct coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals. Duct sealing compound must be removable without damaging ducts or cables.
- B. Inflatable Duct-Sealing System: Wraparound inflatable bladder that seals ducts that are empty or containing conductors against air and water infiltration. System is suitable for use in steel, plastic, or concrete ducts and penetrations.

2.12 SOURCE QUALITY CONTROL

- A. Factory Tests for Handholes and Boxes:
 - 1. Testing Administrant: Engage qualified structural testing agency to evaluate handholes and boxes.
 - a. Tests of materials must be performed by independent testing agency.
 - b. Strength tests of complete boxes and covers must be by independent testing agency or manufacturer. Qualified registered professional engineer must certify tests by manufacturer.
 - 2. Factory Tests and Inspections: Perform the following tests and inspections on handholes and boxes, by, or under supervision of, qualified electrical testing laboratory recognized by authorities having jurisdiction, before delivering to site. Affix label with name and date of qualified testing laboratory's certification of system compliance.
 - a. Precast Concrete Utility Structures: Test and inspect in accordance with ASTM C1037.
 - b. Polymer Concrete and Nonconcrete Handhole and Pull-Box Prototypes: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests

must be for specified tier ratings of products supplied. Testing machine pressure gages must have current calibration certification, complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

3. Nonconforming Work:
 - a. Equipment that does not pass tests and inspections will be considered defective.
4. Factory Test Reports: Prepare and submit factory test and inspection reports.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Coordinate layout and installation of duct, duct bank, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in field. Notify Architect if there is conflict between areas of excavation and existing structures or archaeological sites to remain.
- B. Coordinate elevations of duct and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of duct and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct and duct bank will drain to manholes and handholes, and as approved by Architect.
- C. Clear and grub vegetation to be removed and protect vegetation to remain in accordance with Section 311000 "Site Clearing." Remove and stockpile topsoil for reapplication in accordance with Section 311000 "Site Clearing."

3.2 SELECTION OF UNDERGROUND DUCTS

- A. General requirements:
 1. The standard conduit sizes shall be 2", 3", 4", and 5" for all conduits unless otherwise noted on the drawings.
 2. Conduits shall have long sweep rigid steel metallic or fiberglass elbows, 48" minimum radius for horizontal bends and 36" radius for vertical bends. Steel conduit elbows shall be PVC coated with taped ends.
 3. All joints shall have watertight seals.
 4. Conduit End Bells:
 - a. Conduit end bells for PVC conduit shall be polyvinyl chloride (PVC).
 - b. Conduit end bells for rigid galvanized steel conduit shall be hot-dipped galvanized malleable iron or steel, treaded to the end of the rigid galvanized steel conduit.
- B. Duct for Electrical Cables More Than 600 V: PVC-40, concrete encased unless otherwise indicated.

- C. Duct for Electrical Feeders 600 V and Less: PVC-40, concrete encased unless otherwise indicated.
- D. Duct for Electrical Branch Circuits: PVC-40, direct buried unless otherwise indicated.
- E. Bored Underground Duct: EPEC-40 unless otherwise indicated.
- F. Underground Ducts Crossing Paved Paths Walks and Driveways: PVC-40 encased in reinforced concrete.
- G. Underground Ducts Crossing Roadways and Railroads: PVC-40, encased in reinforced concrete.
- H. Stub-ups: Concrete encased, ERM-C-S, or ERM-C-S-PVC.

3.3 CONCRETE

A. Color additive:

1. The concrete for all medium voltage concrete encased conduit duct banks shall have a medium red color additive. The color additive shall have a minimum concentration per manufacturer's recommendation per yard of concrete and shall be mixed throughout the entire duct bank concrete.

B. Placing, Curing, and Backfill:

1. Precautions shall be used to prevent ducts from floating.
2. Concrete shall be placed with the aid of a mechanical vibrator.
3. Curing shall be continued for at least 7 days in the case of all concrete except high-early-strength concrete for which the period shall be at least 3 days. Excavations should not be backfilled until concrete has cured.
4. In no cases shall duct bank sidewall thickness exceed 12" from side of the duct.

C. Admixture:

1. Air-entraining mixture shall be used for all exterior concrete and shall conform to ASTM C260. The total calculated air content by volume as determined by ASTM C231 shall be as follows.

Maximum Coarse Aggregate Size	Total Air Content, % Includes Trapped Air
3/4"	3-8
1"	4-6

2. Water reducing admixture shall be used to reduce the total water requirements. Water reducing admixture shall meet the requirements of ASTM C494, Type A.
3. Calcium chloride or accelerating admixtures containing calcium chloride shall not be used.

D. Proportioning

1. Concrete slump at the time of placement as determined by ASTM C13 shall be 3" to 4". Tolerance up to 1" above maximum will be allowed providing average batches tested does not exceed maximum.
2. The minimum 28 day concrete compressive strength for concrete shall be 4,000 psi (6 sacks/cu. yd. minimum).

3.4 SELECTION OF UNDERGROUND ENCLOSURES

A. Handholes and Boxes:

1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete, AASHTO HB 17, H-20 structural load rating.
2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Precast concrete, AASHTO HB 17, H-20 structural load rating.
3. Units in Sidewalk and Similar Applications with Safety Factor for Nondeliberate Loading by Vehicles: Precast concrete, AASHTO HB 17, H-10 structural load rating.
4. Cover design load must not exceed load rating of handhole or box.

B. Manholes: Precast or cast-in-place concrete.

1. Units Located in Roadways and Other Deliberate Traffic Paths by Heavy or Medium Vehicles: H-20 structural load rating in accordance with AASHTO HB 17.
2. Units Not Located in Deliberate Traffic Paths by Heavy or Medium Vehicles: H-10 load rating in accordance with AASHTO HB 17.

3.5 EARTHWORK

A. Excavation and Backfill: Comply with Section 312000 "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.

1. Backfill material shall be compacted clean dirt or 3 /4" minus waste rock fill. No concrete of large ricks are to be used.

B. Restoration: Restore area after construction vehicle traffic in immediate area is complete.

C. Restore surface features at areas disturbed by excavation and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

D. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Section 329200 "Turf and Grasses" and Section 329300 "Plants."

E. Cut and patch existing pavement in path of underground duct, duct bank, and underground structures in accordance with "Cutting and Patching" Article in Section 017300 "Execution."

3.6 INSTALLATION OF DUCTS AND DUCT BANKS

A. Reference Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NEMA TCB 2 for installation of underground ducts and duct banks.
2. Consult Architect for resolution of conflicting requirements.

B. Special Techniques:

1. Where indicated on Drawings, install duct, spacers, and accessories into duct-bank configuration shown. Duct installation requirements in this Section also apply to duct bank.
2. Steel raceway, bends, and fittings in on Project must be of same type.
3. Slope: Pitch duct minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope duct from high point between two manholes to drain in both directions.
4. Expansion and Deflection Fittings: Install expansion and deflection fitting in each duct in area of disturbed earth adjacent to manhole or handhole.
5. Install expansion fitting near center of straight-line duct with calculated expansion of more than 3/4 inch.
6. Curves and Bends:
 - a. Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with minimum radius of 48 inch, both horizontally and vertically, at other locations unless otherwise indicated.
 - b. Field bending must be in accordance with NFPA 70 minimum radii requirements, except bends over 45 degrees must be made with minimum radius of 48 inch. Use only equipment specifically designed for material and size involved. Use PVC heating bender for bending PVC conduit.
 - c. Duct must have maximum of 180 degrees of bends between pull points.
7. Joints: Use solvent-cemented joints in nonmetallic duct and fittings and make watertight in accordance with manufacturer's published instructions. Stagger couplings so those of adjacent duct do not lie in same plane. Couple steel conduits to ducts with adapters designed for this purpose and encase coupling with minimum 3 inch of concrete for minimum of 12 inch on each side of coupling.
 - a. Install insulated grounding bushings on steel raceway terminations that are less than 12 inch below grade or floor level and do not terminate in hubs.
8. Installation Adjacent to High-Temperature Steam Lines: Where duct is installed parallel to underground steam lines, perform calculations showing duct will not be subject to environmental temperatures above 104 deg F. Where environmental temperatures are calculated to rise above 104 deg F, and anywhere duct crosses above underground steam line, install insulation blankets listed for direct burial to isolate duct bank from steam line to maintain maximum environmental temperature of 104 deg F.
9. End Bell Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inch o.c. for 5 inch duct, and vary proportionately for other duct sizes.
 - a. Begin change from regular spacing to end-bell spacing 10 ft from end bell, without reducing duct slope and without forming trap in line.
 - b. Grout end bells into structure walls from both sides to provide watertight entrances.

- c. Concrete encased conduit duct bank penetrations into manholes shall continue completely through the wall of the manhole and shall use one large hole rather than several smaller holes. If this method is not practical, the concrete may stop outside the manhole but must be pinned to the manhole with steel pins to prevent any differential settlement.
- 10. Building Wall Penetrations: Make transition from underground duct to steel raceway at least 10 ft outside building wall, without reducing duct line slope away from building and without forming trap in line. Use fittings manufactured for transition to steel raceway type installed. Install steel raceway penetrations of building walls as specified in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
- 11. Install manufactured steel raceway elbows for stub-ups at poles unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
 - a. Couple steel elbows to ducts with adapters designed for this purpose and encase coupling with minimum 3 inch of concrete for minimum of 12 inch on each side of coupling.
- 12. Sealing: Provide temporary closure at terminations of duct with pulled cables. Seal spare duct at terminations. Use sealing compound and plastic plugs with wick for drainage to withstand at least 15 psig hydrostatic pressure.
- 13. Pulling Cord: Install 240 lbf test cord in empty ducts.
 - a. The pull cord shall be rot and mildew resistant, and shall be made of nylon or polypropylene.
 - b. Pull cord shall have permanently printed sequential measurements at one-foot increments.
 - c. Leave not less than 2 feet of slack at each end of pull cord.
- 14. Concrete-Encased Ducts and Duct Bank:
 - a. Excavate trench bottom to provide firm and uniform support for duct. Prepare trench bottoms as specified in Section 312000 "Earth Moving" for pipes 6 inch or less in nominal diameter.
 - b. Width: Excavate trench 12 inch wider than duct on each side.
 - c. Depth: Install so top of duct envelope is at least 36 inch below finished grade unless otherwise indicated. Install so top of duct envelope is below local frost line.
 - d. Support duct on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
 - e. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than five spacers per 20 ft of duct. Place spacers within 24 inch of duct ends. Stagger spacers approximately 6 inch between tiers. Secure spacers to earth and to duct to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
 - a. Install duct with minimum of 3 inch between ducts for like services and 12 inch between power and all other underground utilities; communications, gas, electric, water, telephone etc, and at least 36 inch (900 mm) away from steam pipe lines and steam tunnels, trenches, or manholes.
 - b. Elbows:

- 1) Use manufactured duct elbows for stub-ups and at changes of direction in duct unless otherwise indicated. Extend encasement throughout length of elbow.
 - 2) Use manufactured steel elbows for stub-ups, at building entrances, and at changes of direction in duct run.
- c. Stub-ups to Outdoor Equipment: Extend concrete-encased steel raceway horizontally minimum of 60 inch from edge of equipment base.
- 1) Stub-ups must be minimum 4 inch above finished floor and minimum 3 inch from conduit side to edge of slab.
- d. Stub-ups to Indoor Equipment: Extend concrete-encased steel raceway horizontally minimum of 60 inch from edge of wall. Install insulated grounding bushings on terminations at equipment.
- 1) Stub-ups must be minimum 4 inch above finished floor and no less than 3 inch from conduit side to edge of slab.
- e. Reinforcement: Reinforce concrete-encased duct per drawings. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups. Minimum size of reinforcing steel shall be No.4.
- f. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
- g. Concrete Cover: Install minimum of 3 inch of concrete cover between edge of duct to exterior envelope wall, 2 inch between duct of like services, and 4 inch between power and communications ducts.
- h. Place minimum 6 inch of engineered fill above concrete encasement of duct.
- i. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
- 1) Start at one end and finish at other, allowing for expansion and contraction of duct as its temperature changes during and after pour. Use expansion fittings installed in accordance with manufacturer's published instructions or use other specific measures to prevent expansion-contraction damage.
 - 2) If more than one pour is necessary, terminate each pour in vertical plane and install 3/4 inch reinforcing-rod dowels extending minimum of 18 inch into concrete on both sides of joint near corners of envelope.
- j. Pouring Concrete: Comply with requirements in "Concrete Placement" Article in Section 033000 "Cast-in-Place Concrete." Place concrete carefully during pours to prevent voids under and between duct and at exterior surface of envelope. Do not allow heavy mass of concrete to fall directly onto ducts. Allow concrete to flow around duct and rise up in middle, uniformly filling open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-installation application.

15. Direct-Buried Duct and Duct Bank:

- a. Excavate trench bottom to provide firm and uniform support for duct. Comply with requirements in Section 312000 "Earth Moving" for preparation of trench bottoms for pipes less than 6 inch in nominal diameter.
- b. Width: Excavate trench 3 inch wider than duct on each side.
- c. Depth: Install top of duct at least 36 inch below finished grade unless otherwise indicated.
- d. Set elevation of top of duct bank below frost line.
- e. Place minimum 3 inch of sand as bed for duct. Place sand to minimum of 6 inch above top level of duct.
- f. Support ducts on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
- g. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than five spacers per 20 ft of duct. Place spacers within 24 inch of duct ends. Stagger spacers approximately 6 inch between tiers. Secure spacers to earth and to ducts to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
- h. Install duct with minimum of 3 inch between ducts for like services and 12 inch between power and all other underground utilities; communications, gas, electric, water, telephone etc, and at least 36 inch (900 mm) away from steam pipe lines and steam tunnels, trenches, or manholes.
- i. Install manufactured duct elbows for stub-ups, at building entrances, and at changes of direction in duct direction unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
- j. Install manufactured steel elbows for stub-ups, at building entrances, and at changes of direction in duct.
 - 1) Couple RNC duct to steel raceway with adapters designed for this purpose and encase coupling with minimum 3 inch of concrete.
 - 2) Stub-ups to Outdoor Equipment: Extend concrete-encased steel raceway horizontally minimum of 60 inch from edge of base. Install insulated grounding bushings on terminations at equipment.
 - a) Stub-ups must be minimum 4 inch above finished base and minimum 3 inch from conduit side to edge of base.
 - 3) Stub-ups to Indoor Equipment: Extend concrete-encased steel raceway horizontally on exterior of wall minimum of 60 inch from edge of wall. Install insulated grounding bushings on terminations at equipment.
 - 4) Stub-ups through interior floors must be minimum 4 inch above finished floor and no less than 3 inch from conduit side to edge of equipment pad or floor slab.
- k. After installing first tier of duct, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to 4 inch over duct and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal

compaction. Comply with requirements in Section 312000 "Earth Moving" for installation of backfill materials.

16. Underground-Line Warning Tape: Bury nonconducting warning tape no less than 18 inch above concrete-encased duct and duct banks and approximately 12 inch below grade. Align tape parallel to and within 3 inch of centerline of duct bank. Provide additional warning tape for each 12 inch increment of duct-bank width over nominal 18 inch. Space additional tapes 12 inch apart, horizontally across width of ducts.
 - a. Warning tape shall be fabricated from polyethylene film, shall contain no metal, and shall be 6 inches wide and not less than 3.5 mils thick.
 - b. Warning tape shall be high visibility red in color and imprinted at frequent intervals with black letters having the following wording: CAUTION BURIED ELECTRICAL LINE BELOW.
17. Ground ducts and duct banks in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

3.7 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

A. Reference Standards:

1. Precast Concrete Handholes: Comply with ASTM C891 unless otherwise indicated.
2. Consult Architect for resolution of conflicting requirements.

B. Special Techniques:

1. Cast-in-Place Manholes:
 - a. Finish interior surfaces with smooth-troweled finish.
 - b. Knockouts for Future Duct Connections: Form and pour concrete knockout panels 1-1/2 to 2 inch thick, arranged as indicated.
 - c. Comply with requirements in Section 033000 "Cast-in-Place Concrete" for cast-in-place concrete, formwork, and reinforcement.
2. Precast Concrete Handholes and Manholes:
 - a. Install units level and plumb and with orientation and depth coordinated with connecting duct to minimize bends and deflections required for proper entrances.
 - b. Unless otherwise indicated, support units on level bed of crushed stone or gravel graded from 1 inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
 - c. Field-cut openings for conduits in accordance with enclosure manufacturer's published instructions. Cut wall of enclosure with tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3. Elevations:
 - a. Manhole Roof: Install with rooftop at least 15 inch below finished grade.
 - b. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1 inch above finished grade.
 - c. Install handholes with bottom below frost line, below grade.
 - d. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch above finished grade.
 - e. Where indicated, cast handhole cover frame integrally with handhole structure.
4. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.
5. Manhole Access: Circular opening in manhole roof; sized to match cover size.
 - a. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.
 - b. Install chimney, constructed of precast concrete collars and rings, and cast-iron frame to connect cover with manhole roof opening. Provide moisture-tight joints and waterproof grouting for frame and chimney.
6. Waterproofing: Apply waterproofing to exterior surfaces of manholes after concrete has cured at least three days. Waterproofing materials and installation are specified in Section 071113 "Self Adhering Waterproofing". After duct has been connected and grouted, and before backfilling, waterproof joints and connections, and touch up abrasions and scars. Waterproof exterior of manhole chimneys after mortar has cured at least three days.
7. Dampproofing: Apply dampproofing to exterior surfaces of manholes after concrete has cured at least three days. Dampproofing materials and installation are specified in Section 071113 "Self Adhering Waterproofing". After ducts are connected and grouted, and before backfilling, dampproof joints and connections, and touch up abrasions and scars. Dampproof exterior of manhole chimneys after mortar has cured at least three days.
8. Hardware: Install removable hardware, including pulling eyes, cable stanchions, as required for installation and support of cables and conductors and as indicated.
 - a. Provide Cable hooks in manholes hung from ceiling near walls above cable stanchions for fiber optic cables.
9. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inch for manholes and 2 inch for handholes, for anchor bolts installed in field. Use minimum of two anchors for each cable stanchion.
10. Ground manholes, handholes, and boxes in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

3.8 FIELD QUALITY CONTROL

- A. Field tests and inspections must be witnessed by Architect or Owner.
- B. Tests and Inspections:

1. All duct banks shall be inspected by system owner prior to concrete placement.
2. Demonstrate capability and compliance with requirements on completion of installation of underground duct, duct bank, and utility structures.
3. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide minimum 12-inch-long mandrel equal to duct size minus 1/4 inch. If obstructions are indicated, remove obstructions and retest.
4. Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 260526 "Grounding and Bonding for Electrical Systems."

C. Nonconforming Work:

1. Underground ducts, raceways, and structures will be considered defective if they do not pass tests and inspections.
2. Correct deficiencies and retest as specified above to demonstrate compliance.

D. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.

E. Manufacturer Services: Engage factory-authorized service representative to support field tests and inspections.

1. Manufacturer's Field Reports for Field Quality-Control Support: Prepare and submit report after each visit by factory-authorized service representative, documenting activities performed at Project site.

3.9 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of duct until duct cleaner indicates that duct is clear of dirt and debris. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. Clean internal surfaces of manholes, including sump, and building interiors affected by Work.
 1. Sweep floor, removing dirt and debris.
 2. Remove foreign material.

END OF SECTION 260543

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Power panelboards.
2. Disconnecting and overcurrent protective devices.

1.2 DEFINITIONS

A. GFEP: Ground-fault equipment protection.

B. MCCB: Molded-case circuit breaker.

1.3 REFERENCES

A. Institute of Electrical and Electronics Engineers (IEEE)

1. IEEE Std 344, Standard for Seismic Qualification of Equipment for Nuclear Power Generating Stations.

B. National Electrical Contractor's Association (NECA)

1. NECA 407, Recommended Practice for Installing and Maintaining Panelboards.

C. National Electrical Manufacturers Association (NEMA)

1. NEMA PB 1, Panelboards.
2. NEMA 250, Enclosure Types.

D. National Fire Protection Association (NFPA)

1. NFPA 70, National Electrical Code.

E. Underwriters Laboratories (UL)

1. UL 50, Enclosures for Electrical Equipment.
2. UL 67, Standard for Safety Panelboards.
3. UL 489, Standard for Safety Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures.
4. UL 1449, Standard for Safety Surge Protective Devices.
5. UL 1699, Standard for safety Arc-Fault Circuit-Interrupters.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Power panelboards.
2. Lighting and appliance branch-circuit panelboards.
3. Electronic-grade panelboards.
4. Disconnecting and overcurrent protective devices.
5. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
6. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.
5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Include evidence of listing, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for SPD as installed in panelboard.
7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
8. Include wiring diagrams for power, signal, and control wiring.
9. Key interlock scheme drawing and sequence of operations.
10. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graph paper; include selectable ranges for each type of overcurrent protective device. Provide PDF copies of the coordination curves.

C. Field Quality-Control Submittals:

1. Field quality-control reports.

1.5 INFORMATIONAL SUBMITTALS

A. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

B. Manufacturers' Published Instructions: Record copy of official installation and testing instructions issued to Installer by manufacturer for the following:

1. Recommended procedures for installing panelboards.
2. Recommended torque settings for bolted connections on panelboards.
3. Recommended temperature range for energizing panelboards.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Spare Parts: Furnish to Owner spare parts, for repairing panelboards, that are packaged with protective covering for storage on-site and identified with labels describing contents. Include the following:
 - 1. Keys: Two spares for each type of panelboard cabinet lock.
- B. Special Tools: Furnish to Owner proprietary equipment, keys, and software required to operate, maintain, repair, adjust, or implement future changes to panelboards, that are packaged with protective covering for storage on-site and identified with labels describing contents. Include the following:
 - 1. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
 - 2. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation in accordance with NECA 407.

1.8 WARRANTY

- A. Installer Extended Warranty: Installer warrants that fabricated and installed panelboards perform in accordance with specified requirements and agrees to repair or replace components or products that fail to perform as specified within warranty period.
- B. Manufacturer Warranty: Manufacturer warrants that panelboards perform in accordance with specified requirements and agrees to provide repair or replacement of components or products that fail to perform as specified within extended-warranty period.
 - 1. Initial-Warranty Period: Three years from date of purchase; full coverage for labor, materials, and equipment.

PART 2 - PRODUCTS

2.1 PANELBOARDS COMMON REQUIREMENTS

- A. Fabricate and test panelboards in accordance with IEEE 344 to withstand seismic disturbance at the install sites identified on the Contract Drawings. The install sites are located in Columbia, MO.

- B. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing agency recognized by authorities having jurisdiction, and marked for intended location and application.
- C. Comply with NEMA PB 1.
- D. Comply with UL 67.
- E. Comply with NFPA 70.
- F. Enclosures: Surface-mounted, dead-front, safety type cabinets with door-in-door hinge.
 - 1. Rated for environmental conditions at installed location.
 - a. Outdoor Locations: NEMA 250, Type 3R.
 - 2. Hinged Front Cover with door in door construction: Entire front trim hinged to box and with standard door within hinged trim cover. Trims must cover live parts and may have no exposed hardware.
 - 3. Finishes:
 - a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
- G. Incoming Mains:
 - 1. Location: As indicated on Contract Drawings.
 - 2. Main Breaker: Main lug interiors up to 400 A must be field convertible to main breaker.
- H. Phase, Neutral, and Ground Buses:
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - a. Plating must run entire length of bus.
 - b. Bus must be fully rated for entire length.
 - 2. Interiors must be factory assembled into unit. Replacing switching and protective devices may not disturb adjacent units or require removing main bus connectors.
 - 3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
 - 4. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure.
 - 5. Do not mount neutral bus in gutter.
- I. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Terminations must allow use of 75 deg C rated conductors without derating.
 - 3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
 - 4. Main and Neutral Lugs: Two bolt compression type, with lug on neutral bar for each pole in panelboard.

5. Ground Lugs and Bus-Configured Terminators: Two bolt compression type, with lug on bar for each pole in panelboard.
 - J. Quality-Control Label: Panelboards must be labeled, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards must have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.
 - K. Future Devices: Panelboards must have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
 1. Percentage of Future Space Capacity: 20 percent.
 2. Spare capacity is defined as additional continuous load feeder capacity and space for spare circuit breakers within the panel.
 - L. Panelboard Short-Circuit Current Rating:
 1. Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for 100 percent interrupting capacity.
 - a. Panelboards and overcurrent protective devices rated 240 V or less must have short-circuit ratings as shown on Drawings, but not less than 10,000 A(rms) symmetrical.
 - b. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V must have short-circuit ratings as shown on Drawings, but not less than 14,000 A(rms) symmetrical.
 - M. Surge Suppression: Factory installed as integral part of indicated panelboards, complying with UL 1449 SPD Type 2.
 - N. Trip Indications and Metered Values: All trip indications and metered values shall be displayed on the front of the panelboard after opening the hinged door without removal of any bolted covers.
- 2.2 POWER PANELBOARDS
- A. Listing Criteria: NEMA PB 1, distribution type.
 - B. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
 1. For doors more than 36 inches high, provide two latches, keyed alike.
 - C. Mains: As indicated on the Contract Drawings.
 - D. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers (Square D I-Line circuit breakers are considered to be a bolted connection).
 - E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers (Square D I-Line circuit breakers are considered to be a bolted connection).

- F. Plug-in circuit breakers are not acceptable.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Listing Criteria: NEMA PB 1, lighting and appliance branch-circuit type.
- B. Mains: As indicated on the Contract Drawings.
- C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units. Plug-in circuit breakers are not acceptable.
- D. Doors: Door-in-door construction with concealed hinges; secured with flush or multipoint latch with tumbler lock; keyed alike. Outer door must permit full access to panel interior. Inner door must permit access to breaker operating handles and labeling, but current carrying terminals and bus must remain concealed.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers:
 - a. Inverse time-current element for low-level overloads.
 - b. Instantaneous magnetic trip element for short circuits.
 - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (5 mA trip).
 - 3. GFEP Circuit Breakers: Class B ground-fault protection (30 mA trip).
 - 4. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240 V, single-pole configuration.
 - 5. Sub-feed Circuit Breakers: Vertically mounted.
 - 6. MCCB Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Breaker handle indicates tripped status.
 - c. UL listed for reverse connection without restrictive line or load ratings.
 - d. Lugs: Compression style, suitable for number, size, trip ratings, and conductor materials.
 - e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
 - f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator. Ground-fault sensing shall use individual phase sensing and a neutral current sensor (such as current transformers).
 - g. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in off position.
 - h. Rating Plugs: Three-pole breakers with ampere ratings greater than 150A must have interchangeable rating plugs or electronic adjustable trip units.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.
- B. Receive, inspect, handle, and store panelboards in accordance with NECA 407.
- C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation. If panelboards are received in a degraded condition, notify the Owner and Manufacturer in writing. Coordinate replacement or repair to address unsatisfactory panelboard condition.
- D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's published instructions.
- B. Reference Standards:
 - 1. Panelboards: Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NECA 407.
 - 2. Consult Owner for resolution of conflicting requirements.
- C. Special Techniques:
 - 1. Equipment Mounting:
 - a. Attach panelboard to vertical finished or structural surface behind panelboard as indicated on the Contract Drawings.
 - b. Comply with mounting and anchoring requirements to achieve seismic-rated installation.
 - 2. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
 - 3. Mount top of trim above finished floor as indicated on the Contract Drawings.
 - 4. Mount panelboard cabinet plumb and rigid without distortion of box.
 - 5. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
 - 6. Install overcurrent protective devices and controllers not already factory installed.
 - a. Set field-adjustable, circuit-breaker trip ranges.

- b. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver in accordance with manufacturer's published instructions.
- 7. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- 8. Install filler plates in unused spaces.
- 9. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- D. Interfaces with Other Work:
 - 1. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."
- B. Panelboard Nameplates: Label each panelboard with nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems." The nameplate shall display, at a minimum, the panelboard name, voltage, phase and supply circuit origin.
- C. Device Nameplates: Label each branch circuit device in power panelboards with nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.
- E. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles must be located on interior of panelboard door.
- F. Breaker Labels: Faceplate must list current rating, UL and IEC certification standards, and AIC rating.
- G. Circuit Directory:
 - 1. Provide typewritten directory card inside panelboard door, mounted in metal frame with transparent protective cover.
 - a. Circuit directory must identify specific purpose with sufficient detail to distinguish it from other circuits.

2. Create directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installation. Handwritten directories are not acceptable. Install directory inside panelboard door.

3.4 FIELD QUALITY CONTROL

A. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Field tests and inspections must be witnessed by the Owner.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers and low-voltage surge arrestors stated in NETA ATS, Paragraph 7.6 Circuit Breakers and Paragraph 7.19.1 Surge Arrestors, Low-Voltage. Perform optional tests. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
 - c. Instruments and Equipment:
 - 1) Use infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

D. Nonconforming Work:

1. Panelboards will be considered defective if they do not pass tests and inspections.
2. Remove and replace defective units and retest.

E. Collect, assemble, and submit test and inspection reports, including certified report that identifies panelboards included and that describes scanning results, with comparisons of two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly and lubricate as recommended by manufacturer.

- B. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Owner of effect on phase color coding.
1. Measure loads during period of normal facility operations.
 2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by Owner. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
 3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
 4. Tolerance: In accordance with NECA 407 requirements.

3.6 PROTECTION

- A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature in accordance with manufacturer's published instructions.

END OF SECTION 262416

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Stripping and stockpiling rock.
6. Removing above- and below-grade site improvements.
7. Disconnecting, capping or sealing site utilities.
8. Temporary erosion and sedimentation control.

1.2 MATERIAL OWNERSHIP

- A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.3 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
- B. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
1. Provide alternate route around closed or obstructed traffic ways if requires by Owner or authorities having jurisdiction.
- C. A.Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.
- D. B.Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.
- E. C.Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.
- F. D.The following practices are prohibited within protection zones:
1. Storage of construction materials, debris, or excavated material.
 2. Parking vehicles or equipment.

3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earth Moving."
 1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Locate and clearly identify trees, shrubs, and other vegetation to remain or to be relocated.
- C. Protect existing site improvements to remain from damage during construction.
 1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.
- B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- D. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

- A. General: Protect trees and plants remaining on-site.
- B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Design Professional.

3.4 EXISTING UTILITIES

- A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.
 - 1. Arrange with utility companies to shut off indicated utilities.
- B. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Design Professional not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Design Professional's written permission.

3.5 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
 - 1. Grind down stumps and remove roots, obstructions, and debris to a depth of 18 inches (450 mm) below exposed subgrade.
 - 2. Use only hand methods for grubbing within protection zones.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
 - 1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches (200 mm) and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to depth 6 inches in a manner to prevent intermingling with underlying subsoil or other waste materials.
- C. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

3.7 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
- B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 311000

SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavation for paving and grading.
2. Excavation for building foundations, slabs-on-grade, paving, and grading.
3. Excavation for Site structures.
4. Site filing and backfilling.
5. Drainage course for slabs-on-grade.
6. Consolidation and compaction.
7. Excavation for trenches for utilities and footings.
8. Consolidation and compaction of bedding under utilities.
9. Rough grading.

B. Related Sections:

1. Section 015713 – Temporary Erosion and Sediment Control.
2. Section 311000 – Site Clearing.
3. Section 331100 - Water Utility Distribution Piping
4. Section 333100 – Sanitary Utility Sewerage Piping
5. Section 334100 – Storm Utility

C. Drainage Piping:

1. Section 334613 – Foundation Drainage.

1.2 DEFINITIONS

- A. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials, and bottom of over excavation areas if required by the contract document.
- B. Subbase Course: Aggregate layer placed between the subgrade and hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.
- D. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- E. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill, when sufficient approved soil material is not available from excavations.

- F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated, regardless of the character and density of materials, including reuse or disposal of materials removed.
 - 1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Design Professional. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
 - 2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Design Professional. Unauthorized excavation, as well as remedial work directed by Design Professional, shall be without additional compensation.
- G. Fill: Suitable materials used to raise existing grades.
- H. Finish Grade: The top surface of sod, top surface of topsoil where sod is not indicated or exposed rock surface where indicated on the drawing.
- I. Trench Backfill: Soil material or controlled low-strength material used to fill an excavation.
 - 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 - 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- J. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- K. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.
- L. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. (0.76 cu. m) for bulk excavation or 3/4 cu. yd. (0.57 cu. m) for footing and trench excavation that cannot be removed by rock-excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:
 - 1. Equipment for Footing and Trench: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch- (1065-mm-) maximum-width, short-tip-radius rock bucket; rated at not less than 138-hp (103-kW) flywheel power with bucket-curling force of not less than 28,700 lbf (128 kN) and stick-crowd force of not less than 18,400 lbf (82 kN) with extra-long reach boom.
 - 2. Equipment for Bulk Excavation: Late-model, track-mounted loader; rated at not less than 230-hp (172-kW) flywheel power and developing a minimum of 47,992-lbf (213.3-kN) breakout force with a general-purpose bare bucket.

1.3 SUBMITTALS

- A. Submit in accordance with Division 1 unless otherwise indicated.
- B. Product Data: For each type of material indicated in Part 2 of this section.
- C. Contract Closeout Submittals: Submit in accordance with Division 1.
 - 1. Project Record Documents
 - a. Accurately record location of underground utilities remaining, rerouted utilities, and new utilities by horizontal dimensions from above grade permanent fixtures, elevations or inverts, and slope gradients.
- D. Soil testing reports as required by paragraph 1.4 of this section.

1.4 QUALITY ASSURANCE

- A. Installer's Qualifications: Firm experienced in installation of systems similar in complexity to those required for this Project, plus the following:
 - 1. Not less than 3 years' experience with systems.
 - 2. Successfully completed not less than 5 comparable scale projects using this system.
- B. Testing Agency: A qualified independent geotechnical engineering testing agency shall classify proposed on-Site and borrow soils to verify that soils comply with specified requirements and to perform specified field and laboratory testing.
- C. Pre-excavation Conference:
 - 1. Convene pre-excavation conference under provision of Division 1, one week prior to commencing Work of this Section.
 - 2. Contractor shall be presiding officer at conference.
 - 3. Conference shall be attended by Contractor, Owner's Representative, testing agency, and earthwork subcontractor.
 - 4. Purpose of conference will be to review contract requirements and discuss schedules, work procedures, acceptable materials specified under this Section, locations where specified materials may be incorporated, and quality control.

1.5 PROJECT CONDITIONS

- A. Existing Conditions:
 - 1. Locate existing underground utilities in areas of excavation Work.

- a. Do not interrupt existing utilities serving facilities occupied by the Owner or others except when permitted in writing by Owner's Representative and then only after acceptable temporary utility services have been provided.
- b. Provide not less than 72 hours' notice to Design Professional and Owner's Representative and receive written authorization to proceed before interrupting any utility.

1.6 MAINTENANCE

- A. Where settling is measurable or observable at excavated areas during correction period required by General Conditions, remove surface (pavement, lawn, or other finish), add backfill material, compact as specified in this Section for location of material, and replace surface treatment.
 - 1. Restore appearance, quality, and condition of surface or finish to match adjacent materials.
 - 2. Eliminate evidence of restoration.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General:
 - 1. Provide approved borrow soil materials from off-Site when sufficient approved soil materials are not available from excavations, at no increase in Contract Sum or extension of Contract Time.
 - 2. Dispose of any excess materials legally off site at no increase in contract sum or extension of contract time. On site disposal of suitable materials may only be permitted where shown on the drawings.
 - 3. Fill and backfill materials shall be subject to the approval of testing agency and the Owner's Representative.
 - 4. For approval of fill and backfill materials, notify testing agency and Owner's Representative at least 5 working days in advance of intention to import material.
 - a. Designate proposed borrow area and excavate test pits to permit testing agency to sample as necessary from borrow area for the purpose of making acceptance tests to confirm quality of proposed material.
- B. General Fill Materials:
 - 1. Definition: That material used to obtain finish subgrade levels at locations specified under this section.
 - 2. Acceptable material: Excavated on-Site material or off-Site borrow material which is free from debris, organics, decomposable, and corrodible materials, and containing the proper moisture content, liquid limit, and plasticity index to obtain specified compaction requirements.
 - a. Existing on-Site material proposed for reuse and off-Site borrow material shall be approved by testing agency.

C. Structural Fill and Backfill:

1. Engineered fill is defined as crushed limestone aggregate containing sufficient fines to establish moisture/density relationship. Engineered fill shall be free of frozen soil, organics, rubbish, large rocks, wood, or other deleterious material. Cohesive soils shall be uniformly compacted to at least 95 percent of the maximum standard dry density and be within -2 to +3 percent of optimum moisture content as described by ASTM D698. Engineered fill, such as MoDOT Type 5 Aggregate, shall be compacted to at least 95% of the maximum dry density as determined by the Standard Proctor, ASTM D698. The moisture content shall be high enough to provide for proper compaction but low enough to prevent undue pumping. Should the results of the in-place density tests indicate that the specified compaction limits have not been achieved, the area represented by the test shall be reworked and retested as required until the specified limits are reached. Proposed fill shall be analyzed by the geotechnical engineer prior to use.
2. The fill material shall be placed in layers, not to exceed eight inches in loose thickness, and shall be wetted or dried as required to secure specified compaction. Effective spreading equipment shall be used on each lift to obtain a uniform lift thickness prior to compaction. Each layer shall be uniformly compacted by means of suitable equipment of the type required by the materials composing the fill. The fill layers shall be placed approximately parallel to the finished grade.

D. Low Volume Change Material:

1. Definition: That material used to obtain the upper 24 inches of finish subgrade beneath granular base in building areas, and material used as trench backfill material in building areas.
2. Acceptable material:
 - a. On-site or Off-Site borrow material which is free from debris, organics, decomposable, and corrodible materials with a liquid limit of less than 40 percent, or another material acceptable to the testing agency.
 - 1) Existing on-Site material proposed for reuse, and off-Site borrow material shall be approved by testing agency.
 - b. MoDOT Type 5 Aggregate
 - c. Note, limestone screenings are not acceptable.

E. Granular Fill:

1. Definition: Free-draining granular base used beneath building slabs-on-grade and used as backfill behind foundation and retaining walls.
2. Acceptable materials: MoDOT Type 1 Aggregate.

F. Pavement Subbase Course:

1. Definition: Granular base used beneath concrete pavement and other pavements indicated on Drawings.
2. Acceptable materials: MoDOT Type 5 Aggregate.

G. Bedding Materials:

1. Type 1 aggregate per MoDOT Standard Specification for Highway Construction, Section 1007.

H. Trench Backfill Materials:

1. Slab on grades: Low volume change materials per this section.
2. Pavement areas: MoDOT Type 5 aggregate.
3. Other areas: General Fill Material or other materials specified under this Section at locations specified or indicated on Drawings.

I. Backfill Material:

1. Definition: Material requiring placement and compaction with manual procedures because of restricted spaces or new construction.
2. Acceptable materials: Either General Fill Material, Granular Fill Material, or other materials specified under this Section at locations specified or indicated on Drawings.

J. Unsuitable Material:

1. Definition: That excavated material which does not meet the consistency requirements of any other defined materials in this Section, including muck, frozen material, organic material, topsoil, rubbish, and rock within the limits defined for General Fill Material
2. Dispose of unsuitable material off-Site, at no increase in Contract Sum or extension of Contract Time.
 - a. Submit an acceptable agreement with the property owner on whose property the unsuitable material is placed.

PART 3 - EXECUTION

3.1 EXAMINATIONS

- A. Verification of Conditions: Examine areas and conditions under which Work is to be performed and identify conditions detrimental to proper and timely completion.
1. Verify location and elevations of existing building foundations.
 2. Verify location and elevations of existing underground utilities.
 3. Verify erosion control systems are in place.
 4. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protection:

1. Protect trees, shrubs, lawns, other plant growth, and other features indicated on Drawings to remain.

2. Protect benchmarks, monuments, existing structures, existing fences, existing roads, existing sidewalks, existing paving, and existing curbs from damage caused by settlement, lateral movement, undermining, washout, and other hazards caused by Work of this Section.
 - a. If damaged or displaced, notify Owner's Representative and correct defects as directed by Owner's Representative.
3. Protect above and below grade utilities which are to remain.
4. Protect adjacent and downstream properties from pollution, sedimentation, or erosion caused by the work of this Contract.

B. Precautions:

1. Use all means necessary to control dust on and near the Work, and on and near off-Site borrow storage, and spoil areas, if such dust is caused by performance of the Work of this Section, or if resulting from the condition in which Project Site is left by Contractor.
2. Moisten surfaces as required to prevent dust from being a nuisance to the public, neighbors, and concurrent performance of other Work on Project Site.
3. Identify required lines, levels, contours, and datum.
4. Identify above and below grade utilities.
5. Provide and maintain positive surface drainage

3.3 WATER CONTROL

- A. Provide berms or channels to prevent flooding of subgrades.
- B. Prevent infiltration of water into excavations from whatever sources as may exist.
- C. Prevent ponding of water on finish subgrades.
- D. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.
- E. Prevent flooding of Project Site and surrounding areas.
- F. Promptly remove water collection in depressions.
 1. Provide and maintain ample means and devices with which to remove and dispose of water entering excavations.
 2. Ensure dry excavations and preservation of final lines and grades of bottoms of excavations.

3.4 EXCAVATION, GENERAL

- A. Use of explosives is not permitted.

- B. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth and rock. Do not excavate rock until it has been classified and cross sectioned by Geotechnical Engineer. The Contract Sum will be adjusted for rock excavation according to unit prices included in the Contract Documents. Changes in the Contract Time may be authorized for rock excavation.
 - 1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation.
 - a. Intermittent drilling; ram hammering; or ripping of material not classified as rock excavation is earth excavation.
 - 2. Rock excavation includes removal and disposal of rock. Remove rock to lines and subgrade elevations indicated to permit installation of permanent construction without exceeding the following dimensions:
 - a. 24 inches outside of concrete forms other than at footings.
 - b. 12 inches outside of concrete forms at footings.
 - c. 6 inches outside of minimum required dimensions of concrete cast against grade.
 - d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
 - e. 6 inches beneath bottom of concrete slabs-on-grade.
 - f. 6 inches beneath pipe in trenches, and the greater of 24 inches wider than pipe or 42 inches wide.
- C. Perform excavation to the lines and grades indicated on Drawings within a tolerance of 0.10 foot.
 - 1. Extend excavations a sufficient distance from structures for placing and removing concrete formwork, installing services and other construction, and for inspections.
- D. Perform Excavation Work in compliance with applicable requirements of authorities having jurisdiction, including United States Department of Labor, Occupational Safety and Health Administration (OSHA) "Construction Standards for Excavations, 29 CFR Part 1926".
- E. Perform Work in a manner and sequence that will provide drainage at all times and that will prevent surface water from draining into excavations.
- F. Protect subgrades and foundation soils against freezing temperatures and frost.
 - 1. Provide protective insulation materials as necessary.
- G. When excavating through roots, perform Work by hand cutting roots with sharp axe.
- H. Excavation cut shall not interfere with normal 45 degree bearing splay of foundations.

- I. Machine slope banks to comply with local codes, ordinances, and requirements of agencies having jurisdiction.
 1. Provide materials for shoring and bracing.
 - a. Maintain shoring and bracing in excavations regardless of time period excavations will be open.
 - b. Extend shoring and bracing as excavation progresses
 2. Control surface drainage down slopes.
 3. Cover slopes to prevent loss of moisture content of soil and to prevent raveling.
- J. When materials encountered at subgrade are determined to be unacceptable for use by testing agency, remove such material to depths and limits determined by testing agency.
 1. Backfill with material acceptable to testing agency and compact to density equal to the specified requirements for subsequent fill material.
- K. Where depressions result from, or have resulted from the removal of surface or subsurface obstructions, open depressions to equipment working width, and remove debris and soft material as directed by testing agency, at no increase in Contract Sum or extension of Contract time.
 1. Backfill with material acceptable to testing agency and compact to density equal to the specified requirements for subsequent fill material, at no increase in Contract Sum or extension of Contract Time.
- L. Backfill and compact over-excavations and unauthorized as specified for the area at which it occurs, at no increase in Contract Sum or extension of Contract Time.
 1. Backfill with material acceptable to testing agency and compact to density equal to the specified requirements for subsequent fill material, at no increase in Contract Sum or extension of Contract Time.
- M. Stockpile excavation material which testing agency has approved for reuse.
 1. Stockpile soil materials without intermixing soil materials with different consistencies and gradation.
 2. Place, grade, and shape stockpiles to drain surface water.
 3. Do not stockpile within drip line of trees which are to remain.
 4. Cover stockpiles to prevent wind-blown dust.
- N. Remove unacceptable excavation material from Site, at no increase in Contract Sum or extension of Contract Time.
- O. Hand trim excavations.
 1. Remove loose matter.

P. Excavation for Footings and Foundations:

1. Do not disturb bottom of excavation.
 - a. Excavate by hand to final grade immediately prior to placement of concrete reinforcement.
 - b. Trim bottom of excavations to required lines and grades to leave solid base to receive other work.
2. Drill probe holes at exposed bottom of excavations as directed by testing agency.

3.5 TRENCH EXCAVATIONS

- A. Excavation for subgrade preparation is classified and shall be paid for at the contract unit price. Rock is defined in paragraph 1.2 of this section.
- B. Excavate trenches to gradients, lines, depths, and elevations indicated on Drawings, within a tolerance of 0.10 foot.
- C. Perform excavation Work in compliance with applicable requirements of authorities having jurisdiction, including United States Department of Labor, Occupational Safety and Health Administration (OSHA) "Construction Standards for Excavations, 29 CFR Part 1926".
- D. Do not perform trench excavation in areas to receive fill until fill operations are complete to an elevation of not less than 24 inches above the top of the proposed pipe or conduit for which the trench is to receive.
- E. Perform Work in a manner and sequence that will provide drainage at all times and that will prevent surface water from draining into trenches.
- F. Protect subgrades against freezing temperatures and frost.
- G. Provide protective insulation materials as necessary.
- H. When excavating through roots, perform Work by hand cutting roots with a sharp axe.
- I. Excavation cut shall not interfere with normal 45 degree bearing splay of foundations.
- J. Excavate trenches to uniform width, sufficiently wide to enable installation of utilities and to allow safe inspection of installed utilities.

- K. Excavate trenches 6 inches deeper than bottom of pipe elevation to allow for bedding course
 - 1. Hand excavate for bell of pipe.
 - 2. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
 - 3. Comply with local codes, ordinances, and requirements of agencies having jurisdiction.
 - 4. Provide materials for shoring and bracing.
 - a. Maintain shoring and bracing in trenches regardless of time period trenches will be open.
 - b. Extend shoring and bracing as excavation progresses.
 - 5. Control surface drainage down slopes.
 - 6. Cover slopes to prevent loss of moisture content of soil and to prevent raveling.
 - 7. Hand trim trenches.
 - a. Remove loose matter.
- L. When subgrade materials are encountered which testing agency determines to be unacceptable for use, remove such material to depths and limits determined by testing agency:
 - 1. Backfill with material acceptable to testing agency and compact to density equal to the specified requirements for subsequent fill material.
 - 2. Removal and replacement of unacceptable material will be paid on basis of Unit Prices included in the Contract Documents.
- M. Where depressions result from or have resulted from the removal of surface or subsurface obstructions, open depressions to equipment working width, and remove debris and soft material as directed by testing agency at no increase in Contract Sum or extension of Contract Time.
 - 1. Backfill with material acceptable to testing agency and compact to density equal to the specified requirements for subsequent fill material, at no increase in Contract Sum or extension of Contract Time.
- N. Stockpile excavation material which testing agency has approved for reuse.
 - 1. Stockpile soil materials without intermixing soil materials with different consistencies and gradations.
 - 2. Place, grade, and shape stockpiles to drain surface water.
 - 3. Do not stockpile within drip line of trees which are to remain.
 - 4. Cover stockpiles to prevent wind-blown dust.
- O. Remove unacceptable excavation material from Site, at no increase in Contract Sum or extension of Contract Time.
 - 1. Submit an acceptable agreement with the property owner on whose property the unsuitable material is placed.

3.6 SUBGRADE PREPARATION FOR BUILDING SLABS-ON-GRADE

A. General:

1. Excavation for subgrade preparation is classified and shall be paid for at the contract unit price. Rock is defined in paragraph 1.2 of this section.
2. Testing agency shall be present to observe and evaluate subgrades in building areas prior to placement of fill and/or low volume change materials and shall be present during placement and compaction of fill materials in building areas. Undercut as specified herein to develop 24 inch thick low volume change zone below building floor slabs. Subgrades in building areas shall be observed and evaluated by geotechnical engineer prior to fill and/or low volume change placement. Evaluation may include probing by geotechnical engineer and opening of test pits and/or test trenches with contractors assistance to explore areas of suspected unsuitable materials. Subgrades shall also be proof-rolled with loaded tandem axle dump truck in presence of geotechnical engineer and scarified, moisture conditioned and recompacted as specified herein prior to placement of fill and/or low volume change materials.
3. Fill material shall not be placed, spread, or rolled while the material is frozen or thawing, or during unfavorable weather conditions.
4. Moisture condition or dry fill material as required to obtain specified moisture content limits.
 - a. Material, which is too wet to allow proper compaction, as determined by testing agency, may be spread and permitted to dry assisted by disking, harrowing, or pulverizing.
5. Place fill material using spreading equipment capable of obtaining uniform loose lift thickness.
6. Compact fill material using equipment appropriate to the material being compacted, as determined by testing agency.
7. When Work is interrupted by rain, do not resume Work until testing agency indicates that moisture content and density of previously placed fill area is as specified.
8. Where soil has been softened or eroded by flooding or placement during unfavorable weather conditions, remove damaged areas and recompact to required density.
9. In excavations where testing agency determines that subgrade material is unacceptable, remove unacceptable material and backfill in accordance with procedures determined by testing agency.
10. Minimize construction traffic, including foot traffic, from floor slab finished subgrades in order to prevent unnecessary disturbances of subgrade materials.
 - a. If testing agency determines that finished subgrades have been disturbed, remove disturbed areas and replace and recompact to required density as directed by testing agency.
 - b. If testing agency determines that rutting has occurred, excavate 6 inches, or other depth as directed by testing agency, of subgrade material and recompact as specified for affected area.
 - c. Testing agency shall be present during compaction of material.

- B. In cut areas below building slabs-on-grade requiring less than 24 inches of fill to obtain finish subgrade elevations, and a lateral distance of 5 feet outside building areas, excavate existing materials to a depth of not less than 24 inches below bottom of floor slab granular fill.

1. Scarify subgrade to a depth of 6 inches to result in a surface free from ruts, hummocks, and other uneven features which, in the opinion of the testing agency, would prevent uniform compaction by the equipment proposed for use.
 - a. Moisture condition subgrade to achieve moisture content specified in this Section.
 - b. Compact to a minimum of 95% of the material's maximum Standard Proctor dry density with a moisture content between -2 and +3 percent above optimum moisture content in accordance with ASTM D698.
 - 1) Field density tests shall be taken after the compaction of each layer of fill by testing agency.
 - 2) When tests indicate that any layer of fill or portion thereof does not meet the required compaction density or moisture content, rework non-complying area as required to achieve specified requirements.
2. After scarifying, moisture conditioning, and recompacting, backfill fill areas using low volume change materials placed in loose lifts not exceeding 8 inches.
 - a. Compact each lift of low volume change clay soil to a minimum of 95 percent of the material's maximum Standard Proctor dry density with a moisture content between -2 and +3 percent above optimum moisture content in accordance with ASTM D698. Compact each lift of granular low volume change material to a minimum of 95 percent of the material's maximum standard proctor dry density at a workable moisture content sufficient to obtain the required density.
 - 1) Field density tests shall be taken after the compaction of each layer of fill by testing agency.
 - 2) When tests indicate that any layer of fill or portion thereof does not meet the required compaction density or moisture content, rework non-complying area as required to achieve specified requirements.
3. Fill operations shall continue in compacted layers until finish subgrade elevations have been obtained.
 - a. Compact each lift of low volume change clay soil to a minimum of 95 percent of the material's maximum Standard Proctor dry density with a moisture content between -2 and +3 percent above optimum moisture content in accordance with ASTM D698. Compact each lift of granular low volume change material to a minimum of 95 percent of the material's maximum standard proctor dry density at a workable moisture content sufficient to obtain the required density.
 - 1) Field density tests shall be taken after the compaction of each layer of fill by testing agency.
 - 2) When tests indicate that any layer of fill or portion thereof does not meet the required compaction density or moisture content, rework non-complying area as required to achieve specified requirements.
4. Protect excavations from excessive wetting and drying during construction.
 - a. Remove water entering excavation and remove disturbed or softened soil.

5. The upper 24 inches of fill material shall be low volume change material.
 6. Maintain subgrade moisture content within specified range until building slabs-on-grade are installed.
 - a. Rework non-complying area as required to achieve specified requirements as directed by testing agency.
 - b. Recompect and retest until required density and moisture content is obtained.
- C. In areas below building slabs-on-grade requiring 24 inches or more of fill to obtain finish subgrade elevations, and a lateral distance of 5 feet outside building areas, scarify subgrade to a depth of 6 inches to result in surface free from ruts, hummocks, and other uneven features which, in the opinion testing agency, would prevent uniform compaction by the equipment proposed for use.
1. Moisture condition subgrade to achieve moisture content specified in this Section.
 - a. Compact to a minimum of 95 percent of the material's maximum Standard Proctor dry density with a moisture content between -2 and +3 percent above optimum moisture content in accordance with ASTM D698.
 - 1) Field density tests shall be taken after the compaction of each layer of fill by testing agency.
 - 2) When tests indicate that any layer of fill or portion thereof does not meet the required compaction density or moisture content, rework non-complying area as required to achieve specified requirements.
 2. After scarifying, moisture conditioning, and recompacting, backfill areas using suitable materials as specified herein placed in loose lifts not exceeding 8 inches. Suitable on-site clay materials may be used below the 24-inch thick low volume change zone.
 - a. Compact each lift of suitable clay soil or low volume change material to a minimum of 95 percent of the material's maximum Standard Proctor dry density with a moisture content between -2 and +3 percent above optimum moisture content in accordance with ASTM D698. Compact each lift of granular low volume change material to a minimum of 95 percent of the material's maximum Standard Proctor dry density at workable moisture content sufficient to obtain the required density.
 - 1) Field density tests shall be taken after the compaction of each layer of fill by testing agency.
 - 2) When tests indicate that any layer of fill or portion thereof does not meet the required compaction density or moisture content, rework non-complying area as required to achieve specified requirements.
 3. Fill operations shall continue in compacted layers until finish subgrade elevations have been obtained.
 - a. Compact each lift of suitable clay soil or low volume change material to a minimum of 95 percent of the material's maximum Standard Proctor dry density with a

moisture content between -2 and +3 percent above optimum moisture content in accordance with ASTM D698.

- 1) Field density tests shall be taken after the compaction of each layer of fill by testing agency.
 - 2) When tests indicate that any layer of fill or portion thereof does not meet the required compaction density or moisture content, rework non-complying area as required to achieve specified requirements.
4. Protect excavations from excessive wetting and drying during construction.
 - a. Remove water entering excavation, and remove disturbed or softened soil.
 5. The upper 24 inches of fill material shall be low volume change material.
 6. Maintain subgrade moisture content within specified range until building slabs-on-grade are installed.
 - a. Rework non-complying area as required to achieve specified requirements as directed by testing agency.
 - b. Recompact and retest until required density and moisture content is obtained

D. Tolerances:

1. Top surface of finish subgrade under slabs-on-grade: Plus or minus $\frac{1}{4}$ inch from required elevations.

3.7 SUBGRADE PREPARATION FOR FOUNDATION FOOTING

A. General:

1. Excavation for subgrade preparation is classified and shall be paid for at the contract unit price. Rock is defined in paragraph 1.2 of this section.
2. Testing agency shall be present during placement and compaction of fill material.
3. Fill material shall not be placed, spread, or rolled while the material is frozen or thawing, or during unfavorable weather conditions.
4. Moisture condition dry fill material as required to obtain specified moisture content limits.
 - a. Material which is too wet to allow proper compaction, as determined by testing agency, may be spread and permitted to dry assisted by disking, harrowing, or pulverizing.
5. Place fill material using spreading equipment capable of obtaining uniform loose lift thickness.
6. Compact fill material using equipment appropriate to the material being compacted, as determined by testing agency.
7. When Work is interrupted by rain, do not resume Work until testing agency indicates that moisture content and density of previously placed fill area is as specified.

8. Where soil has been softened or eroded by flooding or placement during unfavorable weather conditions, remove damaged areas and recompact to required density.
9. In excavations where testing agency determines that subgrade material is unacceptable, remove unacceptable material and backfill in accordance with procedures determined by testing agency.
10. Minimize construction traffic, including foot traffic, from floor slab finished subgrades in order to prevent unnecessary disturbances of subgrade materials.
 - a. If testing agency determines that finished subgrades have been disturbed, remove disturbed areas and replace and recompact to required density as directed by testing agency.
 - b. If testing agency determines that rutting has occurred, excavate 6 inches, or other depth as directed by testing agency, of subgrade material and recompact as specified for affected area.
 - c. Testing agency shall be present during compaction of material.

3.8 SUBGRADE PREPARATION AT PAVEMENTS

A. General:

1. Excavation for subgrade preparation is classified and shall be paid for at the contract unit price. Rock is defined in paragraph 1.2 of this section.
2. Testing agency shall be present to observe proof-rolling of subgrades in pavement and sidewalk areas prior to placement of fill and shall be present during placement and compaction of fill materials in pavement and sidewalk areas. Testing agency shall also be present to observe proof-rolling of finished subgrades prior to installation of pavement and sidewalk sections.
3. Fill material shall not be placed, spread, or rolled while the material is frozen or thawing, or during unfavorable weather conditions.
4. Moisture condition or dry fill material as required to obtain specified moisture content limits.
 - a. Material which is too wet to allow proper compaction, as determined by testing agency, may be spread and permitted to dry assisted by disking, harrowing, or pulverizing.
5. Place fill material using spreading equipment capable of obtaining uniform loose lift thickness.
6. Compact fill material using equipment appropriate to the material being compacted, as determined by testing agency.
7. When Work is interrupted by rain, do not resume Work until testing agency indicates that moisture content and density of previously placed fill area is as specified.
8. Where soil has been softened or eroded by flooding or placement during unfavorable weather conditions, remove damaged areas and recompact to required density.
9. In excavations where testing agency determines that subgrade material is unacceptable, remove unacceptable material and backfill in accordance with procedures determined by testing agency.
10. Minimize construction traffic, including foot traffic, from pavement finished subgrades in order to prevent unnecessary disturbances of subgrade materials.

- a. If testing agency determines that finished subgrades have been disturbed, remove disturbed areas and replace and recompact to required density as directed by testing agency.
 - b. If testing agency determines that rutting has occurred, excavate 6 inches, or other depth as directed by testing agency, of subgrade material and recompact as specified for affected area.
 - c. Testing agency shall be present during compaction of material.

- B. In cut areas below pavements requiring less than 12 inches of fill to obtain finish subgrade elevations, and a lateral distance of 5 feet outside pavement areas, excavate existing material to a depth of not less than 6 inches below bottom of pavement subbase course.
 - 1. Proof-roll subgrade and repair as required in paragraph 3.8.E below, then scarify to a depth of 6 inches to result in a surface free from ruts, hummocks, and other uneven features which, in the opinion of the testing agency, would prevent uniform compaction by the equipment proposed for use.
 - a. Moisture condition subgrade to achieve moisture content specified in this Section.
 - b. Compact to a minimum of 95 percent of the material's maximum Standard Proctor dry density with a moisture content between -2 and +3 percent above optimum moisture content in accordance with ASTM D698.
 - 1) Field density tests shall be taken after the compaction of each layer of fill by testing agency.
 - 2) When tests indicate that any layer of fill or portion thereof does not meet the required compaction density or moisture content, rework non-complying area as required to achieve specified requirements.
 - 2. After scarifying, moisture conditioning, and recompacting, backfill areas using approved materials placed in loose lifts not exceeding 8 inches.
 - a. compact each lift to a minimum of 95 percent of the material's maximum Standard Proctor dry density with a moisture content between -2 and +3 percent above optimum moisture content in accordance with ASTM D698.
 - 1) Field density tests shall be taken after the compaction of each layer of fill by testing agency.
 - 2) When tests indicate that any layer of fill or portion thereof does not meet the required compaction density or moisture content, rework non-complying area as required to achieve specified requirements.
 - 3. Protect excavations from excessive wetting and drying during construction.
 - a. Remove water entering excavation and remove disturbed or softened soil.
 - 4. Maintain subgrade moisture content within specified range until pavements are installed.
 - a. Rework non-complying area as required to achieve specified requirements as directed by testing agency.
 - b. Recompact and retest until required density and moisture content is obtained.

- C. In areas below pavements requiring 12 inches or more of fill to obtain finish subgrade elevations, and a lateral distance of 5 feet outside pavement areas, proofroll existing subgrade in presence of testing agency using a fully loaded tandem axle dump truck or similar type of pneumatic tired equipment with a minimum gross weight of 20 tons.
1. Remove soft areas as directed by testing agency and recompact in loose 9 inch lifts to a minimum of 95 percent of the material's maximum Standard Proctor dry density with a moisture content between -2 and +3 percent above optimum moisture content in accordance with ASTM D698.
 - a. Field density tests shall be taken after the compaction of each layer of fill by testing agency.
 - b. When tests indicate that any layer of fill or portion thereof does not meet the required compaction density or moisture content, rework non-complying area as required to achieve specified requirements.
 2. After proof rolling operations are performed and observed soft areas repaired, place approved material in loose lifts not exceeding 8 inches.
 - a. Compact each lift to a minimum of 95 percent of the material's maximum Standard Proctor dry density with a moisture content between -2 and +3 percent above optimum moisture content in accordance with ASTM D698.
 - 1) Field density tests shall be taken after the compaction of each layer of fill by testing agency.
 - 2) When tests indicate that any layer of fill or portion thereof does not meet the required compaction density or moisture content, rework non-complying area as required to achieve specified requirements.
 3. Fill operations shall continue in compacted layers until finish subgrade elevations have been obtained.
 - a. Compact each lift to a minimum of 95 percent of the material's maximum Standard Proctor dry density with a moisture content between -2 and +3 percent above optimum moisture content in accordance with ASTM D698.
 - 1) Field density tests shall be taken after the compaction of each layer of fill by testing agency.
 - 2) When tests indicate that any layer of fill or portion thereof does not meet the required compaction density or moisture content, rework non-complying area as required to achieve specified requirements.
 4. Protect excavations from excessive wetting and drying during construction.
 - a. Remove water entering excavation, and remove disturbed or softened soil.
 5. Maintain subgrade moisture content within specified range until pavements are installed.
 - a. Rework non-complying area as required to achieve specified requirements as directed by testing agency.

- b. Recompact and retest until required density and moisture content is obtained.

D. Tolerances

- 1. Top surface of finish subgrade under paved areas: Plus or minus ¼ inch from required elevations.

E. Immediately prior to placement of pavement subbase course and pavements, proofroll subgrade in presence of testing agency using a fully loaded tandem axle dump truck or similar type of pneumatic tired equipment with a minimum gross weight of 20 tons.

- 1. Remove soft areas as directed by testing agency and recompact in loose 9 inch lifts to a minimum of 95 percent of the material's maximum Standard Proctor dry density with a moisture content between -2 and +3 percent above optimum moisture content in accordance with ASTM D698.
 - a. Field density tests shall be taken after the compaction of each layer of fill by testing agency.
 - b. When tests indicate that any layer of fill or portion thereof does not meet the required compaction density or moisture content, rework non-complying area as required to achieve specified requirements.

3.9 GENERAL SITE FILL

A. General:

- 1. Testing agency shall be present during placement and compaction of fill material.
- 2. Fill material shall not be placed, spread, or rolled while the material is frozen or thawing, or during unfavorable weather conditions.
- 3. Moisture condition or dry fill material as required to obtain specified moisture limits.
- 4. Material which is too wet to allow proper compaction, as determined by testing agency, may be spread and permitted to dry assisted by dishing, harrowing, or pulverizing.
- 5. Place fill material using spreading equipment capable of obtaining uniform loose lift thickness.
- 6. Compact fill material using equipment appropriate to the material being compacted, as determined by testing agency.
- 7. When Work is interrupted by rain, do not resume Work until testing agency indicates that moisture content and density of previously placed fill area is as specified.
- 8. Where soil has been softened or eroded by flooding or placement during unfavorable weather conditions, remove damaged areas and recompact to required density.

B. Perform grading to the contours and elevations indicated on Drawings:

- 1. Uniformly grade areas to a smooth surface, free from irregular surface changes.
- 2. Provide a smooth transition between existing adjacent grades and new grades.

C. Place general fill material in systematic and uniform horizontal lifts not exceeding the following loose-depth-measurements:

1. For fill material to be compacted with heavy compaction equipment: 9 inches.
 2. For fill material to be compacted with hand operated tampers: 4 inches.
- D. Under sidewalks and ramps compact each lift of material to a minimum of 95 percent of the material's maximum Standard Proctor dry density with a moisture content between -2 and +3 percent above optimum moisture content in accordance with ASTM D698
1. In other areas, compact each lift of material to a minimum of 90 percent of the material's maximum Standard Proctor dry density with a moisture content between -2 and +3 percent above optimum moisture content in accordance with ASTM D698
 - a. Field density tests shall be taken after the compaction of each layer of fill by testing agency.
 - b. When tests indicate that any layer of fill or portion thereof does not meet the required compaction density or moisture content, rework on-complying area as required to achieve specified requirements.
- E. Bench existing slopes horizontal sections equal in width to equipment used.
- F. Where embankments, regardless of height, are placed against hillsides or existing embankments having a slope of steeper than 1 vertical to 5 horizontal, bench or step existing slope in approximately 24 inch rises:
1. Place fill in lifts not exceeding 9 inches in loose-depth-measurement
 2. Compact material bladed out, bottom area which was cut to form benches, and fill material being placed, to a minimum of 95 percent of the material's maximum Standard Proctor dry density with a moisture content between -2 and +3 percent above optimum moisture content in accordance with ASTM D698.
 - a. Field density tests shall be taken after the compaction of each layer of fill by testing agency.
 - b. When tests indicate that any layer of fill or portion thereof does not meet the required compaction density or moisture content, rework non-complying area as required to achieve specified requirements.
- G. Remove surplus materials from Site, at no increase in Contract Sum or extension of Contract Time.
1. Submit an acceptable agreement with the property owner on whose property the material is placed.
- H. Tolerances:
1. Top surface of finish subgrade under paved areas: Plus or minus ¼ inch from required elevations.
 2. Top surface of finish subgrade under unpaved surfaces: Plus or minus ½ inch from required elevations.

3.10 INSTALLATION OF GRANULAR FILL

- A. Immediately prior to placement floor slab granular base, testing agency will evaluate subgrade to determine whether moisture content is within specified range, and whether subgrade has been disturbed.
 - 1. In areas where testing agency determines subgrade is not within specified moisture content range, remove non-complying areas and replace and recompact to required density, within specified moisture content range, as directed by testing agency.
 - a. Field density tests shall be taken after the compaction of each layer of fill by testing agency.
 - b. When test indicate that any layer of fill or portion thereof does not meet the required compaction density or moisture content, rework non-complying area as required to achieve specified requirements.
 - 2. If testing agency determines that rutting has occurred or other detrimental conditions exist, excavate 6 inches, or other depth as directed by testing agency, of subgrade material and recompact as specified for affected area.
 - a. Field density tests shall be taken after the compaction of each layer of fill by testing agency.
 - b. When tests indicate that any layer of fill or portion thereof does not meet the required compaction density or moisture content, rework non-complying area as required to achieve specified requirements.
- B. Place granular fill in equal continuous layers not exceeding 6 inches.
 - 1. Compact granular fill using heavy vibrating equipment, in 3 passes, to achieve a total compacted thickness of 4 inches in presence of Owner's representative or testing agency.
 - 2. Compact granular fill in confined areas using a combination of manually operated vibratory plates and "wacker" compaction equipment.

C. Tolerances:

- 1. Top surface of finish subgrade under slabs-on-grade: Plus or minus $\frac{1}{4}$ inch from required elevations.

3.11 INSTALLATION OF PAVEMENT SUBBASE COURSE

- A. Place pavement subbase course in equal continuous layers not exceeding 6 inches.
 - 1. Compact granular fill for pavement and sidewalk subbase course to a minimum of 95 percent of the material's maximum standard proctor dry density in accordance with ASTM D698.
 - 2. Compact granular fill in confined areas using a combination of manually operated vibratory plates and "wacker" compaction equipment.
 - 3. Qualitative tests shall be taken after the compaction of each layer of fill by testing agency.

B. Tolerances:

1. Top surface of finish subgrade under paved areas: Plus or minus ¼ inch from required elevations.

3.12 BEDDING

A. Place and compact bedding course on trench bottoms and where indicated on Drawings.

1. Install materials in continuous layers not exceeding 6 inches compacted depth.

B. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Install bedding to a depth of 6 inches below bottom of pipe bell or conduit, to an elevation of 6 inches above pipe or conduit.

D. Compact bedding materials by slicing with a shovel and compacting with vibratory plates and” wacker” compaction equipment.

E. Support pipe and conduit during placement and compaction of bedding fill.

3.13 INSTALLATION OF BACKFILL

A. Backfill excavations promptly, but not before completion of the following:

1. Surveying location of underground utilities for Record Documents
2. Testing, inspecting, and approval of underground utilities
3. Removal of concrete forms
4. Removal of lumber, rock, paper, and other debris from areas to be backfilled
5. Removal of temporary shoring, bracing, and sheeting

B. Backfill areas to contours and elevations indicated on Drawings, using unfrozen backfill material

1. Do not backfill over porous, wet, frozen, thawing, or spongy surfaces
2. Do not backfill during unfavorable weather conditions
3. Moisture condition or dry backfill material as required to obtain specified moisture content limits
 - a. Material which is too wet to allow proper compaction, as determined by testing agency
4. Place backfill material using equipment capable of obtaining uniform loose lift thickness
5. Compact backfill material using equipment appropriate to the material being compacted, as determined by testing agency

6. When Work is interrupted by rain, do not resume Work until testing agency indicates that moisture content and density of previously laced backfill areas is as specified
 7. Where soil has been softened or eroded by flooding or placement during unfavorable weather conditions, remove damaged areas and recompact to required density.
 8. Compaction in lawn and planter areas is 85% maximum.
- C. Backfilling of curbs, slabs-on-grade, and other structures whose foundation is unprotected from water shall be accomplished as soon as forms are removed, to eliminate possibility of softening of subbase below structure
- D. Backfill foundation walls with granular material, not less than 24 inches in width, to an elevation of 2 feet below finish grade.
1. Backfill simultaneously on each side of unsupported foundation walls.
 2. Backfill upper 2 feet using General Fill Material.
- E. Backfill trenches to contours and elevations indicated on Drawings, using unfrozen backfill material.
1. Do not backfill over porous, wet, frozen, or spongy surfaces.
 2. Do not backfill during unfavorable weather conditions.
 3. Moisture condition or dry backfill material as required to obtain specified moisture content limits.
 - a. Material which is too wet to allow proper compaction, as determined by testing agency, may be spread and permitted to dry assisted by disking, harrowing, or pulverizing.
 4. Place backfill material using equipment capable of obtaining uniform loose lift thickness.
 - a. Employ a placement method of backfill operations which does not disturb or damage utilities in trenches.
- F. Backfill trenches that carry below or pass under footings and that are excavated within 18 inches of footings with concrete.
1. Place concrete to elevation equal to bottom of footings.
- G. Compaction of General Backfill
1. Maintain optimum moisture content of backfill materials to attain required compaction density.
 2. General Fill Materials used for backfill shall be placed in lifts not exceeding 9 inches in loose-depth-measure and compacted as specified for General Site Fill
 3. Granular Fill Materials used for backfill shall be placed in lifts not exceeding 6 inches in loose-depth-measure and compacted as specified for Granular Fill.
 4. Field density tests shall be taken after the compaction of each layer of backfill by testing agency.

- a. When tests indicate that any layer of backfill or portion thereof does not meet the required compaction density or moisture content, rework non-complying area as required to achieve specified requirements.

H. Compaction of Trench Backfill

1. Compact backfill material using equipment appropriate to the material being compacted, as determined by testing agency.
 2. Maintain optimum moisture content of backfill materials to attain required compaction density.
 3. When Work is interrupted by rain, do not resume Work until testing agency indicates that moisture content and density of previously placed backfill area is as specified.
 4. Where soil has been softened or eroded by flooding or placement during unfavorable weather conditions, remove damaged areas and recompact to required density.
 5. General Fill Material used for backfill shall be placed in lifts not exceeding 4 inches in loose-depth-measure with each lift compacted as specified in this section.
 6. MoDOT Standard Specification for Highway Construction Type 5 aggregate used for backfill shall be placed in lifts not exceeding 6 inches in loose-depth-measure and compacted to a minimum of 97 percent of the material's maximum Standard Proctor dry density with a moisture content near optimum in accordance with ASTM D698.
 7. Field density tests shall be taken after the completion of each layer of backfill by testing agency.
- a. When tests indicate that any layer of backfill or portion thereof does not meet the required compaction density or moisture content, rework non-complying area as required to achieve specified requirements.

I. Slope grade away from building not less than 12 inches in 10 foot for a distance of not less than 6 feet outside of building lines.

1. Make grade changes gradual.
2. Blend slopes into level areas.
3. Remove surplus materials from Site, at no increase in Contract Sum or extension of Contract Time
4. Submit an acceptable agreement with the property owner on whose property the material is placed

J. Tolerances:

1. Top surface of finish subgrade under paved areas: Plus or minus ¼ inch from required elevations
2. Top surface of finish subgrade under unpaved areas. Plus or minus ½ inch from required elevations

3.14 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Geotechnical Engineer.
- D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 6938, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
 - 1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.
 - 2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet or less of wall length, but no fewer than two tests.
 - 3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet or less of trench length, but no fewer than two tests.
- E. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.
- F. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- G. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.
- H. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.15 PROTECTION

- A. Protect newly graded areas from freezing and erosion.
- B. Repair and reestablish grades in settled, eroded, and rutted areas to specified tolerances.
- C. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and compact to required density prior to further construction.
 - 1. Testing agency shall be present during compaction of material.

END OF SECTION 312000

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SECTION 316329 - DRILLED CONCRETE PIERS AND SHAFTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Dry-installed drilled piers.

1.2 UNIT PRICES

- A. Drilled Piers: Actual net volume of drilled piers in place and approved. Actual length, shaft diameter, and bell diameter if applicable, may vary, to coincide with elevations where satisfactory bearing strata are encountered. These dimensions may also vary with actual bearing value of bearing strata determined by an independent testing and inspecting agency. Adjustments are made on net variation of total quantities, based on design dimensions for shafts.

1. Base bids on indicated number of drilled piers and, for each pier, the design length from top elevation to bottom of shaft and the diameter of shaft. Refer to division 1 for estimated quantities.
2. Unit prices include labor, materials, tools, equipment, and incidentals required for excavation, trimming, shoring, casings, dewatering, reinforcement, concrete fill, testing and inspecting, and other items for complete drilled-pier installation.

- B. Rock Measurement: Volume of rock actually removed, measured in original position, but not to exceed outside dimensions of drilled piers cast against rock. Unit prices for rock excavation include replacement with approved materials.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to drilled piers including, but not limited to, the following:
 - a. Review geotechnical report.
 - b. Discuss existing utilities and subsurface conditions.
 - c. Review coordination with temporary controls and protections.
 - d. Review measurement and payment of unit prices.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Design Mixtures: For each concrete mixture. Submit alternative design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Shop Drawings: For concrete reinforcement, detailing fabricating, bending, supporting, and placing.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, land surveyor, professional engineer, and testing agency.
- B. Welding certificates.
- C. Material Certificates: From manufacturer, for the following:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Steel reinforcement and accessories.
- D. Material Test Reports: For each material below, by a qualified testing agency:
 - 1. Aggregates: Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- E. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Record drawings.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer that has specialized in drilled-pier work.
- B. Testing Agency Qualifications: Qualified according to ASTM C1077, ASTM D3740, and ASTM E329 for testing indicated.
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.4/D1.4M, "Structural Welding Code - Reinforcing Steel."

1.8 FIELD CONDITIONS

- A. Existing Utilities: Locate existing underground utilities before excavating drilled piers. If utilities are to remain in place, provide protection from damage during drilled-pier operations.

1. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, adapt drilling procedure if necessary to prevent damage to utilities. Cooperate with Owner and utility companies in keeping services and facilities in operation without interruption. Repair damaged utilities to satisfaction of utility owner.
- B. Interruption of Existing Utilities: Do not interrupt any utility to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:
 1. Do not proceed with interruption of utility without Owner's written permission.
- C. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from this data.
 1. Make additional test borings and conduct other exploratory operations necessary for drilled piers.
 2. The geotechnical report is included elsewhere in the Project Manual.
- D. Survey Work: Engage a qualified land surveyor or professional engineer to perform surveys, layouts, and measurements for drilled piers. Before excavating, lay out each drilled pier to lines and levels required. Record actual measurements of each drilled pier's location, shaft diameter, bottom and top elevations, deviations from specified tolerances, and other specified data.
 1. Record and maintain information pertinent to each drilled pier and indicate on record Drawings. Cooperate with Owner's testing and inspecting agency to provide data for required reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Drilled-Pier Standard: Comply with ACI 336.1 except as modified in this Section.

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.
- B. Plain and Deformed Steel Wire: ASTM A1064/A1064M, as drawn.

2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source, throughout Project:
 1. Portland Cement: ASTM C150/C150M, Type II, Supplement with the following:

- a. Fly Ash: ASTM C618, Class C or Class F.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C989, Grade 100 or 120.
- B. Normal-Weight Aggregate: ASTM C33, graded, 3/4-inch nominal maximum coarse-aggregate size. Provide aggregate from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
 - 1. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C94 and potable.
- D. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
 - 2. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.
 - 3. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G.
 - 4. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.

2.4 STEEL CASINGS

- A. Steel Pipe Casings: ASTM A283/A283M, Grade C, or ASTM A36/A36M, carbon-steel plate, with joints full-penetration welded according to AWS D1.1/D1.1M.
- B. Liners: Comply with ACI 336.1.

2.5 CONCRETE MIXTURES

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 limits as if concrete were exposed to deicing chemicals.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- D. Proportion normal-weight concrete mixture as follows:
 - 1. Compressive Strength (28 Days): 4000 psi.
 - 2. Maximum Water-Cementitious Materials Ratio: 0.45.
 - 3. Minimum Slump: Capable of maintaining the following slump until completion of placement:
 - a. 4 inches for dry, uncased, or permanent-cased drilling method.
 - b. 6 inches for temporary-casing drilling method.

4. Air Content: Do not air entrain concrete.

2.6 REINFORCEMENT FABRICATION

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.7 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C94/C94M, and furnish batch ticket information.
 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, vibration, and other hazards created by drilled-pier operations.

3.2 EXCAVATION

- A. Unclassified Excavation: Excavate to bearing elevations regardless of character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions.
 1. Obstructions: Unclassified excavation may include removal of unanticipated boulders, concrete, masonry, or other subsurface obstructions. No changes in the Contract Sum or the Contract Time are authorized for removal of obstructions.
 2. Obstructions: Unclassified excavated materials may include removal of unanticipated boulders, concrete, masonry, or other subsurface obstructions. Payment for removing obstructions that cannot be removed by conventional augers fitted with soil or rock teeth, drilling buckets, or underreaming tools attached to drilling equipment of size, power, torque, and downthrust necessary for the Work is according to Contract provisions for changes in the Work.
- B. Classified Excavation: Excavation is classified as standard excavation, special excavation, and obstruction removal and includes excavation to bearing elevations as follows:
 1. Standard excavation includes excavation accomplished with conventional augers fitted with soil or rock teeth, drilling buckets, or underreaming tools attached to drilling equipment of size, power, torque, and downthrust necessary for the Work.
 2. Special excavation includes excavation that requires special equipment or procedures where drilled-pier excavation equipment used in standard excavation, operating at maximum power, torque, and downthrust, cannot advance the shaft.

- a. Special excavation requires use of special rock augers, core barrels, air tools, blasting, or other methods of hand excavation.
 - b. Earth seams, rock fragments, and voids included in rock excavation area are considered rock for full volume of shaft from initial contact with rock.
- 3. Obstructions: Payment for removing unanticipated boulders, concrete, masonry, or other subsurface obstructions that cannot be removed by conventional augers fitted with soil or rock teeth, drilling buckets, or underreaming tools attached to drilling equipment of size, power, torque, and downthrust necessary for the Work is according to Contract provisions for changes in the Work.
- C. Prevent surface water from entering excavated shafts. Conduct water to site drainage facilities.
- D. Excavate shafts for drilled piers to indicated elevations. Remove loose material from bottom of excavation.
 - 1. Excavate bottom of drilled piers to level plane within 1:12 tolerance.
 - 2. Remove water from excavated shafts before concreting.
 - 3. Excavate rock sockets of dimensions indicated.
- E. Notify and allow testing and inspecting agency to test and inspect bottom of excavation. If unsuitable bearing stratum is encountered, make adjustments to drilled piers as determined by Architect.
 - 1. Do not excavate shafts deeper than elevations indicated unless approved by Architect.
 - 2. Payment for additional authorized excavation is according to Contract provisions for changes in the Work.
- F. End-Bearing Drilled Piers: Probe with auger to a depth below bearing elevation, equal to diameter of the bearing area of drilled pier. Determine whether voids, clay seams, or solution channels exist.
 - 1. Test first three drilled piers and one of every six drilled piers thereafter.
 - 2. Fill augur-probe holes with grout.
- G. Excavate shafts for closely spaced drilled piers and for drilled piers occurring in fragile or sand strata only after adjacent drilled piers are filled with concrete and allowed to set.
- H. Temporary Casings: Install watertight steel casings of sufficient length and thickness to prevent water seepage into shaft; to withstand compressive, displacement, and withdrawal stresses; and to maintain stability of shaft walls.
 - 1. Remove temporary casings, maintained in plumb position, during concrete placement and before initial set of concrete.
 - 2. Slurry method not acceptable for temporary casing
- I. Tolerances: Construct drilled piers to remain within ACI 336.1 tolerances.
 - 1. If location or out-of-plumb tolerances are exceeded, provide corrective construction. Submit corrective construction proposals to Architect for review before proceeding.

3.3 STEEL REINFORCEMENT INSTALLATION

- A. Comply with recommendations in CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy bond with concrete.
- C. Fabricate and install reinforcing cages symmetrically about axis of shafts in a single unit.
- D. Accurately position, support, and secure reinforcement against displacement during concreting. Maintain minimum cover over reinforcement.
- E. Use templates to set anchor bolts, leveling plates, and other accessories furnished in work of other Sections. Provide blocking and holding devices to maintain required position during final concrete placement.
- F. Protect exposed ends of extended reinforcement, dowels, or anchor bolts from mechanical damage and exposure to weather.

3.4 CONCRETE PLACEMENT

- A. Place concrete in continuous operation and without segregation immediately after inspection and approval of shaft by a qualified Special Inspector.
- B. Dry Method: Place concrete to fall vertically down the center of drilled pier without striking sides of shaft or steel reinforcement.
 - 1. Where concrete cannot be directed down shaft without striking reinforcement, place concrete with chutes, tremies, or pumps.
 - 2. Vibrate top 60 inches of concrete.
- C. Coordinate withdrawal of temporary casings with concrete placement to maintain at least a 60-inch head of concrete above bottom of casing.
 - 1. Vibrate top 60 inches of concrete after withdrawal of temporary casing.
- D. Screed concrete at cutoff elevation level and apply scoured, rough finish. Where cutoff elevation is above the ground elevation, form top section above grade and extend shaft to required elevation.
- E. Protect concrete work, according to ACI 301, from frost, freezing, or low temperatures that could cause physical damage or reduced strength.
 - 1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 - 2. Do not use calcium chloride, salt, or other mineral-containing antifreeze agents or chemical accelerators.

- F. If hot-weather conditions exist that would seriously impair quality and strength of concrete, place concrete according to ACI 301 to maintain delivered temperature of concrete at no more than 90 deg F.
 - 1. Place concrete immediately on delivery. Keep exposed concrete surfaces and formed shaft extensions moist by fog sprays, wet burlap, or other effective means for a minimum of seven days.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 - 1. Drilled piers.
 - 2. Excavation.
 - 3. Concrete.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- C. Drilled-Pier Tests and Inspections: For each drilled pier, before concrete placement.
 - 1. Soil Testing: Bottom elevations, bearing capacities, and lengths of drilled piers indicated have been estimated from available soil data.
- D. Concrete Tests and Inspections: ASTM C172/C172M except modified for slump to comply with ASTM C94/C94M.
 - 1. Slump: ASTM C143/C143M; one test at point of placement for each compressive-strength test but no fewer than one test for each concrete load.
 - 2. Concrete Temperature: ASTM C1064/C1064M; one test hourly when air temperature is 40 deg F and below and 80 deg F and above, and one test for each set of compressive-strength specimens.
 - 3. Compression Test Specimens: ASTM C31/C31M; one set of four standard cylinders for each compressive-strength test unless otherwise indicated. Mold and store cylinders for laboratory-cured test specimens unless field-cured test specimens are required.
 - 4. Compressive-Strength Tests: ASTM C39/C39M; one set for each drilled pier but not more than one set for each truck load. Test one specimen at seven days, test two specimens at 28 days, and retain one specimen in reserve for later testing if required.
 - 5. If frequency of testing provides fewer than five strength tests for a given class of concrete, conduct tests from at least five randomly selected batches or from each batch if fewer than five are used.
 - 6. If strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor is to evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
 - 7. Strength of each concrete mixture is satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
 - 8. Report test results in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. List Project identification name and number, date of concrete placement,

- name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests in reports of compressive-strength tests.
9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but not be used as sole basis for approval or rejection of concrete.
 10. Additional Tests: Testing and inspecting agency to make additional tests of concrete if test results indicate that slump, compressive strengths, or other requirements have not been met, as directed by Architect.
 - a. Continuous coring of drilled piers may be required, at Contractor's expense, if temporary casings have not been withdrawn within specified time limits or if observations of placement operations indicate deficient concrete quality, presence of voids, segregation, or other possible defects.
 11. Perform additional testing and inspecting, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.
 12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- E. An excavation, concrete, or a drilled pier will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports for each drilled pier as follows:
1. Actual top and bottom elevations.
 2. Actual drilled-pier diameter at top, bottom, and bell.
 3. Top of rock elevation.
 4. Description of soil materials.
 5. Description, location, and dimensions of obstructions.
 6. Final top centerline location and deviations from requirements.
 7. Variation of shaft from plumb.
 8. Shaft excavating method.
 9. Design and tested bearing capacity of bottom.
 10. Depth of rock socket.
 11. Levelness of bottom and adequacy of cleanout.
 12. Ground-water conditions and water-infiltration rate, depth, and pumping.
 13. Description, purpose, length, wall thickness, diameter, tip, and top and bottom elevations of temporary or permanent casings. Include anchorage and sealing methods used and condition and weather tightness of splices if any.
 14. Description of soil or water movement, sidewall stability, loss of ground, and means of control.
 15. Date and time of starting and completing excavation.
 16. Inspection report.
 17. Condition of reinforcing steel and splices.
 18. Position of reinforcing steel.
 19. Concrete placing method, including elevation of consolidation and delays.
 20. Elevation of concrete during removal of casings.
 21. Concrete volume.
 22. Concrete testing results.
 23. Remarks, unusual conditions encountered, and deviations from requirements.

3.6 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION 316329