Chiller Plant Improvements for STEM Building Project

TCNJ Advertised Bid # AB150036

PROJECT REQUIREMENTS & SPECIFICATIONS

SCOPE OF WORK

DRAWINGS

April 26, 2015
Please place the following advertisement in the Legal Section of Classified Advertising. Please ensure that the invoice for this advertisement is prepared and an affidavit forwarded to The College of New Jersey, Office of Finance and Business Services, Administrative Services Building, Room 201, P.O. Box 7718, Ewing, NJ 08628-0718.

To be published on April 26, 2015. Contact person regarding placement of ad is Roselle Horodeski (609) 771-2495.

THE COLLEGE OF NEW JERSEY
ADVERTISEMENT FOR BIDS
BID #AB150036

Under the provisions of the State College Contracts Law, Chapter 64 of Title 18-A, The College of New Jersey will receive sealed bids for the Chiller Plant Improvements for STEM Building Project until 2:00 P.M. on the 27th day of May, 2015 at The College’s Office of Finance and Business Services, Administrative Services Building, Second Floor, Room 201, Route 31 (Pennington Road), Ewing Township, New Jersey. At 2:00 P.M. all bids will be publicly opened and read in Room 203 of the Administrative Services Building.

The project will be bid as a Single Lump Sum.

No bidder may submit more than one bid.

Bid Documents may be obtained on/after April 26, 2015 via our website (www.tcnj.edu/~budfin/).

A strongly encouraged pre-bid conference/on-site inspection is scheduled on May 5, 2015 at 10:00 A.M. in Room 103 of the Administrative Services Building, located on The College’s Ewing Township, New Jersey campus on Route 31 (Pennington Road).


A bid bond is required in the amount of 10% of the total bid. Bid bond shall consist of a certified check or cashier's check to the order of The College of New Jersey, or an individual or annual bid bond issued by an insurance company or surety company authorized to do business in the State of New Jersey. The successful Bidder(s) is required to provide a Performance and Payment Bond equal to 100% of the contract. A Surety Disclosure Statement and Certification form must accompany the performance bond.

The College will award the contract to the lowest responsible bidder who satisfies the qualification criteria as set forth in the contract documents.

The College of New Jersey reserves the right to reject any or all bids or to waive any informalities in the bidding in accordance with law. No bid shall be withdrawn for a period of sixty (60) days subsequent to the opening of bids without the consent of The College of New Jersey.
Chiller Plant Improvements for STEM Building

Milestone Schedule
Date: 4/26/15

Advertised for bidding April 26, 2015
Pre-Bid Meeting (10:00am) May 5, 2015
Cut off for questions May 8, 2015
Addendum issued May 15, 2015
Bids Received May 27, 2015
Notice of Intent to Award issued May 29, 2015
End of Protest Period June 5, 2015
Notice to proceed issued by June 11, 2015
Start construction June 15, 2015
Substantial completion of field work January 15, 2016
Start-Up and Commissioning April 1, 2016-July 15, 2016
As-Builts and O & M's to TCNJ by February 28, 2016
Project Closed out by July 30, 2016
THE COLLEGE OF NEW JERSEY
Construction Bid Proposal Form

Office of Finance & Business Services          Bid Number: AB150036
Administrative Services Building, Rm. 201      Bid Due Date: May 27, 2015
2000 Pennington Road
Ewing, New Jersey 08628-0718

Project Name: Chiller Plant Improvements for STEM Building

BIDDER INFORMATION

Firm Name:                              Telephone Number:
Contact Person:                         Fax Number:
Address:                                Email Address:
                                          Federal I.D. Number:

SOLICITATION OF CONSTRUCTION BIDS

1. Bid proposals are solicited as follows:
   A. Single Bid (Lump Sum) which combines all trades.
      (1) The total number and types of trades are set forth in the
           Specifications.
      (2) Bidder enters the Bid Price on the line provided.
      (3) Pursuant to the requirements of N.J.S.A. 18A:64-76, bidder lists the
           names of the subcontractors on the Subcontractor Information
           page.

2. The scope of work includes removal and replacement of existing chillers, cooling
towers, and pumps. The installation of a new free-cooling heat exchanger,
modifications to chilled water piping at multiple campus buildings, controls work to
support the project, and electrical upgrades as shown to support the new
equipment.
   A. See Specifications and Drawings for Details (included in RFP package).
   B. The College may issue Addenda or Clarifications which may include
      additions to or deletions from the scope of work; changes to the
      Specifications, Drawings, and proposal form; and clarifications of
      requirements. Bidder is advised to review all Addenda and/or clarifications
      carefully, and shall note the receipt of same with their bid package.
1. PRICES
   A. Bidder submits prices for the Base Bid and any Alternate Proposals and Unit Prices which are listed for the contract of the bid. If there is no cost associated with the Alternate or Unit Price, bidder is required to enter “0.00” or “no change”.
   B. Prevailing wage rates apply (Mercer County).
   C. Bid is to remain good for sixty (60) days after the Bid Due Date.

2. BOND REQUIREMENTS AND SURETY STANDARDS
   A. Bidder must submit with its bid a Certified Check in the amount of ten percent (10%) of the base bid, or a Bid Bond in the amount of ten percent (10%) of the total bid.
   B. The successful bidder must submit a Performance and Payment Bond equal to 100% of the contract. A completed Surety Disclosure Statement and Certification must accompany the Performance and Payment Bond.
      (1) The Performance and Payment Bond form and a sample Surety Disclosure Statement and Certification form are included at the end of this Construction Bid Proposal Form.
   C. All bid deposits shall be returned within three (3) days of Notice of Intent to Award, except for the successful bidder(s) whose bid security shall be returned after execution of a formal contract, and delivery of the Performance Bond/Labor and Material Bond and Certificates of Insurance.
   D. Should the successful bidder fail to enter into said contract after acceptance of bid by the College, then the check or security deposited by that bidder shall, at the option of the College, be retained as liquidated damages, or if Bid Bond has been supplied, principal and surety shall be liable to the amount of the Bid Bond.
   E. Attorneys-in-fact who sign bid bonds or contract bonds must file with each bond a certified copy of their Power of Attorney to sign said bonds.

3. LICENSES, CERTIFICATIONS, REGISTRATIONS, QUALIFICATIONS
   A. The bidder or, as applicable, its subcontractors shall at the time of bid have those required licenses, certifications, registrations, qualifications and the like (“LCRQ”) listed below and shall present satisfactory evidence thereof upon request of the College prior to the notice of intent to award.
      (1) The electrical contractor or subcontractor as applicable shall have a valid electrical license. (An electrical license is not required when the work is below 110Volt)
      (2) The plumbing contractor or subcontractor as applicable shall have a valid plumbing license OR
      (3) The HVACR contractor of subcontractor as applicable shall have a valid HVACR license.
B. The selected bidder/contractor or, as applicable, its subcontractors shall have and shall present satisfactory evidence of all other required LCRQ noted in the Specifications after execution of contract during the submittal process and prior to the start of the applicable work, unless otherwise requested by the College or a date or event specified for that LCRQ in the Specifications.

4. SUBCONTRACTORS

A. Pursuant to New Jersey State Law (N.J.S.A. 18A-76.1), a Single Bid (Lump Sum) bidder discloses its subcontractors to whom the bidder intends to subcontract the work. The Subcontractor Information sheet is provided for this purpose.

5. Under Executive Order 34, the College is responsible for soliciting demographic information from its vendors. The College is required to seek the following information from each firm under contract with the College:

1. Is more than fifty percent (50%) of your company minority owned? (circle one) YES NO
   (African-American, Hispanic, Asian, and/or Native American)

2. Is more than fifty percent (50%) of your company woman owned? (circle one) YES NO

3. What is the ethnicity of the owner of your company: (check applicable according to 51% ownership)

   □ Asian American
   □ Multiple Ethnicities
   □ Non-Minority
   □ Hispanic American
   □ African American
   □ Caucasian American Female
   □ Native American
   □ Unspecified

The College is required to solicit the foregoing information. Your response, however, is strictly voluntary. Please be advised that any contracting decisions made by the College will not be influenced in any way by your decision to provide the above information.

EXECUTIVE ORDER #34: MINORITY AND WOMEN BUSINESS ENTERPRISES

On September 15, 2006, Governor Corzine signed Executive Order 34 establishing a Division of Minority and Women Business Development. The Division is charged with administering and monitoring policies, practices, and programs to ensure that minority and women business enterprises (MWBE) are afforded an equal opportunity to participate in New Jersey’s purchasing and procurement processes.

State entities are required to report to the Division the ethnic and gender composition of the vendors with which those state entities do business.

7. Bidders are required to be registered with the New Jersey Department of Property Management and Construction (DPMC) and possess a DPMC C008 classification at the time of bid submission.

8. **PREVAILING WAGE AND PUBLIC WORKS CONTRACTOR REGISTRATION ACTS**
   - The work described in this project is subject to the New Jersey Prevailing Wage Act, N.J.S.A. 34:11-56.25 et seq. and the Public Works Contractor Registration Act, N.J.S.A. 34:11-56.48 et seq.
   - The Public Works Contractor Registration Act requires the bidder and any subcontractors listed in the bid to be registered with the New Jersey Department of Labor and Workforce Development at the time the bid is submitted. The contractor must submit registration certificates for all listed subcontractors prior to award of the contract.
   - The Contractor must comply with the New Jersey Prevailing Wage Act, N.J.S.A. 34:11-56.25 through 56.57. Workers employed by the Contractor or any subcontractor or sub-subcontractor in the performance of services directly on the project must be paid prevailing wages. As required by N.J.S.A. 34:11-56.27 and 56.28, this contract cannot become effective until the College obtains from the New Jersey Department of Labor and Workforce Development a determination of the prevailing wage rates applicable to the project as of the contract award date and attaches a copy to the contract. As required by N.J.S.A. 34:11-56.27, the Contractor or any subcontractor may be terminated if any covered worker is not paid prevailing wages on the project, and the Contractor and its surety shall be liable for any additional costs which result. The Contractor and its subcontractors must be registered with the New Jersey Department of Labor and Workforce Development (N.J.S.A. 34:11-56.51 et seq.), and the prevailing wage rates must be posted at the job site (N.J.S.A. 34:11-56.32). The Contractor and its subcontractors must prepare accurate certified records of wages paid for each worker on the project (N.J.S.A. 34:11-56.29), and copies for the period covered by each invoice must be attached to the invoice submitted under the contract. In accordance with N.J.S.A. 34:11-56.33, the Contractor's final invoice must include a statement of all amounts still due to workers on the project. The Contractor is also cautioned that it must use job titles and worker classifications consistent with those approved by the Department of Labor and Workforce development, and that, if it intends to pay apprentice rates, it must comply with the Department of Labor and Workforce Development regulations at N.J.A.C. 12:60-7.1 through 7.4.
   - Please refer to [http://lwd.dol.state.nj.us/labor/wagehour/wagerate/wage_rates.html](http://lwd.dol.state.nj.us/labor/wagehour/wagerate/wage_rates.html) for official wage rate determinations for Mercer County, NJ.
9. In order for your proposal to be accepted and deemed valid, your company/firm will be required to comply with the requirements of N.J.S.A. 19:44A-1 et seq/P.L. 2005 Ch. 51 (“Chapter 51”) and Executive Order 117. Enclosed are the requirements of Chapter 51 and Executive Order 117, the forms for Certification and Disclosure. The contract that will be generated based on this bid proposal cannot be awarded without approval of the Certification and Disclosure forms by the State of New Jersey, Department of Treasury. A completed copy of your Certification form is not required at time of bid; however, it will be required from the bidder who receives the notice of intent to award from the College prior to the execution of the contract.

10. Vendors conducting business with any State agency including The College of New Jersey will be required to be registered with the New Jersey Division of Revenue. The vendor will be required to submit a Business Registration Certificate issued by the Department of Treasury, Division of Revenue, with the State of New Jersey prior to the award of a contract. N.J.S.A. 52:32-44. A completed copy of your Certificate is not required at time of bid; however, will be required from the bidder who receives the intent to award from the College.

11. Energy Star energy efficient products: Under Executive Order #11 (Corzine), the College is required to select ENERGY STAR energy-efficient products when acquiring new energy-using products or replacing existing equipment. For products that do not have ENERGY STAR labels, vendors shall follow guidelines established by the New Jersey Clean Energy Program.

12. QUESTIONS
   A. Direct inquiries and correspondence relating to this proposal form and questions regarding the technical specifications and requests for clarification must be submitted in writing via fax to 609-637-5140 or email to horodesk@tcnj.edu and must be received prior to 4:00 p.m. on May 8, 2015.
   B. Should any questions be received, an addendum or clarification will be available on or after May 15, 2015. If an addendum and/or clarification is posted, it SHOULD be noted in the General Agreement section of the bidder’s proposal. Failure to do so may subject Bidder to disqualification.

13. HOW TO SUBMIT THE COMPLETED CONSTRUCTION BID PROPOSAL FORM
   A. Bidder places all pages of the completed form and the requisite additional documents in an envelope, seals the envelope, and labels it with his/her firm name, address, and “Sealed Bid Enclosed for (Bid Number and Project Name)”.
   B. Bidder mails or deliver by hand the sealed bid, no later than 2:00 p.m., May 27, 2015, to The College of New Jersey, Attention: Roselle Horodeski for (specify the Bid Number), Office of Finance & Business Services, Room 201, 2000 Pennington Road, Ewing, New Jersey 08628-0718. At 2:00 p.m., all bids will be...
publicly opened and read in Room 203 of the Administrative Services Building.

C. Contractors are advised that the U.S. Postal Service and all express mail companies deliver to The College’s Mail Room or Receiving Department, not directly to the Office of Budget & Finance. The College is not responsible for lost or misdirected bids.

14. Any bid not prepared and submitted in accordance with the provisions described herein may be rejected by the College. Any bid received after the time and date specified will not be considered. No bidder shall withdraw a bid within sixty (60) days after the date of the bid opening to allow the College to determine the lowest bid that will most economically serve the intentions of this Contract.

15. Any bidder who has defaulted on any contract with the College or any other State Agency may be considered as not responsible and their bid may be rejected. THE COLLEGE OF NEW JERSEY reserves the right to exercise this option, as the College deems proper and/or necessary in its best interest.

16. Bids shall include all costs of any nature necessary to complete the project in the manner and within the time required by the contract.

17. The College reserves the right to require bidders to provide a schedule of values of their lump sum bid price upon request.

18. The College is exempt from all taxes including Federal Excise Tax, Transportation Taxes, State Excise, Sales Tax and local taxes. Rentals of equipment for 28 days or less is not exempt from any tax under the State sales tax act.

19. Before submitting his bid, the bidder shall be familiar with the Drawings, Specifications, and other Documents that will form part of the contract and shall have visited the site of the project to confirm for themselves the character and amount of work involved.

20. No bidder shall be allowed to offer more than one price on each item even though he/she may feel that he/she has two or more types or styles that will meet specifications. Bidders must determine for themselves which to offer. This may be cause for automatic rejection of bid.

21. It is understood and agreed that all prices quoted are firm and not subject to any increase during the life of the contract.

22. Should any difference arise between the contracting parties as to the meaning or intent of these instructions or specifications, the College's decision shall be final and conclusive.
23. Should the bidder discover discrepancies in this Request for Bids, the matter shall be at once brought to the attention of the College, and the discrepancies corrected by written agreement before submission of bid. The correction will be issued by addendum.

24. ACCEPTANCE/REJECTION OF BIDS

A. THE COLLEGE OF NEW JERSEY reserves the right to accept or reject any or all items covered in the bid request, or any portion(s) thereof, re-advertise and/or take such other steps decreed necessary and in the best interest of the College in accordance with law. Where two or more bidders are tied and all other relevant factors being equal, the College reserves the right to make the award to one of the bidders.

B. The bid is irrevocable by the bidder or the bidder's representatives. The bid, and any award made to the bidder by the College, shall bind the bidder and the bidder's heirs, executors, administrators, successors or assigns.

C. Award of contract shall be made to the lowest responsible bidder, whose bid, conforming to the invitation for bids, is the most advantageous to the College.

D. The award of the contract or the rejection of the bids shall be made within sixty (60) days of the date of receiving bids, unless written extensions are requested by the College and accepted by the bidder(s). All bid securities shall be returned immediately if all bids are rejected. The successful bidder(s) to whom the award is to be made will be notified by receipt of a written "Intent to Award" from the College.

E. When award of contract is made in one fiscal year with effective date in the next fiscal year, award shall be contingent upon the availability and appropriation of sufficient funds for that purpose for the year in which said contract takes effect. When a contract shall be awarded for a period in excess of one year, said contract shall be contingent upon the annual availability and appropriation of sufficient funds for that purpose for each year of the contract term.

25. WITHDRAWAL OF BIDS

A. A written request for the withdrawal of a bid, or any part thereof, will be granted if the request is received by the College prior to the specified time of the bid opening.

B. Should the bidder refuse to perform the work for the price provided, they will forfeit their bid security and will be held liable for the difference between their low bid and the next highest/responsive bidder.

26. OSHA COMPLIANCE:

A. The Contractor shall guarantee that all materials, supplies and equipment to be provided under his contract shall meet all applicable requirements, Specifications and standards of the Federal Occupational Safety and Health Act (OSHA) of 1970 as amended to date of acceptance by the College, and shall also apply to Contractors Construction procedures.
27. APPLICABLE LAWS:
   A. The following list of statutes and regulations, which may be applicable in whole or in part, is provided for the benefit of the Contractor and is not meant to be all-inclusive. In the event that other laws are applicable, it shall be the responsibility and obligation of the Contractor to ascertain and comply with them.

   (1) New Jersey Statutes and Regulations
      N.J.S.A. 10:5-31 et seq. and N.J.A.C. 17:27-1 et seq., Affirmative Action
      Prevailing Wage Act, N.J.S.A. 34:11-56.25 et seq.
      N.J.S.A. 52:32-44, Business Registration Certificate
      N.J.S.A. 34:11-56.48 et seq., Public Works Contractor Registration Act

   (2) Federal Statutes
      Immigration Control and Reform Act (1986) – 8 U.S.C.A. Section 1324(a) et seq.
      The Americans with Disabilities Act of 1990

28. EXAMINATION OF SITE, DRAWINGS AND SPECIFICATIONS
   A. Each Bidder shall visit the site of the proposed work and fully acquaint themselves with the conditions as they exist so that they may fully understand the facilities, difficulties, and restrictions attending the execution of the work under this Contract.

   B. Bidders shall also thoroughly examine and be familiar with the Drawings and Specifications. The failure to receive or examine any form, instrument or document, or to visit the site and acquaint himself with conditions there existing shall in no way relieve any bidder from obligation with respect to his bid. By submitting a bid, the bidder agrees and warrants that he has examined the site, the Drawings and Specifications and, that the Specifications and Drawings are adequate and the required result can be produced under the Drawings and Specifications. No claim for any extra will be allowed because of alleged impossibilities in the productions of the results specified or because of unintentional errors or conflicts in the Drawings and Specifications. No change orders will be issued for items, materials or issues that existed on or with respect to the site prior to bidding.

29. DRAWINGS AND SPECIFICATIONS
   A. The project shall be performed in accordance with the requirements of the Drawings and Specifications, subject to modification as provided in General Conditions. The Drawings and Specifications are intended to complement and supplement each other.

   B. Any work required by either of them and not by the other shall be performed as if denoted in both. Should any work be required which is not also denoted in the
Specifications or on the Drawings because of an obvious omission, but which is, nevertheless, necessary for the proper performance of the project, such work shall be performed as fully as if it were described and delineated.

30. FORM OF AGREEMENT
   A. Every successful bidder shall be required to sign the standard form contract, a copy of which is attached. Any proposed language or form changes which in any way modifies the contractor's responsibilities as set forth in the Contract Documents will not be acceptable and will be deemed to constitute a bid exception.

31. MULTIPLE BIDS NOT ALLOWED:
   A. No bidder is allowed to submit more than one bid from an individual, firm, partnership, corporation or association under the same or different name. This will be cause for automatic rejection of each bid.

32. SUBSTITUTIONS:
   A. The bidder may include in their bid substitute materials or equipment or methods in lieu of those specified in the contract documents, but they do so at their own risk. Any substitution must be equivalent in type, function and quality to the item required in the contract. The successful bidder must submit all information required within 20 days of contract award to determine if the proposed substitute is equal to the contract requirements, and any substitution must be approved by the architect and the College.

   B. The College shall have complete discretion to decide whether it will accept any substitution. No substitution shall result in any increase in the contract price or times. The successful bidder in its application for the substitution must certify in writing that the substitution is equal to what is specified in the contract documents in all material respects and will not increase the time or price of the contract work.

   C. Should the substitution be rejected, the contractor will then be required to provide the specified product, material or method at no additional cost to the College and no change in the project schedule.

33. DOCUMENTS/SUBMISSIONS THAT MUST BE PROVIDED BEFORE CONTRACT AWARD:

   • AFFIRMATIVE ACTION: The bidder is required to complete and submit a copy of Initial Project Workforce Report (AA-201) to the College and the Division of Public Contracts Equal Employment Opportunity Compliance verifying that the bidder is operating under a federally approved or sanctioned Affirmative Action program. The bidder also agrees to submit a copy of the Monthly Project Workforce Report once a month thereafter for the duration of this contract to The College and the Division.
• CERTIFICATE OF INSURANCE: The bidder is required to submit proof of liability insurance in accordance with The College’s contract.

• P.L. 2005, Chapter 51 / Executive Order 117 - Contractor Certification and Disclosure of Political Contributions:

  In order for your proposal to be accepted and deemed valid, your company/firm will be required to comply with the requirements of Chapter 51 and Executive Order 117. Enclosed are the requirements of Ch. 51 and EO 117, the forms for Certification and Disclosure. The contract that will be generated based on this bid cannot be awarded without approval of the Certification and Disclosure forms by the State of New Jersey, Department of Treasury.

• New Jersey Business Registration Certificate

• All applicable licenses, certificates, and requirements specified in the scope of work, contract documents and specifications.
The following Bidder’s Checklist is provided as an aid to the bidder. It does not in any way relieve the bidder of its responsibility to insure that its bid proposal is complete.

a. _____ Bidder has completed the Bidder Information section and General Agreement section and filled out the receipt of addendum and clarifications.

b. _____ Bidder has completed the form of proposal and indicated base bid for either Separate Bid or Single Bid (Lump Sum all trades), prices for Alternate Proposals, and Unit Prices.

c. _____ Bidder for Single Bid (Lump Sum) has listed and has disclosed the subcontractors on the Subcontractor Information form.

d. _____ Bidder has enclosed a certified check or bid bond for ten percent (10%) of the amount of the bid.

e. _____ Bidder has completed and enclosed the Non-Collusion Affidavit.

f. _____ Bidder has completed and enclosed the Ownership Disclosure form.

g. _____ Bidder and each disclosed subcontractor has enclosed a copy of its registration certificate in accordance with the requirement of the Public Works Contractor Registration Act. (NJ Dept. of Labor and Workforce Development)

h. _____ Bidder has acknowledged the Affirmative Action Language in accordance with the requirements P.L. 1975 C.127. (NJAC 17:27).

i. _____ Bidder has enclosed its MWBE information.

j. _____ Bidder has enclosed its Electrical and Plumbing License and any other licenses, certifications, certifications, and qualifications.

k. _____ Bidder has enclosed its Vendor Qualification Statement

l. _____ Bidder has included a copy of its latest Experience Modification Rating (EMR Safety Rating). The College requires an average rating over the last 5 years of 1.25 or less.

m. _____ Bidder has included a copy of its DPMC Notice of Classification and Total Amount of Uncompleted Contracts.

n. _____ Bidder has enclosed a copy of its Chapter 51 & EO117 Certification form. A completed copy of your Certification form is not required at time of bid; however, will be required from the bidder who receives the intent to award from the College.

o. _____ Bidder has enclosed a copy of its New Jersey Business Registration Certificate in accordance with the requirements of the New Jersey Division of Revenue. A completed copy of your Certificate is not required at time of bid; however, will be required from the bidder who receives the intent to award from the College.
1. Having examined the plans and specifications with related documents and the site of the proposed work and being familiar with all of the conditions surrounding the construction of the proposed project including the availability of materials and labor, the undersigned hereby proposes to furnish all labor, materials, and supplies, and to construct the project in accordance with the Contract Documents, within the time set forth therein, and at the price stated. This price covers all expenses incurred in performing the work required under the Contract Documents, of which this proposal is a part.

2. Bidder acknowledges receipt of the following Addendums/Clarifications:

Addendum Number _____  Date ________ Addendum Number ____ Date__________
Addendum Number _____  Date ________ Addendum Number ____ Date__________
Addendum Number _____  Date ________ Addendum Number ____ Date__________

3. Bidder acknowledges and affirms that he/she has personal knowledge of or has obtained and reviewed a copy of the valid prevailing wage rates at the time of the bid and for the duration of the contract for all trades involved in the project for the geographical location of the project as issued by the Commissioner of the Department of Labor & Workforce Development, Trenton, NJ 08625 (609) 292-2259 or visiting the Department of Labor website at (http://lwd.dol.state.nj.us/labor/wagehour/wagerate/wage_rates.html).

4. Bidder agrees that its price is good and the bid shall not be withdrawn for a period of 60 calendar days after the scheduled Bid Due Date and Time.

5. Upon conclusion of the 10 business day protest period, Bidder will execute the formal contract within 5 business days and deliver as required in the General Conditions: a Performance and Payment Bond; Surety Disclosure and Certification Statement; and certificates of insurance for general liability, automobile and worker’s compensation.

6. Bidder acknowledges work to commence on site not later than ten (10) calendar days after receipt of a Notice to Proceed.

Respectfully submitted,

(Seal if bid is by Corporation)

__________________________________________
(Signature of Principal)

__________________________________________
(Printed Name of Principal)

__________________________________________
(Title of Principal)
PRICES FOR SINGLE BID (LUMP SUM): Base Bid, Alternate Proposals, and Unit Prices

FORM OF PROPOSAL

To:    The College of New Jersey

for:  Chiller Plant Improvements for STEM Building

Date ______________

A. BID:

1. **Base:** We, ________________________________________________, the Undersigned, in accordance with the published advertisement inviting proposals, will furnish all labor, material, equipment and services necessary for the complete construction, as defined in the advertisement, specimen contract, specifications, addendums/clarifications/bulletins, drawings, and proposal, for the Contract amount indicated below for the above noted project in strict accordance with the Contract Documents and Addenda thereto for the total sum of:

   _______________________________________ Dollars $ __________________

   (words)

   **General Construction (Single overall Prime Contract)**

2. **Deduct Alternate**

   1. Do not install temperature/pressure transmitters on chilled water pipes at Chillers HX. Use existing transmitters on main supply and return pipes. (See drawings for complete details)

      **DEDUCT:** ___________________________________ Dollars $ __________________

      (words)

   2. Do not install temperature/pressure transmitters on condenser water pipes at Chiller/HX. (See drawings for complete details)

      **DEDUCT:** ___________________________________ Dollars $ __________________

      (words)

   3. Do not install condenser water flow meters at chillers/HX. Use differential pressure transmitter to derive the flow. (See drawings for complete details)

      **DEDUCT:** ___________________________________ Dollars $ __________________

      (words)

   4. Do not install condenser water flow meters at each cell of cooling tower-1 in place of 4 cells. (See drawings for complete details)

      **DEDUCT:** ___________________________________ Dollars $ __________________

      (words)
5. Do not install chilled water flow meters at chillers/HX. The flow shall be derived based on the differential pressure across the units. (See drawings for complete details)

DEDUCT: ________________________________ Dollars $__________________
(words)

6. Do not perform any pump bypass modifications/instrumentation in all buildings. (See drawings for complete details)

DEDUCT: ________________________________ Dollars $__________________
(words)

7. Do not include VFD for the electric chiller. Provide constant speed chiller. (See drawings for complete details)

DEDUCT: ________________________________ Dollars $__________________
(words)

8. Do not install plate and heat exchanger and associated piping/instrumentation. (See drawings for complete details)

DEDUCT: ________________________________ Dollars $__________________
(words)

9. Do not install the chiller and associated piping, controls, electrical. (See drawings for complete details)

DEDUCT: ________________________________ Dollars $__________________
(words)

Note: failure to provide DEDUCT Alternate may result in rejection of bid.

3. CHECK LIST FOR BIDDERS:
A check list has been provided in these specifications for the use in completing this proposal. Bidders are encouraged to reference said list to minimize the opportunity for errors by the bidder.

B. UNIT PRICES: We, the Undersigned, agree, if awarded the Contract to perform additional work or delete work at the Unit Prices set forth below or at a negotiated unit price (Unit Prices are for work that is in addition to or is deleted from the base bid work):

No Unit Prices are requested for this bid.

C. AGREEMENT: We, the Undersigned, agree, if awarded the Contract, to execute an agreement for the above stated work and compensation on the Standard Form of Agreement Between Owner and Contractor.

D. SURETY: We, the Undersigned, agree, if awarded the Contract, to execute and deliver to the Owner, prior to the signing of the Contract, the Performance and Payment Bonds as required.
• Contractor shall provide a Maintenance Bond at job completion for a period of one year for 100% of the final contract price.

E. BID SECURITY: The attached bid security is to become the Property of the Owner in the event that the Contract and bond are not executed within the time set forth, as liquidated damages for the delay and additional expense (including the difference between the price provided with said bond and the next lowest responsive bidder) to the Owner caused thereby.
F. STATEMENT:
1. We, the Undersigned, acting through its authorized officers and intending to be legally bound, agree that this bid proposal shall constitute an offer by the Undersigned to enter into a Contract with the acts and things therein provided, which offer shall be irrevocable for sixty (60) calendar days from the date of opening hereof and that the Owner may accept this offer at any time during said period by notifying the Undersigned of the acceptance of said offer.
2. We, the Undersigned, acknowledge receipt of the following Addenda/Clarifications:

<table>
<thead>
<tr>
<th>Addenda Number</th>
<th>Dated</th>
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The undersigned further agrees to comply with the requirements as to conditions of employment, wage rates, and hours of labor set forth in the Contract Documents.

Dated

Firm Name: ________________ Phone Number: ________________
Address: ________________

**If a corporation, give the State of Incorporation, using the phrase: "A corporation organized under the laws of ________________."**
If a partnership, give names of the partners, using also the phrase: "Co-partners trading and doing business under the firm name and style of ________________.
If an individual using a trade name, give individual name, also using the phrase: "An individual doing business under the firm name and style of ________________.

Dated: ________________

STATE OF __________________________ SS.
COUNTY OF __________________________

__________________________, being duly sworn say that the several matters stated in this proposal are in all respects true, and that no member of the State or employee of the College are interested in any way in this proposal.

Sworn and subscribed before me ________________ Bidder signs above line
this _________ day of _____________ 20____

__________________________ ________________
Print Name and Title
Pursuant to the State Colleges Contract Law, N.J.S.A. 18A:64-76.1, all bids submitted shall set forth the names and license numbers of all subcontractors to whom the bidder intends to subcontract the plumbing and gas fitting work; the refrigeration, the heating and ventilating systems and equipment; the electrical work, including any electrical power plants; tele-data, fire alarm, or security systems; the structural steel and ornamental iron work (individually, the “Trade” or collectively, the “Trades”).

For each Trade listed below for which the work will be completed by a subcontractor you must list for each such subcontractor at a minimum the name and, where applicable, license number (or in lieu thereof enclose a copy of the license with this form) and preferably you will also list the subcontractor’s address, telephone number, and fax number. If the work will be self-performed by the bidder, you may indicate that by inserting the name of the bidder (next to “Name”). If work by that Trade is not required per the scope of work of the project, you may indicate that by inserting “Not required” (next to “Name”). If the name of a subcontractor is not provided on this form for any one or more of the Trades, the bidder, in submitting its bid, certifies that, for such Trades, either the work will be self-performed by the bidder, or the work is not required per the scope of work.

**Failure to complete this form as required may result in your bid being disqualified.**

### Plumbing and Gas Fitting Work

List information for Subcontractor, if any:

| Name: | __________________________ |
| License Number: | __________________________ |
| Address: | __________________________ |
| Telephone: | __________________________ |
| Fax: | __________________________ |

### Refrigeration, Heating and Ventilating Systems and Equipment

List information for Subcontractor, if any:

| Name: | __________________________ |
| License Number: | __________________________ |
| Address: | __________________________ |
| Telephone: | __________________________ |
| Fax: | __________________________ |
Electrical Work, including any Electrical Power Plants, Tele-data, Fire Alarm, or Security Systems

List information for Subcontractor, if any:

Name: __________________________
License Number: __________________________
Address:

__________________________
Telephone: __________________________
Fax: __________________________

Structural Steel Work and Ornamental Iron Work

List information for Subcontractor, if any:

Name: __________________________
License Number: __________________________
Address:

__________________________
Telephone: __________________________
Fax: __________________________

________________________________________
Bidder Name

By: __________________________
Signature

________________________________________
Printed Name of Signing Individual

________________________________________
Date
1. Contractor and sub-contractors are requested to check all of the following that apply to their company and, if applicable, submit a copy of their certificate(s):

A. My company is certified by the NJ Department of Treasury, Division of Revenue as a:
   ______ small business ______ minority-owned business ______ female-owned business

B. My company is certified by the NJ Department of Transportation as a:
   ______ small business ______ minority-owned business ______ female-owned business

C. My company is a ______ small business ______ minority-owned or ______ female-owned but is not certified by either NJ Department.

C. ______ My company is not a small business, minority-owned or female-owned.

___________________________
Signed
___________________________
Date
PERFORMANCE BOND & PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned __________________________
___________________as Principal, and___________________________________________________, a
corporation of the State of ____________________, duly authorized to do business in the State of New
Jersey, having an office at __________________________________________________, are hereby held and
firmly bound unto The College of New Jersey in the Penal Sum of
_______________________________________________________________ DOLLARS, for payment of which
well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators,
successors and assigns.

SIGNED this __________ day of _________________________, 20_____

THE CONDITION OF THE ABOVE OBLIGATION IS SUCH THAT, WHEREAS, the above named Principal
did on the __________ day of ____________________, 20_____, enter into a written contract with The College
of New Jersey for _______________________________________________ which said contract is made a part
of this bond as set forth herein;

NOW, if the said _________________________________________________________ shall well and faithfully
do and perform the things agreed by _______________________ to be done and performed according to the
terms of the said contract; shall pay all lawful claims of sub-contractors, materialmen, laborers, persons, forms of
other suppliers or teams. fuel, oils, implements or machinery furnished, used or consumed in the carrying
forward, performing, or completing of said contract, we agreeing and assenting
that this undertaking shall be for
the benefit of any subcontractor, materialman, laborer, person, firm or corporation having a just claim, as well as
for the obligee herein; then this obligation shall be void, otherwise the same shall remain in full force and effect;
it being expressly understood and agreed that the liability of the surety for any and all claims hereunder shall in
no event exceed the penal amount of this obligation as herein stated.

The said surety hereby stipulated and agrees that no modifications, omissions, or additions in or to the terms of
the said contract, or in or to the plans and specifications therefore shall in any wise effect the obligation of said
surety on its bond.

This bond is given in compliance with the requirements of the statutes of the State of New Jersey including

SIGNED, SEALED AND DELIVERED
IN THE PRESENCE OF

_______________________________________ BY:______________________________________
Witness

_______________________________________ BY:______________________________________
Witness as to Surety

_______________________________________ ATTORNEY-IN-FACT
Countersigned

this ______ day of ________________, 20____

BY:______________________________________

NOTE: General Power of Attorney and the current
financial statement of the bonding company
must be attached to each copy (a total of three)
of the Performance Bond.
SURETY DISCLOSURE STATEMENT AND CERTIFICATION

______________________________________, surety(ies) on the attached bond, hereby certifies(y) the following:

(1) The surety meets the applicable capital and surplus requirements of R.S. 17:17-6 or R.S. 17:17-7 as of the surety’s most current annual filing with the New Jersey Department of Insurance.

(2) The capital (where applicable) and surplus, as determined in accordance with the applicable laws of the State of New Jersey, of the surety(ies) participating in the issuance of the attached bond is (are) in the following amount(s) as of the calendar year ending December 31, _____, (insert most recent calendar year for which capital and surplus amounts are available), which amounts have been certified as indicated by certified public accountants (indicating separately for each surety that surety’s capital and surplus amounts, together with the name and address of the firm of certified public accountants that shall have certified those amounts):

______________________________________

______________________________________

(3) (a) With respect to each surety participating in the issuance of the attached bond that has received from the United States Secretary of the Treasury a certificate of authority pursuant to 31 U.S.C. 9305, the underwriting limitation established therein and the date as of which that limitation was effective is as follows (indicating for each surety that surety’s underwriting limitation and the effective date thereof):

______________________________________

______________________________________

(b) With respect to each surety participating in the issuance of the attached bond that has not received such a certificate of authority from the United States Secretary of the Treasury, the underwriting limitation of that surety as established pursuant to R.S. 17:18-9 as of date on which such limitation was so established, is as follows (indicating for each such surety that surety’s underwriting limitation and the date on which that limitation was established):

______________________________________

______________________________________

(4) The amount of the bond to which this statement and certification is attached is $______________________.

(5) If, by virtue of one or more contracts of reinsurance, the amount of the bond indicated under item (4) above exceeds the total underwriting limitation of all sureties on the bond as set forth in items (3) (a) or (3) (b) above, or both, then for each such contract of reinsurance:

(a) The name and address of each such re-insurer under that contract and the amount of that re-insurer’s participation in the contract is as follows:

______________________________________

______________________________________

______________________________________
(b) Each surety that is party to any such contract of reinsurance certifies that each reinsurer listed under item (5) (a) satisfies the credit for reinsurance requirement established under P.L. 1993, c. 243 (C. 17:51B-1 et seq.) and any applicable regulations in effect as of the date on which the bond to which this statement certification is attached shall have been filed with the appropriate public agency.

CERTIFICATION

(to be completed by an authorized certifying agent for each surety on the bond)

I, _______________________ (name of agent), as ______________________ (title of agent)

for _____________________________________ (name of surety),

a corporation/mutual insurance company/other (indicate type of business organization by circling one) domiciled in _______ _______ (state of domicile), DO HEREBY CERTIFY that, to the best of my knowledge, the foregoing statements made by me are true, and ACKNOWLEDGE that, if any of those statements are false, this bond is VOID and I am subject to punishment.

______________________________
(Signature of certifying agent)

______________________________
(Printed name of certifying agent)

______________________________
(Title of certifying agent)

______________________________
(Date of Certification)
MANDATORY EQUAL EMPLOYMENT OPPORTUNITY LANGUAGE
N.J.A.C. 17:27

CONSTRUCTION CONTRACTS

During the performance of this contract, the contractor agrees as follows:

The contractor or subcontractor, where applicable, will not discriminate against any employee or applicant for employment because of age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex. Except with respect to affectional or sexual orientation and gender identity or expression, the contractor will ensure that equal employment opportunity is afforded to such applicants in recruitment and employment, and that employees are treated during employment, without regard to their age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex. Such equal employment opportunity shall include, but not be limited to the following: employment, up-grading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the Public Agency Compliance Officer setting forth provisions of this nondiscrimination clause.

The contractor or subcontractor, where applicable will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex.

The contractor or subcontractor will send to each labor union, with which it has a collective bargaining agreement, a notice, to be provided by the agency contracting officer, advising the labor union or workers' representative of the contractor's commitments under this act and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

The contractor or subcontractor, where applicable, agrees to comply with any regulations promulgated by the Treasurer, pursuant to N.J.S.A. 10:5-31 et seq., as amended and supplemented from time to time and the Americans with Disabilities Act.

When hiring or scheduling workers in each construction trade, the contractor or subcontractor agrees to make good faith efforts to employ minority and women workers in each construction trade consistent with the targeted employment goal prescribed by N.J.A.C. 17:27-7.2; provided, however, that the Dept. of LWD, Construction EEO Monitoring Program may, in its discretion, exempt a contractor or subcontractor from compliance with the good faith procedures prescribed by the following provisions, A, B and C, as long as the Dept. of LWD, Construction EEO Monitoring Program is satisfied that the contractor or subcontractor is employing workers provided by a union which provides evidence, in accordance with standards prescribed by the Dept. of LWD, Construction EEO Monitoring Program, that its percentage of active "card carrying" members who are minority and women workers is equal to or greater than the targeted employment goal established in accordance with N.J.A.C. 17:27-7.2. The contractor or subcontractor agrees that a good faith effort shall include compliance with the following procedures:
(A) If the contractor or subcontractor has a referral agreement or arrangement with a union for a construction trade, the contractor or subcontractor shall, within three business days of the contract award, seek assurances from the union that it will cooperate with the contractor or subcontractor as it fulfills its affirmative action obligations under this contract and in accordance with the rules promulgated by the Treasurer pursuant to N.J.S.A. 10:5-31 et. seq., as supplemented and amended from time to time and the Americans with Disabilities Act. If the contractor or subcontractor is unable to obtain said assurances from the construction trade union at least five business days prior to the commencement of construction work, the contractor or subcontractor agrees to afford equal employment opportunities minority and women workers directly, consistent with this chapter. If the contractor's or subcontractor's prior experience with a construction trade union, regardless of whether the union has provided said assurances, indicates a significant possibility that the trade union will not refer sufficient minority and women workers consistent with affording equal employment opportunities as specified in this chapter, the contractor or subcontractor agrees to be prepared to provide such opportunities to minority and women workers directly, consistent with this chapter, by complying with the hiring or scheduling procedures prescribed under (B) below; and the contractor or subcontractor further agrees to take said action immediately if it determines that the union is not referring minority and women workers consistent with the equal employment opportunity goals set forth in this chapter.

(B) If good faith efforts to meet targeted employment goals have not or cannot be met for each construction trade by adhering to the procedures of (A) above, or if the contractor does not have a referral agreement or arrangement with a union for a construction trade, the contractor or subcontractor agrees to take the following actions:

(1) To notify the public agency compliance officer, the Dept. of LWD, Construction EEO Monitoring Program, and minority and women referral organizations listed by the Division pursuant to N.J.A.C. 17:27-5.3, of its workforce needs, and request referral of minority and women workers;

(2) To notify any minority and women workers who have been listed with it as awaiting available vacancies;

(3) Prior to commencement of work, to request that the local construction trade union refer minority and women workers to fill job openings, provided the contractor or subcontractor has a referral agreement or arrangement with a union for the construction trade;

(4) To leave standing requests for additional referral to minority and women workers with the local construction trade union, provided the contractor or subcontractor has a referral agreement or arrangement with a union for the construction trade, the State Training and Employment Service and other approved referral sources in the area;

(5) If it is necessary to lay off some of the workers in a given trade on the construction site, layoffs shall be conducted in compliance with the equal employment opportunity and non-discrimination standards set forth in this regulation, as well as with applicable Federal and State court decisions;

(6) To adhere to the following procedure when minority and women workers apply or are referred to the contractor or subcontractor:
(i) The contractor or subcontractor shall interview the referred minority or women worker.

(ii) If said individuals have never previously received any document or certification signifying a level of qualification lower than that required in order to perform the work of the construction trade, the contractor or subcontractor shall in good faith determine the qualifications of such individuals. The contractor or subcontractor shall hire or schedule those individuals who satisfy appropriate qualification standards in conformity with the equal employment opportunity and non-discrimination principles set forth in this chapter. However, a contractor or subcontractor shall determine that the individual at least possesses the requisite skills, and experience recognized by a union, apprentice program or a referral agency, provided the referral agency is acceptable to the Dept. of LWD, Construction EEO Monitoring Program. If necessary, the contractor or subcontractor shall hire or schedule minority and women workers who qualify as trainees pursuant to these rules. All of the requirements, however, are limited by the provisions of (C) below.

(iii) The name of any interested women or minority individual shall be maintained on a waiting list, and shall be considered for employment as described in (i) above, whenever vacancies occur. At the request of the Dept. of LWD, Construction EEO Monitoring Program, the contractor or subcontractor shall provide evidence of its good faith efforts to employ women and minorities from the list to fill vacancies.

(iv) If, for any reason, said contractor or subcontractor determines that a minority individual or a woman is not qualified or if the individual qualifies as an advanced trainee or apprentice, the contractor or subcontractor shall inform the individual in writing of the reasons for the determination, maintain a copy of the determination in its files, and send a copy to the public agency compliance officer and to the Dept. of LWD, Construction EEO Monitoring Program.

(7) To keep a complete and accurate record of all requests made for the referral of workers in any trade covered by the contract, on forms made available by the Dept. of LWD, Construction EEO Monitoring Program and submitted promptly to the Dept. of LWD, Construction EEO Monitoring Program upon request.

(C) The contractor or subcontractor agrees that nothing contained in (B) above shall preclude the contractor or subcontractor from complying with the union hiring hall or apprenticeship policies in any applicable collective bargaining agreement or union hiring hall arrangement, and, where required by custom or agreement, it shall send journeymen and trainees to the union for referral, or to the apprenticeship program for admission, pursuant to such agreement or arrangement. However, where the practices of a union or apprenticeship program will result in the exclusion of minorities and women or the failure to refer minorities and women consistent with the targeted county employment goal, the contractor or subcontractor shall consider for employment persons referred pursuant to (B) above without regard to such agreement or arrangement; provided further, however, that the contractor or subcontractor shall not be required to employ women and minority advanced trainees and trainees in numbers which result in the employment of advanced trainees and trainees as a percentage of the total workforce for the construction trade, which percentage significantly exceeds the apprentice to journey worker ratio specified in the applicable collective bargaining agreement, or in the absence of a collective bargaining agreement, exceeds the ratio established by practice in the area for said construction trade. Also, the contractor or subcontractor agrees that, in implementing the procedures of (B) above, it shall, where applicable, employ minority and women workers residing within the geographical jurisdiction of the union.
After notification of award, but prior to signing a construction contract, the contractor shall submit to the public agency compliance officer and the Dept. of LWD, Construction EEO Monitoring Program an initial project workforce report (Form AA 201) electronically provided to the public agency by the Dept. of LWD, Construction EEO Monitoring Program, through its website, for distribution to and completion by the contractor, in accordance with N.J.A.C. 17:27-7. The contractor also agrees to submit a copy of the Monthly Project Workforce Report once a month thereafter for the duration of this contract to the Division and to the public agency compliance officer.

The contractor agrees to cooperate with the public agency in the payment of budgeted funds, as is necessary, for on-the-job and/or off-the-job programs for outreach and training of minorities and women.

(D) The contractor and its subcontractors shall furnish such reports or other documents to the Dept. of LWD, Construction EEO Monitoring Program as may be requested by the Dept. of LWD, Construction EEO Monitoring Program from time to time in order to carry out the purposes of these regulations, and public agencies shall furnish such information as may be requested by the Dept. of LWD, Construction EEO Monitoring Program for conducting a compliance investigation pursuant to Subchapter 10 of the Administrative Code (NJAC 17:27).

IF AWARDED A CONTRACT YOUR COMPANY/FIRM WILL BE REQUIRED TO COMPLY WITH THE AFFIRMATIVE ACTION REQUIREMENTS LISTED ABOVE.

Firm Name:______________________________________________________________

Signature:______________________________________________________________

Title:______________________________________________________________

Date:______________________________________________________________
Additional Mandatory Construction Contract Language
For State Agencies, Independent Authorities, Colleges and Universities Only

The Executive Order No. 151 (Corzine, August 28, 2009) and P.L. 2009, Chapter 335 include a provision which require all state agencies, independent authorities and colleges and universities to include additional mandatory equal employment and affirmative action language in its construction contracts. It is important to note that this language is in addition to and does not replace the mandatory contract language and good faith efforts requirements for construction contracts required by N.J.A.C. 17:27-3.6, 3.7 and 3.8. The additional mandatory equal employment and affirmative action language is as follows:

It is the policy of the [Reporting Agency] that its contracts should create a workforce that reflects the diversity of the State of New Jersey. Therefore, contractors engaged by the [Reporting Agency] to perform under a construction contract shall put forth a good faith effort to engage in recruitment and employment practices that further the goal of fostering equal opportunities to minorities and women.

The contractor must demonstrate to the [Reporting Agency]’s satisfaction that a good faith effort was made to ensure that minorities and women have been afforded equal opportunity to gain employment under the [Reporting Agency]’s contract with the contractor. Payment may be withheld from a contractor’s contract for failure to comply with these provisions.

Evidence of a “good faith effort” includes, but is not limited to:

1. The Contractor shall recruit prospective employees through the State Job bank website, managed by the Department of Labor and Workforce Development, available online at http://NJ.gov/JobCentralNJ;
2. The Contractor shall keep specific records of its efforts, including records of all individuals interviewed and hired, including the specific numbers of minorities and women;
3. The Contractor shall actively solicit and shall provide the [Reporting Agency] with proof of solicitations for employment, including but not limited to advertisements in general circulation media, professional service publications and electronic media; and
4. The Contractor shall provide evidence of efforts described at 2 above to the [Reporting Agency] no less frequently than once every 12 months.
5. The Contractor shall comply with the requirements set forth at N.J.A.C. 17:27.

To ensure successful implementation of the Executive Order and Law, state agencies, independent authorities and colleges and universities must forward an Initial Project Workforce Report (AA 201) for any projects funded with ARRA money to the Dept. of LWD, Construction EEO Monitoring Program immediately upon notification of award but prior to execution of the contract.
NON-COLLUSION STATEMENT

Date:______________________________

The College of New Jersey
The Office of Budget and Finance, Department of Purchasing
Administrative Services Building, Room 201
P.O. Box 7718
Ewing, New Jersey 08628-0718

To Whom It May Concern:

This is to certify that the undersigned bidder____________________________ as not, either directly or indirectly, entered into any agreement, participated in any collusion, or otherwise taken any action in restraint of free competitive bidding in connection with the proposal submitted to The College of New Jersey on the___________ day of____________, 20____.

Signature:__________________________________________________________

Corporate Seal:

Attest by:___________________________________________________________

Sworn to and subscribed before me this______ day of ________, 20____.
My commission Expires:______________________________________________

Notary Public

THIS STATEMENT MUST BE COMPLETED AND SIGNED
STOCKHOLDER DISCLOSURE FORM

Firm Name: _____________________________________________

Address: __________________________________________________________________________

City/State/ZIP: ______________________________________________________________________

List the names and addresses of all individuals, corporations, or any other owner having
10% or greater interest in the corporation or partnership named in item 1. If a listed
owner is a corporation or partnership, then list the names and addresses of holders of 10%
or more interest in that corporation or partnership. If additional space is necessary, list on
an attached sheet. If there are no owners with 10% or more interest in your company,
enter "None" below.

Complete affidavit at bottom of form.

Firm Name       Street       City/Twp       County       State       Zip
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

President of the Firm (Type or print name)               Telephone Number

I certify that (check applicable blanks):

_____ A list of stockholders names and addresses has been submitted to the Secretary
of State of New Jersey and it is current and correct to the best of my knowledge,
with the exceptions as listed above.

_____ The list of stockholders above is current and correct to the best of my
knowledge.

_____ There are no stockholders holding 10% or more interest in this corporation or
firm to the best of my knowledge.

_____ Firm is a sole ownership and not subject to corporation or partnership disclosure
requirement.

Signature of Authorized Representative

Name__________________________________________ Title:________________________

Witnessed by__________________________ Date:__________________

THIS FORM MUST BE COMPLETED, SIGNED, AND WITNESSED
INFORMATION AND INSTRUCTIONS
For Completing The “Two-Year Vendor Certification and Disclosure of Political Contributions” Forms

Background Information

On September 22, 2004, then-Governor James E. McGreevey issued Executive Order 134, the purpose of which was to insulate the negotiation and award of State contracts from political contributions that posed a risk of improper influence, purchase of access or the appearance thereof. To this end, Executive Order 134 prohibited State departments, agencies and authorities from entering into contracts exceeding $17,500 with individuals or entities that made certain political contributions. Executive Order 134 was superseded by Public Law 2005, c. 51, signed into law on March 22, 2005 (“Chapter 51”).

On September 24, 2008, Governor Jon S. Corzine issued Executive Order No. 117 (“E.O. 117”), which is designed to enhance New Jersey’s efforts to protect the integrity of procurement decisions and increase the public’s confidence in government. The Executive Order builds upon the provisions of Chapter 51.

Two-Year Certification Process

Upon approval by the State, the Certification and Disclosure of Political Contributions form (CH51.1R1/21/2009) is valid for a two (2) year period. Thus, if a vendor receives approval on Jan 1, 2009, the certification expiration date would be Dec 31, 2011. Any change in the vendor’s ownership status and/or political contributions during the two-year period will require the submission of new Chapter 51/EO117 forms to the State Review Unit. Please note that it is the vendor’s responsibility to file new forms with the State should these changes occur.

Prior to the awarding of a contract, the agency should first send an e-mail to CD134@treas.state.nj.us to verify the certification status of the vendor. If the response is that the vendor is NOT within an approved two-year period, then forms must be obtained from the vendor and forwarded for review. If the response is that the vendor is within an approved two-year period, then the response so stating should be placed with the bid/contract documentation for the subject project.

Instructions for Completing the Forms

NOTE: Please refer to the next section, “Useful Definitions for Purposes of Ch. 51 and E.O. 117,” for guidance when completing the forms.

Part 1: VENDOR INFORMATION

Business Name – Enter the full name of the Vendor, including trade name if applicable.

Business Type -- Select the vendor’s business organization from the list provided.

Address, City, State, Zip and Phone Number -- Enter the vendor’s street address, city, state, zip code and telephone number.

Vendor Email – Enter the vendor’s primary email address.

Vendor FEIN – Please enter the vendor’s Federal Employment Identification Number.
INFORMATION AND INSTRUCTIONS
For Completing The “Two-Year Vendor Certification and Disclosure of Political Contributions” Forms


Read the following statements and verify that from the period beginning on or after October 15, 2004, no contributions as set forth at subsections 1(a)-(c) have been made by either the vendor or any individual whose contributions are attributable to the vendor pursuant to Executive Order 117 (2008).

NOTE: Contributions made prior to November 15, 2008 are applicable to Chapter 51 only.

Part 3: DISCLOSURE OF CONTRIBUTIONS MADE

Check the box at top of page 2 if no reportable contributions have been made by the vendor. If the vendor has no contributions to report, this box must be checked.

Name of Recipient Entity – Enter the full name of the recipient entity.

Address of Recipient Entity – Enter the recipient entity’s street address.

Date of Contribution – Indicate the date of the contribution.

Amount of Contribution – Enter the amount of the reportable contribution.

Type of Contribution – Select the type of contribution from the list provided.

Contributor Name – Enter the full name of the contributor.

Relationship of Contributor to the Vendor – Indicate relationship of the contributor to the vendor, e.g. officer or partner of the company, spouse of officer or partner, resident child of officer or partner, parent company of the vendor, subsidiary of the vendor, etc.

NOTE: If form is being completed electronically, click “Add a Contribution” to enter additional contributions. Otherwise, please attach additional pages as necessary.

Part 4: CERTIFICATION

Check box A if the person completing the certification and disclosure is doing so on behalf of the vendor and all individuals and/or entities whose contributions are attributable to the vendor.

Check box B if the person completing the certification and disclosure is doing so on behalf of the vendor only.

Check box C if the person completing the certification and disclosure is doing so on behalf of an individual and/or entity whose contributions are attributable to the vendor.

Enter the full name of the person authorized to complete the certification and disclosure, the person’s title or position, date and telephone number.
INFORMATION AND INSTRUCTIONS
For Completing The “Two-Year Vendor Certification and Disclosure of Political Contributions” Forms

USEFUL DEFINITIONS FOR THE PURPOSES OF Ch. 51 and E.O. 117

- “Vendor” means the contracting entity.

- “Business Entity” means any natural or legal person, business corporation, professional services corporation, limited liability company, partnership, limited partnership, business trust, association or any other legal commercial entity organized under the laws of New Jersey or any other state or foreign jurisdiction. The definition also includes (i) if a business entity is a for-profit corporation, any officer of the corporation and any other person or business entity that owns or controls 10% or more of the stock of the corporation; (ii) if a business entity is a professional corporation, any shareholder or officer; (iii) if a business entity is a general partnership, limited partnership or limited liability partnership, any partner; (iv) if a business entity is a sole proprietorship, the proprietor; (v) if the business entity is any other form of entity organized under the laws of New Jersey or any other state or foreign jurisdiction, any principal, officer or partner thereof; (vi) any subsidiaries directly or indirectly controlled by the business entity; (vii) any political organization organized under 26 U.S.C.A. § 527 that is directly or indirectly controlled by the business entity, other than a candidate committee, election fund, or political party committee; and (viii) with respect to an individual who is included within the definition of “business entity,” that individual’s spouse or civil union partner and any child residing with that person.1

- “Officer” means a president, vice-president with senior management responsibility, secretary, treasurer, chief executive officer, or chief financial officer of a corporation or any person routinely performing such functions for a corporation. Please note that officers of non-profit entities are excluded from this definition.

- “Partner” means one of two or more natural persons or other entities, including a corporation, who or which are joint owners of and carry on a business for profit, and which business is organized under the laws of this State or any other state or foreign jurisdiction, as a general partnership, limited partnership, limited liability partnership, limited liability company, limited partnership association, or other such form of business organization.

- “Reportable Contributions” are those contributions, including in-kind contributions, in excess of $300.00 in the aggregate per election made to or received by a candidate committee, joint candidates committee, or political committee; or per calendar year made to or received by a political party committee, legislative leadership committee, or continuing political committee.

- “In-kind Contribution” means a contribution of goods or services received by a candidate committee, joint candidates committee, political committee, continuing political committee, political party committee, or legislative leadership committee, which contribution is paid for by a person or entity other than the recipient committee, but does not include services provided without compensation by an individual volunteering a part of or all of his or her time on behalf of a candidate or committee.

- “Continuing Political Committee” includes any group of two or more persons acting jointly, or any corporation, partnership, or any other incorporated or unincorporated association, including a political club, political action committee, civic association or other organization, which in any calendar year contributes or expects to contribute at least $4,300 to aid or promote the candidacy of an individual, or the candidacies of individuals, for elective public office, or the passage or defeat of a public question, and which may be expected to make contributions toward such aid or promotion or passage or defeat during a subsequent election, provided that the group, corporation, partnership, association or other organization has been determined by the Commission to be a continuing political committee in accordance with N.J.S.A. 19:44A-8(b).

1 Contributions made by a spouse, civil union partner or resident child to a candidate for whom the contributor is eligible to vote or to a political party committee within whose jurisdiction the contributor resides are permitted.
INFORMATION AND INSTRUCTIONS
For Completing The “Two-Year Vendor Certification and Disclosure of Political Contributions” Forms

• “Candidate Committee” means a committee established by a candidate pursuant to N.J.S.A. 19:44A-9(a), for the purpose of receiving contributions and making expenditures.

• “State Political Party Committee” means a committee organized pursuant to N.J.S.A. 19:5-4.

• “County Political Party Committee” means a committee organized pursuant to N.J.S.A. 19:5-3.

• “Municipal Political Party Committee” means a committee organized pursuant to N.J.S.A. 19:5-2.

• “Legislative Leadership Committee” means a committee established, authorized to be established, or designated by the President of the Senate, the Minority Leader of the Senate, the Speaker of the General Assembly, or the Minority Leader of the General Assembly pursuant to N.J.S.A. 19:44A-10.1 for the purpose of receiving contributions and making expenditures.

• “Political Party Committee” means:
  1. The State committee of a political party, as organized pursuant to N.J.S.A. 19:5-4;
  2. Any county committee of a political party, as organized pursuant to N.J.S.A. 19:5-3; or
  3. Any municipal committee of a political party, as organized pursuant to N.J.S.A. 19:5-2.

Agency Submission of Forms
The agency should submit the completed and signed Two-Year Vendor Certification and Disclosure forms, together with a completed Ownership Disclosure form, either electronically to cd134@treas.state.nj.us or regular mail at Chapter 51 Review Unit, P.O. Box 039, 33 West State Street, 9th Floor, Trenton, NJ 08625. Original forms should remain with the Agency and copies should be sent to the Chapter 51 Review Unit.

Questions & Answers
Questions regarding the interpretation or application of Public Law 2005, Chapter 51 (N.J.S.A. 19:44A-20.13) or Executive Order 117 (2008) may be submitted electronically through the Division of Purchase and Property website at http://www.state.nj.us/treasury/purchase/execorder134.htm. Responses to previous questions are posted on the website, as well as additional reference materials and forms.

NOTE: The Chapter 51 Q&A on the website DOES NOT address the expanded pay-to-play requirements imposed by Executive Order 117. The Chapter 51 Q&A are only applicable to contributions made prior to November 15, 2008. There is a separate, combined Chapter 51/E.O. 117 Q&A section dealing specifically with issues pertaining to contributions made after November 15, 2008, available at http://www.state.nj.us/treasury/purchase/execorder134.htm#state.
State of New Jersey
Division of Purchase and Property
Two-Year Chapter 51/Executive Order 117 Vendor Certification and Disclosure of Political Contributions

General Information

Solicitation, RFP or Contract No. AWARD AMOUNT

Description of Services

Agency Contact Information

Agency Contact Person

Phone Number Agency Email

Part 1: Vendor Information

Full Legal Business Name

(Including trade name if applicable)

Business Type

Corporation Limited Partnership Professional Corporation General Partnership

Limited Liability Company Sole Proprietorship Limited Liability Partnership

Address 1 Address 2

City State Zip Phone

Vendor Email Vendor FEIN


I hereby certify as follows:

1. On or after October 15, 2004, neither the below-named entity nor any individual whose contributions are attributable to the entity pursuant to Executive Order 117 (2008) has solicited or made any contribution of money, pledge of contribution, including in-kind contributions, company or organization contributions, as set forth below that would bar the award of a contract to the vendor, pursuant to the terms of Executive Order 117 (2008).

   a) Within the preceding 18 months, the below-named person or organization has not made a contribution to:

      (i) Any candidate committee and/or election fund of any candidate for or holder of the public office of Governor or Lieutenant Governor;

      (ii) Any State, county, municipal political party committee; OR

      (iii) Any legislative leadership committee.

   b) During the term of office of the current Governor(s), the below-named person or organization has not made a contribution to

      (i) Any candidate, committee and/or election fund of the Governor or Lieutenant Governor; OR

      (ii) Any State, county or municipal political party committee nominating such Governor in the election preceding the commencement of said Governor’s term.

   c) Within the 18 months immediately prior to the first day of the term of office of the Governor(s), the below-named person or organization has not made a contribution to

      (i) Any candidate, committee and/or election fund of the Governor or Lieutenant Governor; OR

      Any State, county, municipal/political party committee of the political party nominating the successful gubernatorial candidate(s) in the last gubernatorial election.

PLEASE NOTE: Prior to November 15, 2008, the only disqualifying contributions include those made by the vendor or a principal owning or controlling more than 10 percent of the profits or assets of a business entity (or 10 percent of the stock in the case of a business entity that is a corporation for profit) to any candidate committee and/or election fund of the Governor or to any state or county political party within the preceding 18 months, during the term of office of the current Governor or within the 18 months immediately prior to the first day of the term of Office of Governor.
Part 3: Disclosure of Contributions Made

D Check this box if no reportable contributions have been made by the above-named business entity or individual.

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<th>Name of Recipient</th>
<th>Address of Recipient</th>
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<tr>
<th>Date of Contribution</th>
<th>Amount of Contribution</th>
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<th>Type of Contribution (i.e. currency, check, loan, in-kind)</th>
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<th>Relationship of Contributor to the Vendor</th>
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If this form is not being completed electronically, please attach pages for additional contributions as necessary. Otherwise click "Add a Contribution" to enter additional contributions.
Part 4: Certification

I have read the instructions accompanying this form prior to completing this certification on behalf of the above-named business entity. I certify that, to the best of my knowledge and belief, the foregoing statements by me are true. I am aware that if any of the statements are willfully false, I am subject to punishment.

I understand that this certification will be in effect for two (2) years from the date of approval, provided the ownership status does not change and/or additional contributions are not made. If there are any changes in the ownership of the entity or additional contributions are made, a new full set of documents are required to be completed and submitted. By submitting this Certification and Disclosure, the person or entity named herein acknowledges this continuing reporting responsibility and certifies that it will adhere to it.

(CHECK ONE BOX A, B or C)

D I am certifying on behalf of the above-named business entity and all individuals and/or entities whose contributions are attributable to the entity pursuant to Executive Order 117 (2008).

(A)

(B) D I am certifying on behalf of the above-named business entity only.

(C) D I am certifying on behalf of an individual and/or entity whose contributions are attributable to the vendor.

Signed Name ___________________________ Print Name ___________________________

Phone Number ___________________________ Date ___________________________

Title/Position ___________________________

Agency Submission of Forms

The agency should submit the completed and signed Two-Year Vendor Certification and Disclosure forms, together with a completed Ownership Disclosure form, either electronically to cd134@treas.state.nj.us, or regular mail at Chapter 51 Review Unit, P.O. Box 039, 33 West State Street, 4th Floor, Trenton, NJ 08625. The agency should save the forms locally and keep the original forms on file, and submit copies to the Chapter 51 Review Unit.
Pursuant to Public Law 2012, c. 25, any person or entity that submits a bid or proposal or otherwise proposes to enter into or renew a contract must complete the certification below to attest, under penalty of perjury, that the person or entity, or one of the person or entity's parents, subsidiaries, or affiliates, is not identified on a list created and maintained by the Department of the Treasury as a person or entity engaging in investment activities in Iran. If the Director finds a person or entity to be in violation of the principles which are the subject of this law, s/he shall take action as may be appropriate and provided by law, rule or contract, including but not limited to, imposing sanctions, seeking compliance, recovering damages, declaring the party in default and seeking debarment or suspension of the person or entity.

I certify, pursuant to Public Law 2012, c. 25, that the person or entity listed above for which I am authorized to bid/renew:

- is not providing goods or services of $20,000,000 or more in the energy sector of Iran, including a person or entity that provides oil or liquefied natural gas tankers, or products used to construct or maintain pipelines used to transport oil or liquefied natural gas, for the energy sector of Iran, AND
- is not a financial institution that extends $20,000,000 or more in credit to another person or entity, for 45 days or more, if that person or entity will use the credit to provide goods or services in the energy sector in Iran.

In the event that a person or entity is unable to make the above certification because it or one of its parents, subsidiaries, or affiliates has engaged in the above-referenced activities, a detailed, accurate and precise description of the activities must be provided in part 2 below to the Division of Purchase and Property under penalty of perjury. Failure to provide such will result in the proposal being rendered as non-responsive and appropriate penalties, fines and/or sanctions will be assessed as provided by law.

PART 2: PLEASE PROVIDE FURTHER INFORMATION RELATED TO INVESTMENT ACTIVITIES IN IRAN

You must provide a detailed, accurate and precise description of the activities of the bidding person/entity, or one of its parents, subsidiaries or affiliates, engaging in the investment activities in Iran outlined above by completing the boxes below.

EACH BOX WILL PROMPT YOU TO PROVIDE INFORMATION RELATIVE TO THE ABOVE QUESTIONS. PLEASE PROVIDE THOROUGH ANSWERS TO EACH QUESTION. IF YOU NEED TO MAKE ADDITIONAL ENTRIES, PLEASE ADD AN ADDITIONAL SHEET.

| Name | Relationship to Bidder/Offeror |
|------|--------------------------------|---|
|      |                                |---|

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<tr>
<th>Bidder/Offeror Contact Name</th>
<th>Contact Phone Number</th>
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Certification: I, being duly sworn upon my oath, hereby represent and state that the foregoing information and any attachments thereto to the best of my knowledge are true and complete. I attest that I am authorized to execute this certification on behalf of the above-referenced person or entity. I acknowledge that the State of New Jersey is relying on the information contained herein and thereby acknowledge that I am under a continuing obligation from the date of this certification through the completion of any contracts with the State to notify the State in writing of any changes to the answers of information contained herein. I acknowledge that I am aware that it is a criminal offense to make a false statement or misrepresentation in this certification, and if I do so, I recognize that I am subject to criminal prosecution under the law and that it will also constitute a material breach of my agreement(s) with the State of New Jersey and that the State at its option may declare any contract(s) resulting from this certification void and unenforceable.

Full Name (Print): ___________________________ Signature: ___________________________

Title: ___________________________ Date: ___________________________
MACBRIDE PRINCIPLES FORM

BIDDER'S REQUIREMENT: TO PROVIDE A CERTIFICATION IN COMPLIANCE WITH MACBRIDE PRINCIPLES AND NORTHERN IRELAND ACT OF 1989

Pursuant to Public Law 1995, c. 134, a responsible bidder selected, after public bidding, by the Director of the Division of Purchase and Property, pursuant to N.J.S.A. 52:34-12, or the Director of the Division of Building and Construction, pursuant to N.J.S.A. 52:32-2, must complete the certification below by checking one of the two representations listed and signing where indicated. If a bidder who would otherwise be awarded a purchase, contract or agreement does not complete the certification, then the Directors may determine, in accordance with applicable law and rules, that it is in the best interest of the State to award the purchase, contract or agreement to another bidder who has completed the certification and has submitted a bid within five (5) percent of the most advantageous bid. If the Directors find contractors to be in violation of the principles which are the subject of this law, they shall take such action as may be appropriate and provided by law, rule or contract, including but not limited to, imposing sanctions, seeking compliance, recovering damages, declaring the party in default and seeking debarment or suspension of the party.

I certify, pursuant to N.J.S.A. 52:34-12.2 that the entity for which I am authorized to bid:

☐ has no ongoing business activities in Northern Ireland and does not maintain a physical presence therein through the operation of offices, plants, factories, or similar facilities, either directly or indirectly, through intermediaries, subsidiaries or affiliated companies over which it maintains effective control; or

☐ will take lawful steps in good faith to conduct any business operations it has in Northern Ireland in accordance with the MacBride principles of nondiscrimination in employment as set forth in N.J.S.A. 52:18A-89.8 and in conformance with the United Kingdom’s Fair Employment (Northern Ireland) Act of 1989, and permit independent monitoring of their compliance with those principles.

I certify that the foregoing statements made by me are true. I am aware that if any of the foregoing statements made by me are willfully false, I am subject to punishment.

Signature: ____________________________________________

Print Name: __________________________________________

Title: ________________________________________________

Firm Name: __________________________________________

Date: ____________________
VENDOR QUALIFICATION SHEETS

Vendors are requested to submit evidence of qualifications to meet all requirements as required by the Office of Finance & Business Services at The College of New Jersey by providing the information listed below.

If this information is being requested as part of an RFP or RFQ, vendors may be requested to furnish additional information for clarification purposes. This will in no way change the vendor’s original proposal.

TO BE COMPLETED BY VENDOR

1. Please list the types of commodities that your company can provide.
   
   A.
   
   B.
   
   C.

2. The number of years your firm has been providing these services. _____ Year(s)

3. Location of vendor's office that will be responsible for managing contract/service:
   
   Name: __________________________________________
   
   Telephone: ______________________ Fax:____________________________
   
   Email Address: ________________________________________________
   
   Street Address: ________________________________________________
   
   City/State/Zip: ________________________________________________

   Federal Identification Number: ________________________________

4. Address where all purchase orders and payment are to be mailed by users of any contract(s) resulting from this proposal (if different from above).

   Purchase Orders:
   
   Firm Name: ________________________________________________
   
   Street Address: ________________________________________________
   
   City/State/Zip: ________________________________________________

   Remittances:
   
   Firm Name: ________________________________________________
   
   Street Address: ________________________________________________
   
   City/State/Zip: ________________________________________________
5. Name of insurance company:
   Street Address:__________________________________________
   City/State/Zip:__________________________________________
   Types of Insurance:______________________________________

6. Name of individual to contact for sales/services information:
   Name:____________________________________________________
   Telephone:______________________________________________
   Email Address:___________________________________________
   Street Address:__________________________________________
   City/State/Zip:___________________________________________

7. List the names and titles of personnel who will service this contract:
   ________________________________________________________
   ________________________________________________________

8. Is your firm registered with the Secretary of State of New Jersey?  Yes____ No____
9. Is your firm incorporated?                                    Yes____ No____
   A) In What State? ____________________________

10. Is your firm considered a small business in the State of New Jersey? If yes, please attach a certificate or certification statement from the New Jersey Commerce and Economic Growth Commission. If no and you would like to register, please contact the New Jersey Commerce and Economic Growth Commission at 609-777-0885.
    Small Business:                                            Yes____ No____
    A) What category does your firm fall under?
       Gross Revenues do not exceed $500,000 _______
       Gross Revenues do not exceed $5 million _______
       Gross Revenues do not exceed $12 million _______
Under Executive Order 34, TCNJ is responsible for soliciting demographic information from its vendors. TCNJ is required to seek the following information from each firm under contract with us:

1. Is more than fifty percent (50%) of your company minority owned? (circle one)  YES  NO
   (African-American, Hispanic, Asian, and/or Native American)

2. Is more than fifty percent (50%) of your company woman owned? (circle one)  YES  NO

3. What is the ethnicity of the owner of your company: (check applicable according to 51% ownership)
   ... Asian American
   ... Multiple Ethnicities
   ... Non-Minority
   ... Hispanic American
   ... African American
   ... Caucasian American Female
   ... Native American
   ... Unspecified

TCNJ is required to solicit the foregoing information. Your response, however, is strictly voluntary. Please be advised that any contracting decisions made by TCNJ will not be influenced in any way by your decision to provide the above information.

EXECUTIVE ORDER #34: MINORITY AND WOMEN BUSINESS ENTERPRISES

On September 15, 2006, Governor Corzine signed Executive Order 34 establishing a Division of Minority and Women Business Development. The Division is charged with administering and monitoring policies, practices, and programs to ensure that New Jersey owned minority and women business enterprises (MWBE) are afforded an equal opportunity to participate in New Jersey’s purchasing and procurement processes.

State entities are required to report to the Division the ethnic and gender composition of the vendors with which we do business.

VENDOR QUALIFICATIONS.

11. Please provide a list of former or present clients. Also, indicate the name of a contact person and telephone number for reference purposes. Any personnel from The College of New Jersey listed as a reference will not be considered a valid reference.

   A. Client Name:
      
      Contact Name:
      
      Telephone Number:
      
      Fax Number:
      
      Email Address:
      
   B. Client Name:
      
      Contact Name:
Telephone Number:
Fax Number:
Email Address:

C. Client Name:
   Contact Name:
   Telephone Number:
   Fax Number:
   Email Address:

D. Client Name:
   Contact Name:
   Telephone Number:
   Fax Number:
   Email Address:
VENDOR QUALIFICATIONS- continued

12. Please answer the following questions related to your prior experience:

   a. Has the bidder been found, though either court adjudication, arbitration, mediation, or other contractually stipulated alternate dispute resolution mechanism, to have: failed to provide or perform goods or services; or failed to complete the contract in a timely manner; or otherwise performed unsatisfactorily under a prior contract with the contracting unit? If yes, attach summary of details on a separate sheet.

      Yes_________   No_________  

   b. Has the bidder defaulted on a contract, thereby requiring the local unit to utilize the services of another contractor to provide the goods or perform the services or to correct or complete the contract? If yes, attach summary of details on a separate sheet.

      Yes_________   No_________  

   c. Has the bidder defaulted on a contract, thereby requiring the local unit to look to the bidder’s surety for completion of the contract or tender of the costs of completion? If yes, attach summary of details on a separate sheet.

      Yes_________   No_________  

   d. Has the bidder been debarred or suspended from contracting with any of the agencies or departments of the executive branch of the State of New Jersey at the time of contract award, whether or not the action was based on experience with the contracting unit. If yes, attach summary of details on a separate sheet.

      Yes_________   No_________  

Firm Name:________________________________________________________________________

Signature:________________________________________________________________________

Title:______________________________________________________________________________

Date:______________________________________________________________________________
CONTRACT FOR CONSTRUCTION

Agreement made on , 2015 between The College of New Jersey as the project owner, and, as the Construction Contractor

Contractor:
Address:

Project: Chiller Plant Improvements for STEM Building

1. EMPLOYMENT OF CONTRACTOR/PROJECT DESCRIPTION. The College employs the Contractor and the Contractor agrees to perform the construction for the project identified above. The project is described in the College's plans and specifications prepared by the project architect.

2. CONTRACT DOCUMENTS. This contract includes the plans and specifications, and also the following documents:

   1. Request for Bids
   2. Contractor's Bid
   3. General Conditions of the Contract for Construction
   4. Addenda and clarifications issued before the bid due date
   5. Project Bidding Schedule

3. PROJECT ARCHITECT. The project architect is responsible for the design of the project, acting as the College's representative on the project, and performing the duties of the project architect during the construction and completion of the project. The project architect is:

   AE Firm:
   Address:

4. SCOPE OF WORK. The Contractor shall perform the construction work specified in this contract including the contract documents. The Contractor shall assume full responsibility for constructing and completing the project and all the work in this contract and the contract documents, including providing all labor, subcontractors, materials and equipment required, and providing all supervision, management, and scheduling required in the general conditions and as noted throughout the contract documents.

5. CONTRACT TIMES. All dates and durations specified for the start of construction, the milestones dates specified in this contract and the substantial completion and final completion of the project are agreed to be of the essence.

   a. CONSTRUCTION START. The construction work shall start no later than 10 calendar days after the College issues a Notice to Proceed to the Contractor.

   b. MILESTONES. The construction tasks or activities shall be completed within the following number of calendar days after the construction start date (the actual dates will be set forth in the Notice to Proceed):
c. **SUBSTANTIAL COMPLETION.** The construction work and the project shall be substantially completed, meaning capable of being reasonably utilized for the purpose intended, within ______________ calendar days after the construction start date (the actual date will be set forth in the Notice to Proceed). Substantial Completion pertains to all milestone dates of the project schedule.

d. **FINAL COMPLETION.** The construction work, the project and the contract shall be finally completed within ______________ calendar days after the construction start date (the actual date will be set forth in the Notice to Proceed). The requirements for final completion are defined in the general conditions of the contract for construction as well as the technical specifications of the project.

e. **DELAYS AND EXTENSIONS OF CONTRACT DATES.**

1. **Delays Warranting Extensions.** If the Contractor is unavoidably prevented from completing any part of the work within the milestone, substantial completion or final completion dates in this contract by causes beyond the control and without the fault of the Contractor or its subcontractors, those contract dates will be extended by amounts equal to the time lost due to such delays, provided the Contractor requests extensions in accordance with the general conditions. The Contractor's right to extensions, the terms and conditions of extensions, and the right to extra compensation for certain extensions shall be governed by the general conditions.

2. **Requests for Extensions.** The Contractor must provide the College with a written notice of delay and request for an extension within 24 hours of the beginning of a delay, or it will not be entitled to an extension. Written notices and requests must comply with the general conditions, and the failure to submit them will preclude the Contractor from making any claim for an extension under the contract.

f. **EXTENSION TERMS.** The contract dates will be extended for the delays specified in the general conditions to the extent the delays prevent completion of the work required by the contract dates and shall be calculated in accordance with the general conditions. When there is a delay warranting an extension of the contract dates, the College is not required to authorize extra compensation to fund efforts to reduce or eliminate the effect of the delay, but if the College elects to do so, and requires such efforts as a change to the contract, the Contractor shall perform the extra work and be entitled to extra compensation for it under the change order provisions in the contract and the general conditions. The possibility of additional compensation to accelerate because of delays shall not apply to delays for which the Contractor is responsible under the contract and general conditions.

6. **LIQUIDATED DAMAGES FOR DELAY.** If the Contractor fails to substantially complete the project by the substantial completion date specified, the Contractor shall pay the following amounts as liquidated damages for delay for each calendar day that the project is not substantially complete beyond the substantial completion date. Liquidated damages shall be established at 1/20th of 1% of the base contract amount per calendar day.

The College and the Contractor agree that the actual loss to the College from construction delays and the inability to use the project in a substantially completed state are for the most part difficult to quantify, and that the foregoing liquidated damages formula results in damages amounts that are reasonable and are not penalties and are not intended to be penalties. The College and the Contractor agree that the amount of liquidated damages per calendar day for delays in the substantial completion of the project is a reasonable estimate of the damage to the College for not being able to use the project in a substantially completed state. The College may deduct liquidated damages from payments due under this contract, but its failure to
withhold liquidated damages to assert claims for liquidated damages shall not be deemed a waiver of the College’s right to withhold or to assert claims for damages for any delays which occur at any time on the project.

7. CONTRACT PRICE. The Contractor shall be paid $_____________ for the complete performance of this contract which was proposed by the Contractor in its bid and accepted by the College. The Contractor shall be entitled to additional compensation for authorized changes which include the cost of the changes and mark-ups included in change orders approved by the College in accordance with the change order provision in the general conditions.

8. PAYMENTS TO CONTRACTOR. The Contractor will be paid by the College in accordance with this paragraph and the general conditions in the contract.

   a. MONTHLY PROGRESS PAYMENTS. The College will make progress payments as the work proceeds based on written invoices submitted monthly by the Contractor and approved by the architect and the College. No payments will be made until the Contractor submits a unit schedule break down showing the portions of the total contract price for each principal category of work and value loaded CPM schedule allocating the contract price among the schedule activities. Monthly progress payment amounts shall be based on the percentages of the work completed as of the end of the pay period (less earlier payments). All payment requests or invoices and all payments shall be governed by the general conditions as well as the special requirements of this contract, including the requirement that progress payments shall be based on a unit schedule breakdown and a value loaded CPM schedule.

   b. RETAINAGE. The College will retain 2% of the amount due on each partial payment pending completion of the contract.

       Upon acceptance of the work performed pursuant to the contract, all amounts being withheld by the College shall be released and paid in full to the contractor within 45 days of the final acceptance date agreed upon by the contractor and the State college, without further withholding of any amounts for any purpose whatsoever, provided that the contract has been completed as indicated. The holding and release of retainage shall be governed by the general conditions.

   c. CHANGE ORDERS. The Contractor shall invoice for change order work in the monthly contract progress payment invoices as the change order work is performed, but only after a written change order and TCNJ issued Purchase Order has been signed by the College.

   d. FINAL PAYMENT. Upon final completion of all work included in the contract including all change orders, upon acceptance of the work by the architect and the College, upon the satisfactory completion of all of the requirements in the general conditions for completion, and upon the issuance of the certificate of final completion, the Contractor will be paid the fully adjusted contract balance including any retainage withheld. The invoice for final payment and final payment shall also be subject to the general conditions and the special requirements of this contract.

   e. PAYMENT TERMS. All invoices and payments shall also be subject to the general conditions, including the provisions regarding payments, and to the right of the College to withhold payments or to make deductions from payments. See also the Prevailing Wage Act requirements in paragraph 22. The College will pay proper final invoices within 30 days of their submission to the College with the approval of the architect.
f. **SUBMISSION OF INVOICES:** Prior to the submission of the invoice, the contractor will submit to the owner and architect, in draft form, a “pencil copy” of the monthly invoice for review and approval setting forth each line item the contractor intends to request payment in that invoice based on the claimed percent completed for that line item. Upon receipt of said “pencil copy”, the owner and architect shall observe the work and in place and, on the basis of such observations, will either approve the amounts requested or modify the contractor’s request, based on the owners independent assessment of the work in place. The owner will then return the pencil copy invoice to the contractor for the contractor to then adjust and submit the final invoice with the agreed to percentages completed per line item to the owner for payment. No invoice shall be submitted for payment until all amounts and completion percentages have been determined in this manner.

g. For the purposes of the State’s Prompt Payment of Contractors and Subcontractors Act (N.J.S.A. 2A:30A-1, et seq.)

(1) An invoice will be deemed to have been received when it is received by the owner at the address designated in the pre-construction conference for receipt of the invoices.

(2) The “billing date” as that term is used in N.J.S.A. 2A:30A-2 shall be the earlier of the date upon which an invoice for payment is approved for payment or 20 days after the invoice is received, unless within such 20 day period the invoice is found to be incomplete or otherwise unacceptable and returned to the contractor, with a written explanation of deficiencies.

(3) In the event that an invoice is found to be deficient and returned to the contractor, the “billing date” shall be calculated from the date that a corrected invoice is received.

(4) Payment shall be considered to have been made on the date on which a check for such payment is dated.

(5) Payment terms (e.g. “net 20”) offered by the contractor shall not govern the owners obligation to make payment.

(6) The following periods of time will not be included in the calculation of the due date of any contractor invoice:

- Anytime elapsed between receipt of an improper invoice and its return to the contractor, not to exceed 20 calendar days; or

- Any time elapsed between the owner’s return of an improper invoice to the contractor and the owner’s receipt of a corrected invoice.

h. **LIMITATIONS ON APPLICABILITY:** The provisions of this Article shall not govern the owner’s payment obligations nor shall they supersede or modify any other contractual provision allowing the withholding of monies from the contractor to the extent that the contractor has not performed in accordance with the provisions of the contract. Nor shall this Article govern the owner’s payment obligations nor supersede or modify any other contractual provision governing contractor claims for additional compensation beyond the base contract price and approved change orders.

i. **INTEREST:** Interest shall be payable on amounts due the contractor if not paid within thirty (30) calendar days after the billing date specified in the above subparagraph, as provided under the State’s Prompt Payment of Contractors and Subcontractors Act. Interest on amounts due shall be payable to the contractor for the period beginning on the day after the required payment date and ending on the date on which the check for payment is drawn. Interest may be paid by separate payment to the contractor, but shall be paid within 30 days of payment of the principal amount of the approved invoice. Nothing in this article shall be construed as entitling the contractor to payment of interest on any sum withheld by the owner for any reason permitted under the contract or applicable law, or on any claim for additional compensation, over and above sums due under the base contract or approved change orders.
j. **SUSPENSION OF PERFORMANCE:** A contractor not paid sums due under an approved invoice within thirty (30) days of the billing date may suspend performance without penalty for breach of contract, but only after providing the owner with seven (7) days written notice of non-payment, and only in the event that the owner fails to furnish the contractor, within that seven day period, with a written statement of the amount withheld and the reasons for the withholding. Nothing herein shall be construed to excuse the contractor’s nonperformance, or to limit the owner’s rights and remedies relating to such nonperformance, with regard to any monies withheld from the contractor upon the proper notice provided under this Article, or with regard to any contractor claim disputed by the owner.

k. **Alternative Dispute Resolution:** Disputes regarding nonpayment of a contractor’s invoice under this Article may be submitted to a mediator upon agreement of the College. In such event, the College and the contractor shall share equally the fees and expenses of the selected mediator. Provided, however, that nothing herein shall be construed, in whole or in part, as a waiver, release or modification of the provisions of the New Jersey Contractual Liability Act, N.J.S.A. 59:13-1, et seq., as it governs claims against the College.

9. **CHANGES, CHANGE ORDERS AND CHANGE ORDER DELAYS.** The College may at any time authorize and direct written changes in the work which change the scope of the work and which increase or decrease the contract price. All changes including adjustments of the contract price shall be governed by this paragraph and the change order provision in the general conditions. If a change issued by the College delays the completion of any activity in the project CPM schedule, the time allowed for that activity shall be extended, and if a delay in that activity delays other activities, the critical path or the completion dates in the contract, then they too will be extended. The Contractor shall make reasonable efforts in scheduling changed work so that it does not delay or extend activities in the CPM schedule critical path, including the substantial and final project completion dates. The Contractor shall also make alternate proposals for change order work which include acceleration for the changed work where feasible to achieve this goal, and shall include the cost of such efforts in its change order requests and proposals. Change orders must specify whether they result in any delay (or extension) to any activities in the schedule, including an identification of the activities and the amount of delay in each. If no delay or extension is specified in a change order, it will be deemed an agreement by the College and the Contractor that no delay or extension results from the change order.

10. **CONTRACTOR’S REPRESENTATIONS.** The Contractor represents to the College that it has:

a. **EXAMINATION OF CONTRACT DOCUMENTS.** Examined and carefully studied the contract documents and the other documents in the bid documents, and that they are sufficient for performing the contract work at the contract price.

b. **EXAMINATION OF SITE.** Visited the site and become familiar with and is satisfied as to the general, local and site conditions that may affect the cost, progress, and performance of the contract work.

c. **FAMILIARITY WITH LAW.** Familiarized itself with all federal, state, and local laws and regulations that may affect the cost, progress, and performance of the contract work.

d. **FAMILIARITY WITH OTHER INFORMATION AND OTHER DOCUMENTS.** Carefully studied all reports of investigations and tests of site and subsurface conditions at or contiguous to the site and all drawings of physical conditions at the site including surface or subsurface composition, water, structures and utilities at or near to the site.
e. **ADDITIONAL INFORMATION NOT REQUIRED FOR BIDDING OR CONTRACT PERFORMANCE.** Does not consider that any further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the work at the contract price.

11. **ASSIGNMENT OF CONTRACT.** The Contractor may not assign this contract or any rights under or interests in the contract including its right to payments under the contract.

12. **CONTRACTOR PERSONNEL ASSIGNED.** The College reserves the right to request and have any member of the contractor’s or subcontractor’s staff replaced on the project for any reason.

13. **DOMESTIC MATERIALS - N.J.S.A. 52:33-2.** Notwithstanding any inconsistent provision of any law, and unless the head of the department, or other public officer charged with the duty by law, shall determine it to be inconsistent with the public interest, or the cost to be unreasonable, only domestic materials shall be acquired or used for any public work.

   This section shall not apply with respect to domestic materials to be used for any public work, if domestic materials of the class or kind to be used are not mined, produced or manufactured, as the case may be, in the United States in commercial quantities and of a satisfactory quality.

14. **NOTIFICATIONS/AUTHORIZED REPRESENTATIVE:**

   a. **Notice to the Contractor.** Written notices to the Contractor should be addressed to:

   __________________________________________________________________________
   __________________________________________________________________________
   __________________________________________________________________________

   b. **Notice to the College/Authorized Representative:** Written notices from the Contractor to the College should be addressed to:

   The College of New Jersey
   PO Box 7718,
   Ewing, New Jersey 08628

   The College’s contracting officer hereby authorizes the Owner’s project representative to receive all contract related correspondence.

15. **CLAIMS BY THE CONTRACTOR.**

   a. **GENERAL PROVISIONS APPLICABLE TO ALL CLAIMS.** Claims by the Contractor against the College shall be subject to the New Jersey Contractual Liability Act, N.J.S.A. 59:13-1, et seq. including the notice and time for suit provisions. For the purpose of determining the time within which The Contractor must file suit under the New Jersey Contractual Liability Act, 'completion of the contract' shall be deemed to have occurred upon achievement of substantial completion as defined in section 12A of these General Conditions.
The Contractor also agrees that it shall not be entitled to assert claims against the College for any compensation beyond that provided for in this contract by reason of the acts or omissions of any third parties, including but not limited to the project architect and any other contractor on this project. The Contractor also agrees that it may not assert claims for extra costs for home office expenses, home office overhead, lost profits or revenue or consequential damages as that term is defined in law. All claims shall also be subject to the terms of this contract including the general conditions, and the Contractor may not assert any claims for extra costs unless it maintains all the records of its estimated and actual costs as required by paragraph 16 and the general conditions. The Contractor also agrees that suits against the College must be pursued in the county where the project is located.

1. Notice of litigation shall be filed in writing with the other party to the Owner-Contractor Agreement and with the court having competent jurisdiction and a copy shall be filed with the Architect and the Construction Manager. The litigation shall be made within the time limits specified herewith where applicable, and in all other cases within a reasonable time after the claim, dispute and other matter in question has arisen, and in no event shall it be made after the date when institution of legal or equitable proceedings based on such claim, dispute or other matter in question would be barred by the applicable statute of limitations.

2. Unless otherwise agreed in writing, the Contractor shall carry on the Work and maintain its progress during any proceedings, and the Owner shall continue to make payments to the Contractor in accordance with the Contract Documents.

   b. DELAY CLAIMS. The Contractor agrees that it may not assert claims for extra compensation by reason of any delays in its work resulting from acts or omissions of any third parties irrespective of extensions granted under paragraph 5, including but not limited to delays caused by third parties such as the project architect, other contractors, utilities and governmental authorities. The College shall only be required to pay additional compensation for delays caused by the College itself, and only to the extent required by N.J.S.A. 2A:58B-3 (delayed performance caused by the College's own negligence, bad faith, active interference or other tortuous conduct, but not for reasons contemplated by the parties and not for the negligence of others including others under contract with the College on the theory that such negligence should be imputed to the College). The College shall not be liable for any period of delay when there is a concurrent delay for which it is not responsible. Finally, the Contractor also agrees that it can only assert claims for extra costs due to delays for extra costs at the job site, and may not assert claims for extra costs for home office expenses, home office overhead, lost profit or revenue, or consequential damages as that term is defined in law.

   c. CLAIMS BASED ON CONTRACT DOCUMENTS AND INFORMATION PRIOR TO BIDDING. The Contractor agrees that it can assert no claims for extra compensation beyond the bid and contract price for constructing the completed project by reason of any errors, omissions or deficiencies in the contract documents to the extent that a reasonably competent contractor should discovery the error, omission or deficiency in connection with the preparation of a bid because of its obligation to review and study the bid documents before submitting its bid, and because of its representation in paragraph 10 that it did so. In addition, the Contractor agrees that it can assert no claims for extra compensation beyond the bid and contract price for constructing the completed project by reason any lack of information affecting the construction of the project at the time of bidding, or errors in the information included or referenced in the
bid documents except to the extent permitted by Article 1 of the general conditions. The Contractor shall notify the College in writing before submitting its bid of any errors or omissions in the information provided or be precluded from seeking extra compensation or asserting a claim.

d. **MEDIATION.** If a dispute or claim arises out of or relates to this contract, or the breach thereof, and if the dispute cannot be settled through negotiation, the parties agree first to try in good faith to settle the dispute by mediation administered by the American Arbitration Association under its Construction Industry Mediation Rules before resorting to arbitration or litigation. The Owner reserves the right to request a mediation if it deems it necessary.

16. **COST RECORDS FOR EXTRAS, AUDITS, CLAIMS:** Pursuant to N.J.A.C. 17:44-2.2, the Contractor shall maintain all documentation related to products, transactions or services under this contract for a period of five years from the date of final payment. Such records shall be made available to the New Jersey Office of the State Comptroller upon request.

The Contractor shall maintain and retain weekly payroll, material, subcontractor, supplier, overhead and other cost and accounting records for the project, and for additional services or extras required by the College, including all costs which the Contractor is entitled to be paid under the contract. The Contractor shall require its subcontractors on the project to do likewise. The Contractor shall also maintain all estimates and takeoffs used in preparing and calculating its bid price. The records shall be maintained and shall be made available to the College or its representatives when requested. These records shall be maintained in accordance with generally accepted accounting principles and practices for a period of 5 years after final payment is received by the Contractor, or the duration of any dispute or lawsuit arising out of the project, whichever is later. Any failure to maintain or produce such records shall preclude the Contractor from being paid or retaining any payments which are based on costs or which should be, and expenses of it or its subcontractors including extra costs which are reflected in the records. This includes the basic contract compensation as well as extra compensation for change orders and claims of any kind.

17. **INDEMNITY/LIABILITY TO THIRD PARTIES:** The Contractor agrees to defend, indemnify and save harmless the College and its officers, agents, servants and employees from and against any and all suits, demands, claims, losses and damages of any kind arising out of, or claimed to have arisen out of any negligent act, error, omission or breach by the Contractor, its officers, agents, servants, employees, consultants, subcontractors or suppliers, in the performance of this contract. The Contractor shall, at its own expense, defend, and pay all charges for attorneys and all costs and other expenses arising from such suits or claims. If any judgment is rendered against the College or any of its officers, agents, servants or employees for which indemnification is required under this paragraph, the Contractor shall satisfy and discharge it. The College shall give prompt written notice to the Contractor of claims and suits for which indemnity is required in this paragraph.

18. **INSURANCE BY THE CONTRACTOR:** The Contractor shall procure and maintain at its own expense, insurance for damages imposed by law and assumed under this contract until at least 1 year after the completion and acceptance of the project. The insurance shall be of the kinds and in the amounts required in this paragraph, and shall be issued by insurance companies approved to do business in New Jersey. The College of New Jersey, the State of New Jersey, and the NJ Educational Facilities Authority shall be named as an additional insured on the Commercial General Liability Insurance policy. The Contractor expressly agrees that any insurance protection required by this
contract shall in no way limit the Contractor’s obligations under this contract, and shall not be construed to relieve the Contractor from liability in excess of such coverage. Nor shall it preclude the College from taking such actions as are available to it under any other provisions of this contract or law.

a. TYPES AND MINIMUM AMOUNTS OF INSURANCE REQUIRED:

   (1) Commercial General Liability Insurance (CGL). Commercial General Liability insurance ISO 1088 or later occurrence form of insurance including contractual liability with limits of at least $5,000,000 combined single limit for bodily injury and property damage liability for each occurrence. The CGL policy shall also include products/completed operations with limits of at least $5,000,000 per occurrence. This insurance shall be maintained for at least 1 year after the completion of the project.

   (2) Automobile Liability Insurance. The Automobile Liability Insurance policy shall cover owned, non-owned and hired vehicles and have limits of at least $1,000,000 combined single limit for bodily injury and property damage for each occurrence.

   (3) Workers Compensation/ Employer Liability. Workers Compensation Insurance shall be maintained by the Contractor and all subcontractors in accordance with the requirements of the law of New Jersey. They shall also maintain Employer's Liability insurance with limits of at least $500,000 for each occurrence.

b. EVIDENCE OF INSURANCE. The Contractor shall when this contract is signed and before beginning the work required under this contract, provide the College with valid certificates of insurance signed by an insurance provider or authorized agent or underwriter to evidence the Contractor’s insurance coverage as required in this paragraph, and also copies of the policies themselves. The certificates of insurance shall specify that the insurance provided is of the types and in the amounts required in this paragraph, and that the policies cannot be canceled except after 30 days written notice to the College.

c. CANCELLATION. The certificates of insurance shall provide for 30 days written notice to the College before any cancellation, expiration or non-renewal during the term the insurance is required by this contract. The Contractor shall also be required to provide the College with valid certificates of renewal when policies expire. The Contractor shall also, when requested, provide the College with additional copies of each policy required under this contract, which are certified by an agent or underwriter to be true copies of the policies issued to the Contractor.

d. REMEDIES FOR LACK OF INSURANCE. If the Contractor fails to renew any of its required insurance policies, or any policy is canceled, terminated or modified, the College may refuse to pay monies due under this contract. The College, in its sole discretion and for its sole benefit, may use monies retained under this paragraph to attempt to renew the Contractor’s insurance or obtain substitute coverage if possible for the College's sole benefit, and may invoke other applicable remedies under the contract including claims against the Contractor and its surety. During any period when the
required insurance is not in effect, the College may also, in its sole discretion, either suspend the work under the contract or terminate the contract.

19. **PAYMENT AND PERFORMANCE BOND.** The Contractor is required to furnish the College with a payment bond and a performance bond from an approved surety as described in the general conditions and bid documents. They shall conform to N.J.S.A. 2A:44-147. This contract will not become effective until these bonds are provided to and approved by the College. The bonds must also be accompanied by the surety disclosure statement and certification required by N.J.S.A. 18A:64-68.

20. **ABANDONMENT, POSTPONEMENT, TERMINATION OF PROJECT:** The College reserves the right to terminate this contract for convenience at any time by written notice to the Contractor. Unless otherwise directed, the Contractor shall immediately stop all work upon receipt of such a notice. The College also reserves the right to suspend performance and to terminate for default or improper performance by the Contractor. The rights and duties of the Contractor and the College in the event of a termination or a suspension shall be governed by the general conditions.

21. **CONTRACT TERMS, CHANGES, AND LAW:** This contract (including the completed checklist which is attached) constitutes the entire agreement between the College and the Contractor, and it shall be governed by the law of New Jersey. The terms and conditions of this contract may not be changed except by a writing signed by the Contractor and the College.

22. **PREVAILING WAGE STATUTE.** The Contractor must comply with the New Jersey Prevailing Wage Act, N.J.S.A. 34:11-56.25 through 56.57. Workers employed by the Contractor or any subcontractor or sub-subcontractor in the performance of services directly on the project must be paid prevailing wages. As required by N.J.S.A. 34:11-56.27 and 56.28, this contract cannot become effective until the College obtains from the New Jersey Department of Labor a determination of the prevailing wage rates applicable to the project as of the contract award date and attaches a copy to the contract. As required by N.J.S.A. 34:11-56.27, the Contractor or any subcontractor may be terminated if any covered worker is not paid prevailing wages on the project, and the Contractor and its surety shall be liable for any additional costs which result. The Contractor and its subcontractors must be registered with the New Jersey Department of Labor (N.J.S.A. 34:11-56.51 et seq.), and the prevailing wage rates must be posted at the job site (N.J.S.A. 34:11-56.32). The Contractor and its subcontractors must prepare accurate certified records of wages paid for each worker on the project (N.J.S.A. 34:11-56.29), and copies for the period covered by each invoice must be attached to the invoice submitted under the contract. In accordance with N.J.S.A. 34:11-56.33, the Contractor's final invoice must include a statement of all amounts still due to workers on the project. The Contractor is also cautioned that it must use job titles and worker classifications consistent with those approved by the Department of Labor, and that, if it intends to pay apprentice rates, it must comply with the Department of Labor's regulations at N.J.A.C. 12:60-7.1 through 7.4.

23. **DISCRIMINATION IN EMPLOYMENT.** The Contractor and any subcontractors employed by it shall comply with N.J.S.A. 10:2-1 through 10:2-4 and N.J.S.A. 10:5-1 et seq., including N.J.S.A. 10:5-31 through 35, which prohibit discrimination in employment in public contracts. The statute and the rules and regulations promulgated thereunder shall be considered to be part of this contract and binding upon the Contractor and its subcontractors. If the College is notified of any violation of the public contract awarding regulations in accordance with N.J.A.C. 17:27-7.4 concerning the financing of minority and women outreach and training programs, the College reserves the rights to deduct the outreach and training allocation from the contract. During the performance of this contract, the Contractor agrees that:
a. In the hiring of persons for the performance of work under this contract or any subcontract hereunder, or for the procurement, manufacture, assembling or furnishing of any such materials, equipment, supplies or services to be acquired under this contract, no contractor, nor any person acting on behalf of such contractor or subcontractor, shall, by reason of race, creed, color, national origin, ancestry, marital status, gender identity or expression, affectional or sexual orientation or sex, discriminate against any person who is qualified and available to perform the work to which the employment relates;

b. No contractor, subcontractor, nor any person on his behalf shall, in any manner, discriminate against or intimidate any employee engaged in the performance of work under this contract or any subcontract hereunder, or engaged in the procurement, manufacture, assembling or furnishing of any such materials, equipment, supplies or services to be acquired under such contract, on account of race, creed, color, national origin, ancestry, marital status, gender identity or expression, affectional or sexual orientation or sex;

c. There may be deducted from the amount payable to the contractor by the contracting public agency, under this contract, a penalty of $50.00 for each person for each calendar day during which such person is discriminated against or intimidated in violation of the provisions of the contract; and

d. This contract may be canceled or terminated by the contracting public agency, and all money due or to become due hereunder may be forfeited, for any violation of this section of the contract occurring after notice to the contractor from the contracting public agency of any prior violation of this section of the contract.

24. **COMPLIANCE WITH PROCUREMENT STATUTES:** The Contractor warrants and represents that this contract has not been solicited or secured, directly or indirectly, in a manner contrary to the law of New Jersey, and in particular the provisions of N.J.S.A. 18A:64-6.1, 6.2 and 6.3, and that the Contractor has not and shall not violate the law of New Jersey relating to the procurement of or the performance of this contract by any conduct, including the paying of any gratuity of any kind, directly or indirectly, to any College employee or officer. Any violation of this provision shall be cause for the College to terminate this contract, to retain all unpaid and/or unearned monies, and to recover all monies paid. The Contractor shall notify the College in writing of any interest which any officer, employee or consultant of the College has in, or association with, any contractor, subcontractor, material supplier, consultant, or manufacturer, or other party which has any interest in this project.

25. **CONFLICT OF INTEREST:** a. No vendor shall pay, offer to pay, or agree to pay, either directly or indirectly, any fee, commission, compensation, gift, gratuity, or other thing of value of any kind to any State officer or employee or special State officer or employee, as defined by N.J.S.A. 52:13D-13b. and e., in the Department of the Treasury or any other agency with which such vendor transacts or offers or proposes to transact business, or to any member of the immediate family, as defined by N.J.S.A. 52:13D-13i., of any such officer or employee, or any partnership, firm, or corporation with which they are employed or associated, or in which such officer or employee has an interest within the meaning of N.J.S.A. 52:13D-13g.

b. The solicitation of any fee, commission, compensation, gift, gratuity or other thing of value by any State officer or employee or special State officer or employee from any State vendor shall be reported
in writing forthwith by the vendor to the Attorney General and the Executive Commission on Ethical Standards.

c. No vendor may, directly or indirectly, undertake any private business, commercial or entrepreneurial relationship with, whether or not pursuant to employment, contract or other agreement, express or implied, or sell any interest in such vendor to, any State officer or employee or special State officer or employee having any duties or responsibilities in connection with the purchase, acquisition or sale of any property or services by or to any State agency or any instrumentality thereof, or with any person, firm or entity with which he is employed or associated or in which he has an interest within the meaning of N.J.S.A. 52:13D-13g. Any relationships subject to this provision shall be reported in writing forthwith to the Executive Commission on Ethical Standards, which may grant a waiver of this restriction upon application of the State officer or employee or special State officer or employee upon a finding that the present or proposed relationship does not present the potential, actuality or appearance of a conflict of interest.

d. No vendor shall influence, or attempt to influence or cause to be influenced, any State officer or employee or special State officer or employee in his official capacity in any manner which might tend to impair the objectivity or independence of judgment of said officer or employee.

e. No vendor shall cause or influence, or attempt to cause or influence, any State officer or employee or special State officer or employee to use, or attempt to use, his official position to secure unwarranted privileges or advantages for the vendor or any other person.

f. The provisions cited above in paragraph 3a. through 3e. shall not be construed to prohibit a State officer or employee or special State officer or employee from receiving gifts from or contracting with vendors under the same terms and conditions as are offered or made available to members of the general public subject to any guidelines the Executive Commission on Ethical Standards may promulgate under paragraph 3c.

26. SET-OFF FOR STATE TAX NOTICE: Pursuant to N.J.S.A. 54:49-19, and notwithstanding any other provision of law to the contrary, Whenever any taxpayer under contract to provide goods or services to the State of New Jersey or its agencies or instrumentalities, and including the legislative and judicial branches of State government, or under contract for construction projects of the State of New Jersey or its agencies or instrumentalities, and including the legislative and judicial branches of State government, is entitled to payment for the goods or services or on that construction project and at the same time the taxpayer is indebted for any State tax, the Director of the Division of Taxation shall seek to set off so much of that payment as shall be necessary to satisfy the indebtedness. The director, in consultation with the Director of the Division of Budget and Accounting in the Department of the Treasury, shall establish procedures and methods to effect a set-off. The director shall give notice of the set-off to the taxpayer, the provider of goods or services or the contractor or subcontractor of construction projects and provide an opportunity for a hearing within 30 days of such notice under the procedures for protests established under R.S.54:49-18, but no request for conference, protest, or subsequent appeal to the Tax Court from any protest under this section shall stay the collection of the indebtedness. No payment shall be made to the taxpayer, the provider of goods or services or the contractor or subcontractor of construction projects pending resolution of the indebtedness. Interest that may be payable by the State pursuant to P.L.1987, c.184 (C.52:32-32 et seq.), to the taxpayer, the provider of goods and services or the contractor or subcontractor of construction projects shall be stayed.
THE COLLEGE OF NEW JERSEY

By____________________________________
    William Rudeau, Director of Construction

Date______________________________

By____________________________________
    Curt Heuring, Vice President of Administration

Date______________________________

By____________________________________
    Mark Mehler, Executive Director of Procurement

Date______________________________

CONTRACTOR:

By____________________________________

Title__________________________________

Date__________________________________
THE COLLEGE OF NEW JERSEY

December 2007

GENERAL CONDITIONS
OF THE
CONTRACT FOR CONSTRUCTION
# TABLE OF CONTENTS

## ARTICLE 1. CONTRACT DOCUMENTS, INTERPRETATION, INFORMATION FOR BIDDERS, CLAIMS BASED ON BID AND CONTRACT DOCUMENTS

A. Definitions .................................................................................................................. 1
B. Intent of Contract Documents ..................................................................................... 2
C. Interpretation of Contract Documents ........................................................................... 2
D. Law and Referenced Standards .................................................................................... 2
E. Plans and Specifications .............................................................................................. 3
F. Order of Precedence of Contract Documents ............................................................... 3
G. Organization of Plans and Specifications ...................................................................... 3
H. Required Approvals .................................................................................................... 3
I. Conformity of Work to Contract Documents ................................................................. 3
J. Work Involving Existing Structures ............................................................................. 4
K. Verification of Dimensions .......................................................................................... 4
L. Manufacturer Literature .............................................................................................. 4
M. Quality -- General Requirement ................................................................................ 4
N. Examination of Contract Documents Before Bidding/Errors, etc. .............................. 4
O. Site Information ........................................................................................................... 4
P. Sufficiency of Documents Provided for Bidding ......................................................... 5
Q. Examination of Site Before Bidding ......................................................................... 5
R. Hazardous Materials On Site ..................................................................................... 5
S. Limitation on Claims Based on Contract Documents and Information Provided for Bidding 5

## ARTICLE 2. THE COLLEGE

A. General Rights and Responsibilities of the College ................................................. 5
B. College Representative, Authority to Decide Contract Questions .............................. 6
C. Required Approvals ................................................................................................... 6
D. Information Required from College ........................................................................... 6
E. Permits, Responsibility for ........................................................................................ 6
F. College Inspection of the Project ............................................................................... 7
G. College Inspectors, Duties and Limitations ................................................................. 7
H. College Rejection of Defective Work ......................................................................... 7

## ARTICLE 3. ARCHITECT

A. Architect's General Role ............................................................................................. 8
B. Architect's Access and Facilities .................................................................................. 8
C. Limitation of Architect's Responsibilities ..................................................................... 8
D. Architect Rejection of Work ....................................................................................... 8
E. Architect Review of Contractor Submittals ................................................................. 8
F. Architect Review of Contractor As-Built Plans ............................................................ 8
G. Architect Determination of Satisfactory Completion ................................................. 9

## ARTICLE 4. CONTRACTOR

A. Contractor Responsibility for Performance of the Contract and Work ....................... 9
B. Contractor Key Personnel .......................................................................................... 9
C. Contractor Supervision of Contract Work/Superintendent ........................................ 9
D. Cooperation with College and Other Contractors ...................................................... 9
E. Performance of College Directives ................................................................ .......... 10
ARTICLE 5. PERFORMANCE OF WORK

A. Protection of Work/Materials, etc. ................................................................. 10
B. Safety and Safety Programs ........................................................................... 11
C. Working Hours ................................................................................................. 11
D. Site Security ....................................................................................................... 11
E. Site Use .............................................................................................................. 11
F. Submittals (Shop Drawings, Product Data, Samples) ...................................... 11
G. Layout and Dimensional Control ..................................................................... 11
H. Construction Access, Roads, Walks, and Parking ......................................... 12
I. Construction Site Condition, Storage, Dust Control ..................................... 12
J. Photographs ....................................................................................................... 12
K. Project Sign ....................................................................................................... 13
L. Soil Conservation .............................................................................................. 13
M. Temporary Facilities, Services, Electric, Heat and Enclosures .................... 13
N. Substitutions (To Be Included in Bid) ............................................................ 13
O. License Fees .................................................................................................... 14

ARTICLE 6. SUBCONTRACTORS ........................................................................ 14

A. Contractor Responsibility for Subcontracted Work ................................... 14
B. Subcontractor Identification and Approval .................................................. 14
C. Subcontractor Qualifications ......................................................................... 15
D. Subcontractor Compliance with Contract/Subcontractor Supervisors .......... 15
E. No Contract Relationship Between College and Subcontractors ............... 15

ARTICLE 7. TIME, LIQUIDATED DAMAGES, DELAY CLAIMS AGAINST COLLEGE ................................. 15

A. Contract Times ................................................................................................. 15
B. Liquidated Damages For Delay ...................................................................... 15
C. Delay Claims Against The College ............................................................... 16
D. Mediation ......................................................................................................... 16

ARTICLE 8. PROJECT SCHEDULE .................................................................. 16

A. General Schedule Requirements ................................................................... 16
B. Form and Content of Schedule ...................................................................... 16
C. Computerization of Schedule ........................................................................ 17
D. Weather Inclusion in Schedule ...................................................................... 18
E. Schedule Updates ............................................................................................ 18
F. Meetings/Eight Week Bar Charts .................................................................. 18
G. Schedule Documentation for Contract Payments .......................................... 19
H. Progress, and Recovery Schedules ............................................................... 19
I. Contractor Failure to Provide Schedule Updates .......................................... 19
J. Scheduler Qualifications .................................................................................. 19

ARTICLE 9. EXTENSIONS, COMPENSATION FOR CERTAIN EXTENSIONS ................................................. 19

A. Delays Warranting Extensions of Contract Dates ......................................... 19
B. Weather Delays ............................................................................................... 20
C. Float Time Use ............................................................................................... 20
D. Calculation of Extensions ............................................................................... 20
E. Elimination of Delays and Extensions (Acceleration) .................................... 20
### ARTICLE 10. PAYMENTS TO CONTRACTOR

- **F. Requests for Extensions Required**
- **G. Compensation for Certain Extensions and Limitations**

#### A. Monthly Progress Payments
- **21**

#### B. Unit Schedule Breakdown/CPM Activity Price Breakdown
- **22**

#### C. Invoices for Monthly Progress Payments: Form and Content
- **22**

#### D. Payment for Materials and Equipment Procured But Not Installed
- **23**

#### E. Retainage
- **23**

#### F. Payment For Change Order Work
- **24**

#### G. Final Payment
- **24**

#### H. Payment Terms
- **24**

#### I. Payment Based on Partial Acceptance (Limitation)
- **24**

#### J. Failure to Pay Amounts in Dispute Not to Affect Performance
- **24**

#### K. Waiver of Certain Claims by College Against Contractor in Connection with Final Payment
- **24**

### ARTICLE 11. CHANGES

- **A. Changes Authorized**
- **24**

- **B. Change Request or Directive**
- **25**

- **C. Change Orders Which Are Protested**
- **25**

- **D. Changes Affecting Contract Times**
- **25**

- **E. Contractor Initiated Change Order Requests**
- **25**

- **F. Change Order Amounts**
- **26**

- **G. Right to Audit Extra Costs (Before and After Payment)**
- **26**

- **H. Change Orders with Both Price Increases and Decreases**
- **26**

- **I. Waiver of Rights In Connection with Change Orders Issued Without Protest**
- **27**

### ARTICLE 12. COMPLETION

- **A. Substantial Completion**
- **27**

- **B. Final Completion**
- **28**

### ARTICLE 13. SUSPENSION AND TERMINATION OF CONTRACT

- **A. Suspension**
- **28**

- **B. Termination for Convenience**
- **29**

- **C. Termination for Cause**
- **29**

- **D. Surety Takeover Following Termination for Cause**
- **30**

### ARTICLE 14. WARRANTY/DEFECTIVE WORK AND MATERIALS

- **A. General One Year Warranty; HVAC Two Year Warranty**
- **30**

- **B. Defective Work, Materials and Equipment**
- **31**

### ARTICLE 15. MISCELLANEOUS

- **A. Insurance, Bonds, Indemnification**
- **31**

- **B. Prevailing Wage**
- **31**

- **C. Employment Discrimination**
- **32**
D. Patents ................................................................................................................................. 32
E. Emergencies Affecting Safety. ............................................................................................ 32
F. Contractor Compliance with Law. .......................................................................................... 32
G. Environmental Protection - Contractor Duty to Comply with Law.................................... 32
H. No Personal Liability of College Officials ......................................................................... 33
I. Recovery of Monies by College from other Contracts with the Contractor........................... 33
J. Buy American Requirement. ............................................................................................... 33
K. Modification of Contract (Form). ........................................................................................ 33
L. State Sales Tax Exemption. ................................................................................................. 33
M. Assignment of Contract Funds and Claims Prohibited. .................................................... 34
N. Independent Contractor Status. .......................................................................................... 34
O. Third Party Beneficiary Rights Not Intended ...................................................................... 34
P. Gifts to College Employees and Agents Prohibited. ........................................................... 34
Q. Contractor Claims: Procedures and Limitations. ............................................................... 34
R. Cost Records a Condition of Receiving or Retaining Extra Compensation on
   Extras, Changes and Claims .............................................................................................. 35
ARTICLE 1. CONTRACT DOCUMENTS, INTERPRETATION, INFORMATION FOR BIDDERS, CLAIMS BASED ON BID AND CONTRACT DOCUMENTS.

A. Definitions.

Definitions for the purpose of the contract include the following:

Addendum: A document issued to bidders by the College prior to the bid due date which supplements, revises or modifies the bid solicitation documents furnished for bidding purposes, and which must be identified and included in bids for the contract.

Architect: The architect (A/E) engaged by the College to design the project, to prepare the design documents and assist with bid documents, and may administer the construction contract and act as the agent of the College as described in the contract.

Bulletin: A document prepared by the architect describing proposed changes or additions to the work in the contract document which is issued after contract award. If the College decides to implement the change, it will provide the bulletin to the Contractor and ask it to submit a change order proposal or request (in accordance with the change order provision in the contract, general conditions and other sections of the bidding documents).

Change Order Proposal or Request: A written proposal or request submitted by the contractor in accordance with the change order provision of the contract, general conditions and other sections of the bidding documents, including proposals submitted in response to contract change directives which proposes cost, time and other terms under which the contractor will perform changed work under the contract. If accepted by the College, a written change order signed by the Vice President Facilities Management, Construction and Campus Safety and purchase order signed by the Contracting Officer of the College, and if accepted by the Contractor in writing, it will become part of the contract as a change order.

Contract Amendment: The contract can only be amended by (1) a written amendment identified as such which is signed by the College and the Contractor, (2) a change order signed in accordance with the contract documents, (3) a written contract change directive (CCD) issued by the College which should result in a change order unless issued to address some fault of the Contractor, (4) a written approval or acceptance by the College or the architect of a change requested by the Contractor in writing, provided the request for a change is specifically identified in a submittal.

Contract Change Directive (CCD): A contract change directive (CCD) is a written directive issued by the College which orders an addition, deletion or revision in the work, or a response to an emergency. A contract change directive does not by itself change the contract, but it should result in a change order which does change the contract price or times if warranted. A CCD should specify the terms of the change order which will result, and/or specify a deadline for the submission by the Contractor of a proper change order request, and/or contain other similar terms.

Contract Documents: The contract documents include the signed contract, the bid solicitation documents, the Contractor's bid proposal, and the contract documents listed in the contract. They include but are not limited to the general conditions, any supplemental general conditions, any addenda, plans and specifications, and change orders which are issued and approved by the College after the contract is awarded.

Contract Limit Lines: The lines shown on the contract plans which limit the boundaries of the project site, and beyond which no construction work or activities shall be performed by the Contractor unless otherwise specified in the contract documents including the plans and specifications and supplemental general conditions.

Contracting Officer: The Associate Treasurer of the College shall be the Contracting Officer in connection with the contract and the project. The Contracting Officer and other designee shall have authority to act on behalf of the College under the contract.
Field Order (FO): A written order issued by the architect or the College which requires minor changes in the work which do not result in a change in the contract price or the contract time. If the Contractor believes that a field order warrants the issuance of a change order which changes the contract times or price, it must notify the College and the architect in writing within 48 hours, and its notice must specify the terms of the change order which it believes are warranted, including specific time and price change requests.

Owner’s Representative: The Owner’s representative is a person or persons designated by the Owner to act on its behalf in administering the construction contract for the College. The Owner’s representative may include the Director of Campus Construction, the Project Manager or an independent construction manager working for the Office of Campus Construction.

Site Superintendent: The site superintendent is a person or persons designated by the Owner to witness, observe, record and report on activities in and around the construction site. The site superintendent does not have the authority to stop or change the scope of work of the contract for construction.

Supplemental General Conditions: The part of the contract documents which amends or supplements the general conditions for the project.

B. Intent of Contract Documents.

The intent of the contract documents is to describe a functionally complete and aesthetically acceptable project to be constructed and completed by the Contractor in every detail in accordance with the contract documents. Any work, services, materials, equipment or documentation that may be reasonably inferred from the contract documents or from prevailing custom or trade usage as being required to produce a complete project shall be supplied whether or not specifically identified at no additional cost to the College. Where the contract documents describe portions of the work in general terms but not in complete detail, only the best construction practices and only materials and workmanship of the first quality are to be used. Only where the contract documents specifically describe a portion of the project as being performed by others is the contract work to be considered to include less than the entire project.

C. Interpretation of Contract Documents.

When two or more interpretations of a specification for the work are possible, the most stringent or the highest cost interpretation shall apply as determined by the Architect. The Architect (or in the absence of the Architect, the Owner) shall be the sole interpreter of the plans and specifications and the contractor's performance therewith. It is the intent of these plans and specifications to provide materials of a quality consistent with the highest standards provided under similar circumstances in the same general geographical area.

D. Law and Referenced Standards.

The Contractor is required to comply with all federal, state and local laws and regulations which apply to the project, the work and the contract. Where the contract documents refer to any publication, including but not limited to any standard, which affects any portion of the work or the project, it shall be considered to mean the edition or revision in effect on the bid due date unless otherwise specified in the contract documents. No provision in any publication including any standard shall change or affect the duties and responsibilities of the College, the Architect or the Contractor. Nor shall they create an obligation on the part of the College or the Architect to supervise or direct the Contractor’s work.
E. Plans and Specifications.

The plans will include general plans and such details as deemed necessary to give a comprehensive representation of the construction required. The Contractor shall keep one set of plans available at the project site which shall be available for inspection by the College and the Architect at all times. All alterations affecting the requirements in the plans must be authorized in writing, and shall be promptly noted on the Contractor's record set of plans which are maintained at the site for inspection by the Contractor, the College and the Architect.

F. Order of Precedence of Contract Documents.

Each of the contract documents is an essential part of the contract, and a requirement specified in one part of the documents is binding as if specified in all. The contract documents are intended to be complementary and to describe and provide for a complete project. If there is any conflict among the contract documents, the signed contract and all approved change orders shall control. As to the other contract documents, the order of the precedence shall be as follows:

(a) Contract
(b) Addenda
(c) Supplemental General Conditions
(d) General Conditions
(e) Specifications
(f) Plans
   i. Notes
   ii. Large Scale Details
   iii. Sections
   iv. Elevations
   v. Plans
(g) Scope of Work Description

G. Organization of Plans and Specifications.

The arrangement of the plans and the organization of the specifications into divisions, sections or articles shall not be construed by the Contractor as being intended to divide or allocate the work among subcontractors or trades or to establish the scope of the work to be performed by particular subcontractors or trades. The Owner is not liable for the Contractor dividing and separating the contract documents into individual packages to sub-contractors and therefore contract items not being figured for by the contractor accordingly. The contract documents work together as a whole, and therefore the contractor is required to coordinate the entire package with all its sub contractors.

H. Required Approvals.

In all cases where approvals or decisions under the contract documents are required from the College, the work shall not proceed without the required approvals and decisions in writing.

I. Conformity of Work to Contract Documents.

All work performed shall conform to the lines, grades, cross-sections, dimensions, material requirements, tolerances, details and other information in the contract documents. The purpose of tolerances is to accommodate occasional minor variations from the middle portion of the tolerance range which are unavoidable despite reasonable construction practices. When a maximum or minimum tolerance value is specified, the material and the work shall be controlled so that they shall not be preponderantly of borderline quality or dimension.
J. Work Involving Existing Structures.

On projects involving alterations, remodeling, repairs, installations or other work in pre-existing structures or systems, the Contractor shall by personal inspection of the existing structures and systems satisfy itself as to the accuracy of any information provided which may affect the quantity, size and/or quality of materials required for a satisfactorily completed contract and project, including information which is not identified or included in the plans and specifications. The Contractor shall provide all material and labor required to complete the work and contract based on conditions which can be reasonably observed by a competent and diligent contractor before bidding.

K. Verification of Dimensions.

The Contractor shall verify all dimensions at the job site and shall take any and all measurements necessary to verify the information in the plans. The Contractor shall properly and accurately layout and survey the work. Any errors or discrepancies affecting the layout of the work shall be reported to the Architect and the College immediately in writing. No work affected by any error or discrepancy shall proceed until such discrepancy is resolved by a written decision of the Architect with the consent of the College.

L. Manufacturer Literature.

Manufactured articles, materials and equipment shall be installed, applied, connected, erected, used, cleaned and conditioned in accordance with the manufacturer's written instructions unless otherwise specified in the contract documents. If there is any conflict between manufacturer literature and the contract documents, it shall be reported by the Contractor to the Architect and the College in writing, and the Contractor shall not proceed without a written decision by the Architect with the consent of the College.

M. Quality -- General Requirement.

Where no explicit quality or standard are specified for work, materials or equipment, they shall be new, of good quality, free of defects, suitable for their intended use, in conformity with the contract documents, and consistent with the highest quality of the surrounding work and of the construction of the project generally.

N. Examination of Contract Documents Before Bidding/Errors, etc.

The Contractor represents and warrants that before bidding it examined and carefully studied the contract documents and other documents included or referred to in the bid documents. The Contractor also represents and warrants that the documents are sufficient for bidding and performing the contract work at the contract price. Should it appear that any of the work or materials are not sufficiently or properly detailed or explained in the contract documents, the Contractor shall notify the College in writing before the bid deadline for submitting questions.

Errors, omissions, conflicts, discrepancies, inconsistencies or other defects in the contract documents or between the contract documents and any codes, standards or other applicable documents which are capable of being discovered by a diligent and competent contractor before bidding shall be reported to the College in writing before the bid deadline for submitting questions. If errors, omissions, inconsistencies or other defects in the contract documents are not discovered until after the bid due date, the Contractor shall promptly notify the College and the Architect of them, provide written recommendations regarding changes or corrections to resolve any such errors, omissions, inconsistencies or defects, and obtain the Architect’s written interpretation and approval before proceeding with the work affected.

O. Site Information.

Soil borings, test pits or other subsurface or site information regarding the physical site and subsurface conditions on or near the site may have been obtained from independent contractors for the purpose of preparing the design documents for the project rather than for the purpose of contractor estimating or bidding. Such information may be identified or included in the contract documents so that it can be reviewed by bidders during the bidding phase, but
because of the limited nature and purpose of the information, it shall not be considered to be part of the contract documents, and the Contractor must assume responsibility for interpreting and relying upon the information.

P. Sufficiency of Documents Provided for Bidding.

The Contractor represents and warrants that before bidding it carefully studied all reports, surveys and documents included or identified in the bid documents regarding observations, inspections, investigations and tests of the site and subsurface conditions at or near to the site, and all information provided to bidders regarding physical conditions at or near the site, including surface and subsurface composition, water, structures and utilities, and that it determined that no further examinations, investigations, tests, studies or data were necessary for bidding or the performance of the contract work at the contract price. If the Contractor concluded that additional information is required, it must notify the College in writing before the bid deadline for submitting questions.

Q. Examination of Site Before Bidding.

The Contractor represents and warrants that before bidding it visited the site and familiarized itself with and was satisfied as to the general, local and site conditions which may affect the cost, progress and performance of the work and the contract, and that its bid and bid price take into account all such conditions. No additional costs will be borne by the Owner for conditions that existed and were reasonably observable or described at the time of bidding.

R. Hazardous Materials On Site.

The Contractor will not be responsible for hazardous environmental conditions uncovered or discovered on the site which were not disclosed in the contract documents. If such conditions are discovered, the Contractor shall stop work and notify the College in writing immediately. The College may issue a written directive to the Contractor requiring it to stop work until the hazardous environmental condition is remedied, and the Contractor will be entitled to an extension of the contract times if an extension is warranted under the provisions of the contract and the general conditions regarding extensions. The College may also make changes in the contract in response to the conditions, and the contract will be changed in accordance with the change order provisions in the contract and the general conditions.

S. Limitation on Claims Based on Contract Documents and Information Provided for Bidding.

The Contractor may not assert claims for extra compensation beyond the bid and contract price for constructing the completed project by reason of any errors, omissions, inconsistencies, or defects in the contract documents which are discoverable by a diligent and competent contractor, because of its obligation to review and study the bid documents before submitting its bid, and because of its obligation to notify the College in writing before submitting its bid of errors, omissions, inconsistencies, and defects in the documents. This limitation on claims may be modified and further restricted in the signed contract when the contract requires the Contractor to participate in any aspect of the design phase.

The Contractor may assert claims for extensions and additional compensation in accordance with the contract and general conditions if information regarding the site which is identified in the bid or contract documents is factually inaccurate, and the inaccuracy is one which a reasonably competent and diligent contractor would not discover in preparing a bid. The Contractor may not assert a claim for an extension or extra compensation when it claims, not that the information is factually inaccurate, but rather that conclusions, inferences or judgments made in reliance on accurate information prove to be incorrect.

ARTICLE 2. THE COLLEGE.

A. General Rights and Responsibilities of the College.

The College as the owner of the project is entitled to have the Contractor perform and complete the contract work in accordance with the contract documents, including the time of completion, quality and documentation requirements of the contract. The College for its part undertakes to furnish the site, to notify the Contractor of any restrictions on the site which could affect the Contractor's performance of the contract, to obtain approvals relating to the site which are needed for the construction to proceed, to pay the Contractor in accordance with the contract, and to act
reasonably in reviewing all documentation, claims and questions properly submitted to it under the contract. The College also undertakes to provide the information and items which it expressly agrees in the contract documents to provide.

The College shall also have such other rights and responsibilities as are specified in the contract documents. The College will not supervise the Contractor's work or be responsible for the Contractor's construction means and methods, or the contractor's safety practices, or any failure of the Contractor to comply with the contract or any laws or regulations.

B. College Representative, Authority to Decide Contract Questions.

The Contracting Officer delegates its authority to the Owner’s representative who is authorized to act and make decisions on behalf of the College regarding matters specified in the contract documents. However, the Owner’s representative is not authorized to make or agree to changes to the contract involving time, contract price or material changes.

All changes to the contract including change orders that modify contract price, contract time or other material change to the contract must be reviewed and approved by the Contracting Officer or his/her designee. The contracting officer designates that the Vice President for Facilities Management, Construction and Campus Safety is authorized to approve change orders.

The Owner’s representative, in consultation with the Architect, is authorized to decide on behalf of the College all questions regarding the quality, acceptability and rate of progress of the work, all questions regarding the interpretation of the contract documents, all questions regarding the acceptability of the performance of the contract by the Contractor, and all questions regarding the compensation due to the Contractor. Where the Owner’s representative is authorized to render decisions under the contract regarding disputes or claims, he/she shall consult with the Architect and shall not act arbitrarily so as to unfairly benefit either the College or the Contractor.

C. Required Approvals.

In all cases where approvals or decisions are required from the College under the contract documents, such approvals or decisions shall be made reasonably, except in cases where a specific standard applies such as, for example, situations where the College is entitled to exercise unqualified discretion in selecting the types of materials, products or construction which it decides to procure.

D. Information Required from College.

Information which the contract documents specify the College will provide shall be provided with reasonable promptness.

E. Permits, Responsibility for.

The College will arrange and pay for permits and permit inspections, including building code permits except to the extent that the specifications specify otherwise. The Contractor will arrange for and coordinate all inspections and the dates and times for all inspections with local, state and independent agencies and include the Owner’s representative or the site superintendent.
F. **College Inspection of the Project.**

The College shall have the right to be represented at the site by the Owner’s representative(s), the site superintendent and other College employees designated by the College, the project architect, and other consultants designated by the College or the architect. They shall have the right to visit the site, inspect work and materials, inspect project documentation, conduct tests, attend meetings, meet with Contractor and subcontractor representatives, investigate problems, conduct studies, and make reports. They shall be allowed access to all parts of the work, and the Contractor shall furnish them with information and assistance when they request it.

The Contractor shall give the College and the architect timely notice of readiness of work for observation, inspection and testing, and shall cooperate with these efforts. The Contractor shall also comply with any inspection and testing procedures specified in the contract documents.

The Contracting Officer, the Architect and the Owner’s representative shall have the right to direct the Contractor to remove or uncover unfinished work if deemed necessary to inspect work or materials in place.

If work is covered before it is inspected because the College, the architect or any consultant were not afforded a reasonable notice and opportunity to inspect, or where the contract documents or any law require an inspection, the Contractor shall uncover and replace work at its own expense if required to do so by the College.

If any other portion of the work not specifically required to be inspected is covered, and the College or the architect did not ask to observe or inspect the work before it was covered, the College may nonetheless ask to inspect the work. If the College does so, the Contractor shall uncover the work for inspection. If the work uncovered is found to be in accordance with the contract documents, the cost of uncovering and replacement shall be paid by the College by a change order. If the work uncovered is found not to be in compliance with the contract documents, the Contractor shall pay all costs of uncovering and replacement, and also remedy the defect or deficiency at its own cost.

The College at all times retains the right to stop all or part of the work by a written direction because of defective work until the defect is eliminated. This right shall not give rise to any duty on the part of the College to exercise the right for the benefit of the Contractor or those performing its contract.

G. **College Inspectors, Duties and Limitations.**

If the College designates inspectors to inspect work and materials and project documentation, they will not be authorized to alter or waive any requirements or provisions in the contract documents. The College's inspectors will not be authorized to issue instructions contrary to the contract documents or to act as foremen or employees of the Contractor. College inspectors will have the authority to reject unsuitable work or materials, subject to written confirmation by the Owner’s representative. If the Contractor believes that any action of a College inspector is contrary to the contract documents, it shall notify the Owner’s representative and the Architect in writing within 48 hours. The College does not undertake to have inspectors sufficient in number to inspect every item of work or material as it is provided, or to have inspectors with the expertise needed to judge every aspect of the work.

The Contractor shall remain responsible for defective work or materials irrespective of any inspections or lack of inspections during the work. If the Contractor seeks a binding determination of the acceptability of work or materials during the performance of the contract, it shall do so by making a written request for such a determination to the Owner’s Representative with a copy to the Architect.

H. **College Rejection of Defective Work.**

The College shall have the right to reject defective work, materials, or equipment at any time, and to require the Contractor to remove and replace it at the Contractor's expense. The Contractor shall also be responsible for repairing damage to other work caused by defects or deficiencies in its work. The Owner’s representative, upon consultation with the Architect may elect to accept work or materials which do not conform to the contract and to credit or reduce the
contract price, but the College shall have no contractual obligation to elect this remedy. Changes to the contract in these circumstances must be recorded via regular change order process.

ARTICLE 3. ARCHITECT

A. Architect's General Role.

The project architect is by contract with the College responsible for the design of the project. During construction, the architect is responsible for reviewing Contractor submittals to determine if they conform to the contract documents and good industry practice, to provide some level of inspection to determine if work and materials provided conform to the contract documents and good industry practice, and to review Contractor payment applications. During the performance of the work the architect may investigate any defects and deficiencies in the work or materials provided, and make recommendations to the College regarding the defects or deficiencies. The architect will conduct inspections to determine if the Contractor has achieved proper substantial and final completion and submitted all documents required at completion. The Contractor shall cooperate with and render assistance to the architect in the performance of these duties.

B. Architect's Access and Facilities.

The Contractor shall allow the architect and its consultants access to the project at all times, and shall facilitate their access to inspect work and materials and project documentation. The architect and its consultants shall be permitted to attend job meetings, scheduling meetings and other meetings at the site, and the Contractor shall facilitate their ability to do so. The Contractor shall provide an office at the site for the project architect if the specifications require it to do so.

C. Limitation of Architect's Responsibilities.

The architect will not be responsible for or have control of construction means and methods, or safety precautions and programs in connection with the work. The architect will not be responsible for or have control of acts or omissions of the Contractor, its subcontractors, or any of their agents or employees, or any other person performing any of the contract work.

D. Architect Rejection of Work.

The architect may recommend rejection of work or materials which it believes do not conform to the contract documents. Whenever the architect considers it necessary or advisable, it may recommend to the College special inspections or testing of work or materials, including completed work and materials.

E. Architect Review of Contractor Submittals.

The architect will review, approve or take other appropriate action regarding Contractor submittals, such as shop drawings, product data and samples, to assure that they conform with the design requirements and contract documents. The approval of a specific item shall not normally be deemed to constitute approval of an assembly of which the item is a component.

F. Architect Review of Contractor As-Built Plans.

The architect will periodically review the Contractors' as-built plans maintained at the site to ensure that they are up-to-date, and shall review the completed as-built plans at project completion to ensure that they are complete and are provided to the College.
G. Architect Determination of Satisfactory Completion.

The architect will conduct inspections to determine the dates of substantial and final completion and to determine if the Contractor has properly substantially and finally completed the project. The architect will obtain from the contractor all written warranties and all other documents which the Contractor is required to provide at the time of the project completion. The architect will make a recommendation to the College regarding final project and final contract acceptance.

ARTICLE 4. CONTRACTOR.

A. Contractor Responsibility for Performance of the Contract and Work.

The Contractor shall perform all of the duties in the contract documents, shall furnish the labor, materials and equipment to complete the construction of the project in accordance with the contract, and furnish all services, labor, materials and equipment necessary or appropriate to construct the project. The Contractor shall manage, supervise, schedule, direct, and inspect the work as competently, skillfully, and efficiently as possible, and shall be solely responsible for all construction means, methods, techniques, safety, security, sequences, procedures, and coordination.

The Contractor shall comply with all applicable laws, and shall establish and maintain reasonable quality assurance and safety programs in connection with its work. The Contractor shall complete the contract in compliance with the contract documents and by milestone, substantial completion and final completion dates in the contract or any authorized extensions thereof. The Contractor shall maintain good order and discipline at the site at all times.

B. Contractor Key Personnel.

The Contractor shall assign to the project a project executive, project manager, superintendent, and scheduler, and such other key personnel as are specified in the contract or as required to carry out the requirements of the project. The College has the authority to reject and have replaced any staff member of the contractor or subcontractors for any reason.

C. Contractor Supervision of Contract Work/Superintendent.

The Contractor shall supervise and be responsible for the acts and omissions of the Contractor's employees, agents, subcontractors, sub-subcontractors, suppliers and other persons performing portions of the work and the contract. The Contractor's designated project superintendent shall be at the project site at all times when work is in progress. The Contractor may designate in writing an alternate superintendent which must be approved by the College. The superintendent (or alternate) shall have full authority to represent and act for the Contractor at the site, and shall have full authority to execute orders and directives of the College without delay.

Communications to the superintendent shall be deemed to have been given to the Contractor. The superintendent shall be capable of and authorized to respond to all hazardous and unsafe conditions at the project site and to implement prompt corrective measures to eliminate all unsanitary, hazardous or dangerous conditions at the site. The College may suspend all or part of the work at the project site if the superintendent or alternate is not present at the project site, and such suspensions shall not be the basis of a claim against the College.

The superintendent shall attend all meetings at the project site including job meetings, scheduling meetings, and meetings with the College and/or the architects. The superintendent shall have a written plan which must be approved by the College for responding to emergencies when the work is not in progress. The Contractor shall also utilize qualified competent craftsmen on the project.

D. Cooperation with College and Other Contractors.

The College reserves the right to contract for and perform other or additional work on or adjacent to the project site. When separate contracts are let within the limits of the project site, or in areas adjacent to the site, the Contractor
shall perform its work so as not to interfere with or hinder the progress or completion of the work being performed by other contractors. The Contractor shall also affirmatively cooperate with such other contractors and coordinate its activities with theirs, and include coordination measures in the project CPM construction schedule. The Contractor shall arrange its work and shall place and dispose of materials being used so as not to interfere with the operation of other contractors within the limits of the project site. The Contractor shall join its work with that of the other contractors in an acceptable manner and shall perform the work in proper sequence with that of other contractors.

If there is a disagreement as to the respective rights of the Contractor and others doing work within the limits of or adjacent to the project site, the College shall determine the respective rights of the contractors involved to secure the satisfactory completion of all affected work. The Contractor shall not be entitled to additional compensation beyond its contract price which may arise because of inconvenience, delay, or loss experienced by it as a result of the presence and operations of other contractors working within the limits of or adjacent to the project site.

The Owner reserves the right to occupy any portion of the Project which is ready for occupancy prior to completion and acceptance of the Project, after Local and State Construction Enforcing Agency approval. The occupancy of any portion of the Project does not constitute an acceptance of any work nor does it waive the Owner's right to liquidated damages or constitute an acceptance of any work as the Project will be accepted as a whole and not in units. Prior to such occupancy, however, the Architect, a representative of the Owner, and the Contractor shall fully inspect the portions of the Project to be occupied, preparing a complete list of omissions of materials, faulty workmanship, or any items to be repaired, torn out or replaced. The Owner will assume responsibility for damage to premises so occupied of any items not on this list when such damage is due to greater than normal wear and tear, but does not assume responsibility for improper or defective workmanship or materials.

E. Performance of College Directives.

When the College issues a written directive to the Contractor under the authority of any provision in the contract or general conditions, the Contractor shall perform as directed in a diligent manner and without delay. Compliance with written directives shall not adversely affect the rights of the Contractor under the contract or law, but if the Contractor objects to a directive of the College, or claims that a directive infringes upon its rights or entitles it to a change order, it shall notify the College in writing within 2 business days of any directive and describe any objection it has to the directive and the reasons for its objection. Objection to a written directive does not relieve the contractor of the obligation to comply with the directive and proceed in a diligent manner to implement the directive without delay.

ARTICLE 5. PERFORMANCE OF WORK

A. Protection of Work/Materials, etc.

The Contractor, shall at its own expense, protect all finished work and materials from damage and keep them protected until the project is accepted as substantially completed, and shall repair or replace any work or material damaged before acceptance. After the project is accepted as substantially complete, the Contractor will remain responsible up through final completion for damage to work and materials caused by it or its subcontractors or others participating in the performance of its contract obligations. The Contractor shall also secure and protect its own tools, equipment, materials and supplies, and the College shall have no liability for damage, theft or injury to the Contractor's property.
B. Safety and Safety Programs.

The Contractor shall have full responsibility for safety at the project site at all times up to final completion and acceptance of the project and the contract. The Contractor shall provide for the safety of all individuals on the project site, and take measures to ensure that individuals on or near the project site are not injured by the performance of the contract. The Contractor shall establish and maintain a project safety program in accordance with all applicable laws including OSHA, good industry practice, and any additional requirements in the contract documents. If the College or the Architect become aware of an unsafe situation, the Contractor will immediately respond to remedy the safety concern.

C. Working Hours.

Except as required for the safety or protection of persons or property, or as specified in the contract documents, all work at the site shall be performed during regular working hours, and not on Saturdays, Sundays, or legal holidays without the prior written consent of the College which will not be unreasonably withheld.

D. Site Security.

The Contractor shall provide, maintain and oversee security at the site if required in the specifications. The project site shall be fenced as specified in the specifications, and the Contractor shall control access when gates are unlocked or open.

E. Site Use.

The Contractor shall confine construction equipment, storage and work to the project site absent written approval from the College. Any request by the Contractor to use areas outside the project site must be described in written form and included with the Contractor's bid.

F. Submittals (Shop Drawings, Product Data, Samples).

The Contractor shall submit to the architect with reasonable promptness a schedule for all submittals, including shop drawings, product data and samples required by the contract documents. Submittals shall be complete as to quantities, details, dimensions and design criteria. The architect and the College will approve submittals if they conform to the contract documents, the design concept and good industry practice. The Contractor shall note its approval of all submittals and the date for any submittals prepared by any subcontractor or supplier, and it shall be responsible for determining and verifying all materials, field dimensions, field construction criteria, and coordination requirements pertaining to the submittal.

The Contractor will not be relieved of responsibility of deviations in submittals from the requirements in the contract documents by reason of approvals of the submittals unless the Contractor specifically identifies the deviation in the submittal and the architect and the College specifically and expressly approve the deviation. The Contractor shall be responsible for errors or omission in its submittals. No work or materials included in a submittal shall begin until the submittal is approved by the architect and the College.

G. Layout and Dimensional Control.

The Contractor shall be responsible for locating and laying out the project components and all of the project parts on the project site in strict accordance with the plans, and shall accurately establish and maintain dimensional control. The Contractor shall employ a competent and licensed New Jersey engineer or land surveyor as appropriate to perform all layout work and to fix the level and location of excavations, footing base plates, columns, walls, floors and roof lines. The Contractor shall furnish to the College and the architect certifications that each such level is as required by the plans as the work progresses.
The plumb lines of vertical surfaces shall be tested and certified by the Contractor's engineer or surveyor as the work proceeds. The engineer or surveyor shall establish all points, lines, elevations, grades and bench marks for the proper control and execution of the work. The engineer or surveyor shall establish a single permanent benchmark to be approved by the architect, to which all three coordinates of dimensional control can and shall be based. The engineer or surveyor shall verify all College-furnished topographical and utility survey data, and all points, lines, elevations, grades and benchmarks provided.

Should any discrepancies be found between information in the plans and the actual site or field conditions, the Contractor shall notify the architect and the College in writing, and shall not proceed with any work affected until it receives written instructions from the College.

The contractor is required to provide a final “as built” survey from a New Jersey Licensed/Certified Surveyor of the project site showing all structures, elevations, grades and required information on the project site and submit to the College in CADD format.


The Contractor shall construct and keep all roadways, drives, walkways and parking areas within or near the site free and clear of debris, gravel, mud or any other site materials, including, for example, by the cleaning of muddy wheels and undercarriages on vehicles before they exit the site. The Contractor shall be responsible for any citations, fines, or penalties imposed on it or the College for failing to comply with applicable local rules or laws regarding its use of roads and the like.

The Contractor shall obtain permission in writing from the College before using for construction purposes any existing driveways, parking areas, walkways or areas not specifically designated for such use in the contract documents. The Contractor shall maintain such driveways and areas in good and clean condition during construction and not damage them. At final acceptance and completion, it shall leave them in the same condition as they were at the start of the work. Conditions of such facilities before use shall be photographed and otherwise documented by the Contractor. The Contractor shall not commence construction of permanent driveways, parking areas or walks on the project without the written approval of the College.

Any existing walkways, driveways, aprons, or curbs damaged by the work of this contract shall be replaced in kind immediately upon project completion, or as required to maintain campus safety and campus aesthetics.

I. Construction Site Condition, Storage, Dust Control.

The Contractor shall provide reasonable, safe and orderly storage for its equipment, tools and materials, and not unreasonably encumber the site. The Contractor shall keep the site and the project free from the accumulation of refuse, debris and scrap materials caused by its operations so that the site has a neat, orderly and workman-like appearance. Loading, cartage, hauling and dumping will be at the Contractor's expense. The Contractor shall provide at its expense temporary dust-proof partitions around areas of work in existing buildings, and where reasonably required in new building areas.

J. Photographs.

The Contractor shall provide at its expense monthly progress photographs of the project. The photographs shall be 8 inches by 10 inches and shall be submitted to the College in duplicate monthly. Unless otherwise specified in the supplemental general requirements, four photographs shall be submitted each month which provide views of the project taken from the same four points each month which should be selected by the architect.
K. **Project Sign.**

The Contractor shall at its expense provide, erect and maintain two project signs at the site which shall be
described in the contract documents. The College will specify the locations. The sign shall be painted by a professional
sign painter. No other sign will be permitted at the site. The Contractor shall remove the signs when the project is finally
accepted unless the College requests that it be removed earlier.

L. **Soil Conservation.**

The Contractor shall employ reasonable measures to conserve the soil at the site, and determine and comply
with all soil conservation measures required by the Mercer County Soil Conservation District.

Contractor shall coordinate and schedule all Soil Conservation inspections and provide the College with all site
inspection notes, approvals or notices.

M. **Temporary Facilities, Services, Electric, Heat and Enclosures.**

The Contractor shall provide storage areas, temporary drives and sidewalks, employee parking areas, staging
areas, excavation borrow/spoil areas, commercial canteen areas, field offices including a meeting room, telephones, toilet
facilities, and other temporary facilities which are necessary to perform the work or which may be required by the project
specifications. The Contractor shall locate these facilities on the project site, and the location shall be subject to the
approval of the College.

The Contractor shall provide adequate and clean temporary toilet facilities on the project site in locations to be
approved by the College, and they shall be serviced at least twice a week by a firm qualified and experienced in such
functions. The Contractor shall provide such temporary electricity, water, and other utilities which are necessary to
perform the work, or which may be required by the project specifications. The Contractor shall also supply such
temporary enclosures and heat which are necessary to perform the work or which may be required by the project
specifications. The contractor and the subcontractors will not enter or use any College facilities not required by the work
of the contract.

Temporary electric and heat shall be furnished by the Contractor for the benefit of other contractors working on
the project if specified in the project specifications.

The Contractor shall not anticipate using the permanent heating or air conditioning system in a building for
temporary heat or air conditioning prior to the acceptance of the project as substantially complete unless specified
otherwise.

Any natural gas, or combustible material, or hazardous material containers utilized by the Contractor must be
stored in a safe, ventilated location approved by the College. The Contractor must also submit for approval a reasonable
safety plan for the operation of temporary heat equipment.

N. **Substitutions**

The Contractor may include in their bid substitute materials or equipment or construction methods in lieu of
those specified in the contract documents, but they do so at their own risk. Any substitution must be equal in type,
function and quality to the item required in the contract. The Contractor must submit all information required within 20
days of contract award to determine if the proposed substitute is equal to the contract requirements, and any substitution
must be approved by the architect and the College.

The College shall have complete discretion to decide whether it will accept any substitution. No substitution
shall result in any increase in the contract price or times. The Contractor in its application for the substitution must certify
in writing that the substitution is equal to what is specified in the contract documents in all material respects and will not
increase the time or price of the contract work.
Should the substitution be rejected, the contractor will then be required to provide the specified product, material or method at no additional cost to the College and no change in the project schedule.

O. License Fees.

The Contractor shall be responsible for obtaining the right to use any equipment, design, device or material required to perform the contract, and to include in its contract price any license fee or royalty required.

ARTICLE 6. SUBCONTRACTORS.

A. Contractor Responsibility for Subcontracted Work.

The Contractor shall be fully responsible to the College for the proper performance of the contract irrespective of whether the work is performed by the Contractor's own forces or by subcontractors employed by the Contractor. The Contractor shall be responsible for the acts and omissions of its subcontractors and suppliers on the project and shall take appropriate measures if they are not properly supervising or performing their work.

B. Subcontractor Identification and Approval.

The Contractor shall include with its bid for the contract the names, addresses and license numbers of all subcontractors which it proposes to utilize on the project for plumbing and gas fitting work, HVAC work, electrical work, structural steel and ornamental iron work. No subcontractor may perform work on the project until it has been approved by the College.

Within 20 days after Notice to Proceed, the Contractor shall furnish to the College in writing for review by the Architect a list of the names of all Subcontractors, Sub-subcontractors, fabricators, manufacturers, sources of supply, articles, devices, fixtures, pieces of equipment, materials and processes proposed for each item of Work on List of Subcontractors, AIA Document G805. The Architect or Owner will promptly notify the Contractor in writing if either the Owner or Architect, after due investigation, has reasonable objection to any names on such list. Failure of the Owner and Architect to make objection within 10 days to any name on the list shall constitute acceptance of such name.

In submitting the names of subcontractors, the Contractor shall list 1) the name and address of the Subcontractor, 2) the name and address of all Sub-subcontractors for each significant subdivision of the trade or work 3) reference in the form of a list of at least 3 jobs similar in size and quality to this Project performed in the last 5 years, with name and location of work, dollar value and names of the Owner and Architect.

In submitting sources of supply of materials, articles and pieces of equipment including those under subcontracts and sub-subcontracts, the Contractor shall list 1) the name and address of the source of supply 2) the name of the manufacturer of the items.

If the College disapproves a proposed subcontractor, it will provide the reason for its decision in writing. The College will not be liable for any extra cost or delays caused by the reasonable disapproval of proposed subcontractors. The approval of subcontractors by the College shall not relieve the Contractor of the responsibility for complying with all of the provisions of the contract including those performed by the subcontractors. Subcontractors approved by the College may not be changed without prior notice to and approval by the College.
C. **Subcontractor Qualifications.**

The College may disapprove a proposed subcontractor if it has a reasonable objection to the subcontractor, or if there is evidence of poor performance on other projects or financial problems, or if the subcontractor has been suspended or debarred by any public agency within the State of New Jersey, or if the subcontractor is not properly licensed and registered to do business in New Jersey or with the New Jersey Department of Labor regarding prevailing wages, or if the subcontractor has been charged with or convicted of violating any laws including but not limited to the New Jersey Prevailing Wage Act, criminal laws, public procurement laws, anti-trust laws, election laws, laws against employment discrimination, environmental laws, tax laws, professional licensing laws, or laws regarding attempts to improperly influence College or other public officials. Subcontractors shall also utilize qualified, competent craftsmen on the project.

D. **Subcontractor Compliance with Contract/Subcontractor Supervisors.**

The Contractor shall require its subcontractors on the project to comply with all pertinent terms of the contract and contract documents, and shall include all appropriate terms and provisions in subcontracts on the project to achieve proper contract performance. Each subcontractor shall have competent superintendents and foremen supervising their work, and the Contractor shall take appropriate measures if they do not do so.

E. **No Contract Relationship Between College and Subcontractors.**

Nothing in the contract or contract documents shall create any contractual relationship or duties between the Contractor's subcontractors and the College.

**ARTICLE 7. TIME, LIQUIDATED DAMAGES, DELAY CLAIMS AGAINST COLLEGE.**

A. **Contract Times.**

The Contractor shall begin the contract work within 10 days after the issuance of a notice to proceed by the College, and shall perform the work in the contract by the dates specified in the contract, including milestone, substantial completion and final completion dates.

B. **Liquidated Damages For Delay.**

If the Contractor fails to substantially complete the project by the substantial completion date specified, the Contractor shall pay the amounts specified in the contract as liquidated damages for delay for each calendar day that the task remains incomplete beyond the substantial completion date.

The College and the Contractor agree that the actual loss to the College from construction delays and the inability to use the project in a substantially completed state are for the most part difficult to quantify, and that the foregoing liquidated damages formula results in damages amounts that are reasonable and are not penalties. The College and the Contractor agree that the amount of liquidated damages per calendar day for delays in the substantial completion of the project is a reasonable estimate of the damage to the College for not being able to use the project in a substantially completed state. The College may deduct liquidated damages from payments due under this contract, but its failure to withhold liquidated damages or to assert claims for liquidated damages shall not be deemed a waiver of the College’s right to withhold or to assert claims for damages for any delays which occur at any time on the project.
C. Delay Claims Against The College -- Limitations

The Contractor may not assert claims against the College for extra compensation by reason of any delays in its work resulting from acts or omissions of any third parties irrespective of extensions granted under the contract, including but not limited to delays caused by third parties such as the project architect, other contractors, utilities and governmental authorities.

The College shall only be required to pay additional compensation for delays caused by the College itself, and only to the extent required by N.J.S.A. 2A:58B-3 (delayed performance caused by the College's own negligence, bad faith, active interference or other tortuous conduct, but not for reasons contemplated by the parties and not for the negligence of others including others under contract with the College on the theory that such negligence should be imputed to the College). The College shall not be liable for any period of delay when there is a concurrent delay for which it is not responsible.

When the Contractor is entitled to extra compensation for delay under the contract and general conditions, it can only assert claims for extra costs at the job site, and may not assert claims for extra costs for home office expenses, home office overhead, lost profit or consequential losses. Any additional compensation under this paragraph shall also be subject to the provisions in the contract and general conditions regarding claims, and the provisions in the contract and general conditions regarding the maintenance and availability of cost records.

D. MEDIATION

If a dispute or claim arises out of or relates to this contract, or the breach thereof, and if the dispute cannot be settled through negotiation, the parties agree first to try in good faith to settle the dispute by mediation administered by the American Arbitration Association under its Construction Industry Mediation Rules before resorting to arbitration or litigation. The Owner reserves the right to request a mediation if it deems it necessary.

ARTICLE 8. PROJECT SCHEDULE.

A. General Schedule Requirements.

The Contractor shall schedule the construction work and determine the most feasible means and order for the work to complete the project within the times required by the contract. The Contractor shall prepare a project schedule and monthly schedule updates which must be approved by the College and the architect, and it shall perform the contract and the work in accordance with the schedule. The project schedule should include a schedule of submittals for approval. The project schedule must be submitted before any work (other than mobilization to site and general layout and site preparatory work) on the project can begin under the notice to proceed. When the Contractor's schedule is approved by the College, it shall become an additional contract document and the Contractor shall be required by the contract to comply with it. The project schedule and updates shall be used in determining the amount of the monthly progress payments to the Contractor. The College may also use the schedule and updates to determine if the Contractor is adequately planning and performing the work in accordance with the contract.

B. Form and Content of Schedule.

The Contractor shall prepare the project schedule using Critical Path Method (CPM) scheduling techniques. The Contractor shall utilize the latest revision of Primavera P3 or Microsoft Scheduling software. The Contractor shall prepare a detailed schedule which shows how it will plan, organize, execute and complete the work. The schedule shall be in the form of an activity oriented network diagram (CPM). The principles and definitions used in this section shall be as set forth in the Associated General Contractors of America (AGC) publication "Construction Planning and Scheduling", copyright 1994.

The detailed network diagram shall provide sufficient detail and clarity of form and technique so that the Contractor can plan, schedule and control its work properly, and the College and the architect can readily monitor and follow the progress of all portions of the work. The network diagram shall comply with the limitations imposed by the
The CPM schedule shall include the arrow or network diagram and the computer produced schedule with dates. The schedule shall include and reflect the following factors:

1. Project phasing, and contract milestones and completion dates.
2. The structural breakdown of the project.
3. The types of work to be performed and the labor trades involved.
4. Reasonable logic and activity durations.
5. Reasonable coordination of all activities.
6. Purchase, manufacture and delivery activities for all major materials and equipment.
7. Deliveries of College furnished equipment.
8. Allowances for work by separate contractors identified in writing by the College at the time of contract award.
9. Submittals and approvals of shop drawings, material samples, and other required submittals.
10. Subcontract work.
11. Crew flows and sizes (manpower).
12. Assignment of responsibility for performing all activities.
13. Access and availability to work areas.
14. Identification of interfaces and dependencies with preceding, concurrent and follow-on contractors, and sequences and interdependence of activities.
15. Testing and inspections.
16. Phased or total inspection, acceptance, and takeover by the College.
17. Utilization of schedule to determine amounts of monthly progress payments.
18. Activities required of the College and the project architect such as approvals, including reasonable durations for the activities.

Activities should be set forth in working days and have a maximum duration of 60 days, except for non-construction activities such as the procurement and delivery of materials and equipment. All durations shall be the result of definitive manpower and resource planning by the Contractor. The level of detail in the schedule shall be subject to the approval of the College. The schedule shall include a reasonable approach to achieve milestones and completion dates in the contract. Any failure of the Contractor to include any element of the work in the schedule shall not excuse the Contractor from completing that work and all of the work needed to complete the project by the completion dates in the contract.

The network diagram is to be prepared by a computer plotter. The logic diagram will be pure logic and shall not be drawn to time scale. The logic diagram shall be drawn on 30” x 42” size sheets and prepared on a tracing/mylar or similar material suitable for reproducing high quality prints.

C. Computerization of Schedule.

The mathematical analysis of the detailed network diagram shall be made by computer, and the tabulation for each activity shall include the following:

1. Activity numbers.
2. Activity descriptions.
3. Durations in work days for each activity.
4. Earliest start date (by calendar date).
5. Earliest finish date (by calendar date).
6. Latest start date (by calendar date).
7. Latest finish date (by calendar date).
8. Slack or total float in work days.

The following computer documents shall be prepared as part of the initial schedule submission and each update:
1. Activity file sort, including sorts listing activities required of the College and the project architect, such as approvals.
2. Eight week "Lookahead" detailed bar chart.
3. Eight week summary bar chart.
4. Additional computer sorts requested by the College.
5. High density floppy disks or CDs of all computer files.

D. Weather Inclusion in Schedule.

Seasonal weather conditions shall be included in the schedule, including average precipitation, temperature and other weather conditions typical in the geographic area over a 5 year period by quarterly period (spring, summer, fall, winter).

E. Schedule Updates.

The Contractor shall prepare schedule updates monthly until its contract and the project are completed. The first update shall be issued 30 calendar days after the construction start date specified in the notice to proceed. Updates shall include the following information:

1. Actual start and completion dates for activities.
2. Activity percent completion.
3. Remaining durations for activities in progress.

Each schedule update shall also include a narrative report which includes the following information:

1. Summary of work completed during update period.
2. Comparison of actual progress and status to activities and dates in original schedule.
3. Analysis of critical path including affect of activity progress on critical path.
4. Analysis of secondary critical paths, meaning float within 10 days of the project critical path.
5. Analysis of time lost or gained during the update period.
6. Identification of problem areas.
7. Identification of change orders and delays impacting or delaying the project under the project schedule.
8. Solutions or proposed solutions to current problems and delays.
9. Extensions requested by the Contractor, including activities affected and the amounts, and the reasons for the requests.
10. Extensions granted by the College for delays and changes, including the activities affected and the amounts, and any effect on the critical path and contract completion dates.
11. Delays in activities required of the College and the project architect, and activities which they are required to complete in the update period following the issuance of the update.

All schedule updates must be submitted to the College and the architect for approval. Schedule updates including the reports which are approved by the College shall be deemed to be official records of the progress and status of the project under the schedule and the contract, and may be utilized by the College in determining if the Contractor is adequately planning and performing the work under contract.

F. Meetings/Eight Week Bar Charts.

The Contractor’s project manager and scheduler shall arrange for and attend monthly progress and scheduling meetings with the College and the project architect. Monthly progress meetings shall be scheduled 3 to 7 days after monthly schedule updates and reports are issued and provided to the College and the project architect. The purpose of these meetings will be to review past progress, current status, problem areas, delays, measures to reduce delays, future progress, and the Contractor’s most recent schedule update and report. At the monthly progress meetings, the Contractor
shall provide look ahead summary and detailed bar charts showing the work and activities to be performed and/or completed during the 8 week period following the schedule update.

G. Schedule Documentation for Contract Payments.

The Contractor will not be entitled to payments under the contract until a project schedule has been submitted to and approved by the College. No payment will be made under the contract if, when the payment is due, a schedule update and narrative report is due under this paragraph but has not been submitted to and approved by the College. The original CPM project schedule shall include a breakdown allocating the total contract price among the network activities in the schedule which must be approved by the College.

H. Progress, and Recovery Schedules.

The Contractor shall perform its work in accordance with the schedule. If the Contractor's work falls behind the requirements of the schedule, it shall at its own cost institute measures to improve its progress and bring its work in compliance with the schedule, including but not limited to increasing manpower, increasing work hours per shift, increasing shifts, increasing working days per week, and re-scheduling work activities to perform them concurrently where feasible.

If monthly schedule updates show that the Contractor's progress has fallen behind the project schedule so as to jeopardize the achievement of milestone or completion dates in the contract by more that 10 work days, the Contractor shall, if requested by the College in writing, prepare a recovery schedule with acceleration measures to regain the lost time, and shall proceed in accordance with the recovery schedule in additional to the project schedule at its own cost.

I. Contractor Failure to Provide Schedule Updates.

If the Contractor fails to provide monthly schedule updates and reports when required, the College can elect in it sole discretion to employ any of the following remedies: 1) not make progress payments; 2) on 10 days written notice to the Contractor, retain its own consultant to provide schedule updates and reports and deduct the cost from the contract price; 3) terminate the contract for default in accordance with the termination provision in these general conditions.

J. Scheduler Qualifications.

The Contractor must utilize a scheduler which satisfies the qualification requirements for the project. If at any time during the project it appears that the Contractor's scheduler is not competent to provide the scheduling services required in this article, the Contractor shall within 10 days after a written notice and demand from the College, retain a replacement scheduler which is competent to provide the services required. The College may also utilize any of the remedies in this article and the contract and general conditions for the Contractor's failure to provide proper schedule updates and reports.

ARTICLE 9. EXTENSIONS, COMPENSATION FOR CERTAIN EXTENSIONS.

A. Delays Warranting Extensions of Contract Dates.

If the Contractor is unavoidably prevented from completing any part of the work within the milestone, substantial completion or final completion dates in the contract by causes beyond the control and without the fault of the Contractor or its subcontractors, those contract dates will be extended by amounts equal to the time lost due to such delays, provided the Contractor requests extensions in accordance with this article. Delays warranting extensions of the contract dates include unforeseeable and unavoidable delays caused by the College, the project architect, other contractors employed by the College, utility owners or other third parties, acts of God, acts of governmental authorities, wars, abnormal weather conditions, fires, floods, earthquakes, epidemics, plagues, and other unavoidable casualties. The contractor has 24 hours to notify the owner in writing from the start of a delay with a clear and concise reason for the delay, otherwise the delay will not be reviewed. This limited time frame is to provide the College the opportunity to
immediately address the issue and limit the amount of time in the potential delay and its potential impact on the project schedule.

B. Weather Delays.

No time extensions will be granted for time lost due to normal seasonal weather conditions. To qualify for a time extension due to unusually severe or abnormal weather conditions, the Contractor must demonstrate that the weather conditions during a given quarterly period (summer, fall, winter, spring) were more severe at the project site than the previous five year average for the geographic area by quarter, and that the weather conditions critically impacted contract milestone, substantial completion or final completion dates by delaying the performance of work on the project's critical path. No time extensions will be considered for any weather conditions that do not affect work on the critical path or contract dates.

Where the cause of delay is due to weather conditions, extension of time shall be granted only for unusually severe weather, as determined by reference to historical data. The term "historical data" as used in the preceding sentence shall be construed according to this formula: Average rainfall (or snow or low temperature) for the past five years for the month in question, plus 10 percent. In other words, weather is not deemed to be unusually severe unless it is 10 percent worse than the average for that month over the last five years.

Apart from extension of time, no payment or allowance of any kind shall be made to the Contractor as compensation for damages on account of hindrance or delay from any cause in the progress of the work, whether such delay be avoidable or unavoidable. The Contractor agrees that he will make no claim for compensation, damages for any such delays, and will accept in full satisfaction for such delays said extension of time.

C. Float Time Use.

Float time in the schedule is not for the exclusive use of either the Contractor or the College. Float time is available for use by both parties to facilitate the effective use of available resources and to minimize the impact of problems and delays which may arise during construction. No time extension will be granted as a result of any problem, change order or delay which only results in the loss of available positive float on the project schedule. Float time shown on the project schedule shall not be used by the Contractor in a manner which is detrimental to the interests of the College or the project.

D. Calculation of Extensions.

Extensions will be calculated based on the effect of delays on the project schedule and the activities in the schedule. If the Contractor is entitled to an extension for a delay based on the nature of the delay under this article, the activities in the schedule affected by the delay will be extended by the amount they are affected. If extensions of activities in the project schedule affect the critical path and delay the contract milestone and completion dates, they too will be extended to the extent affected. The critical path and contract dates will only be extended to the extent that they are actually affected under the schedule by a delay for which the Contractor is entitled to an extension.

If for any scheduled activity or period there are concurrent delays which include delays for which the Contractor is entitled to an extension and delays for which the Contractor is not entitled to an extension, the Contractor will be given an extension for the delays for which it is entitled to extension so that it will not be liable to pay liquidated damages for delay, unless the College eliminates or reduces that delay. A concurrent delay will not justify an extension to the Contractor if it has minimal effect on the completion of the project, and/or if it would likely have been avoided if it had become apparent that it was having an effect on the progress of the project and the project completion date.

E. Elimination of Delays and Extensions (Acceleration).

If the effect of a delay for which the Contractor is entitled to an extension can be reduced or eliminated by changes in the schedule or other measures which have no material adverse impact on the Contractor in terms of cost or otherwise, the Contractor shall employ those measures so that no extension is required or so that a shorter extension is
required. If the Contractor is entitled to extensions for delays, and if the College (in its sole discretion) notifies the Contractor in writing that it prefers to eliminate the lost time to avoid or reduce the extension required, by changes or additional efforts such as acceleration efforts, the Contractor shall perform those measures as a change to the contract to be compensated under the change order provisions of the contract and the general conditions.

F. Requests for Extensions Required.

The Contractor must provide the College with a written notice of delay and request for an extension within 24 hours of the beginning of a delay, or it will not be entitled to a review. The written notices of delay and requests for extensions must include the nature and cause of the delay, the known extent of the delay, the work activities on the project schedule affected by the delay and the extent of the affect to each, and suggestions or proposals to reduce or eliminate the delay.

G. Compensation for Certain Extensions and Limitations.

Under the contract and general conditions, the College does not assume responsibility for many types of delays, including additional costs resulting from extensions granted because of those delays. Where the College is responsible for a delay under the express terms of the contract and general conditions, it will pay extra compensation for any extension granted because of the delay.

Compensation by the College for delays (and extensions) for which it is responsible under the contract and general conditions shall only include additional costs actually incurred at the site, and shall not include home office expense, home office overhead, lost profit or consequential losses. Any additional compensation under this paragraph shall be subject to the provisions in the contract and general conditions regarding claims, and the provisions in the contract and general conditions regarding the maintenance and availability of cost records.

No compensation will be paid if an extension for a delay for which College is responsible is concurrent with another delay for which the Contractor is not entitled to an extension, or is concurrent with another delay which the Contractor is entitled to an extension but the College is not responsible for the other delay.

If the College requests a change in the contract work, potential delays and extensions which result from the change and any resulting extra compensation for the change shall be addressed under the change order provisions in the contract and the general conditions in addition to this article.

ARTICLE 10. PAYMENTS TO CONTRACTOR.

The College will pay the Contractor as full compensation for performing the contract the contract price as adjusted by approved change orders which increase or decrease the contract price. The College will do so in accordance with this article, any supplemental general conditions regarding payment, and the payment terms in the signed contract. Payment provisions in the supplemental general conditions which add to or modify this provision shall take precedence over this provision. Payment provisions in the signed contract which add to or modify payment terms shall take precedence over the supplemental general conditions and this article.

A. Monthly Progress Payments.

The College will pay the Contractor monthly progress payments as the contract work proceeds and will pay for work completed, less retainage. The Contractor shall submit monthly invoices using the College's invoice form for the work completed in each calendar month, and the monthly invoice shall be submitted in accordance with the contract. The Contractor shall be entitled to monthly progress payments based on the percentage of the contract work completed (less earlier payments), and that amount shall be based on the unit schedule breakdown and the update of the CPM for the billing period showing schedule activities completed and progress on incomplete activities, in conjunction with the values assigned to those activities. If there is a discrepancy between the amount due based on the unit schedule breakdown and the amount due based on the CPM update, the Contractor shall only be entitled to the lesser amount unless the Owner’s Representative, in his/her sole discretion, decides otherwise.
B. Unit Schedule Breakdown/CPM Activity Price Breakdown.

Before the contract is signed, the Contractor shall submit to the College and the architect a unit schedule breakdown (schedule of values) utilizing the College’s form which reasonably allocates the contract price among the principal categories of work and materials in the contract. The unit schedule breakdown must be signed by the Contractor and is subject to approval by the architect and the College for use in calculating monthly progress payments under the contract. The Contractor shall not "front end load" the unit schedule breakdown. The unit schedule breakdown may include line items for mobilization, bonds and insurance.

The Contractor's proposed CPM schedule shall reasonably allocate the contract price among the activities in the schedule so that monthly CPM schedule updates can be utilized in connection with the unit schedule breakdown in determining the amount of monthly progress payments. The Contractor's unit schedule breakdown and CPM activity price breakdown must be approved by the architect and the College before any payments are made under the contract.

C. Invoices for Monthly Progress Payments: Form and Content.

The Contractor must utilize the College's invoice form and the invoice forms must be completed before they are submitted for payment. Each invoice must be signed by the Contractor, and shall certify that the work and materials represented as having been provided have been provided, and that all subcontractors and all suppliers on the project have been paid all amounts legitimately due for work and materials billed to the College in earlier invoices which were paid by the College.

Invoices for monthly project payments must include the status of the work in the unit schedule breakdown and the CPM update for the billing period which shows the activities completed or started and the value of them based on the CPM schedule. Invoices must also include certified payrolls for the Contractor and all subcontractors for the billing period, affirmative action monthly manning reports, a certification of subcontractor/supplier payments, a partial waiver of liens, a list of all materials stored to date including descriptions, values, quantities and location, and any documents required in the contract documents.

The Contractor will be entitled to have an invoice paid if the architect and the College approve the invoice including the percentage of work completed, and if the quality of the work and materials conform to the contract documents. The approval of invoices shall not waive claims for defects or deficiencies in the work or materials provided, or the right to subsequently inspect the project as a complete and functioning whole.
D. Payment for Materials and Equipment Procured But Not Installed.

The Contractor may seek payment in monthly invoices for materials and equipment delivered to the project site but not yet incorporated into the work. The Contractor shall include with its monthly invoices a list of the stored equipment, the amount and type of stored materials, and the place where they are stored. Each invoice which seeks payment for materials and equipment delivered to the project site but not installed or incorporated into the work shall include a signed bill of sale to the College and an invoice from the supplier. All risk of loss or damage for materials and equipment delivered in the project site shall remain with the Contractor.

The College will only rarely pay for material or equipment stored off site, and only when it determines in its sole discretion that there is good cause. The College will consider no request to pay for materials or equipment stored off site unless the Contractor includes a written request for such payment with its bid for the project. If the College does agree to pay for material or equipment stored off site during the performance of the contract, it will do so when the contract is signed.

If the College does agree to pay for materials and equipment stored off site, such payments shall be subject to any conditions in the signed contract, and in all cases, a bill of sale to the College, a paid invoice, insurance and proof the storage facility is bonded will have to be provided to the College when each payment is sought. The location will have to be specified in writing and the material or equipment will have to be inspected by the College. The Contractor and it performance bond surety must agree in writing that they retain all risk of loss or damage, and each payment application must contain a consent to payments for materials stored off site signed by the Contractor's bonding company.

Payments on account of materials or equipment not incorporated in the Work but delivered and suitably stored at the site, or at some other location agreed upon in writing, may be made by the Owner subject to the following conditions:

Such materials or equipment shall have been fabricated or assembled specifically for the Project and delivered to storage no earlier than needed for the orderly progress of the Work as demonstrated by the Progress Schedule.

Title to such materials or equipment shall pass to the Owner pursuant to the Contractor's bill of sale which shall contain guarantee of replacement thereof in the event of damage thereto or disappearance thereof due to any cause. The Contractor shall also affirm that it will pay for such materials or equipment immediately upon receipt of payment therefore from the Owner.

In the case of off site storage, the Contractor shall also provide Consent of Surety to such payment and insurance of such materials or equipment against the perils set forth in the General Conditions both while storage and during transportation to the site. Raw materials or other materials or equipment readily duplicated or usable on other projects will be paid for only after the materials are incorporated in the construction.

E. Retainage.

The College will retain 2% of the amount due on each partial payment pending completion of the contract.

Upon acceptance of the work performed pursuant to the contract, all amounts being withheld by the College shall be released and paid in full to the contractor within 45 days of the final acceptance date agreed upon by the contractor and the State college, without further withholding of any amounts for any purpose whatsoever, provided that the contract has been completed as indicated.

F. Payment for Change Order Work.

The Contractor shall invoice for change order work in the monthly contract progress payment invoices as the change order work is performed, but may only do so after a written change order has been signed by the appropriate College personnel and a purchase order issued by the College.
G. Final Payment.

Upon final completion of all work included in the contract including all change orders, upon acceptance of the work by the architect and the College, and upon the issuance of the final acceptance certificate, the Contractor will be paid the fully adjusted contract balance including any retainage. The Contractor shall submit an invoice for the final payment, and that invoice must include a release of all claims except claims expressly identified and described in the invoice including the amounts. The final invoice must be accompanied by all warranties, guarantees, manufacturer literature, approved as-built drawings, shop drawings required, and other documents which the Contractor is required by the contract to provide to the College at the time of final completion. The final invoice must also include a written signed consent to the final payment signed by the Contractor's bonding company.

H. Payment Terms.

All invoices and payments shall be subject to the terms of the contract and the general conditions, including the provisions regarding payments, and to the right of the College to withhold payments or to make deductions from payments for damages, defective work, liquidated damages, third party claims, failure to complete work, contract requirements, failure to comply with schedule obligations or other causes authorized by the contract documents. See also the Prevailing Wage Act requirements in the signed contract.

I. Payment Based on Partial Acceptance (Limitation).

The College will not accept portions of the project as substantially or finally complete unless specified elsewhere. If the specifications authorize partial acceptances, they will also specify the terms and conditions of such acceptances.

J. Failure to Pay Amounts in Dispute Not to Affect Performance.

The failure of the College to pay any amount requested by the Contractor in an invoice based on a determination that the invoice is improper or some other dispute shall not entitle the Contractor to stop or slow down the performance of the contract work.

K. Waiver of Certain Claims by College Against Contractor in Connection with Final Payment.

In its final acceptance certificate the College shall certify that it has no claims against the Contractor in connection with the performance and completion of the contract except for claims listed in the final acceptance certificate, such as claims for cost overruns, delays, or known defects. The College's certification shall not apply to or release post-completion claims, such as claims for defects or other problems in the completed project which are discovered or which become serious after project completion, warranty or maintenance claims, indemnity or contribution claims, claims for damage occurring after completion, or other claims for the performance of post-completion obligations in the contract or problems which manifest themselves after completion.

ARTICLE 11. CHANGES.

A. Changes Authorized.

The College may at any time authorize and direct changes in the work or accelerations of the work which increase or decrease the contract price. All changes including changes in the contract price shall be governed by this Article and the change provision in the contract. All changes must be in a written change order signed by the Vice President for Facilities, Construction and Campus Safety, the Owner’s Representative, the architect and the contractor. A Purchase Order will then be issued by the College and signed by the Contracting Officer. At which time the contractor can then bill for the completed change order work. Any extensions in the contract times and increases in compensation because of extensions resulting from changes shall be governed by Article 9 regarding extensions, but the authorization for the extra compensation itself resulting from an extension must be contained in a change order which complies with
this Article as well. The College may elect to have changed work on the project which is within the scope of this contract performed by another contractor. Changes in the contract shall not affect the surety bond protection or insurance coverage required by the contract.

B. Change Request or Directive.

The College may request a change in the work or materials to be provided under the contract by a written contract change directive ("CCD") signed by the Owner’s Representative. If the College is of the opinion that no change in the contract price or times is required because of the change request, it shall so state in the CCD. A CCD may include provisions regarding the scope of the changed work or materials, and may also include conditions including time parameters or an upset price. A CCD may provide that specified contract work shall stop until further notice, but the Contractor shall not stop or delay any contract work because of a CCD unless the CCD provides that work should stop because of the change. A CCD may provide that the performance of changes shall not commence until a change order is issued and a subsequent purchase order is issued and signed by the Contracting Officer, or that changed work should proceed before a change order and purchase order are issued by the College to maintain the progress of the project.

C. Change Orders Which Are Protested.

If the Contractor protests the terms of a change order, it shall notify the College in writing within 2 business days of its protest. It shall describe the terms which it objects to and the reasons for its protest. It shall include supporting documentation if appropriate. The College may elect to direct the Contractor in writing to perform the change order requirements despite the protest. If it does so, the Contractor's right to pursue further relief based on the protest shall be preserved and the contractor shall immediately proceed with the change work.

D. Changes Affecting Contract Times.

Changes and change orders shall not affect or extend any of the contract times unless the change order itself specifies that it changes contract times. If a change order issued by the College delays the completion of any activity in the project CPM schedule, the time allowed for that activity shall be extended, and if a delay in that activity delays other activities, the critical path or the completion dates in the contract, they too will be extended. The Contractor shall make reasonable efforts in scheduling changed work so that it does not delay or extend activities in the CPM schedule including the substantial and final project completion dates. The Contractor shall also make alternate proposals for change order work which include acceleration for the changed work where feasible to achieve this goal, and shall include the cost of such efforts in its change order requests.

Change orders must specify whether they result in any delay (or extension) to any critical path activities in the schedule, including an identification of the activities and the amount of delay in each. If no delay or extension is set forth in a change order, it will be deemed an agreement by the College and the Contractor that no delay or extension results from the change order.

E. Contractor Initiated Change Order Requests.

If the Contractor contends that any directive or communication from the College or architect, or any condition, event or circumstance entitles it to a change order changing the contract scope, terms, price or times, it shall submit a written change order request to the Owner’s Representative within 5 days of the event upon which the request is based. The written request shall specify the terms of the change order requested, and include all documentation and information which the Contractor seeks to have considered in support of the request, or which is necessary to a proper consideration of the request.

F. Change Order Amounts.

All price changes or amounts in change orders shall be based on (1) lump sum, (2) actual work time and materials plus mark-ups for overhead and profit, or (3) unit prices times actual quantities which may or may not include separate mark-ups for overhead and profit. If a change order price is to be based on a lump sum price or a unit price, the
College may request the submission of such documentation regarding market price or cost which it reasonably deems necessary to determine a lump sum or unit price. If a change order is based on actual work time and material costs, it will include a not-to-exceed price.

Applications for payment for change order work shall be included in monthly progress payment invoices as the change order work is performed, but only after a purchase order has been issued to the contractor by the College. For change orders based on time and material costs or unit prices times actual quantities, the time spent, material provided, and quantities performed shall be recorded in daily time slips, material invoices, and quantity of work performed tickets which are signed by a representative of the College to certify that the work and materials were provided, and the quantities. Labor costs and material costs for change orders shall be based on actual costs to the Contractor without any mark-ups except as provided in this Article.

Mark-ups may be added to time and material costs where a change order is authorized to be paid on a time and material basis, and also unit price change orders if the change order price term expressly authorizes mark-ups as a separate additional charge to be added to the unit price. When mark-ups for overhead and profit are authorized, the standard mark-up for overhead and profit shall be 15% of net costs properly invoiced in the change order. The schedule for mark ups is as follows:

- 15% of direct costs for overhead, profit, bond, and insurance for work performed directly by the contractor;
- 15% of direct costs for overhead, profit, bond, and insurance for work performed directly by the subcontractor and 5% of the direct and indirect costs of the work performed by the subcontractor for the contractor;
- 15% of direct costs for overhead, profit, bond, and insurance for work performed directly by the subcontractor’s subcontractor and 5% of the direct and indirect costs of the work performed by the subcontractor’s subcontractor for the subcontractor and 5% of the direct and indirect costs of the work performed by the subcontractor for the contractor;

There shall be no additional mark-ups for materials or suppliers and bond and insurance costs are included in the noted mark ups above. Refer to Division 1 specifications also for further delineation of items included in mark ups.

CONTRACTOR MUST USE THE COLLEGE OF NEW JERSEY FORM INCLUDED IN THE PAYMENT PROCEDURE DOCUMENTS.

G. Right to Audit Extra Costs (Before and After Payment).

The College reserves the right to audit all change orders and additional costs claimed and/or paid under the contract at any time. The obligation of the Contractor, subcontractors and suppliers to establish, maintain and produce cost records and remedies for failing to do so specified elsewhere in these general conditions and the contract shall govern. If an audit reveals that actual costs invoiced to the College and/or paid by the College in change orders exceed the actual costs incurred, the Contractor shall refund the excess, or the College may deduct the excess from future payments under the contract, or the College may assert claims against the Contractor and/or its surety for such overpayments.

H. Change Orders with Both Price Increases and Decreases.

If a change order reduces the scope of the work or materials to be provided by the Contractor under the contract, the change order shall provide for a reduction in the contract price in the amount of the actual reduction in cost. If a change order results in both added costs and reduced costs, they shall be combined for a net plus or minus contract price adjustment, and when mark-ups are applicable, they shall only be added to a net increase in the contract price which results from a combination of additions and deductions in the change order.

I. Waiver of Rights In Connection with Change Orders Issued Without Protest.

The Contractor shall not be entitled to seek any additional compensation or any extension of the contract times beyond the amounts and any extensions included in a change order signed by the College or a written change order
request submitted by the Contractor to the College for approval, the intent being that the Contractor must disclose all additional costs and delays claimed to result from a change so that the College can take measures in considering the change to effect cost savings and avoid delays. The failure to include extra costs or delays in a change order request will preclude the Contractor from later claiming such costs or delays in connection with the change in any form or fashion.

ARTICLE 12. COMPLETION.

A. Substantial Completion.

When the Contractor believes that the project is substantially complete, meaning all essential requirements of the contract have been sufficiently completed so that the project can be occupied and used for its intended purpose, it can make a written request to the architect and the College to conduct an inspection and to issue a certificate of substantial completion. The Contractor's request shall list all work and contract requirements which remain to be completed or corrected and an estimate of the value of the incomplete items.

The architect and the College will conduct an inspection, and if they determine the Contractor has substantially completed the project, the College will issue a certificate of substantial completion. If they determine that the Contractor has not achieved substantial completion, the College will notify the Contractor in writing and will list the work and contract requirements which must be completed for substantial completion and provide a punchlist. They will also assign a value to the incomplete items to be added to the 2% retainage held after the certificate of substantial completion is issued. The College and the architect will re-inspect when the Contractor notifies them in writing that those items have been completed.

Any failure of the College or architect to include incomplete or deficient items in a certification of substantial completion or a notice regarding a substantial completion inspection shall not affect the Contractor's obligation to properly complete all requirements of the contract.

The College will not issue a certificate of substantial completion unless it can occupy and use the project for its intended purpose, and the Contractor agrees that the College's use and occupancy of the project shall not affect the Contractor's obligation to complete the project and contract requirements. The Contractor also agrees that its completion of the project will not unreasonably interfere with the College's occupancy and use of the project.

Unless otherwise specified in the supplemental general conditions, a certificate of substantial completion will not be issued unless an unqualified temporary or permanent certificate of occupancy is issued, and the College is able to use and occupy the project without interruption.

After substantial completion, the Contractor is relieved of the duty of maintaining and protecting the project, and of its responsibility for damage to the project occurring after substantial completion, except insofar as such damage or any repair is covered by warranty, or is caused or made necessary by the act of the Contractor or anyone for whom the Contractor is legally or contractually responsible, or is attributable to defects. The issuance of a certificate of substantial completion shall not void or alter any of the other terms of the contract documents, including but not limited to terms relating to warranties, or relieve the Contractor of its obligation to complete the work or remedy defective work or materials, unless such terms are expressly modified by the certificate of substantial completion.

Guarantee periods for equipment, workmanship and materials shall commence when the certificate of substantial completion is issued or from the completion and acceptance of equipment, workmanship or materials, which ever is later, unless otherwise specified in the supplemental general conditions or the certificate of substantial completion.

The rights of the Contractor regarding payments upon the issuance of the certificate of substantial completion shall be as provided in the payment article of these general conditions and the contract.

B. Final Completion.
The Contractor shall notify the architect and the College in writing when it has completed the project and all of the contract requirements. The architect and the College will then conduct an inspection and issue a certificate of final completion if the project and all contract requirements have been totally completed. If any items remain incomplete or unsatisfactory, the College will notify the Contractor in writing and list the incomplete or unsatisfactory items. The Contractor shall immediately complete and correct any unfinished items and notify the architect and College and request a follow-up inspection for final acceptance.

The certificate of final completion will not be issued until all documents required by the contract have been provided, including warranties, maintenance and operating instructions, certificates, insurance, shop drawings required and as-built drawings approved by the architect. Final completion must include leaving the entire project site and project clean, neat and orderly. All distortions, cracks, delaminating and deteriorations of finished surfaces must be remedied. All broken items shall be repaired. All paint spots, stains and plaster must be removed. All unused equipment and excess material shall be removed. The project and the site shall be clean and finished.

If the Contractor unreasonably delays completing and correcting items needed for the issuance of the certificate of final completion, the College may unilaterally issue a certificate of final completion which lists incomplete and defective items, and which deducts liquidated damages and the cost of remedying incomplete and defective items from the final amount due to the Contractor under the contract.

Final payment will not be made until the certificate of final completion is issued, and the final payment shall be subject to the payment provision in the contract and these general conditions.

ARTICLE 13. SUSPENSION AND TERMINATION OF CONTRACT.

A. Suspension.

The College shall have the right to stop or suspend the work in whole or in part at any time. The work may only be stopped or suspended by a written directive of the Owner’s Representative, except in an emergency. The representative of the College may stop or suspend the work in whole or in part on an emergent basis, either verbally or in writing, but any such emergent suspension or stop work order shall be confirmed by a written directive from the Owner’s Representative within 48 hours. The College may stop or suspend the work because of any conditions affecting health or safety on or off site, any dangerous condition, any environmental hazard, the convenience of the College, or the public interest. If a directive to stop or suspend all or part of the work includes directions to secure the site, the Contractor shall perform the work required in the directive. The Contractor shall also maintain the safety and security of the project during the suspension for the protection of the site, work in place, materials and equipment on site, persons on or near the site, and the College's property.

If all or part of the work is suspended in response to a problem or condition caused by the Contractor's performance of its contract, or parties other than the College itself, or conditions over which the College has no control, the Contractor will not be entitled to any additional compensation for the suspension. If the College directs the suspension of work because of the improper performance of the contract by the Contractor or those performing its contract, the Contractor will not be entitled to any extension of any contract dates or additional compensation by reason of the suspension. If a suspension is directed for reasons other than fault of the Contractor or others involved in its performance of the contract, the Contractor will be entitled to an extension under and to the extent authorized in Article 9, and additional compensation under and to the extent authorized by Article 11.

B. Termination for Convenience.

The College may by a written directive terminate the contract at any time before completion for the College's convenience or where it concludes that it is in the public interest to do so. The Contractor shall complete any items of work specified in the notice of termination for convenience and any work necessary to make the site safe for all persons and property at or near the project site when the College terminates the contract for convenience under this Article.
Absent Contractor fault or violation of the contract, the Contractor shall be paid in full for all completed work, subject to the payment provisions in the contract and these general conditions. The Contractor will not be entitled to payment for costs and mark-ups for work or materials not provided before the termination, or costs for work and materials not provided unless the Contractor cannot avoid liability to pay those costs, or profit on the portion of the contract which will not be performed because of the termination, or other types of damages. The extra compensation payable to the Contractor in connection with a termination for convenience may include the cost of materials or equipment purchased for the project before termination but not installed if the Contractor cannot otherwise use or sell them.

The Contractor will also be entitled to reasonable costs in reasonable amounts for additional direct costs in connection with the termination, but not administrative, home office or overhead costs, lost profit, or consequential damages. In addition, any claims shall be subject to the provisions in the contract and general conditions regarding claims and the maintenance of cost records.

The Contractor shall also include provisions similar to this provision in subcontracts and supply contracts for the project. When a termination for convenience is directed by the College, the contract shall be closed out in accordance with the provisions of the contract and these general conditions regarding payment and project completion.

C. Termination for Cause.

The College may terminate the contract for cause if the Contractor commits substantial violations of the contract and contract documents, persistently fails to perform the work in accordance with the contract documents including the project schedule, fails to comply with applicable laws, rules or regulations, fails to pay subcontractors or suppliers to the extent reasonably required, become insolvent or becomes a debtor in a bankruptcy proceeding, fails to pay its debts, is found to have made false or misleading statements to the College in writing in obtaining the contract or payments, fails to comply with employment discrimination laws, fails to pay prevailing wages, fails to maintain or renew the required insurance, fails to maintain proper protection for the safety of persons or property on the site, fails to comply with reasonable and authorized directives of the College under the contract, or assigns its rights or interests under the contract or payments under the contract to any third party.

If the College terminates the contract for cause, it shall first send a notice of intent to terminate to the Contractor and the Contractor's surety. The notice shall direct the Contractor to remedy or eliminate the deficiency within a specified time if the problem is one that can be eliminated. If the Contractor fails to reasonably comply with the directive and notice, the College may after 10 days issue a notice of termination to the Contractor and its surety which terminates the contract effective immediately and specifies the reason for the termination.

If the contract is terminated the Contractor shall secure the site and take measures to leave the site safe for persons, material, work in place and equipment before departing the site, and shall remove all tools and equipment within 5 days of the termination effective date. The Contractor shall not remove any materials or equipment stored on site. When the contract is terminated, the Contractor shall deliver to any location designated by the College materials purchased for the project and paid for by the College, but not stored on site, together with all appropriate warranties and guaranties.

If the Contractor's surety does not takeover the completion in accordance with this Article, the College may appropriate any or all materials on the site which may be suitable and acceptable and may enter into an agreement for the completion of the project with another contractor, or use other methods to complete the project.

All damages, costs and charges incurred by the College together with the cost of completing the work, will be deducted from any monies due or which may become due to the Contractor for work completed by it before the termination. If such expenses exceed the sum available from the unpaid contract balance, the Contractor and its surety shall be liable and shall pay to the College the amount of such excess in addition to other damages.

The rights and remedies of the College in connection with a termination for cause shall be in addition to other rights and remedies which it has under law, the contract, and the Contractor's bond.
If the College terminates the contract for cause and it is subsequently determined by a court that the Contractor was not in default, or that the termination was legally unjustified, the termination will be deemed to be a termination for convenience under this Article, and the rights and remedies of the Contractor and its surety for the termination will be limited to those which exist in connection with a termination for convenience. If the College terminates the contract for cause, neither the Contractor nor the College may file a suit to recover on any claims arising out of the project before the project is substantially complete.

D. Surety Takeover Following Termination for Cause.

If the College terminates the Contractor for cause, the Contractor's performance bond surety may elect to takeover and complete the Contractor's work and obligations under its contract. If the surety elects to takeover the completion of the contract, it may only do so on the following conditions:

1. The surety must notify the College that it will takeover completion of the contract by a written notice of intent which is signed by a representative authorized to bind the surety within 5 calendar days of the surety's receipt of the College's notice of termination.

2. The surety and the College must execute a written takeover agreement within 10 days after the surety sends its notice of intent to takeover. In the agreement, the surety must agree to assume the obligation to complete the balance of the work under the contract and to perform all of the Contractor's obligations under the contract at the surety's sole cost and expense, and to utilize only contractors approved by the College which approval shall not be unreasonably withheld. The agreement shall provide that the surety is entitled to be paid the unpaid balance under the terminated Contractor's contract in accordance with and subject to the terms of the contract and general conditions.

3. The takeover agreement signed by the surety and the College must also provide that the surety is not relieved of any of its obligations under its payment and performance bond for the project, and that the College retains its right to withhold money for contract payments to compensate damages or for other reasons where authorized under the contract or the general conditions.

4. The takeover agreement signed by the surety and the College must also provide that it is without prejudice to and is subject to all of the rights and remedies of the College, the surety, and the defaulted Contractor, and the surety may not require the College to agree to a takeover agreement which seeks to extinguish any such rights.

5. The surety must also pay without delay all obligations of the terminated Contractor for work and materials on the project, subject to a reasonable allowance of time to investigate and verify claims.

ARTICLE 14. WARRANTY/DEFECTIVE WORK AND MATERIALS.

A. General Work One Year Warranty; HVAC Systems Two Year Warranty.

The Contractor warrants and guarantees for a one year period that all work, materials and equipment conform to the contract documents and will not fail or manifest defects, that the project and all its components will be fit for their intended functions, and that all material and equipment will be new and of good quality.

The general one year warranty period shall commence when the certificate of substantial completion is issued, and the one year period shall commence on that date for all components of the project, including any equipment activated and operated before substantial completion, such as HVAC systems, electrical systems and elevators.

During the one year warranty period, the Contractor shall repair and remedy at its own expense any premature failure, defects or deficiencies in any work, materials or equipment which are discovered or which develop during the one year period, and shall do so within 5 days after receipt of a written warranty claim from the College. The Contractor shall also repair damages caused by any failure or defect covered by this warranty. A failure to provide the warranty
service required shall constitute a breach of this warranty obligation as well as other applicable provisions of the contract. This warranty shall not cover failures caused by misuse or abuse by the College.

This general one year warranty is intended to provide the College with prompt warranty service for all aspects of the project for the one year period. It is not intended to limit or extinguish any additional warranties required by any of the contract documents, or provided by manufacturers of systems, equipment or materials provided under the contract. It is not intended to eliminate or reduce the College's rights and remedies under the contract and law for defects and deficiencies in the work, materials and equipment, the time period of the Contractor's general responsibility and liability.

B. Defective Work, Materials and Equipment.

Apart from the general one year warranty provided for in this Article, the Contractor shall be responsible for defective work, materials and equipment and any failure of these items to comply with the contract documents. This obligation shall extend beyond substantial completion, final completion and the general one year warranty in this Article.

If defects in materials or equipment or non-conforming items are discovered during construction and before completion, the Contractor shall promptly correct them at its own expense. If the Contractor fails to correct defective or non-conforming work, material or equipment in response to a written notice from the College, either during construction or after completion, the College may employ others to provide the remedial work and the Contractor and its surety shall be liable for the cost thereof and damages incurred. The Contractor and its surety shall also be liable for the cost of making good all work and material destroyed or damaged by defects or the correction of defects.

If any portion of the Contractor's contract monies remains in the custody of the College, either earned or unearned, the College may deduct money paid to others to remedy defects after notice is sent to the Contractor and damages when the Contractor fails to provide a remedy in response. The Contractor's responsibility for defects and non-conforming work, material and equipment shall not be limited in time except by law.

The Contractor's responsibility for defective work shall not be affected by either the performance or the lack of performance of inspections by the College or the architect. The issuance of payments, a certification of substantial completion or a certification of final completion shall not constitute acceptance of work, material or equipment which is deficient or not in compliance with the contract, or limit the Contractor's warranty or the other contract obligations.

ARTICLE 15. MISCELLANEOUS.

A. Insurance, Bonds, Indemnification.

The Contractor shall provide and/or maintain the insurance, bonds and indemnification required by the contract and law.

B. Prevailing Wage.

The Contractor and its subcontractors shall comply with the New Jersey Prevailing Wage Act, N.J.S.A. 34:11-56.25 through 56.57 and the provisions in the contract regarding prevailing wages.

C. Employment Discrimination.

The Contractor and its subcontractors shall comply with all laws prohibiting discrimination against employees, and shall comply with the provision in the contract regarding employment discrimination.

D. Patents.

If any design, device, material or process covered by patents or copyright is used in the work, the Contractor shall provide for such use by a suitable agreement with the patent or copyright owner. The Contractor shall bear all costs arising from the use of patented materials, equipment, or processes and all copyrighted materials used on or incorporated
in the work. The Contractor shall defend, indemnify and save harmless the College from any and all claims for infringement by reason of the use of any such patented or copyrighted items.

E. Emergencies Affecting Safety.

If there is an emergency affecting the safety of persons or property, the Contractor shall take immediate action to prevent damage, injury or loss. The Contractor shall notify the College of the situation and all actions being taken immediately or as soon as possible. If, in the opinion of the Contractor, immediate action is not required, the Contractor shall notify the College of the emergency situation and proceed in accordance with the College's instructions. However, if loss, damage, injury or death occurs that could have been prevented by the Contractor's prompt and immediate action, the Contractor shall be liable for all costs, damages, claims, actions, suits, attorney's fees and other expenses which result.

Any additional compensation or extension of time claims by the Contractor on account of emergency work shall be determined in accordance with the changes provisions of the contract documents. The Contractor shall be responsible for emergencies and costs and delays resulting therefrom which could have been foreseen or prevented with normal diligence, planning, and supervision of the work, or which are caused by the Contractor's failure properly to perform the contract.

The Contractor shall provide the College with a list of the names and telephone numbers of its employees and employees of each subcontractor designated to be contacted in case of an emergency during non-working hours. A copy of this list will shall be displayed prominently at the site so that it is visible when the site is secured and shall be provided to the College's campus police department.

F. Contractor Compliance with Law.

The Contractor shall keep fully informed of all federal, state and local laws, ordinances, regulations and orders of agencies which have jurisdiction or authority which in any manner affect those employed on the project or the project. The Contractor shall at all times observe and comply with, and cause its agents and employees to observe and comply with, all such laws, ordinances and regulations, or orders. The Contractor shall also protect and indemnify the College and its representatives against any claim or liability arising from the violation of any laws, ordinances, regulations, or orders, whether by the Contractor or its employees, agents, subcontractors at any tier, suppliers or materialmen.

G. Environmental Protection - Contractor Duty to Comply with Law.

The Contractor shall comply with all applicable federal, state and local laws and regulations and all conditions of permits pertaining to the protection of the environment. Necessary precautions shall be taken to prevent pollution of streams, lakes, ponds, rivers, wetlands, groundwater, reservoirs, and property by chemicals, fuels, oils, bitumens, or other harmful or hazardous materials as defined by law. Nor shall the Contractor pollute the atmosphere from particulate or gaseous matter in violation of law.

H. No Personal Liability of College Officials.

In carrying out any of the provisions of the Contract, or in exercising any right or authority granted to them by or in connection with the contract, there shall be no liability upon any officer or employee of the College, either personally or as officials of the College, it being agreed that in all such functions they act only as agents and representatives of the College.

I. Recovery of Monies by College from other Contracts with the Contractor.

When the contract documents authorize the College to withhold or deduct money from any monies due to the Contractor, or require the Contractor to pay or return monies for any reason, the College may in its discretion withhold any monies due the Contractor under any other contracts between the Contractor and the College. This right shall not affect the rights of the College against the Contractor or its surety under this contract, and the College shall not be
obliged to exercise this right as to any other contract as a condition of exercising its rights against the Contractor or surety under this contract.

J. **Buy American Requirement.**

The Contractor shall comply with N.J.S.A. 52:32-1 and N.J.S.A. 52:33-1 et seq., which prohibit the use by the Contractor or subcontractors of materials or farm products produced and manufactured outside of the United States on any public work.

K. **Modification of Contract.**

No modification or amendment of the contract shall be effective unless it is in writing and signed by both the College and the Contractor.

L. **State Sales Tax Exemption.**

Materials, supplies or services for exclusive use in constructing the project are exempt from the State sales tax. Rentals of equipment are not exempt from any tax under the State Sales Tax Act.
M. Assignment of Contract Funds and Claims Prohibited.

The Contractor shall not transfer or assign to any party any contract funds, due or to become due, or claims of any nature it has against the College without the written approval of the College. The College in its sole discretion and considering primarily the interests of the College may elect either to grant or to deny such approval.

N. Independent Contractor Status.

The relationship of the Contractor to the College is that of an independent contractor. The Contractor agrees that it shall conduct itself consistent with such status, and shall not hold itself out as or claim to be an officer, employee or agent of the College. The Contractor shall not make any claim or demand for any right or privilege applicable to officers or employees of the College, including but not limited to, workers compensation, unemployment insurance benefits, social security coverage, or retirement benefits.

O. Third Party Beneficiary Rights Not Intended.

It is specifically agreed between the College and the Contractor that no provisions of the contract documents are intended to make the public or any member thereof a third party beneficiary of the contract, or to authorize anyone not a party to the contract to maintain a suit for personal injuries, property damage or other claims under the contract. It is also the intent of the College and the Contractor that no individual or firm which supplies materials, labor, services, or equipment to the Contractor for the performance of the work shall be a third party beneficiary of the contract.

P. Gifts to College Employees and Agents Prohibited.

The Contractor shall not give any gifts of any nature, nor any gratuity in any form, nor loan any money or anything of value to any College employee or relative thereof, or any agent of the College. The Contractor shall not rent or purchase any equipment or supplies of any kind from any College employee or relative thereof or any agent of the College.

Q. Contractor Claims: Procedures and Limitations.

Claims by the Contractor against the College shall be subject to the New Jersey Contractual Liability Act, N.J.S.A. 59:13-1, et seq. including the notice and time for suit provisions. For the purpose of determining the time within which The Contractor must file suit under the New Jersey Contractual Liability Act, 'completion of the contract' shall be deemed to have occurred upon achievement of substantial completion as defined in section 12A of these General Conditions.

The Contractor also agrees that it shall not be entitled to assert claims against the College for any compensation beyond that provided for in this contract by reason of the acts or omissions of any third parties, including but not limited to the project architect and any other contractor on the project. The Contractor may not assert claims for extra costs for home offices expenses, home office overhead, lost profits or revenue, or consequential damages as that term is defined in law. All claims shall also be subject to all other pertinent provisions of the contract and the contract documents including the general conditions. The Contractor also agrees that it may not assert any claims for extra costs or damages unless it maintains all the records of its estimated and actual costs as required by this Article. The Contractor also agrees that suits against the College must be pursued in the county where the project is located.
R. Cost Records a Condition of Receiving or Retaining Extra Compensation on Extras, Changes and Claims.

The Contractor shall maintain and retain weekly payroll, material, subcontractor, supplier, overhead and other cost and accounting records for the project, and for additional services or extras required by the College, including all costs which the Contractor is entitled to be paid under the contract. The Contractor shall require its subcontractors on the project to do likewise. The Contractor shall also maintain all estimates and takeoffs used in preparing and calculating its bid price for the contract and change orders. The records shall be maintained and shall be made available to the College or its representatives when requested. These records shall be maintained in accordance with generally accepted accounting principles and practices for a period of 3 years after final payment is received by the Contractor, or the duration of any dispute or law suit arising out of the project, whichever is later.

Any failure to maintain or produce the records required by this Article shall preclude the Contractor from claiming or being paid or retaining any payments or being paid on any claims which are based on costs, expenses or losses incurred by the Contractor or its subcontractors which should be reflected in the records required by this Article or good business practices. This record keeping requirement applies to records related to the basic contract compensation as well as extra compensation for change orders and claims of all kinds.

No claim by the Contractor against the College for payment, whether for contract work, extras, changes or claims which is based to any degree on costs which should be recorded in cost records required by this Article or good business practices may be asserted against the College to the extent the cost records do not exist or are not provided to the College upon demand.

The College reserves the right to audit the records of the Contractor and its subcontractors for up to 3 years after the final acceptance of the project, and to demand repayment by the Contractor and its surety of any overpayments discovered in an audit.
CHILLER PLANT IMPROVEMENT
FOR STEM BUILDINGS

ISSUED FOR BID –
SPECIFICATIONS

MARCH 2015

WM Group Services, LLC
Two Penn Plaza, Suite 552
New York, NY 10121
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>SECTION NUMBER</th>
<th>SECTION TITLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIVISION 01</td>
<td>GENERAL</td>
</tr>
<tr>
<td>01010</td>
<td>SUMMARY OF WORK</td>
</tr>
<tr>
<td>01025</td>
<td>MEASUREMENT AND PAYMENT</td>
</tr>
<tr>
<td>01100</td>
<td>PROJECT PROCEDURES</td>
</tr>
<tr>
<td>01300</td>
<td>SUBMITTALS AND SUBSTITUTIONS</td>
</tr>
<tr>
<td>01310</td>
<td>QUALITY CONTROL</td>
</tr>
<tr>
<td>01320</td>
<td>TEMPORARY FACILITIES</td>
</tr>
<tr>
<td>01330</td>
<td>CONTRACT CLOSEOUT</td>
</tr>
<tr>
<td>01340</td>
<td>PROJECT RECORD DOCUMENTS</td>
</tr>
<tr>
<td>01524</td>
<td>CONSTRUCTION WASTE MANAGEMENT</td>
</tr>
<tr>
<td>DIVISION 02</td>
<td>DEMOLITION</td>
</tr>
<tr>
<td>02070</td>
<td>SELECTIVE DEMO</td>
</tr>
<tr>
<td>DIVISION 03</td>
<td>CIVIL</td>
</tr>
<tr>
<td>03200</td>
<td>CONCRETE REINFORCEMENT</td>
</tr>
<tr>
<td>03300</td>
<td>CAST IN PLACE CONCRETE</td>
</tr>
<tr>
<td>DIVISION 09</td>
<td>PAINTING</td>
</tr>
<tr>
<td>09900</td>
<td>PAINTING</td>
</tr>
</tbody>
</table>
DIVISION 15 - MECHANICAL

15010 - GENERAL PROVISIONS MECHANICAL
15080 - INSULATION
15100 - PIPING
15110 - VALVES
15150 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
15170 - MOTORS
15172 - VARIABLE FREQUENCY DRIVES
15190 - MECHANICAL IDENTIFICATION
15200 - SIDESTREAM FILTER
15300 - HEAT TRACE FOR HVAC PIPING
15680 - PACKAGED COOLING TOWER
15685 - PACKAGED ELECTRIC CENTRIFUGAL CHILLER
15730 - PLATE AND FRAME HEAT EXCHANGER
15735 - HYDRONIC PUMPS
15900 - INSRUMENTATION
15950 - SEQUENCE OF OPERATION FOR CHILLER PLANT CONTROLS

DIVISION 17 - COMMISSIONING

17010 - COMMISSIONING

DIVISION 26 - ELECTRICAL
260000 - ELECTRICAL SUMMARY & SCOPE OF WORK
260001 - ELECTRICAL CLOSE-OUT
260005 - DRAWING COORDINATION
260500 - BASIC ELECTRICAL MATERIALS AND METHODS
260513 - MEDIUM-VOLTAGE CABLES
260519 - CONDUCTORS AND CABLES
260523 - CONTROL VOLTAGE ELECTRICAL POWER CABLES
260526 - GROUNDING AND BONDING
260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
260533 - RACEWAYS, BOXES AND CABINETS
260543 - DUCTS AND UTILITY STRUCTURES
260553 - ELECTRICAL IDENTIFICATION
260800 - INDEPENDENT ELECTRICAL TESTING
261219 - PAD MOUNTED LIQUID FILLED TRANSFORMERS
261300 - MEDIUM VOLTAGE SWITCHGEAR
262213 - DRY TYPE TRANSFORMERS
262416 - PANELBOARDS
262419 - MOTOR CONTROL CENTERS
262713 - ELECTRICITY METERING
262726 - WIRING DEVICES
262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS
262923 - EXISTING VARIABLE-FREQUENCY MOTOR CONTROLLER PROGRAMMING
263111 - DITIAL, ADDRESSABLE FIRE-ALARM SYSTEM
264113 - LIGHTNING PROTECTION
264950 - SUBSTATION CONTROL HOUSE
265113 - INTERIOR LIGHTING
265623 - EXTERIOR LIGHTING

DIVISION 27 - COMMUNICATIONS

271500 - COMMUNICATIONS HORIZONTAL CABLES

END OF TOC
SECTION 01010 - SUMMARY OF WORK

PART 1- GENERAL

1.01 RELATED DOCUMENTS

Drawings and general provisions of the specifications, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.02 WORK COVERED BY CONTRACT DOCUMENTS

A. The Project consists of all work noted on the drawings and in these specifications for the 2014 Chiller Plant Improvement- STEM Project

1. Project Location: The College of New Jersey, Ewing New Jersey
2. Owner: The College of New Jersey, State of New Jersey

1.03 CONTRACTS

A. The project contract is between The College of New Jersey and the single prime contractor performing the work specified.

B. Definition of Extent of Contract Work: The contract documents, specifications, project drawings, manufacturer’s installation handbooks, TCNJ form of agreement, and the contractors response to the RFP represent the extent of the construction contract.

1.04 CONTRACTORS USE OF PREMISES

A. General: During the construction period the Contractor shall have full use of the premises for construction operations, including use of the site. The contractor’s use of the premises is limited only by the Owner’s right to perform work, retain other contractors on portions of associated projects, or to access the building for the occupants.

1. Contractor is to coordinate their work with the activities for each work location.

B. Use of the Site: Limit use of the premises to areas required for equipment and material storage and access to the roof area. Confine operations to areas within contract limits indicated. Do not disturb portions of the site beyond the areas immediately adjacent to the building where the work is being performed.

1. Owner Occupancy: Allow for Owner occupancy and use by the public.
2. Driveways and Entrances: Keep driveways and entrances serving the premises clear and available to the Owner, the Owner’s employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials unless previously approved by the owner. Schedule deliveries to minimize space and time requirements or storage of materials and equipment on-site.
3. Burial of Waste Materials: Disposal of organic and hazardous materials on-site either by burial or burning, will not be permitted.
3. Parking is allowed with in the construction fence only. If more parking is needed, there is additional parking provided at the colleges Carlton Avenue parking lot. The contractor is responsible to shuttle workers back and forth as needed.

C. Use of the Existing Building: Maintain any existing building in a weathertight condition throughout the construction period. Repair damage caused by construction operations. Take all precautions necessary to protect the building, its contents, components, and systems and its occupants during the construction period.

PART 2 - PRODUCTS (Not Applicable)

PART 3- EXECUTION (Not Applicable)

END OF SECTION 01010
SECTION 01025 – MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.01 SCHEDULE OF VALUES

A. Each Contractor shall prepare a schedule of values in coordination with the preparation of progress schedule. Correlate line items with other administrative schedules and forms required for the work, including progress schedule, payment request form, listing of subcontractors, schedule of allowances if any, schedule of alternates if any, listing of products and principal suppliers and fabricators, and schedule of submittals. Break down principal subcontract amounts into multiple line items for each entity of work. Round off to nearest whole dollar, but with total equal to Contract Sum. Submit 4 copies of schedule of values to the Owner and Architect for review and approval.

- Upon Owner/Architect approval, Owner will return the Schedule of Values to the Contractor for the Contractor to submit to the bonding company for their acceptance. Payments will not be made to the Contractor until the bonding company has provided a written acceptance to the Owner.

B. The schedule of values shall be tabulated into subcontracts and trades with the Quantity, Labor, Material, and Total Cost indicated. The Schedule of Values shall include such items as bonds, insurance, allowances and alternates, punchlist/close out documents and shall enclose copies of invoices and/or cancelled checks from bonding and insurance agents.

C. Schedule of values shall be submitted on AIA Form G703 or similar form approved by the Architect and Owner.

D. Each Contractor's monthly application for payment shall be in the same schedule form, reflecting the same items from above. Unit costs shall be realistic for their part of the Work.

1.02 CHANGES IN THE WORK

A. When a change in the Work includes a category or categories of Work both added to and deducted from the Contract, the total quantities of added Work and of deleted Work shall be determined separately for each category and the appropriate unit price or net cost of the Work shall be applied to the difference between the two total quantities.

B. Unit prices shall be inclusive of all costs and shall be applied to units of measure as defined in the Specifications for each category of Work.

C. For all extra Work performed by the Contractor, the gross cost to the Owner shall include the net cost of the Work to the Contractor plus an allowance for overhead and profit not to exceed 15% of the net cost.

D. For all extra Work performed by a Subcontractor, the gross cost to the Owner shall include the net cost of the Work to the Subcontractor plus an allowance for overhead and profit not to exceed 15% of the net cost, plus the Prime Contractor's overhead and profit not to exceed 5% of the Subcontractor's cost.

E. Net cost of extra Work shall be the actual or pro-rated cost of:
1. Labor, including foreman, at the prevailing rate of wages, contributions and taxes.

2. Materials entering permanently into the Work, including delivery to the site.

3. The ownership or rental cost of construction equipment and expendable tools, pro-rated for the time necessary for the Work.

4. Power and consumable supplies for the operation of power equipment, pro-rated for the time necessary for the Work.

5. Insurance and Bonds.

F. Gross costs shall be net costs plus the mark up allowances described above, such mark up allowances being inclusive, of all cost of superintendence, supervision, engineering, overhead, profit, administrative and site office expenses and all other general expenses.

1.03 APPLICATIONS FOR PAYMENT

A. Except as otherwise indicated, sequence of progress payments for the Contractor shall be regular, and each shall be consistent with previous applications and payments. It is recognized that certain applications involve extra requirements, including initial applications, applications at times of substantial completion, and final payment applications.


C. Except as otherwise indicated, complete every entry provided on the form, including notarization and execution by authorized persons. Incomplete applications will be returned by Architect and Owner without action. Entries shall match current data of schedule of values, progress schedules and reports. Listing shall include amounts of fully executed change orders issued prior to first day of the period of construction covered by application. Applications for payment shall include weekly payroll report. Contractor shall furnish to the Owner certified payroll reports for each payroll period with pay request, indicating name craft, social security number and actual hourly rate of wages paid to each workman employed on the project. A certified payroll record is defined as "a payroll record which is attested to by the employer, or corporate officer of such company, or an authorized agent of the employer." A payment request will not be paid until the Owner receives the certified payrolls.

D. Submit one "pencil" copy of each proposed payment application to the architect and owner, for review, not less than seven days prior to formal submissions of application.

E. Submit 4 executed copies of each payment application. Transmit with a transmittal form listing attachments, and recording appropriate information related to application.

F. Breakdown may include a line item for General Conditions. General Conditions shall include the cost of general supervision, trailers, temporary utilities and other general expenses directly related to the project and not considered overhead. The general conditions item shall be billed on monthly progress payments on a percentage of work completed.
1.04 INITIAL PAYMENT APPLICATION

A. The principal administrative actions and submittals which shall precede or coincide with submittal of the Contractor's first payment application can be summarized as follows, but not necessarily by way of limitation.

1. Listing of subcontractors and principal suppliers and fabricators.
2. Schedule of values.
4. Schedule of submittals (preliminary if not final).
5. Copies of acquired building permits and similar authorizations and licenses from governing authorities for current performance of the work.
6. Data needed by Owner to secure related insurance coverages.
7. Performance and Payment Bond.
8. Insurance Certificates.

1.05 PROGRESS PAYMENTS

A. Based upon application for payments submitted to the Architect and the Owner, by the Contractor, on or about the 25th day of each month for the period ending the last day of the previous second month, and Certificate of Payment issued by the Architect and the Owner, the Owner will make progress payments on account of the Contract Sum to the Contractor as follows:

1. On or after the 20th day of each month, the Contractor shall submit to the Architect and Owner a "pencil copy" indicating the previous payment and the proposed amounts for each line item for the current period. After review and approval or changes, the Contractor shall prepare the final billing for presentation to the Architect and Owner.

2. a. Whenever any contract, the total price of which exceeds $100,000, entered into by a State college, for the construction, reconstruction, alteration or repair of any building, structure, facility or other improvement to real property, requires the withholding of payment of a percentage of the amount of the contract, the contractor may agree to the withholding of payments in the manner prescribed in the contract, or may deposit with the State college registered book bonds, entry municipal bonds, State bonds or other appropriate bonds of the State of New Jersey, or negotiable bearer bonds or notes of any political subdivision of the State, the value of which is equal to the amount necessary to satisfy the amount that otherwise would be withheld pursuant to the terms of the contract. The nature and amount of the bonds or notes to be deposited shall be subject to approval by the State college. For purposes of this section, "value" shall mean par value or current market value, whichever is lower.

If the contractor agrees to the withholding of payments, the amount withheld shall be deposited, with a banking institution or savings and loan association insured by an agency of the Federal government, in an account bearing interest at the rate currently paid by such institutions or
associations on time or savings deposits. The amount withheld, or the bonds or notes deposited, and any interest accruing on such bonds or notes, shall be returned to the contractor upon fulfillment of the terms of the contract relating to such withholding. Any interest accruing on cash payments withheld shall be credited to the State college.

b. Any contract, the total price of which exceeds $100,000, entered into by a State college involving the construction, reconstruction, alteration, repair or maintenance of any building, structure, facility or other improvement to real property, shall provide for partial payments to be made at least once each month as the work progresses, unless the contractor shall agree to deposit bonds with the State college pursuant to section 1.

c. 1. With respect to any contract entered into by a State college pursuant to section 2 for which the contractor shall agree to the withholding of payments pursuant to section 1, 2% of the amount due on each partial payment shall be withheld by the State college pending completion of the contract.

2. Upon acceptance of the work performed pursuant to the contract for which the contractor has agreed to the withholding of payments pursuant to subsection a. of this section, all amounts being withheld by the State college shall be released and paid in full to the contractor within 45 days of the final acceptance date agreed upon by the contractor and the State college, without further withholding of any amounts for any purpose whatsoever, provided that the contract has been completed as indicated. If the State college requires maintenance security after acceptance of the work performed pursuant to the contract, such security shall be obtained in the form of a maintenance bond. The maintenance bond shall be no longer than two years and shall be no more than 100% of the project costs.

d. This act shall take effect immediately. This bill supplements the “State College Contracts Law,” P.L.1986, c.43 (C.18A:64-52 et seq.), and applies to any State college contract for over $100,000 which involves the construction, reconstruction, alteration or repair of any building, structure, facility or other improvement to real property. Under the provisions of this bill, whenever a contract of this type requires the withholding of payment of a percentage of the amount of the contract, the contractor would have the choice of either agreeing to a retainage deduction from each monthly progress payment, or the contractor could choose to deposit bonds in the amount necessary to satisfy the amount that otherwise would be withheld under the contract. If a contractor chooses a retainage deduction from each monthly payment, then the retainage would be limited to 2% of the amount due on each partial payment. Upon acceptance of the work performed pursuant to the contract for which the contractor has agreed to a retainage deduction, all amounts being withheld by the State college must be paid in full to the contractor within 45 days of the final acceptance date agreed upon by the contractor and the State college. The bill provides that if the State college requires maintenance security after acceptance of the work performed under the contract, the security must be obtained in the form of a maintenance bond, which is required to be no longer than two years and no more than 100% of the project costs. The provisions of this bill are similar to provisions in the “Local Public Contracts Law,” P.L.1971, c.198 (C.40A:11-1 et seq.) and the “Public School Contracts Law,” P.L.1977, c.114 (C.18A:18A-1 47 et seq.).

3. Upon substantial completion, the retainage shall, upon the Architect/Owner’s approval, remain at 2% of the value of work completed. Final release of retained monies will occur only upon the
total completion of all punch list and closeout documentation to the satisfaction of the Architect and Owner.

4. For each day's delay in the Contractor's submission of an application for payment acceptable to the Architect and Owner, the Owner may delay one day in making his progress payment.

5. Owner shall make payments within 30 days of receipt of said monthly pay requisition.

1.06 APPLICATION AT TIME OF SUBSTANTIAL COMPLETION

A. Following issuance of certificate of substantial completion on each Contractor's work, and also in part as applicable to prior certificates on portions of completed work as designated, a "special" payment application may be prepared and submitted by Contractor. The principal administrative actions and submittals which shall precede or coincide with such special applications can be summarized as follows, but not necessarily by way of limitation:

1. Occupancy permits and similar approvals or certifications by governing authorities and franchised services, assuring Owner's full access and use of completed work.

2. Warranties, guarantees, maintenance agreements and similar provisions of Contract Documents.

3. Test/adjust/balance records, maintenance instructions, meter readings, start up performance reports, and similar change over information germane to Owner's occupancy, use, operation and maintenance of completed work.

4. Final cleaning of the work.

5. Application for reduction (if any) of retainage, with consent of surety.

6. Advice to Owner on coordination of shifting insurance coverages, including proof of extended coverage as required.

7. Listing of Contractor's incomplete work, recognized as exceptions to certificate of substantial completion.

1.07 FINAL PAYMENT APPLICATION

A. The administrative actions and submittals which shall precede or coincide with submittal of the Contractor's final payment application can be summarized as follows, but not necessarily by way of limitation.

1. Completion of project closeout requirements.

2. Completion of items specified for completion beyond time of substantial completion, regardless of whether special payment application was previously made.

3. Assurance, satisfactory to Owner and Owner, that unsettled claims will be settled and that work not actually completed and accepted will be completed without undue delay.

4. Transmittal of required project construction records to Owner via the Owner.
5. Proof, satisfactory to Owner and Owner, that taxes, fees and similar obligations of Contractor have been paid.

6. Removal of temporary facilities, services, surplus materials, rubbish and similar elements.

7. Notarized consent of surety for final payment.

1.08 WAIVER OF LIENS

A. Each Contractor, for himself, and for all Subcontractors and material men, agrees that no mechanic's lien or other claim shall be filed or maintained by the Contractor or by any Subcontractor, material men, laborer or any other person whatsoever for, or on account of any work performed or materials furnished under this Contract. This agreement shall be an independent contract, and the Contractor shall execute and deliver a separate Waiver of Liens in form and substance satisfactory to the Architect and Owner contemporaneously with the execution of the Owner-Contractor Agreement and before any work is begun at the site.

B. In every subcontract entered into by each Contractor after execution of this Contract or in connection herewith, the Contractor shall incorporate a provision, similar to the foregoing paragraph, to the effect that neither the Subcontractor nor any party acting through or under him shall file or maintain any mechanic's lien or other claim against the Architect or Owner in connection with the Work.

END OF SECTION 01025
SECTION 01100 - PROJECT PROCEDURES

PART 1 - GENERAL

1.01 SPECIAL REQUIREMENTS

A. Schedule: Contractor shall provide a master schedule showing sequencing of work utilizing the CPM method. The Contractor shall supply a schedule with all subcontractor activities, relationships, and durations, utilizing the CPM method via SureTrak/Primavera, Version 3.0, or a Microsoft scheduling software to the Owner on a working version CDrom and coordinate their schedule with the Owner.

- The Contractor is required to update at the end of each month the CPM Schedule based on the percentage completed for each activity on the approved schedule (in concert with the submission of the percentage completed in the monthly proposed schedule of values).
- The contractor in their bid includes a cost of $500.00 per month for this schedule submission, for the duration of construction (per the milestone schedule in the bidding documents). This only applies to projects in excess of 2 million dollars in base price price. The contractors schedule of values shall include this cost, and can only be billed for upon TCNJ’s successful receipt of said schedule. Should any schedule not be received at the end of any month during construction, TCNJ will issue a deduct change order in the amount of $500.00 to the contractor.

B. Each Contractor shall take all necessary precautions to ensure the safety of all structural elements during all phases of all work. No materials, cranes, trucks or any other construction loads shall be placed on any part of the structure until the Contractor has determined the adequacy of that structure to carry the intended load without damage or overstress.

C. Entrance into, or other use of the building will not be permitted except as may be necessary for the execution of the Work, and shall be subject to the restrictions and instructions of the Owner.

NOTE: any personnel working in any residence hall, including delivery personnel are to have a State Police Background check completed before entering any residence hall. Contractor is to provide the background check for all personnel at the kick off meeting, and/or prior to start of their work. Should a person not have a background check but is on site for a short period of time, said person shall be escorted by a TCNJ project manager/superintendent and/or a designated person that has provided the appropriate background check information. All back ground checks will be forwarded to TCNJ police for review and filing.

NOTE: any personnel working in a residence hall must where a badge with the name of the vendor/contractor they work for and their personal name. This badge must be worn at all times.

D. Routes of ingress and egress to areas where work is being performed shall be subject to the restrictions and instructions of the Owner.

E. Materials shall be moved through the Building using rubber tired vehicles which shall be properly controlled at all times to avoid damage to existing wall, floor or ceiling surfaces.

F. Water damage cannot be tolerated and it is incumbent upon Contractors to take any steps necessary to keep the existing premises dry at all times.

G. Any damage to the new building from heavy equipment, striking the Building or any other
damage to any part of the premises shall be repaired at the expense of the Contractors.

H. All welding and cutting shall be performed by qualified and certified welders. Certificates shall be on file with the Contractor prior to commencement of any welding.

I. No work shall start before 8:30am unless agreed to in advance with the College.

PART 2 - PRODUCTS
NOT APPLICABLE

PART 3 - EXECUTION

3.01 GENERAL

A. Contractors shall perform the work on or about the premises in a careful manner with full consideration to fire protection as required by the National Fire Protection Association Standards, National Board of Fire Underwriters and State and Local Departments having jurisdiction. Fire resistant materials shall be used for temporary enclosures.

B. Chemical extinguishers approved by the Owner shall be provided by the General Contractor during the progress of the work where and as required by the Owner, the Local Fire Marshal and the National Board of Fire Underwriters.

C. The Contractor shall maintain an active program of fire prevention to keep workmen fire conscious during the entire life of the Contract. Designate one member of the organization to execute and coordinate fire control measures of his own organization and that of all subcontractors under his jurisdiction.

D. All sub-contractors shall cooperate with the Contractor in carrying out the above program.

E. Storage of flammable materials will not be permitted in the Building unless written permission is obtained from the Owner. Storage of all such materials shall be the Contractors' responsibility.

F. On-site open burning of rubbish, garbage, trade waste, leaves or plant life is prohibited.

G. Safety Program: The Contractor shall institute a safety program in accordance with OSHA and any local, state, or federal guidelines. The contractor shall name a safety officer to monitor this program and shall submit a safety report at job meetings.

H. Stockpiling: Stockpiling of materials on site will be allowed (but limited due to the limited space on this site). Such materials shall not impair or impede the functioning of the facility. Materials stored on site shall be secured to prevent loss from theft, damage, vandalism or fire. By stockpiling materials on site, the contractor assumes full responsibility for said materials, and shall protect them to the fullest extent possible. Specific locations for stockpiling materials shall be coordinated with the Architect, and Owner.

I. Safety Barriers: The Contractor shall erect safety barriers to deter and prohibit unauthorized access to the construction site; such barriers may take the form of fences and shall be clearly marked with...
signage prohibiting unauthorized access. The Contractor shall be responsible for safety barriers within the building. The contractor shall be liable for damages to persons or property due to the construction process if adequate safety measures are not undertaken. The Owner and Architect shall review safety precautions for their adequacy but shall not be held liable for Contractors failure to maintain or provide adequate protection.

J. Sequencing: The Contractor will work with the Sub-Contractors to sequence the work during the submission of monthly project schedules. Contractors shall endeavor to coordinate their work efforts with the Owner’s requirements. Interruptions of utility services shall be coordinated with the Architect, and Owner, but in no instance shall last longer than 2 hours.

K. Limited staging and on site parking will be provided by General Contractor. The Contractor will coordinate parking areas with all the subcontractors and TCNJ.

1. Parking will be available at Carlton Avenue. Contractor will provide shuttle service to and from the site.

2. Contractor will be permitted to have vehicles on site with in the construction fencing only. Contractor is to provide stone in all parking areas on site to prevent the buildup of ruts and mud, thus minimizing the amount of mud leaving the site and being left behind on TCNJ roads.

L. Site Utilities: Electric power and water are available on site. Toilet facilities will be made available by the Contractor. These facilities shall remain clean by the Contractors throughout the course of the project. The Contractors shall repair and/or replace any damaged fixtures, partitions, etc. The Electrical Sub-Contractor shall tie in a temporary power panel (or panels as required) for all trades to use during construction. Interruption of building services shall not occur without prior consent and coordination by the Owner and Owner.

1. Provide portable toilets for all construction personnel.

M. Construction Lighting: The Electrical Sub-Contractor shall run sufficient strings and fixtures to maintain a 50 foot-candle/sq.ft.intensity of light throughout the project areas.

N. Dumpster Location and Cleanup: The Architect and Owner shall coordinate the dumpster location with the Contractors. The Contractor shall be responsible for obtaining, maintaining, and disposing of dumpsters, and shall maintain clean work areas throughout the course of the project.

- Contractor is to provide adequate manpower during the entire course of the project to maintain the site in a clean, neat and professional manner. At a minimum the contractor is to clean the entire site twice per week (on different days) by picking up all debris in and around the site. Sweeping the entire building daily is required once the floor slabs are in place. Contractor is to place garbage cans on each floor minimum 3 per floor in designated locations to assist in keeping the site clean. The owner will not tolerate a building project that is not maintained in a professional manner at all times.

3.02 PROGRESS MEETINGS

A. Progress Meetings shall be held bi-weekly at the job site at a regular time and day mutually agreed upon. The frequency may be changed by the Architect or Owner to reflect current conditions. The
Contractors, those of his/their subcontractors concerned with current progress or with scheduling of future progress, the Architect, the Owner, and the Owner shall each be represented at these job meetings by persons familiar with the details of the work and authorized to conclude matters relative to work progress, establishment of progress schedules, etc., as may be necessary to expedite completion of the work.

B. The Contractors and his/their subcontractors attending these meetings shall present complete and definite reports as to the status of their respective work, conditions of product and equipment manufacturer, labor availability, productivity and cooperation, shipping data, time of completion, sequence of the work, safety program, and any other information bearing upon the execution of the Contract or subcontract. For the Owner's convenience the Owner will chair the meetings.

3.03 MONTHLY REPORTS

A. The Contractor is to provide TCNJ a brief monthly status report on the last working day of each month dividing the status of the project into the following categories (report must be complete in all respects, piece meal submissions will not be accepted):
   a. Project overview
   b. Financial status
   c. Updated project schedule
   d. Change order request log
   e. Submittal log
   f. RFI log
   g. Owner/Architect issues that need immediate resolution
   h. Order/delivery issues

B. The Contractor is to provide TCNJ with this monthly report, and include in their bid a cost of $500.00 per month for all projects in excess of 2 million dollars base bid price for the duration of the construction period as noted in the bidding milestone schedule. This total cost will be listed in the contractor’s schedule of values and can be billed for on a monthly basis only if said report is received in whole as noted above. Should TCNJ not receive said complete report a deduct change order will be issued to the contractor for $500.00 for that month.

END OF SECTION 01100
SECTION 01300 – SUBMITTALS AND SUBSTITUTIONS

PART 1 – GENERAL

1.1 PROGRESS SCHEDULE / COORDINATION DRAWINGS

A. The Contractor's schedule, shall coordinate with all trades to produce a coordinated CPM via Suretrak/Primavera version 3.0 or a Microsoft scheduling program schedule indicating the start and completion dates for each portion of the work as defined by the schedule of values, with the total time as defined by the contract time and milestone dates as set forth in these specifications. The Contractor’s CPM schedule shall be submitted in electronic format (Suretrak 3.0 or a Microsoft Scheduling program) to and reviewed by the Owner and Architect prior to first application for payment. Any revisions or additional information requested by the Owner or Architect shall be provided. (No payment shall be made to any Contractor not providing a schedule that reflects their entire work).

• Also refer to Section 01100-1 – Project Procedures.

B. The Contractor shall revise the progress schedule on a monthly basis as the work progresses reflecting therein any delays, including those not within the Contractor's control, or accelerations in the progress of the work. The progress schedule, as revised for any weekly period, shall be discussed at the bi-weekly job meetings with the Owner, the Architect, and the Contractor and the major trades in order to insure that the percentage of actual completion of any portion of the work as called for in the progress schedule for that bi-weekly period is attained. Monthly updates to the progress schedule shall be made prior to application for payment.

C. Should any delay occur in the progress of the work or any portion thereof, the Contractor shall be required to implement all necessary measures to accelerate the construction, to meet the percentages of completion dictated by the progress schedule on the applicable dates, without additional cost to the Owner.

1.2 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

A. Shop drawings, product data and samples will not be processed by the Owner and/or Architect until the list of subcontractors, material suppliers and fabricators is submitted as required under Paragraph 3.12 of the General Conditions.

• The successful Contractor shall submit their list of proposed substitutions with in 20 calendar days of the Contract Award.

• The Architect shall be compensated on an hourly basis for review of all shop drawings or samples that do not meet the requirements of the contract documents after two submissions. The compensation shall be deducted from the contractor's contract via a deduct change order, or other means that both parties agree to.

B. Coordinate preparation and processing of submittals with performance of the work so that work will not be delayed by submittals. Allow two weeks for review/approval by the Architect for the approval process. Allow additional time if processing must be delayed to permit coordination with subsequent submittals with others.

C. Provide permanent marking on each submittal to identify Project, date, Contractor, subcontractor, submittal name, Specification section, drawing reference, and similar information to distinguish it from other submittals. Show Contractor's executed review and approval marking and provide space
(5" x 7") for Architect's Action marking and space for Owner's review marking. Package each submittal appropriately for transmittal and handling. Submittals received, which are lacking the above information, will be returned without action. Submittals, which are received from sources other than through Contractor’s office, will be returned without action.

D. Each submission shall be complete, with all options clearly marked and with all components required for the assembly fully described and detailed. Submissions missing important information will be returned unchecked.

E. Transmittal Form: Submittals shall be accompanied by a transmittal form. Provide Contractor's certification on form, ready for execution, stating that information submitted complies with requirements of contract documents.
   • Transmit all submittals and shop drawings to the Architect or Engineer with a copy of the transmittal to the Owner.

F. Except as otherwise indicated in individual work sections, comply with requirements specified herein for each indicated category of submittal. Provide and process intermediate submittals, where required between initial and final, similar to initial submittals.

G. Maintain returned final set of samples at project site, in suitable condition and available for quality control comparisons by Architect, and by Owner.

H. Do not proceed with installation of materials, products or systems until final copy of applicable shop drawings, product data and samples are in possession of Installer.

I. Provide newly prepared shop drawings, on reproducible sheets, with graphic information at accurate scale, with company name of preparer indicated. Show dimensions and note which are based on field measurement. Identify materials and products in the work shown. Indicate compliance with standards, and special coordination requirements. Do not allow shop drawing copies without appropriate final Action markings by Architect to be used in connection with the work.

1. Initial and Intermediate Submittals: One correctable translucent reproducible print and 5 blue line or black line prints; reproducible will be returned.
2. Final Submittal: 6 prints, plus 3 additional prints where required for maintenance manuals; 4 will be retained and remainder will be returned, one of which shall be marked up and maintained by Contractor as "Record Document".
3. Electronic submittals are acceptable in AutoCad format only. Contractor shall be responsible for printing and distribution of multiple copies as required.

J. Collect required product data into one submittal for each unit of work or system; and mark each copy to show which choices and options are applicable to the project. Include manufacturer's standard printed recommendations for application and use, compliance with standards, application of labels and seals, notation of field measurements that have been checked, and special coordination requirements. Maintain one set of product data for each submittal at project site, available for reference by Architect and others.

K. Submittals will be accepted from the Contractor only. Submittals received from other entities will be returned without review or action.
   1. Submittals received without a transmittal form will be returned without review or action.
   2. Transmittal form: Use a form matching the sample form attached to this section. Include the
following:
   a. List of deviations.
   b. The Contractor's certification signature.

3. Fill out a separate transmittal form for each submittal; also include the following:
   a. Other relevant information.
   b. Request for additional information.

L. Do not submit product data, or allow its use on the project, until compliance with requirements of Contract Documents has been confirmed by Contractor. Submittal is for information and record unless otherwise indicated. Initial submittal is final submittal unless returned promptly by Architect marked with an Action that indicates and observed noncompliance. Submit 6 copies, plus 3 additional copies, which will be returned, where required for maintenance manuals.

1. Electronic submittal are acceptable in 8 ½” x 11” format only.

M. Provide three (3) samples identical with final condition of proposed materials or products for the work. Include range samples, not less than 3 units, where unavoidable variations between units of each set. Provide full set of optional samples where Architect's selection is required. Prepare samples to match Architect's sample where so indicated. Include information with sample to show generic description, source or products name and manufacturer, limitations, and compliance with standards. Samples are submitted for review and confirmation of color, pattern, texture and kind by Architect. Architect will not test samples, except as otherwise indicated, for compliance with other requirements, which are therefore the exclusive responsibility of the Contractor.

N. Upon receipt of a signed copy of the Architects' Waiver form, electronic copies of CAD drawings of the Contract Documents will be provided by the Architect for Contractor's use in preparing submittals. Copy of Waiver form is attached.

O. Product Selection Procedures: Procedures for product selection include the following:

1. Product: Where Specification paragraphs or subparagraphs titled "Product" name a single product and manufacturer, provide the named product or an equivalent.

2. Manufacturer/Source: Where Specification paragraphs or subparagraphs titled "Manufacturer" or "Source" name single manufacturers or sources, provide a product of the manufacturer or source that complies with requirements, or an equivalent.

3. Products: Where Specification paragraphs or subparagraphs titled "Products" introduce a list of names of both products and manufacturers, provide one of the products listed that complies with requirements, or an equivalent. Comply with provisions of "Product Options and Substitutions," Section 1.4 of Division 1300 of these specifications when submitting an equivalent product.

4. Manufacturers: Where specification paragraphs or subparagraphs titled "Manufacturers" introduce a list of manufacturers' names, provide a product by one of the manufacturers listed, or an equivalent, that complies with requirements. Comply with provisions of "Product Options and Substitutions," Section 1.4 of Division 1300 of these specifications when submitting an equivalent product.

5. Product Options: Where Specification paragraphs or subparagraphs refer to "Product Options and Substitutions," indicate that size, profiles, and dimensional requirements on Drawings are
based on a specific product or system; provide the specific product or system or an equivalent product or system by another manufacturer. Comply with provisions of "Product Options and Substitutions," Section 1.4 of Division 1300 of these specifications when submitting an equivalent product.

6. Basis of Design Products: Where Specification paragraphs or subparagraphs titled "Basis-of-Design Products" introduce or refer to a list of manufacturers' names, provide either the specified product or an equivalent. Drawings and Specifications indicate sizes, profiles, dimensions and other characteristics that are based on the product names. Comply with the provisions of "Product Options and Substitutions," Section 1.4 of Division 1300 of these specifications when submitting an equivalent product.

1.3 MISCELLANEOUS SUBMITTALS

A. Miscellaneous submittals related directly to the work include warranties, maintenance agreements, workmanship bonds, survey data and reports, physical work records, quality testing and certifying reports, copies of industry standards, record drawings, field measurement data, operating and maintenance materials, overrun stock, and similar information, devices and materials applicable to the work and not processed as shop drawings, product data or samples.

B. Refer to sections for specific general requirements on warranties, product/workmanship bonds, and maintenance agreements. In addition to copies desired for Contractor's use, furnish 2 executed copies, except furnish 3 additional copies where required for maintenance manuals.

C. For the Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, and similar documents, correspondence and records established in conjunction with compliance with standards and regulations bearing upon performance of the work.

1.4 PRODUCT OPTIONS AND SUBSTITUTIONS

A. DEFINITIONS

1. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

   a. Named Products: Items identified by manufacturer's product name, including make or model number or other designation, shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.

   b. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.

   c. Equivalent Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
2. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

3. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

4. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.

5. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

B. General Requirements:

1. The requirements for substitutions do not apply to specified Contractor options on products and construction methods. Revisions to Contract Documents, where requested by Owner or Architect are changes, not substitutions. Contractor's determination of and compliance with governing regulations and orders issued by governing authorities do not constitute substitutions and do not constitute a basis for change orders. Otherwise, Contractor's requests for changes in products, materials, and methods of construction required by Contract Documents are considered requests for substitutions, and are subject to requirements hereto.

2. To the greatest extent possible, provide products, materials and equipment of a singular generic kind and from a single source.

3. Where more than one choice is available as options for Contractor's selection of a product or material, select an option that is compatible with other products and materials already selected. Total compatibility among options is not assured by limitations within Contract Documents, but shall be provided by Contractor. Compatibility is a basic general requirement of product/material selections.

4. Any and all contractor substitutions that require additional work by other trades not specifically called for in the documents shall be paid for by the contractor requesting the substitution if any other trade increase is required.

5. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.

C. Submittals: Submit 6 copies, utilizing Substitution Request Form, CSI Form 13.1.A, fully identified for product or method being requested for substitution, including related specification section and drawing numbers, and fully documented to show compliance with requirements for substitutions. Include product data/drawings, description of methods, samples where applicable, Contractor's details comparison of significant qualities between specified item and proposed substitution, statement of effect on construction time and coordination with other affected work and contractors, cost information or proposal, warranty information, compatibility with other work, approval of all authorities having jurisdiction, and Contractor's statement to the effect that proposed substitution will result in overall work equal to or better than work originally indicated.

D. Contractor's options for selecting products are limited by Contract Documents requirements, and governing regulations. Required procedures include, but are not necessarily limited to, the
following for various indicated methods or specifying:

1. Single product/manufacturer name; provide product indicated or equivalent, except advise Architect before proceeding, where known that named product is not a feasible or acceptable selection.

2. Two or more product/manufacturer names; provide one of the named products or equivalent, at Contractor's option; but excluding products which do not comply with requirements. Advise Architect before proceeding.

3. Equivalent; where named products in Specifications text are accompanied by the term "or equivalent", or other language of similar effect, comply with those Contract Documents provisions concerning substitutions for obtaining Architect's approval of equivalent product.

4. Named, except as otherwise indicated, is defined to mean manufacturer's name for product, as recorded in published product literature, of latest issue as of date of Contract Documents. Refer requests to use products of a later or earlier model to Architect for acceptance before proceeding.

5. Where compliance with an imposed standard, code or regulation is required, selection from among products that comply with requirements including those standards, codes and regulations, is Contractor's option.

6. Provide products which comply with specific performances indicated, and which are recommended by manufacturer, in published product literature or by individual certification, for application indicated. Overall performance of a product is implied where product is specified for specific performance.

7. Provide products that have been produced in accordance with prescriptive requirements, using specified ingredients and components, and complying with specified requirements for mixing, fabricating, curing, finishing, testing and similar operations in manufacturing process.

8. Where matching of an established sample is required, final judgment of whether a product proposed by Contractor matches sample satisfactorily is Architect's judgment. Where no product within specified cost category is available, which matches sample satisfactorily and complies with requirements, comply with Contract Document provisions concerning substitutions for selection of a matching product outside established cost category or not complying with requirements.

9. Where specified product requirements include "...as selected from manufacturer's full range of colors, patterns, textures..." or words of similar effect, the selection of manufacturer and basic product data is to comply with requirements of the Contract, and selection shall be from the full range of products within the requirements. Where specified product requirements include "... as the industry...", or words to that effect, selection of product complying with requirements, is Architect's selection, including designation of manufacturer, where necessary to obtain desired color, pattern or texture.

E. Substitutions may be permitted by the Architect, if, in his opinion, the requirements of the proposed substitution comply with the requirements specified for the material, article or piece of equipment; however, the Architect is not required to permit substitution pursuant to the case of Whitten Corporation vs. Paddock, Incorporated, United States District Court, Massachusetts, April 12, 1974, affirmed by the Federal First Circuit Court, December 14, 1974.

F. After award of contract, the Contractor may submit substitutes to the Architect for review, fully documented and certified, and accompanied by a proposal for a reduction in the Contract Sum.

G. Contractor's request for substitution will be received and considered when extensive revisions to Contract Documents are not required and changes are in keeping with general intent of Contract

The College of New Jersey Submittals and Substitutions
Chiller Plant Improvement for STEM buildings 01300-6 Mar, 2015
Documents; when timely, fully documented and properly submitted; and when one or more of following conditions is satisfied, all as judged by Architect. Otherwise, requests will be returned without action except to record noncompliance with these requirements.

1. Where request is directly related to an "equivalent" clause or other language of same effect in Contract Documents.
2. Where required product, material or method cannot be provided within Contract Time, but not as a result of Contractor's failure to pursue the work promptly or coordinate various activities properly.
3. Where required product, material or method cannot be provided in a manner which is compatible with other materials of the work, or cannot be properly coordinated therewith, or cannot be warranted (guaranteed) as required, or cannot be used without adversely affecting Owner's insurance coverage on completed work, or will encounter other substantial noncompliances which are not possible to otherwise overcome except by making requested substitution, which Contractor thereby certifies to overcome such incompatibility, uncoordination, nonwarranty, noninsurability or other noncompliance as claimed.
4. Where substantial advantage is offered Owner, in terms of cost, time or other valuable considerations, after deducting offsetting responsibilities Owner may be required to bear, including additional compensation to Architect for redesign and evaluation services, increased cost of other work by Owner or separate Contractors, and similar considerations.

H. Contractor's submittal of, and Architect's acceptance of, shop drawings, product data or samples which indicate work not complying with requirements of Contract Documents, does not constitute an acceptable and valid request for, nor approval of, a substitution.

I. QUALITY ASSURANCE

Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.

1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

J. EQUIVALENT PRODUCTS

Where products or manufacturers are specified by name, Contractor must submit the following, in addition to other required submittals, to obtain approval of an unnamed product proposed as an equivalent:

1. Evidence that the proposed product does not require extensive revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and
names and addresses of architects and owners, if requested. 
5. Samples, if requested.

1.5 OPERATION AND MAINTENANCE INSTRUCTIONS AND EQUIPMENT WARRANTIES

A. The Contractor shall orient and instruct the responsible maintenance personnel designated by the Owner in the Operation of all equipment and shall provide the maintenance personnel with pertinent literature and operational manuals for all equipment. Date and time of demonstrations shall be mutually agreed upon with the Owner. Provide qualified personnel for as long as necessary to fully orient and instruct the Owner. Contractor shall videotape instruction session and provide owner with completed video.

B. The manuals shall be submitted in (quadruplicate) 3-ring loose-leaf type binders to the Architect for approval with all additional information that the Architect may request and considers necessary for the proper servicing and maintenance of all equipment. Manuals are to include plain paper copies of approved shop drawings and catalog cuts. The quality of the copies may be subject to approval by the Architect. Upon completion and approval, 3 copies will be forwarded to the Owner and one copy retained by the Architect.

C. Manuals shall include no less than the following:
1. Operating Procedures:
   a. Typewritten procedures indicating each mode of operation of each piece of equipment or system. Procedures shall indicate the status of each component of a system in each operating mode.
   b. Procedures shall indicate names, symbol numbers, valve tags, circuit numbers, schematic control and wiring diagrams, locations of thermostats, manual starters, control cabinets, and other controls of each system.
   c. Emergency shutdown procedures for each piece of equipment or system, both automatic and manual as appropriate.
2. Maintenance Schedule: Typewritten schedule describing manufacturer’s recommended schedule of maintenance and maintenance procedures.
3. Catalog cuts and shop drawings:
   a. Catalog cuts shall clearly indicate the exact model and type of each piece of equipment installed in the Project, including all options provided.
   b. Catalog cuts shall fully describe equipment including physical, electrical, mechanical and other characteristics, performance characteristics and installation or erection diagrams.
   c. Catalog cuts shall indicate spare part numbers and name, address and telephone number of local representative or service department.
4. Typewritten list of all subcontractors on the Project including name, address, telephone number and responsibility on the Project.
5. Manuals shall be indexed with dividers indicating each system or piece of equipment.
6. Warranties, permits, inspection stickers/approvals and Certificate of Occupancy are to be included.

D. Required equipment warranties shall be submitted in three copies to the Architect.

E. The Contractor shall video tape all instructional sessions and demonstrations and provide the Owner with a copy of the videotape at the end of all demonstrations.
PART 2 - PRODUCTS
NOT APPLICABLE
PART 3 - EXECUTION

3.1 ACTION ON SUBMITTALS

A. One copy of all submissions will be returned to the Contractor for his files. The Contractor shall mark up other copies so as to conform with the copy returned to him and forward them to all interested Contractors, Subcontractors, and Suppliers.

B. The Architect will review and stamp submitted shop drawings in one of the following ways (the actual stamp may be different; below language is shown for an example only)
   1. "No Exceptions Taken": Approved.
   2. "Make Corrections Noted": Approved, provided the work complies with corrections marked on the submittal.
   3. "Revise and Resubmit": Do not commence work of this submittal. Revise and resubmit or prepare a new submittal; comply with notations marked on submittal.
   4. "Rejected": Fundamentally not in compliance. Prepare a new submittal. No notations or comments made.

C. Work shall be executed in accordance with "Approved", "Approved As Noted", or "Resubmit for Record" stamp only.

D. Architect's review of shop drawings/submittals will constitute checking for general arrangement only, and shall not relieve the Contractor of responsibility for complete compliance with Drawings and Specifications. Contractor shall be responsible for quantities and dimensions to assure a proper fit under field conditions.

3.2 DISTRIBUTION

A. Provide additional distribution of submittals, not included in foregoing copy submittal requirements, to subcontractors, suppliers, fabricators, installers, governing authorities and others as necessary for proper performance of the work. Include such additional copies in transmittal to Architect where required to receive Action marking before final distribution. Show such distributions on transmittal forms.

3.3 COLOR SELECTIONS

A. All colors for all finished surfaces and materials will be selected or approved by the Architect. The color selections will be made at one time to provide a complete and coordinated color schedule which, upon acceptance of the Owner, will be provided to the Contractor. Any and all specific color selections for materials not noted on drawings or in specification shall be chosen by Architect after submittal of samples.

B. It is imperative that all color information be submitted to the Architect by the Contractor before color selections can be made. If any color selection information is not available when colors are needed to meet the project schedule, the Architect will select colors from one of the named manufacturers in the Specifications, and the Contractor will be required to exactly match that color. A claim for delay will not be accepted if the color schedule is late due to the failure of the
Contractor to provide the Architect with all required color information, nor will an extra be entertained if the selected color is not available from the manufacturer the Contractor intended to use but neglected to submit.

C. The Contractors are reminded of the requirement to declare all substitutions within 20 days of execution of their Contract as specified.

END OF SECTION 01300
SECTION 01310 - QUALITY CONTROL

PART 1 - GENERAL

1.01 TRADESMEN AND WORKMANSHIP

A. Each Contractor shall ensure that tradesmen performing work at site are skilled and knowledgeable in methods and craftsmanship needed to produce required quality levels for workmanship in completed work. Remove and replace work which does not comply with workmanship standards as specified and as recognized in the construction industry for applications indicated. Remove and replace other work damaged or deteriorated by faulty workmanship or its replacement.

B. In certain instances, specification text requires that specific work be assigned to specialists or expert entities, who shall be engaged for performance of those units of work. These shall be recognized as special requirements over which Contractor has no choice or option. These assignments shall not be confused with, and are not intended to interfere with, normal application of regulations, union jurisdictions and similar conventions. One purpose of such assignments is to establish which party or entity involved in a specific unit of work is recognized as "expert" for indicated construction processes or operations. Nevertheless, final responsibility for fulfillment of entire set of requirements remains with Contractor.

1.02 INSPECTION, TESTS AND REPORTS

A. Required inspection and testing services are intended to assist in determination of probable compliances of the work with requirements, but do not relieve any Contractor of responsibility for those compliances, or for general fulfillment of requirements of Contract Documents. Specified inspections and tests are not intended to limit any Contractor's quality control program. Afford reasonable access to agencies performing tests and inspections.

B. Contractors are responsible for all testing associated with their work (foundations, soils compaction, concrete, steel etc.) and shall submit the name of their proposed testing agency within 15 days of Notice-to-Proceed. Each Contractor is responsible to coordinate the activities of the testing agency to assure that work is tested prior to being covered up or other activities associated to the work begin.

PART 3 - EXECUTION

3.01 REPLACEMENT OF WORK

A. The Contractor shall, within 24 hours after rejection of Work, remove all materials and equipment so rejected and immediately replace said Work, at his cost, to the satisfaction of the Architect. Should the Work of the Owner or other Contractors be damaged by such removal or replacement, the Contractor shall reimburse the Owner or other Contractors for all cost incurred for correcting said damage.

3.02 EXAMINATION

A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify
the existence and location of mechanical and electrical systems and other construction affecting the Work.

1. Before construction, verify the location and points of connection of utility services.

B. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

C. Acceptance of Conditions prior to work starting: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
   a. Description of the Work.
   b. List of detrimental conditions, including substrates.
   c. List of unacceptable installation tolerances.
   d. Recommended corrections.

2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.03 PREPARATION

A. Existing Utility Information: Furnish information to local utility and Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Existing Utility Interruptions: 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 Owner not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Owner's/Owner's written permission.
C. **Field Measurements:** Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

D. **Space Requirements:** Verify space requirements and dimensions of items shown diagrammatically on Drawings.

E. **Review of Contract Documents and Field Conditions:** Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

### 3.04 CONSTRUCTION LAYOUT

A. **Verification:** Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to existing conditions and dimensions. If discrepancies are discovered, notify Architect and Owner promptly.

### 3.05 INSTALLATION

A. **General:** Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. **Tools and Equipment:** Only use the best quality tools and equipment with proper attenuations for the latest acceptable sound levels.

F. **Anchors and Fasteners:** Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.

G. **Joints:** Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
H. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

END OF SECTION 01310
SECTION 01320 - TEMPORARY FACILITIES

PART 1 - GENERAL

1.01 DESCRIPTION OF REQUIREMENTS

A. Specific administrative and procedural minimum actions are specified in this section, as extensions of provisions in General Conditions and other Contract Documents. Nothing in this section is intended to limit types and amounts of temporary work required, and no omission from this section will be recognized as an indication that such temporary activity is not required for successful completion of the work and compliance with requirements of Contract Documents.

B. Each Contractor is specifically assigned certain responsibilities for temporary facilities to be used by all Contractors, other entities at the site, the Owner's work forces and other personnel including occupants of the project, the Owner, the Architect, test agencies, personnel of governing authorities, and similar entities and personnel authorized to be at the project site during construction. In general, each Contractor is assigned the responsibilities for installation, operation and removal of each temporary facility which is related by recognized trades to its scope of contract work; and, except as otherwise indicated, each is responsible for costs and use charges associated therewith, including fuel, power usage, water usage and similar usage costs. The Contractor is responsible for temporary facilities not related to any other Contractor's scope of contract work and not otherwise specifically assigned, as designated by the Architect.

C. No costs or usage charges for temporary facilities are chargeable to the Owner, nor can any Contractor's cost or usage charges for temporary facilities be accepted as the basis for a change order extra. The total costs and usage charges for temporary facilities are included, collectively, in the Contract Amounts.

1.02 GENERAL REQUIREMENTS

A. Each Contractor shall provide and operate all hoists, cranes, helicopters and furnish and erect all ladders and scaffolding required by him and his subcontractors, constructed to afford proper protection to craftsmen, their Work and other Work in progress and previously executed.

1.03 JOB CONDITIONS

A. Each Contractor shall establish and initiate use of each temporary facility at time first reasonably required for proper performance of the total work of project. Terminate use and remove facilities at earliest reasonable time, when no longer needed or when permanent facilities have, with authorized use, replaced the need.

B. Each Contractor shall install, operate, maintain and protect temporary facilities in a manner and at locations that will be safe, nonhazardous, sanitary, protective of persons and property, and free of deleterious effects.

1.04 ENVIRONMENTAL PROTECTION

A. Each Contractor shall provide facilities, establish procedures, and conduct construction activities in a manner that will ensure compliance with environmental and other regulations controlling
construction activities at project site. The Contractor shall designate one person, the Construction Superintendent or other, to enforce strict discipline on activities related to generation of wastes, pollution of air/water/soil, generation of noise, and similar harmful or deleterious effects which might violate regulations or reasonably irritate persons at or in vicinity of project site. Anti-pollution measures required by D.E.P., as applicable are to be followed.

1.05 SECURITY

A. The Contractor shall maintain complete security on the site at all times during and outside of normal working hours to protect the Work and all field offices, and to secure the area of construction by restricting all trespassers.
   • This means locking the doors and/or gates. A guard is not required.

1.06 TEMPORARY CONSTRUCTION FACILITIES

A. Where mud, snow, ice or other hazardous conditions exist in the purview (Scope of Work) of any Sub Contractor, the Contractor shall remove the hazards immediately and replace with suitable material for the other contractors use. If the Owner is compelled to remove the hazards with their own forces due to inaction by the Contractor, then that Contractor will be back-charged for the work performed by the Owner.

B. No welding, cutting by torch, or Work utilizing or causing flammable waste shall be done unless adequate fire protection is provided and maintained for the duration of the Work in the area of operations.

1.07 DEBRIS CONTROL (Refer to Section 01524 for further delineation)

A. The Contractor shall be responsible for daily cleaning up of spillages and debris resulting from his operations and from those of his Subcontractors; and shall be responsible for complete removal and disposition of hazardous and toxic waste materials. The Contractor shall provide containers at grade, sufficient for the depositing of nonhazardous/nontoxic waste materials, and shall remove such waste materials from project site at least weekly during cold weather (daily high temperatures below 50°F) and at least twice weekly during mild and warm weather.
   • Contractor is responsible to provide and pay for all dumpsters.

B. The Contractor shall daily clean all mud, dirt and debris resulting from all trades operations from the adjacent streets, sidewalks, drives and parking areas and shall repair all damage caused by the cleaning to the satisfaction of the Owner.

C. The Contractor is to provide and maintain appropriate means of trash disposal (i.e., chutes) to grade/dumpster. Multiple units may be required and shall be figured for in the bid.

PART 2 - EXECUTION

2.01 ENCLOSURES

A. At earliest possible date, the Contractor shall secure project area against unauthorized entrance at times when personnel are not working. Provide secure temporary enclosure at ground floor and other locations of possible entry, with locked entrances.
B. Where any form of demolition will expose the interior of the building to weather, demolition shall follow the erection of weatherproof walls by the Contractor installed inside the demolition line, sealed and flashed, as required, to keep all water from the building interior. Keep temporary weatherproofing in place until new construction has been completed to the stage where water will not enter the building.

C. The Contractor shall provide constant protection against rain, wind, storms, frost or heat to maintain the work, materials, apparatus and fixtures free from damage. At the end of each day's work, cover work likely to be damaged. During cold weather, protect work from damage by freezing and provide such enclosures and heating apparatus as may be necessary diligently to prosecute the Work without stoppage for reason of unfavorable weather.

D. Wherever a Contractor provides openings through walls or slabs, each location shall be adequately protected at the end of each working day with temporary enclosures to make these areas tight. Openings through exterior walls shall be watertight.

E. Install an 8 foot high fence around the entire site with wind screening. Provide gates as needed to properly access the site to complete the work. Remove the fence once the project is substantially completed. Fence is to have poles into the ground where the fence will be untouched per a period of time, and can have feet with sand bags in areas that the fence may have to be moved occasionally to not interfere with the work.

F. For renovation projects: Contractor is to maintain the building in a water tight condition during all construction activities by whatever means necessary. Contractor is to never do any more removal work during any given day than that contractor can replace in the same day in order to make sure the occupants of the building will be protected from the possibility of water leakage into the building. Should any leakage occur, the contractor is to immediately make the building water tight (on a 24 hour basis) and repair any damage caused by the leakage or replace any equipment damaged by the leakage.

2.02 TEMPORARY ELECTRICITY

A. Power is available on site.

2.03 TEMPORARY VENTILATION

A. A trade requiring ventilation for Work shall provide fans to induce circulation of air.

2.04 TEMPORARY TELEPHONES

A. Each Contractor is responsible for their own telephone service and for payment of all charges relating to that service.

2.05 TEMPORARY WATER

A. Water is available on site.

2.06 TEMPORARY SANITARY FACILITIES
A. Starting at time of start of work at project site, the Contractor shall provide and maintain self-contained toilet units of type acceptable to governing authorities, adequate, at all stages of construction, for use of personnel at project site. Provide separate facilities for male and female personnel when both sexes are working, in any capacity, at project site. Facilities shall remain in use until completion of project. Use of permanent facilities will not be permitted.

2.07 REMOVAL AND RESTORATION

A. Prior to acceptance of the Project, each contractor shall remove temporary work for which he has been responsible.

2.08 OWNER'S RIGHTS

A. If any Contractor fails to carry out his responsibilities in providing temporary facilities, as set forth above, the Owner shall have the right to take such action as he deems proper for the protection and conduct of the Work, and to deduct the cost thereof from the amount due the Contractor at fault.

B. Extended work days, hours, shifts, weekend work, etc. may be allowed upon coordination and approval by Architect, Owner at no additional cost to the Owner.
   • Should the schedule begin to slip, for any reason, each contractor will be required to work additional shifts or weekends to recover the lost time. Should there be a cost to the College for this overtime work, the contractor will be required to reimburse the owner for said costs.

2.09 Parking: parking is allowed for two vehicles only. All other parking is to be at the TCNJ Carlton Avenue parking lot. The contractor is responsible to shuttle workers back and forth as needed.

END OF SECTION 01320
SECTION 01330 – CONTRACT CLOSEOUT

PART 1 – GENERAL

1.01  DEFINITION

A.  Closeout is hereby defined to include general requirements near end of Contract Time, in preparation for final acceptance, final payment, normal termination of Contract, occupancy by Owner and similar actions evidencing completion of the work. Specific requirements for individual units of work are specified in sections of Divisions 2 through 26. Time of closeout is directly related to Substantial Completion, and therefore may be either a single time period for entire work or a series of time periods for individual parts of the work which have been certified as substantially complete at different dates. That time variation, if any, shall be applicable to other provisions of this section.

B.  Substantial completion shall be defined that every material item has been installed. Nothing is missing and therefore, the punch list can begin.

1.02  PREREQUISITES TO SUBSTANTIAL COMPLETION

A.  Prior to requesting the Architect's inspection for certification of substantial completion, for either entire work or portions thereof, complete the following and list known exceptions in request:

1. In progress payment request coincident with or first following date claimed, show either 100% completion for portion of work claimed as substantially complete, or list incomplete items, value of incomplete items, and reasons for being incomplete.

2. Include supporting documentation for completion as indicated in these Contract Documents.
   a. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.

3. Submit statement showing accounting of changes to the Contract Sum.
4. Advise Owner of pending insurance change over requirements.
5. Submit specific warranties, workmanship/maintenance bonds, maintenance agreements, final certifications and similar documents.
6. All fire sprinklers, devices, alarm system, roofing system, doors, insulation, etc. requiring FM Research approval to submit certification from Factory Mutual.
7. Obtain and submit releases enabling Owner's full and unrestricted use of the work and access to services and utilities, including occupancy permits, operating certificates, and similar releases.
8. Deliver tools, spare parts, extra stocks of materials, and similar physical items to Owner obtaining a signed receipt of materials delivered. Refer to individual work sections for required quantities of spare parts, extra and overrun stock, maintenance tools and devices, keys, and similar physical units to be submitted.
9. Complete start up testing of systems, and instructions of Owner's operating/maintenance personnel. Discontinue, or change over, and remove from project site temporary facilities and services, along with construction tools and facilities, mockups, and similar elements.
10. Complete final clean up requirements.
11. Touch up and otherwise repair and restore marred exposed finishes.
12. Inspection: Submit a written request for inspection for Substantial Completion to Project
Manager. On receipt of request, Architect and Project Manager will either proceed with
inspection or notify Contractor of unfulfilled requirements. Architect will prepare the
Certificate of Substantial Completion after inspection, the Project Manager will notify
Contractor of items, either on Contractor's list or additional items identified by Architect that
must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous
inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final
Completion.

B. Upon receipt of Contractor's request, the Project Manager and Architect will proceed with
substantial completion inspection. Following inspection, the Architect will either prepare the
certificate of substantial completion, or advise the Contractor of work which shall be performed
prior to issuance of certificate. The work remaining to be performed shall be completed prior to the
punch list for final acceptance.

C. Upon receipt of Contractor's notice that work has been completed, including all punch list items, but
excepting incomplete items delayed because of circumstances acceptable to the Project Manager and
Architect, the Project Manager and Architect will reinspect the work. Upon completion of
reinspection, the Architect will either prepare the certificate of final acceptance or advise the
Contractor of work not completed or obligations not fulfilled as required for final acceptance.

D. In the event that the work is not completed or obligations are not fulfilled as required for final
acceptance and the Architect/CM is required to reinspect the work more often than the two
inspections described, the Contractor shall compensate the Architect and/or the Project Manager at
the rate of $500.00 for each additional site visit required for reinspections. The compensation shall
be processed by change order as a deduction to the Contractor's Contract Sum, which amount will be
paid to the Architect or Project Manager by the Owner, through a change order as an addition to the
Architect's or Project Manager’s Contract Sum.

E. Substantial Completion shall be defined for this project that every element of the
project/construction and the contract, based on the contract and amended drawings and specification
sections, are installed and the building is deemed complete, less repairs and/or touch up type work
that would be generally referred to as punchlist work. If any components of the building, or site
work associated with this contract are not installed, the project cannot be deemed substantially
completed.

1.03 PREREQUISITES TO FINAL ACCEPTANCE

A. Prior to requesting Project Manager and Architect's final inspection for certification of final
acceptance and final payment, complete the following and list known exceptions, in request:

1. Submit final payment request with final releases and supporting documentation not previously
submitted and accepted. Include certificates of insurance for products and completed
operations where required.
2. Submit release of liens for all subcontractors.
3. Submit Contractor's statement that his final application, as presented, is the final bill and no
other claims will be presented.

4. Submit updated final statement, accounting for additional changes to Contract Sum including change orders and allowances.

5. Submit certified copy of Architect's final punch list of itemized work to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, endorsed and dated by Architect.

6. Submit one set of record documents, bound copies of maintenance/operating manuals, final project photographs, damage or settlement survey, property survey, and similar final record information.

7. Complete final clean up requirements.

8. Touch up and otherwise repair and restore marred exposed finishes.

9. Submit notarized consent of surety to final payment.

10. Submit final liquidated damages settlement statement, if required, acceptable to Project Manager and the Owner.

11. Revise and submit evidence of final, continuing insurance coverage complying with insurance requirements.

12. A letter from the Owner's representative certifying that he has been properly instructed in the operation and maintenance of equipment by the Contractor.

13. 10% one year Maintenance Bond.


15. Fire Alarm Certification and Description - NFPA form 72C including local County of Chester.

16. HVAC Contractor to submit certified balancing report.

17. Final acceptance by Architect of record documents

B. Except as otherwise indicated or requested by Project Manager/Architect, remove temporary protection devices and facilities that were installed during course of the work to protect previously completed work during remainder of construction period.

1.04 CLEAN UP

A. Remove waste materials from site and dispose of in a lawful manner.

PART 2 - PRODUCTS

NOT APPLICABLE

PART 3 - EXECUTION

3.01 CLEANING

A. Where extra materials of value remaining after completion of associated work have become Owner's property, dispose of these to Owner's best advantage as directed.

B. After Substantial Completion of the Work, each Contractor shall do the final cleaning of the surfaces of his installations as may be required by the various Specification sections.

C. After each Contractor has cleaned their work, The General Contractor shall engage a professional cleaning service to perform final cleaning of the work consisting of cleaning each surface or unit to
normal clean condition. Comply with manufacturer's instructions for cleaning operations and chemicals. The following are examples, but not by way of limitation, of cleaning levels required:

1. Remove labels that are not required as permanent labels.
2. Clean transparent materials, including mirrors and window/door glass, to a polished condition, removing substances that are noticeable as vision obscuring materials. Replace broken glass and damaged transparent materials.
3. Clean exposed exterior and interior hard surfaced finishes, to a dirt free condition, free of dust, stains, films and similar noticeable distracting substances. Except as otherwise indicated, avoid disturbance of natural weathering of exterior surfaces. Restore reflective surfaces to original reflective conditions.
4. Wipe surfaces of mechanical and electrical equipment clean, including elevator equipment and similar equipment; remove excess lubrication and other substances.
5. Remove debris and surface dust from limited access spaces including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics and similar spaces.
6. Vacuum and clean carpeted surfaces and similar soft surfaces.
7. Clean light fixtures and lamps to function with full efficiency.
8. Clean and wax or polish all hard floors following manufacturer’s instructions.
9. Clean all window surfaces inside and outside.
10. Perform final cleaning in, on and around all casework, sinks, toilets fixtures, etc.
11. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
12. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
13. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
14. Remove tools, construction equipment, machinery, and surplus material from Project site.
15. Remove snow and ice to provide safe access to building.
16. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
17. Sweep concrete floors broom clean.
18. Replace parts subject to unusual operating conditions.
19. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
20. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
21. Clean ducts, blowers, and coils if units were operated without filters during construction.
22. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
23. Leave Project clean and ready for occupancy.

D. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

3.02 RECORD DOCUMENTS (Refer to Section 01340, project requirements for submitting Record Documents)
3.03 REMOVE TEMPORARY FACILITIES

A. At the completion of the work prior to final payment, remove all temporary facilities entirely from site, including, but not limited to, the following: Field offices, trailers, shanties, sheds, job telephone, temporary toilets, temporary enclosures, dust barriers and other temporary protection devices.

END OF SECTION 01330
SECTION 01340 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Project record documents consisting of:
   a. Record drawings.
   b. Record project manual (specifications).

1.02 SUBMITTALS

A. Project Record Documents: Submit after substantial completion, but prior to final completion.

1. Record drawings: Submit in form of opaque prints.
   a. Sets shall include all drawings, whether changed or not.

2. Other record documents: Submit originals or good quality photocopies.

3. Each Sub contractor is responsible for their respective trade, record documents and record drawings. Combine with General Contractor record drawing documents for a complete set.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

3.01 MAINTENANCE OF PROJECT RECORD DOCUMENTS

A. Do not use record documents of any type for construction purposes.

B. Maintain record documents in a secure location at the site while providing for access by the contractor and the architect during normal working hours; store in a fire-resistive room or container outside of normal working hours.

C. Record information as soon as possible after it is obtained.

D. Assign a person or persons responsible for maintaining record documents.

E. Record the following types of information on all applicable record documents:

   1. Dimensional changes.
   2. New and revised details.
   3. Revisions to electrical circuits.
   4. Locations of utilities concealed in construction.
   5. Particulars on concealed products which will not be easy to identify later.
   6. Changes made by modifications to the contract; note identification numbers if applicable.
   7. New information which may be useful to the owner, but which was not shown in either the contract documents or submittals.
3.02 RECORD DRAWINGS

A. Maintain a complete set of opaque prints of the contract drawings, marked to show changes.
B. Where the actual work differs from that shown on the drawings, mark this set to show the actual work.
   1. Mark location of concealed items before they are covered by other work.
   2. Mark either record contract drawings or shop drawings, whichever are best suited to show the change.
C. When the contractor is required by a provision of a modification to prepare a new drawing, rather than to revise existing drawings, obtain instructions from the architect as to the drawing scale and information required.
D. Keep drawings in labeled, bound sets.
   1. Mark with red pencil.
   2. Mark work of separate contracts with different colors of pencils.
   3. Incorporate new drawings into existing sets, as they are issued.
E. Where record drawings are also required as part of operation and maintenance data submittals, copy marks to another opaque print obtained from the architect.

3.03 RECORD PROJECT MANUAL

A. Maintain a complete copy of the project manual, marked to show changes.
B. Where the actual work differs from that shown in the project manual, mark the record copy to show the actual work.
   1. Include a copy of each addendum and modification to the contract.
   2. In addition to the types of information required on all record documents, record the following types of information:
      a. Product options taken, when the specification allows more than one.
      b. Proprietary name and model number of actual products furnished, for each product, material, and item of equipment specified.
      c. Name of the supplier and installer, for each product for which neither a product data submittal nor a maintenance data submittal was specified.

3.04 TRANSMITTAL TO OWNER (through the Architect)

A. Collect, organize, label, and package ready for reference.
   1. Bind print sets with durable paper covers.
   2. Label each document (and each sheet of drawings) with "PROJECT RECORD DOCUMENTS - This document has been prepared using information furnished by _____" [insert the contractor's name], and the date of preparation.
B. Submit to the Project Manager for transmittal to the Architect, unless otherwise indicated.

C. Submit to the Architect four (4) sets of Operation and Maintenance Manuals in three-ring binders, by volume, and indexed per binder (with one master index) to be transmitted to the Architect/Engineer for approval: All to be submitted at one time, not piece meal. Indexing should follow the specification section numbers.

- Include all inspection/approvals/certifications
- All approved submittals and cut sheets as well as manufacturer's operation and maintenance manuals for each section.
- Manuals are to be completed in volumes, three ring binders, starting with Division 1 and continuing through the last projects Division. The number of volumes is determined by the number of spec section the projects has and by the amount of paper/copies for complete sets of three ring binders.
- List of all contractors and vendors for the project with names, addresses and phone numbers.

END OF SECTION 01340
SECTION 01524 – CONSTRUCTION WASTE MANAGEMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for the following:

1. Salvaging nonhazardous demolition and construction waste.
2. Recycling nonhazardous demolition and construction waste.
3. Disposing of nonhazardous demolition and construction waste.

B. Related Sections include the following:

1. All of Division 1 and attached specifications and drawings that make a part of this contract.

1.3 DEFINITIONS

A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.

C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

1.4 SUBMITTALS

A. Waste Management Plan: Submit 4 copies of plan within 30 days of date established for the Notice to Proceed.

B. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.

C. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
D. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

E. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Waste Management Conference: Conduct conference at Project site to comply with requirements in Division 1. Review methods and procedures related to waste management including, but not limited to, the following:

1. Review and discuss waste management plan.
2. Review requirements for documenting quantities of each type of waste and its disposition.
3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
5. Review waste management requirements for each trade.

1.6 WASTE MANAGEMENT PLAN

A. General: Develop plan consisting of waste identification, and waste reduction work plan. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of demolition, site-clearing, and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.

C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

1. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
2. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
3. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
4. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
5. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location on Project site where materials separation will be located.
PART 2 - PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement waste management plan as approved by Project Manager. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

1. Comply with Division 1 Section "Temporary Facilities" for operation, termination, and removal requirements.

B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.

1. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
2. Comply with Division 1 Section "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

A. Salvaged Items for Sale and Donation: Not permitted on Project site.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. General: Recycle beverage containers used by on-site workers.

B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to the Contractor.

C. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical.

1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.

   a. Inspect containers and bins for contamination and remove contaminated materials if found.

2. Stockpile processed materials on-site without intermixing with other materials. Place, grade,
and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Stockpile materials away from construction area.
4. Store components off the ground and protect from the weather.
5. Remove recyclable waste off Owner's property and transport to recycling receiving or processor.

3.4 RECYCLING DEMOLITION WASTE

A. Asphaltic Concrete Paving: Break up and transport paving to asphalt-recycling facility.
B. Concrete: break up and sort rebar as best as possible. Recycle all concrete.
C. Recycle all metal products from the building before demolition (aluminum, steel etc)
D. Recycle as much product as possible and provide a complete report to TCNJ to confirm the percentage recycled on the project.

3.5 RECYCLING CONSTRUCTION WASTE

A. Packaging:
   1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
   3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
   4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:
   1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.

3.6 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
   1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
   2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials on site.
C. Burying: Do not bury waste materials on site.
D. Disposal: Transport waste materials off Owner's property and legally dispose of them.
E. Washing waste materials into sewers or drains is not permitted.

END OF SECTION 01524
PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Removal and demolition of selected items from selected areas of the building as indicated on the drawings.

1.2 SUBMITTALS

A. Prior to the commencement of operations, submit a schedule indicating the proposed methods and sequence of operations for the selective removals and demolition work. The sequence of operations shall be planned in detail to ensure uninterrupted operation of occupied areas of the building.

B. Submit details and procedure for dust and noise control.

1.3 RESPONSIBILITY, PROTECTION, DAMAGES, RESTRICTIONS

A. Condition of space

1. The owner assumes no responsibility for the actual condition of the space in which removals and demolition work is performed.

B. Owner has no knowledge of presence of any asbestos or other hazardous building materials in the items to be demolished. If contractor encounters any such material during demolition, the work will be immediately stopped and contractor shall report all findings and such material presence to the owner.

C. Protections

1. Provide temporary barricades and other forms of protection required to protect property, personnel, and general public from injury due to selective removals and demolition work.
   a. Provide protective measures as required to provide free and safe passage of employees, personnel of other trades and the general public.
   b. Protect from damage existing finish work that is to remain in place and which becomes exposed during operations.
   c. Protect floors with building paper or other suitable covering.

D. Damage

1. Promptly repair any and all damages to all property and finishes caused by the removals and demolition work to the satisfaction of the Architect and Resident Engineer, at no extra cost to the Owner.

E. Explosives

1. The use of explosives is prohibited.

F. Power-driven Tools for interior removals and demolition.

1. Only hand-held, electric, power-driven tools conforming to the following criteria shall be used to cut or drill concrete and masonry:
a. Electric Chiseling Hammer
   1) Power Data 115 Volts AC
   2) 7-8 Amps
   3) Three-wire grounded connection
   4) Percussion 2400-2600 Impacts/Minute
   5) Type/Size Hand-held (+ 18-inch length)
   6) Unit Weight 12-15 pounds (minus chisel bit)

b. Electric Hammer Drill
   1) Power Data 115 Volts AC
   2) 5-8 Amps
   3) Three wire grounded connection
   4) Percussion 2400 – 3200 Impacts/Minute
   5) Type/Size Hand-held (+ 18-inch length)
   6) Unit Weight 12-15 pounds (minus chisel bit)
   7) Speed Data 500 RPM Max (Under load)

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 INSPECTION

A. Prior to commencement of the selective removals and demolition work, inspect the areas in which the work will be performed. Determine and list the existing conditions of rooms, area surfaces and equipment. After the work in each respective area is completed, determine if the adjacent surfaces or equipment have been damaged as a result of the work; if so, the damage shall be corrected at the Contractor’s expense.

3.2 REMOVAL AND DEMOLITION WORK

A. Perform selective demolition work in a systematic manner and use such methods as are required to complete the work indicated, and in accordance with the Specifications and governing City, State and Federal regulations.

B. When walls, partitions, floors and ceilings (or portions thereof) are indicated to be removed; unless indicated otherwise:
   1. Remove all items attached to the surfaces of the construction to be removed.
   2. Remove electrical wiring, to include, but not limited to, specific lighting, communications, alarms, conduits, devices, fixtures, and other electrical items and accessories occurring on or in the construction to be removed. Disconnect power and remove wiring and conduit back to the source.

3.3 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove debris, rubbish and other materials resulting from the removals and demolitions work, from the building immediately; transport and legally dispose of materials off-site. The disposal method shall be in accordance with City, State, and Federal regulations.
B. Burning of removed materials is not permitted on the job site.

3.4 CLEAN-UP AND REPAIRS

A. Upon completion of removals and demolition work, remove all tools and equipment, and any remaining demolished materials from the site.

B. Repair all damaged areas caused by the removals and demolition work. Repair any adjacent construction or surfaces soiled or damaged by selective demolition materials at the site.

C. All areas in which work was performed under this Section shall be left “broom-clean”.

END OF SECTION
SECTION 03200 - CONCRETE REINFORCEMENT

Part 1 - GENERAL

1.01 WORK INCLUDED

A. Reinforcing steel bars, welded steel wire fabric, fabricated steel bar or rod mats for cast-in-place concrete.

B. Support chairs, bolsters, bar supports, and spacers for supporting reinforcement.

1.02 RELATED WORK

A. Section 03300 - Cast-In-Place Concrete.

1.03 REFERENCES: All reinforcement shall comply with the requirements of these specifications and the more stringent of the following codes, standards and specifications.

A. ACI 301 - Specifications for Structural Concrete for Buildings.

B. ACI 315 - Details and Detailing of Concrete Reinforcement.

C. ANSI/ASTM A82 - Cold Drawn Steel Wire for Concrete Reinforcement.


E. ANSI/ASTM A185 - Welded Steel Wire Fabric for Concrete Reinforcement.

F. ASTM A615 - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.


H. CRSI 63 - Recommended Practice for Placing Reinforcing Bars.

I. CRSI 65 - Recommended Practice for Placing Bar Supports, Specifications and Nomenclature.

1.04 QUALITY ASSURANCE

A. Perform concrete reinforcement work in accordance with CRSI Manual of Standard Practice, and Documents 63 and 65.

B. Conform to ACI 301.

1.05 SHOP DRAWINGS

A. Indicate sizes, spacing, locations and quantities of reinforcing steel, wire fabric, bending and cutting schedules, splicing, stirrup spacing, supporting and spacing devices.
1.06 CERTIFICATES

A. Submit mill test certificates of supplied concrete reinforcing, indicating physical and chemical analysis.

Part 2 - PRODUCTS

2.01 MATERIALS

A. Reinforcing Steel: ASTM A615, 60 ksi (414 mPa) yield grade billet-steel deformed bars, epoxy-coated finish.

B. Welded Steel Wire Fabric: ANSI/ASTM A185 plain type in flat sheets; uncoated finish.

C. Welded Deformed Steel Wire Fabric: ANSI/ASTM 497; in flat sheets; uncoated finish.

2.02 ACCESSORY MATERIALS

A. Tie Wire: Minimum 16 gauge (1.5 mm) annealed type.

B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during installation and placement of concrete.

C. Chairs, Bolsters, Bar Supports, Spacers Adjacent to Concrete Surfaces: Plastic coated, plastic tipped, or stainless steel type; sized and shaped as required.

2.03 FABRICATION

A. Fabricate in accordance with ACI 315, providing concrete cover specified in ACI-318.

B. Locate reinforcing splices not indicated on drawings at points of minimum stress. Indicate locations of splices on shop drawings.

Part 3 - EXECUTION

3.01 INSTALLATION

A. Before placing concrete, clean reinforcement of foreign matter or coatings.

B. Place, support, and secure reinforcement against displacement. Do not deviate from alignment or measurement.
SECTION 03300 - CAST-IN-PLACE CONCRETE

Part 1 - GENERAL

1.01 DESCRIPTION

Work under this section consists of furnishing everything necessary for and incidental to the execution and completion of all cast-in place concrete work, as indicated on the drawings and specified herein.

A. Cast in place concrete.

B. Grouting under base plates and bearing plates.

1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Section 03200 – Concrete Reinforcement.

1.03 REFERENCES (LATEST EDITION)

A. Codes and Standards:
   1. Comply with the provisions of the following codes, specifications, and standards except where more stringent requirements are shown or specified:
      a. Local Building Code.
      c. ACI 301 - Specifications for Structural Concrete for Buildings.
      d. ACI 304 "Guide for Measuring, Mixing, Transporting and Placing Concrete."
      e. ACI 306 - Cold Weather Concreting.
      f. ACI 309 - Guide for Consolidation of Concrete.
      g. ACI 311.4R - Guide for Concrete Inspection.
      h. ACI 315.80 - Details and Detailing of Concrete Reinforcement.
      j. ACI 318 - Building Code Requirements of Reinforced Concrete.
      m. Concrete Reinforcing Steel Institute, "Manual of Standard Practice".
      n. ASTM C618 - Flay Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.
      o. ASTM E154 - Materials for Use as Vapor Barriers Under Concrete Slabs and as Ground Cover in Crawl Spaces.

1.04 QUALITY ASSURANCE

A. The Contractor is responsible for quality control.
   1. Inspection or testing by the Owner does not relieve the Contractor of his responsibility to perform the Work in accordance with the Contract Documents.
2. Workmanship: The Contractor is responsible for correcting concrete work that does not conform to the specified requirement, including strength, tolerances and finishes. Correct deficient concrete by means acceptable to the Engineer.

Part 2 - PRODUCTS

2.01 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type 11 for footings, sumps, slabs and walls, etc. Use only one manufacturer of cement throughout the Project.

B. Aggregates: Provide aggregates in conformance to ACI 301 and ASTM C33. Provide aggregates from a single source for all concrete.
   1. Local aggregates not complying with ASTM C33 but which have shown by special test or actual service to produce concrete of adequate strength and durability may be used when acceptable to the Engineer.
   2. Do not use aggregates containing soluble salts or other substances such as iron sulphides, pyrite, marcasite, or ochre, which can cause stains on exposed concrete surfaces.
   3. Fine Aggregate: Clean, sharp, natural sand free from loam, clay, lumps or other deleterious substances.
      a. Dune sand, bank-run sand, and manufactured sand are not acceptable.
   4. Coarse Aggregate: Clean, uncoated, processed aggregate containing no clay, mud, loam, or foreign matter, as follows:
      a. Crushed stone, processed from natural rock or stone.
      b. Washed gravel, either natural or crushed. Use of pit or bank run gravel is not permitted. Aggregate to have minimum of two fractured faces.
      c. Maximum Aggregate Size: Not larger than one-fifth of the narrowest dimension between sides of forms, one-third of the depth of slabs, or wall, not three-fourths of the minimum clear spacing between individual reinforcing bars or bundles of bars. These limitations may be waived if, in the judgement of the Engineer, workability and methods of consolidation are such that concrete can be placed without honeycomb or voids.

C. Water: Clean, fresh, potable.

2.02 CONCRETE ADMIXTURES

A. Provide admixtures produced by established reputable manufacturers and use in compliance with the manufacturer's printed directions. Do not use admixtures which have not been incorporated and tested in the accepted mixes, unless otherwise authorized in writing by the Engineer.

Use of admixtures shall be correlated with weather conditions as well as with the equipment installation schedules in terms of minimum strength required to be attained by the concrete to sustain equipment loads.

C. Water-Reducing Admixture: ASTM C 494, Type A.

D. Set-Control Admixtures: ASTM C 494, as follows:
   1. Type B, Retarding.
   2. Type C, Accelerating.
   3. Type D, Water-Reducing and Retarding.
   4. Type E, Water-Reducing and Accelerating.
   5. Type F or G, High Range Water Reducing Admixture (SuperPlasticizer).

E. Calcium chloride or admixtures containing calcium chloride will not be permitted in concrete.

2.03 RELATED MATERIALS

A. Bonding Agent:
   1. Cementitious rubber based latex bonding agents - Film forming, freeze thaw-resistant
      compound suitable for brush or spray application complying with ASTM C1059.
   2. Epoxy-Resin Bonding Agent - 2-component, mineral filled, epoxy-polysulphide
      polymer complying with ASTM C881.

2.04 NON-SHRINK GROUT

A. Cementitious Grouts: Provide pre-mixed, non-metallic, non-corrosive, non-staining
   product containing selected silica sands, portland cement, shrinkage compensating agents,
   plasticizing and water reducing agents, complying with CRD-C621 and ASTM C827.
   1. Minimum compressive strength when tested according to ASTM C109.
      a. 2500 psi after one day.
      b. 7000 psi after 28 days.
   2. Initial setting time shall be not less than 45 minutes when tested in accordance with
      ASTM C191.
   3. Grout shall contain no corrosive iron, aluminum or gypsum.

B. Epoxy Grouts: Provide multi-component, non-shrink flowable, fast setting, non-staining,
   chemical attack and impact resistant epoxy based grout complying with ASTM C531,
   C579 and C827.
   1. Minimum compressive strength:
      a. 10,000 psi after one day.
      b. 11,000 psi after seven days.
   2. Epoxy grouts giving out noxious fumes shall be avoided.

2.05 CONCRETE CURING MATERIALS

A. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz.
   per sq. yd. complying with AASHTO M182, Class 3.

B. Moisture-Retaining Cover: One of the following, complying with ASTM C171.
   1. Waterproof paper.
   2. Polyethylene film - white opaque.
C. Membrane-Forming Curing Compound: ASTM C 309, Type I with fugitive dye. Membrane-forming curing compound shall be compatible with floor toppings, hardeners, or covering.

D. Resin Base Liquid Membrane-Forming Curing Compound: Federal Spec. TT-C-800, Type I with fugitive dye. Membrane-forming curing compound shall be compatible with floor toppings, hardeners, or covering.

2.06 CURING AND HARDENING COMPOUND:

A. Sodium Silicate Compound:
   1. Saniseal by Master Builders.
   2. Eucosil by Euclid Chemical Co.
   3. Curetox by Toch Brothers.
   5. Masterseal or MasterKure or MB-429 manufactured by Master Builders.

   These products shall be used for remedial curing and hardening subject to review by the Engineer.

2.07 CONCRETE PROPORTIONING AND DESIGN OF MIXES

A. All concrete, cured and tested in accordance with applicable ASTM standards shall develop an ultimate strength at 28 days as herein specified. Seventy percent (70%) of the 28-day ultimate strength shall be indicated by tests conducted at 7 days.

B. In accordance with applicable provisions of ASTM C94, prepare design mixes for each type and strength of concrete as follows:
   1. Standard weight concrete consisting of the specified Portland cement, aggregates, admixtures, and water to produce the following strength:
      a. Compressive strength: 4000 psi minimum at 28 days all other concrete.

C. Proportion mixes by either laboratory trial batch or field experience method, using materials to be employed on the project for each class of concrete required, complying with ACI 211.1 for normal weight concrete and ACI 211.2 for structural lightweight concrete, and report to the Engineer the following data:
   1. Complete identification of aggregate source of supply.
   2. Tests of aggregates for compliance with specified requirements.
   3. Scale weight of each aggregate.
   4. Absorbed water in each aggregate.
   5. Brand, type, and composition of cement.
   6. Brand, type, and amount of each admixture.
   7. Amounts of water used in trial mixes.
   8. Proportions of each material per cu. yd.
   9. Gross weight and yield per cu. yd. of trial mixtures.
   10. Measured slump.
   11. Measured air content.
   12. Compressive strength developed at 7 days and 28 days from not less than 2 test cylinders cast for each 7-and 28 day test, and for each 50 cubic yard or fraction thereof concrete poured.
D. Admixtures:
   1. Use air-entraining admixture in all concrete, unless otherwise indicated. Add air-entraining admixture at the manufacturer's prescribed rate to result in concrete at the point of placement having air content within the following limits:
      a. 4% for maximum 2" aggregate.
      b. 6% for maximum 3/4" aggregate.
      c. 7% for maximum 1/2" aggregate.
   2. Use admixtures for water-reducing and set-control in strict compliance with the manufacturer's directions.
   3. Use amounts of admixtures as recommended by the manufacturer for climatic conditions prevailing at the time of placement. Adjust quantities and types of admixtures as required to maintain quality control.
   4. Air content should be measured using the Volumetric method described in ASTM C 173 for lightweight concrete and the pressure method described in ASTM C231 for normal weight concrete.

E. Slump Limits:
   1. Proportion and design mixes to result in concrete slump at the point of placement as follows:
      a. Reinforced housekeeping pads: Not less than 1" and not more than 3".
      b. All other Normal Weight Concrete: Not less than 1" and not more than 4".

Part 3 - EXECUTION

3.01 CONCRETE MIXING

A. General: Concrete may be mixed at batch plants or it may be transit mixed as specified herein so long as the batch plant is no more than 15 minutes away from the job site during normal rush hour traffic. Batch plants must comply with the requirements of ACI 304, with sufficient capacity to produce concrete of the qualities specified in quantities required to meet the construction schedule. All plant facilities are subject to testing laboratory inspection and acceptance of the Engineer.

B. Job Site Mixing: Concrete mixed at site should conform to the following:
   1. General: Mix concrete in a batch mixer conforming to the requirements of the "Concrete Plant Standards of the Concrete Plant Manufacturer's Bureau". Mixer shall bear the manufacturer's rating plate indicating mixed capacity and recommended revolutions per minute.
   2. Admixtures: Where approved for use, dispense liquid admixtures by means of an automatic dispenser or similar metering device. Weigh or measure powdered admixtures volume as recommended by the manufacturer. Accurately measure all admixtures to within plus or minus 5 percent. Provide suitable agitating equipment to ensure uniform distribution of ingredients.
   3. Mixing: Charge batch into the mixer so that some water will enter in advance of the cement and aggregates. Allow water to flow into the mixer until the end of the first 25 percent of the specified mixing time. Provide controls to ensure that the batch cannot be discharged until the specified mixing time has elapsed. Provide controls to
insure that no additional water may be added during mixing. Discharge the entire batch before recharging.

4. Mixing Time: Mix each batch of 2 cubic yards or less for not less than 1-1/2 minutes, and not more than 5 minutes after all ingredients are in the mixer before any part of the batch is released. Increase mixing time by 15 seconds for each additional cubic yard or fraction thereof. Do not exceed 30 minutes total elapsed time between intermingling of damp aggregates and cement to the discharge of the complete mix into forms.

C. Ready-Mix Concrete:
1. Comply with the requirements of ASTM C94, and as herein specified. Proposed changes in mixing procedures must be accepted by the Engineer before implementation. Plant equipment and facilities should conform to the requirements of the "Concrete Plant Mixer Standards of the Mixer Manufacturers Division of the Concrete Plant Manufacturer's Bureau".
2. When the air temperature is 90°F or greater, the maximum mixing and delivery time shall be reduced to 60 minutes. Additional reductions in mixing and delivery time may be required when weather or other conditions exist that contribute to rapid setting of concrete. When a truck mixer is used for the complete mixing of the concrete, begin the mixing operation within 30 minutes after the cement has been intermingled with the aggregates.
3. Furnish duplicate delivery tickets with each load of concrete delivered to the site, one for the Engineer and one for the Contractor. In addition to the requirements of ASTM C94, provide the following information on delivery tickets:
   a. Type and Brand of Cement.
   b. Cement Content per cu. yd. of concrete.
   c. Maximum size of aggregate.
   d. Total water content expressed as water/cement ratio.
   e. Amount of water added at job site.

D. Retempering: Mix concrete only in quantities for immediate use. Discard concrete which has set, do not retemper. Adding water to the mix at the jobsite will not be permitted unless prior approval is obtained from the Engineer.

3.02 PREPARATION

A. Preplacement Inspection:
1. Before placing concrete, coordinate, inspect, and complete the formwork installation, reinforcing steel, preformed joint fillers, vapor barriers, water stops and items to be embedded or cast-in. Notify other crafts involved in ample time to permit the installation of their work, cooperate with other trades in setting such work as required. All embedded items shall be secure in position before concrete is placed.
2. Thoroughly wet wood forms immediately before placing concrete, as required where form coatings are not used. Where coating is used, apply with a brush or spray covering the form evenly without excess drip. Do not use form oil, which causes softening or permanent staining of the concrete.
3. The General Contractor shall coordinate the installation of anchors, inserts, and sleeves for electrical, mechanical plumbing, heating, ventilating, and air-conditioning work subject to the inspection and acceptance by the subcontractors of
the particular trades involved. Finish voids in sleeves and inserts temporarily with readily removable material.

3.03 PLACING CONCRETE

A. Cooperate and coordinate the requirements for installation of embedded items specified and furnished in other sections of the Specifications.
   1. Obtain templates and instructions for setting embedded items.
   2. Coordinate work with requirements for mechanical and electrical installations and accommodations.

B. General: Place concrete in compliance with the practices and recommendations of ACI 304, and as specified herein.
   1. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete that has hardened sufficiently to cause the formation of seams or planes of weakness within the section. If a section cannot be placed continuously, provide construction joints as herein specified. Perform concrete placement at such a rate that concrete which is being integrated with fresh concrete is still plastic. Deposit concrete as nearly as practicable to its final location to avoid segregation due to rehandling of flowing. Do not subject concrete to any procedure that will cause segregation.
   2. Do not use concrete which becomes nonplastic and unworkable, or does not meet the required quality control limits, or which has been contaminated by foreign materials. Do not use retempered concrete. Remove rejected concrete from the project site and dispose of in an acceptable location.

C. Concrete Conveying:
   1. General: Handle concrete from the mixer to the place of final deposit as rapidly as practicable and in a manner which will assure that the specified quality of the concrete is obtained.

D. Bonding:
   1. Roughen surfaces of set concrete at all joints, except where bonding is obtained by use of a concrete bonding agent, and clean surfaces of laitance, coatings, loose particles, and foreign matter. Roughen surfaces in a manner to expose bonded aggregate uniformly and not to leave laitance, loose particles of aggregate, or damaged concrete at the surface.
   2. Prepare for bonding of fresh concrete to fully cured hardened concrete or existing concrete by using an epoxy resin bonding agent as follows:
      a. Handle and store epoxy-resin adhesive binder in compliance with the manufacturer's printed instructions, including safety precautions.
      b. Mix the epoxy-resin adhesive binder in the proportions recommended by the manufacturer, carefully following directions for safety of personnel.
      c. Before depositing fresh concrete, thoroughly roughen and clean hardened concrete surfaces and coat with epoxy-resin grout not less than 1/16” thick. Place fresh concrete while the epoxy-resin material is still tacky, without removing the in-place grout coat, and as directed by the epoxy-resin manufacturer.

E. Cold Weather Placing:
1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures, in compliance with the requirements of ACI 306 and as herein specified.

2. When the air temperature has fallen to or is expected to fall below 40°F, provide adequate means to maintain the temperature in the area where concrete is being placed at either 70°F for 3 days or 50°F for 5 days after placing. Provide temporary housing or coverings including tarpaulins or plastic film. Keep protections in place and intact at least 24 hours after artificial heat is discontinued. Avoid rapid dry-out of concrete due to overheating, and avoid thermal shock due to sudden cooling or heating.

3. When air temperature has fallen or is expected to fall below 40°F, uniformly heat all water and aggregates before mixing as required to obtain a concrete mixture temperature of not less than 50°F and not more than 80°F at point of placement.

4. Do not use frozen materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials. Ascertain that forms, reinforcing steel, and adjacent concrete surfaces are entirely free of frost, snow, and ice before placing concrete.

5. Do not use calcium chloride, salt and other materials containing antifreeze agents or chemical accelerators, unless otherwise accepted in mix designs.

6. Use set-control admixtures when required and accepted in mix design.

F. Hot Weather Placing:

1. When hot weather conditions exist that would seriously impair the quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.

2. Temperature of concrete at time of placing shall not exceed 90°F. Contractor shall maintain an accurate reading thermometer at the jobsite the check temperature of concrete. Concrete shall be rejected before placing if temperature of concrete exceeds 90°F.

3. Special precautions to protect fresh concrete before and during finishing shall be mandatory when the rate of evaporation of surface moisture from concrete exceeds 0.2 pounds per square foot per hour. Rate of evaporation shall be determined in accordance with ACI 305. Special precautions shall include the following:
   a. Good planning and close coordination between supplier and jobsite shall be maintained to ensure prompt placement of concrete upon arrival at jobsite.
   b. Cool ingredients before mixing to reduce concrete temperature at time of placement. Mixing water may be chilled, or chipped ice may be used to control the concrete temperature provided the water equivalent of the ice is calculated to the total amount of mixing water.
   c. Dampen subgrade and forms.
   d. Erect windbreaks to reduce wind velocity over the concrete.
   e. Erect sunshades to reduce concrete surface temperatures.
   f. Cover reinforcing steel with water-soaked burlap so that the steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
   g. Utilize fogging to cool and moisten surrounding air. Fog nozzles, specifically designed for concrete fogging, which produce a fog blanket shall be used. Common garden hose nozzles or other nozzles which produce an excessive washing spray shall not be allowed.
h. Provide temporary covering such as wet burlap, plastic membrane, curing paper, or other suitable means of reducing evaporation.

i. Use set control admixtures when required and accepted in mix design.

3.04 PUMPED CONCRETE - PUMPING, CONVEYING AND PLACING

A. General
1. If pumped concrete is proposed for use, design and submit mixes specifically for pumping, and obtain the Engineer's written permission to use pumping method. The Contractor shall submit a sketch showing concrete mixer and air compressor locations outside of the plant and the hose routing for the Owner's and the Engineer's approval.
2. Conform to ACI 304.2R.

B. Use admixtures that will aid in pumping, as follows:
1. Air entrainment sufficient for 5 to 7 percent air.
2. Superplasticizer.

C. To facilitate pumping, adjust standard mix proportion to produce the proper volume of fine aggregate.

D. Cement content shall be sufficient to accommodate specified slump.

E. Use fine aggregates with fineness modulus between 2.2 and 2.8. Use gradations indicated in ACI 304.2R.

F. Use a properly combined coarse and fine aggregate gradation by volume that will prevent from being squeezed through voids between aggregate particles.

G. Concrete shall be conveyed by pumps only when permitted by the Owner. Pumping shall conform to ACI 304.2R unless otherwise specified.

H. Pumping equipment shall be of type designed to handle types, classes and volumes of concrete to be conveyed, without segregation. Pumping distance shall be within limits recommended by pump manufacturer. Pipeline shall be steel or flexible hose.

I. Pumping equipment shall be so operated that a continuous stream of concrete without air pockets is produced.

J. Discharge end of line shall be placed as near final position of concrete as possible but in no case more than 5 feet away.

K. When pumping is completed, the concrete remaining in pipeline shall be ejected without contaminating concrete in place. After each operation, the equipment shall be thoroughly cleaned, and flushing water shall be wasted outside the forms and not allowed to spill on floor, pavement or yard.

3.05 FINISH OF FORMED SURFACES

A. Rough Form Finish:
1. Provide as-cast rough form finish to formed concrete surfaces that are to be concealed in the finished work or by other construction, unless otherwise indicated.
2. Standard rough form finish shall be the concrete surface having the texture imparted by the form facing material used, with tie holed and defective areas repaired and patched and all fins and other projections exceeding 1/4" in height rubbed down or chipped off.

B. Rubbed Finish:
   1. Concrete exposed to view on inside or outside shall receive a rubbed finish.
   2. Concrete shall be formed with form facing material that will produce a smooth, hard, uniform texture on the concrete. The arrangement of the facing material shall be orderly and symmetrical with the number of seams kept to the practical minimum.
   3. Immediately upon removal of forms, concrete shall have all fins completely removed and tie holes, stone pockets, and other defective areas patched. Surfaces shall be wetted and rubbed with carborundum brick or other abrasive until uniform color and texture are produced. No cement grout shall be used other than the cement paste drawn from the concrete itself by the rubbing process.

3.06 CONCRETE CURING AND PROTECTION

A. General:
   1. Protect freshly placed concrete from premature drying and excessive cold or hot temperature for the period of time necessary for hydration of the cement and proper hardening of the concrete.
   2. Start initial curing as soon as free moisture has disappeared from the concrete surface after placing and finishing.
   3. Begin final curing procedures immediately following initial curing and before the concrete has dried. Continue final curing for at least 7 days and in accordance with ACI procedures except high early strength concrete shall be cured for at least three days. Avoid rapid drying at the end of the final curing period.

B. Curing Methods:
   1. Perform curing of concrete by moist curing, by moisture-retaining cover curing, by membrane curing, or by combinations thereof, as herein specified.
      a. For curing, use only water that is free of impurities that could etch or discolor exposed, natural concrete surfaces.
      b. Care shall be taken to ensure that no damage is done to fresh concrete during application of curing method. The contractor shall protect other construction areas from excess water.
   2. Provide moist curing by any of the following methods:
      a. Keeping the surface of the concrete continuously wet by covering with water.
      b. Continuous water-fog spray.
      c. Covering the concrete surface with the specified absorptive cover, thoroughly saturating the cover with water, and keeping the absorptive cover continuously wet. Place absorptive cover so as to provide coverage of the concrete surfaces and edges, with a 4" lap over adjacent absorptive covers.
   3. Provide moisture-retaining cover curing as follows:
      a. Cover the concrete surfaces with the specified moisture retaining cover for curing concrete, placed in the widest practicable width with sides and ends lapped at least 3" and sealed by waterproof tape or adhesive. Immediately
repair any holes or tears during the curing period using cover material and waterproof tape.

4. Provide liquid membrane curing as follows:
   a. Apply the specified membrane-forming curing compound to damp concrete surfaces as soon as the water film has disappeared. Apply uniformly in a 2-coat continuous operation by power spray-equipment in accordance with the manufacturer's directions. Recoat areas which are subjected to heavy rainfall within 3 hours after initial application. Maintain the continuity of the coating and repair damage to the coat during the entire curing period.
   b. Do not use membrane curing compounds on surfaces that are to be covered with a coating material applied directly to the concrete or with a covering material bonded to the concrete, such as liquid floor hardener, waterproofing, damp proofing, membrane roofing, flooring, painting, and other coatings and finish materials, unless otherwise acceptable to the Engineer. The Contractor shall obtain from the curing compound manufacturer a written guarantee that its compound will not be detrimental to bonding of flooring adhesives or surface materials. This guarantee shall be submitted to the Engineer at the time request is made for use of membrane curing compounded.
   c. Do not use curing compounds on surfaces to which additional concrete or cementitious finishing materials are to be applied. Such areas shall be cured by moist curing method.

3.07 NON-SHRINK GROUT

   A. Grout column base plates, equipment bases and other locations noted on the Drawings with non-shrinking grout.

   B. Perform all grouting in accordance with recommendations of ACI and the grout manufacturer's printed specifications for site preparation, product mixing and placing.

3.08 MISCELLANEOUS CONCRETE ITEMS

   A. Filling-in: Fill in holes and openings left in concrete structures for the passage of work of other trades is in place. Mix, place, and cure concrete as herein specified, to blend with in-place construction. Provide all other miscellaneous concrete filling shown or required to complete the work.

   B. Equipment Bases and Foundations: Provide machine and equipment bases and foundations, as shown on the drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with certified diagrams or templates of the manufacturer furnishing the machines and equipments.

3.09 FIELD QUALITY CONTROL AND TESTING

   A. Concrete shall meet or exceed the properties for concrete as defined in the mix design criteria and as herein specified. Failure of the concrete to meet any of these requirements shall be considered grounds for rejection of the concrete or the portion of the work performed with it.

   B. Formed Concrete Dimensional Tolerances:
1. Formed concrete having any dimension smaller than required, and outside the specified tolerance limits recommended by ACI 317, will be considered deficient in strength and will be rejected if the appearance or function of the structure is adversely affected.

2. Formed concrete having any dimension greater than required will be rejected if the appearance or function of the structure is adversely affected, or if the larger dimensions interfere with other construction. Repair or remove and replace rejected concrete as required to meet the construction conditions. When permitted, accomplish the removal of excessive material in a manner to maintain the strength of the section without affecting function and appearance.

3.10 SPECIFIC TESTS, INSPECTIONS AND METHODS REQUIRED FOR LABORATORY TESTING - CAST-IN-PLACE CONCRETE

A. Test for Concrete Materials: as per the requirements of Local Building Codes and the following ASTM Standards.

1. For normal weight concrete, test aggregates by method of sampling and testing of ASTM C33.

2. For lightweight concrete, test aggregates by the method of sampling and testing of ASTM C330.

3. For Portland cement, submit certificate of materials properties and compliance with requirements of ASTM C150.

4. Submit written reports to the Engineer for each material sampled and tested, prior to start of the work. Provide the project identification name and number, date of report, name of Contractor, name of concrete testing service, source of concrete aggregates, material manufacturer and brand name for manufactured materials, values specified in the referenced specification for each material, and test results. Indicate whether or not material is acceptable for intended use.

5. Certificates of material properties and compliance with specified requirements may be submitted in lieu of testing, when acceptable to the Engineer. Certificates of compliance must be signed by the materials producer and the Contractor.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes surface preparation, painting and finishing of exposed interior and exterior items and surfaces.
   1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop-priming and surface treatment specified under other Sections.

B. Paint exposed surfaces whether or not colors are designated in schedules, except where a surface or material is specifically indicated not to be painted, is galvanized, or is to remain natural. Where an item or surface is not specifically mentioned, paint the same as similar adjacent materials or surfaces. If color or finish is not designated, the Owner will select from standard colors or finishes available.
   1. Painting includes field-painting exposed bare pipes and ducts, hangers, exposed steel and iron work.
   2. Insulated pipes shall be field prime painted prior to application of thermal insulation.
   3. Where indicated in these documents.

1.2 SUBMITTALS

A. General: Submit the following according to Conditions of the Submittal Specification Sections.

B. Product data for each paint system specified, including block fillers and primers.
   1. Provide manufacturer's technical information including label analysis and instructions for handling, storage and application of each material proposed for use.
   2. List each material and cross-reference the specific coating, finish system and application. Identify each material by the manufacturer's catalog number and general classification.
   3. Provide certification by the manufacturer that products supplied are in compliance with local regulations controlling use of volatile organic compounds (VOC's).

C. Samples for initial color selection in the form of manufacturer's color charts.
   1. After color selection, the Owner will furnish color chips for surfaces to be coated.

1.3 QUALITY ASSURANCE

A. Applicator Qualifications: Engage an experienced applicator who has completed painting system applications similar in material and extent to those indicated for the Project that have resulted in a construction record of successful in-service performance.

B. Single-Source Responsibility: Provide primers and undercoat paint produced by the same manufacturer as the finish coats.
1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the job site in the manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and the following information:
   1. Product name or title of material.
   2. Product description (generic classification or binder type).
   3. Manufacturer's stock number and date of manufacture.
   4. Contents by volume, for pigment and vehicle constituents.
   5. Thinning instructions.
   6. Application instructions.
   7. Color name and number.

B. Store materials not in use in tightly covered containers in a well ventilated area at a minimum ambient temperature of 45 deg F (7 deg C). Maintain containers used in storage in a clean condition, free of foreign materials and residue.
   1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing and application.

1.5 JOB CONDITIONS

A. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 deg F (10 deg C) and 90 deg F (32 deg C).

B. Apply solvent-based paints only when the temperature of surface to be painted and surrounding air temperatures are between 45 deg F (7 deg C) and 95 deg F (35 deg C).

C. Do not apply paint in snow, rain, fog or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
   1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by the manufacturer during application and drying periods.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to the following:
   1. Devoe and Raynolds Co. (Devoe).
   2. Fuller O'Brien (Fuller).
   3. The Glidden Company (Glidden).
   5. PPG Industries, Pittsburgh Paints (PPG).
   7. The Sherwin-Williams Company (S-W).
2.2 PAINT MATERIALS, GENERAL

A. Material Compatibility: Provide block fillers, primers, finish coat materials and related materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by the manufacturer based on testing and field experience.

B. Material Quality: Provide the manufacturer's best-quality trade sale paint material of the various coating types specified. Paint material containers not displaying manufacturer's product identification will not be acceptable.
   1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish the manufacturer's material data and certificates of performance for proposed substitutions.

2.3 PRIMERS

A. Primers: Provide the manufacturer's recommended factory-formulated primers that are compatible with the substrate and finish coats indicated.

B. Available Products: Subject to compliance with requirements, prime coat materials that may be incorporated in the Work include, but are not limited to, the following:
      a. Devoe: 13101 Miffolac Cover Up Rust Penetrating Primer.
      b. Fuller: 621-04 Blox-Rust Alkyd Metal Primer.
      c. Glidden: 5210 Glid-Guard Universal Fast-Dry Metal Primer.
      e. PPG: 6-208 Red Inhibitive Metal Primer.
      f. P&L: Effecto Rust-Inhibiting Primer.
      g. S-W: Kem Kromik Metal Primer B50N2/B50W1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions under which painting will be performed for compliance with paint application requirements. Surfaces receiving paint must be thoroughly dry before paint is applied.
   1. Do not begin to apply paint until unsatisfactory conditions have been corrected.
   2. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.

3.2 PREPARATION

A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures and similar items already installed that are not to be painted, or provide surface-applied protection prior to surface preparation and painting. Remove these items, if necessary, to completely paint the items and adjacent surfaces. Following completion of painting operations in each space or area, have items reinstalled by workers skilled in the trades involved.
B. Cleaning: Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease prior to cleaning. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

C. Surface Preparation: Clean and prepare surfaces to be painted according to the manufacturer's instructions for each particular substrate condition and as specified.
   1. Provide barrier coats over incompatible primers or remove and reprime. Notify Owner in writing about anticipated problems using the specified finish-coat material with substrates primed by others.
   2. Ferrous Metals: Clean ungalvanized ferrous metal surfaces that have not been shop-coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with recommendations of the Steel Structures Painting Council (SSPC).

D. Materials Preparation: Carefully mix and prepare paint materials according to manufacturer's directions.
   1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
   2. Stir material before application to produce a mixture of uniform density; stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.
   3. Use only thinners approved by the paint manufacturer and only within recommended limits.

3.3 APPLICATION

A. General: Apply paint according to manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.

B. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces or conditions detrimental to formation of a durable paint film.
   1. Provide finish coats that are compatible with primers used.
   2. The number of coats and the film thickness required are the same regardless of the application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. Sand between applications where sanding is required to produce a smooth even surface according to the manufacturer's directions.
   3. Apply additional coats if undercoats, stains, or other conditions show through final coat of paint until paint film is of uniform finish, color, and appearance. Give special attention to ensure that surfaces, including edges, comers, crevices, welds, and exposed fasteners, receive a dry film thickness equivalent to that of flat surfaces.

C. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
   1. Allow sufficient time between successive coats to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.
D. Application Procedures: Apply paints and coatings by brush, roller, spray or other applicators, according to the manufacturer's directions.
   1. Brushes: Use brushes best suited for the material applied.
   2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by the manufacturer for the material and texture required.
   3. Spray Equipment: Use airless spray equipment with orifice size as recommended by the manufacturer for the material and texture required.
   4. Minimum Coating Thickness: Apply materials no thinner than the manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.

E. Mechanical items to be painted include, but are not limited to, the following:
   1. Pipe hangers and supports, support steel.
   2. Accessory items.
   3. Uninsulated piping
   4. Insulated pipe (primer only)
   5. Ductwork

F. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime-coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no bum-through or other defects due to insufficient sealing.

G. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with specified requirements.

3.4 FIELD QUALITY CONTROL

A. The Owner reserves the right to invoke the following test procedure at any time and as often as the Owner deems necessary during the period when paint is being applied:
   1. The Owner will engage the services of an independent testing agency to sample the paint material being used. Samples of material delivered to the Project will be taken, identified, sealed, and certified in the presence of the Contractor.
   2. The testing agency will perform appropriate tests for the following characteristics as required by the Owner:
      a. Quantitative materials analysis.
      b. Abrasion resistance.
      c. Apparent reflectivity.
      d. Flexibility.
      e. Washability.
      f. Absorption.
      g. Accelerated weathering.
      h. Dry opacity.
      i. Accelerated yellowness.
      j. Recoating.
      k. Skinning.
      l. Color retention.
      m. Alkali and mildew resistance.
3. If test results show material being used does not comply with specified requirements, the Contractor may be directed to stop painting, remove non-complying paint, pay for testing, repaint surfaces coated with rejected paint, and remove rejected paint from previously painted surfaces if, upon repainting with specified paint, the two coatings are incompatible.

3.5 CLEANING

A. Cleanup: At the end of each work day, remove empty cans, rags, rubbish and other discarded paint materials from the site.
   1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.

3.6 PROTECTION

A. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as acceptable to Owner.

B. Provide “Wet Paint” signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.
   1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.7 INTERIOR PAINT SCHEDULE

A. General: Provide the following paint systems for the various substrates, as indicated.

B. Semigloss Finish: Two coats over primer, with total dry film thickness not less than 2.5 mils.
   1. Primer: Galvanized metal primer.
      b. Fuller: 621-05 Blox-Rust Latex Metal Primer.
      c. Glidden: 5229 Gild-Guard All-Purpose Metal Primer.
      d. Moore: Ironclad Galvanized Metal Latex Primer # 155.
      e. PPG: 6-215/216 Speedhide Galvanized Steel Primer.
      g. S-W: Galvite B50W3.
   2. Undercoat: Interior enamel undercoat.
      e. PPG: 6-6 Speedhide Quick-Dry Enamel Undercoater.
      a. Devoe: 26XX Velour Alkyd Semigloss Enamel.
      b. Fuller: 110XX Fullerglo Alkyd Semigloss Enamel.
      d. Moore: Satin Impervo Enamel #235.
e. PPG: 27 Line Wallhide Semigloss Enamel.
f. P&L: Cellu-Tone Alkyd Satin Enamel.
g. S-W: Classic 99 Semigloss Enamel A40 Series.

END OF SECTION
SECTION 15010 - GENERAL PROVISIONS – MECHANICAL

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This section covers and applies to all work included in DIVISION 15.

B. Work in this Section includes providing labor, materials, equipment, services necessary, fabrication, installation and testing for fully operational and safe systems including all necessary materials, appurtenances and features whether specified or shown in the contract documents or not, in conformity with all applicable codes and authorities having jurisdiction for the mechanical work covered by all sections within DIVISION 15 of the specifications.

C. Provide cutting and patching.

1.2 QUALITY ASSURANCE

A. All equipment and accessories to be the product of a manufacturer regularly engaged in its manufacture.

B. Supply all equipment and accessories new and free from defects.

C. Supply all equipment and accessories in compliance with the applicable standards listed in article 1.3 of this section and with all applicable national, state and local codes.

D. All items of a given type shall be the products of the same manufacturer.

1.3 SUBMITTALS FOR 15010

A. Submit the following items as hereinafter specified:
   1. List of proposed manufacturers.
   2. Schedule of Division 15 submittals.
   3. Layout Drawings.
   4. Coordinated Drawings.
   5. As-built Record Drawings.
   6. Records of filing and permitting required by authorities having jurisdiction.
   7. Operating and Maintenance Manuals.

1.4 SUBMITTAL REQUIREMENTS

A. Submit shop drawings, product data, samples and certificates of compliance required by contract documents.

B. Schedule of submittals, as agreed to by the Engineer, will set the basis of the minimum required submittals. Engineer reserves the right to request submittals for additional items not listed in the schedule. Such requested submittals shall be provided by the Contractor at no additional cost.

C. Submittal Format shall be as follows:
1. Submit a minimum of one binder for each specification section. Do not combine items from different specification sections within the same binder.

2. Successively number each submittal with reference to the specification section number.

3. Prepare each submittal with a consistent one page title block, providing each with the submittal’s respective information, as follows:
   a. Complete project title and project number.
   b. Date of Submission.
   c. Submittal number as follows:
      1) Contractor’s submittal number.
      2) Appropriate specification section number.
      3) Drawing and or detail number where applicable.
      4) Revision number.
      5) Number shall correspond to the master submittal schedule.
   d. Referenced addendum or change order number as applicable.
   e. Name and Address of Engineer.
   f. Name and Address and telephone number of Contractor.
   g. Name and Address and telephone number of subcontractor.
   h. Stamp with printed name and signature of Contractor's representative certifying:
      1) Review of submittal.
      2) Verification of products, field measurements and field construction criteria.
      3) Coordination of shop drawing and/or information in submittal with requirements of work of this Division and other Divisions of Contract Documents.

4. Include with each submittal, directly following each submittal’s title block, complete index with following information:
   a. Main header indicating SUBMITTAL INDEX.
   b. Column headers indicating the following:
      1) SUBMITTED ITEM (Equipment or Product type).
         a) Field to contain model name and number.
      2) SUPPLIER
         a) Field to contain supplier contact name, address and phone number.
      3) MANUFACTURER
         a) Field to contain manufacturer contact name, address and phone number.
      4) CD REFERENCE, Referencing construction documents.
         a) Field to contain specification page number(s) and drawing sheet number(s) as applicable.
      5) PAGE NO. (TAB NO may be used, if provided).
         a) Page number shall reference location of information within submitted binder.
   c. All items within PART 2-PRODUCTS of each specification section shall be listed within the index - in the same order as specified. Items provided within the submittal shall have information for each of the above index columns, as applicable.
   d. Under the column header “PAGE NO.”, each specified item that is not included within the submittal shall be specifically identified within the index with one of the following explanations:
      1) PREVIOUSLY SUBMITTED or PRV SBMT’D (For items not part of submittal, but previously submitted).
      2) FUTURE SUBMITTAL or FUT SBMT’L(for outstanding items, remaining to be submitted).
      3) NOT APPLICABLE or N/A (for items specified, but not to be used).
5. Nomenclature, legend, symbols and abbreviations on submitted material shall be same as used in contract documents.

D. Submittals for each section must be provided either in its entirety or in no more than two partial packages. Exception: Partial submittals may exceed two separate packages when expressly required by specification section or when authorized in writing by project consultant engineer. Such authorization will be provided upon request by the Contractor.

E. Resubmission Requirements:
   1. Make any corrections or change in Submittals required. Resubmit for review until no exceptions are taken or a resubmission is not required.
   2. Shop Drawings and Product Data:
      a. Revise initial drawings or data, and resubmit as specified for initial submittal.
      b. Indicate any changes which have been made other than those requested.
   3. Clearly identify resubmittal by original submittal date, number and revision number and indicate all changes from previous submittal.
   4. If more than two submissions are required (initial submittal and one resubmittal) based on rejection or lack of compliance by submittal, then the Contractor shall:
      a. Arrange for additional reviews by the Design Engineers.
      b. Pay all costs for such additional reviews.

F. Corrections or comments made on the shop drawings during review do not relieve the Contractor from compliance with requirements of the drawings and specifications. Shop drawing checking by the Engineer is only for review of general conformance with the design concept of the project and general compliance with the information given in the contract documents. The Contractor is responsible for:
   1. Confirming and correlating all quantities and dimensions.
   2. Selecting fabrication processes and techniques of construction.
   3. Coordinating his work with that of all other trades.
   4. Performing his work in a safe and satisfactory manner.

G. Layout (Shop) Drawings:
   1. Submit Layout Drawings indicating this division’s work. If the proposed layout deviates from design documents, such deviations shall be clearly identified on the submitted drawings.
   2. Layout Drawings for mechanical rooms shall be at a minimum scale of ¼”=1’-0”.

H. Coordinated Drawings:
   1. Coordinated Drawings shall show work of all trades including, but not limited to:
      a. Piping, including:
         1) HVAC, plumbing and fire protection.
         2) Minor Piping such as drains, air vents, condensate piping, etc.
         3) Sleeves and penetrations.
         4) Expansion devices, anchors, guides and hangers.
      b. Mechanical Equipment.
      c. Supports and suspension devices.
      d. Piping high points and low points.
      e. Electrical Equipment.
      f. Main Electrical conduits and bus ducts.
      g. Equipment support and suspension devices including hangers, supports and bracing.
h. Structural and architectural constraints including:
   1) Beams, braces, trusses, flanges, constraints, walls, openings ratings, doors, wall
types, glazing.
   i. Show location of:
      1) Valves.
      2) Piping specialties.
      3) Control and electrical panels.
      4) Disconnect switches
      5) Others as required.

2. Provide sections and elevations for all mechanical rooms, mechanical areas, areas with
routed duct mains, areas with routed piping mains, and areas adjacent to the existing
structure.

I. As-built (Record) Drawings:
   1. Provide after installation is complete. Final signoff and acceptance will not occur prior
to submission of As-built drawings.
   2. Indicate as-built conditions and all revisions that occurred subsequent to “Coordinated
Drawings” submittal, fully illustrating all revisions made by all trades in the course of
work.
   3. Dimension physical locations of piping with reference elevations and distances above
finished floors, below beams, from wall faces, underground (invert elevations) and
from column lines.
   4. Exact location, type and function of concealed valves, controllers, piping, piping drains
and isolators.
   5. Indicate all equipment sizes and capacities and tag numbers.
   6. Provide drawing on reproducible mylar or as directed by Owner.
   7. These drawings shall be for as-built record purposes for the Owner’s use and are not
considered shop drawings.

J. Operating Instructions, Maintenance Manuals and Parts Lists:
   1. Before requesting acceptance of work, submit one set for review by Engineer.
   2. After review, furnish five printed and bound sets.
   3. Include:
      a. Manufacturer's name, model number, service manual, spare-parts list, and
descriptive literature for all components.
      b. Maintenance instructions.
      c. Instruction for starting, operation and programming.
      d. Detailed and simplified one line, color coded flow and wiring diagram.
      e. Name, address and phone number of contractors equipment suppliers and service
agencies.
      f. Assemble manufacturer's equipment manuals in chronological order, following the
specification alpha-numeric system, in heavy duty 3-ring binders clearly titled on
the spine and front cover with appropriate index dividers.

1.5 RELATED WORK AND REQUIREMENTS

A. Carefully check the documents of each section with those of other sections and Divisions.
Ascertain the requirements of any interfacing materials or equipment being furnished and/or
installed by those sections and Divisions, and provide the proper installation and/or required
interface.
1.6 REFERENCE STANDARDS

A. Published codes, specifications, standards, tests or recommended methods of trade, industry or governmental organizations apply to work in this Division where cited below:
   2. ARI - Air-Conditioning and Refrigeration Institute.
   3. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers.
   4. ASME - American Society of Mechanical Engineers.
   6. AWS - American Welding Standards.
   7. FM - Factory Mutual.
   8. Local Utility Authorities.
   9. National, State and Local Codes of all authorities having jurisdiction.
   10. NEMA - National Electrical Manufacturer's Association.
   12. OSHA - Occupational Safety and Health Act.
   13. State Energy Code having jurisdiction
   15. UL - Underwriters' Laboratories, Inc.
   16. UMC - Uniform Mechanical Code.
   17. UPC - Uniform Plumbing Code.

B. In addition to complying with all other legal requirements, comply with current provisions of governing codes and regulations in effect during progress of the Work, and with the following:
   1. Drawings and specification requirements shall govern where they exceed Code and Regulation requirements.
   2. Where requirements between governing Codes and Regulations vary, the more restrictive provisions shall apply.
   3. Nothing contained in Contract Documents shall be construed as authority or permission to disregard or violate legal requirements. The Contractor shall immediately draw the attention of the Engineer to any such conflicts noted in the Contract Documents.

1.7 DESCRIPTION OF BID DOCUMENTS

A. Specifications:
   1. Specifications, in general, describe quality and character of materials and equipment.
   2. Specifications are of simplified form and include incomplete sentences.
   3. Words or phrases such as "The Contractor shall," "shall be," "furnish," provide," "a," "an," "the," and "all" etc. have been omitted for brevity.

B. Drawings:
   1. Drawings in general are diagrammatic and indicate scope, sizes, routing, locations, connections to equipment and methods of installation, but not necessarily offsets, obstructions or structural conditions. Locations on drawings may be distorted for purposes of clearness and legibility.
   2. Contractor to provide additional offsets, fittings, hangers, supports, valves, drains as required for construction and coordination with work of other trades.
3. Scaled and figured dimensions are approximate and are for estimating purposes only but shall be followed with sufficient accuracy to coordinate with other work and structural limitations.

4. Before proceeding with work, check and verify all dimensions and carefully check space requirements with other Work to ensure that all equipment and materials can be installed in spaces allotted.

5. Assume all responsibility for fitting of materials and equipment to other parts of equipment and structure.

6. The Contractor is responsible for installing the work in such a manner that it will conform to the structure and architectural elements, avoid obstructions, maintain headroom, leave adequate clearance for proper maintenance and repairs, and provide clearances and access required by codes.

7. Make adjustments that may be necessary or requested in order to resolve space problems, preserve headroom avoid architectural openings, structural members and work of other trades.

C. If any part of Specifications or Drawings appears unclear or contradictory, consult with Engineer for interpretation and decision as early as possible during bidding period. Do not proceed with such work without Engineer’s decision.

D. Typical details, where shown on the drawings, apply to each and every item of the project where such items are applicable. Typical details are not repeated in full on the plans, and are diagrammatic only, but with the intention that such details shall be incorporated in full.

1.8 DEFINITIONS

A. "Furnish" or "Provide": to supply, install and connect up complete and ready safe and regular operation of particular work referred to unless specifically otherwise noted.

B. "Install": to erect, mount and connect complete with related accessories.

C. "Supply": to purchase, procure, acquire and deliver complete with related accessories.

D. "Work": labor, materials, equipment, apparatus, controls, accessories, and other items required for proper and complete installation.

E. "Piping": pipe, tube, fittings, flanges, valves, controls, strainers, hangers, supports, unions, traps, drains, insulation, and related items.

F. "Wiring": raceway, fittings, wire, boxes and related items.

G. "Concealed": embedded in masonry or other construction, installed in furred spaces, within double partitions or hung ceilings, in trenches, in crawl spaces, or in enclosures.

H. "Exposed": not installed underground or "concealed" as defined above.

I. "Indicated," "Shown" or "Noted": as indicated, shown or noted on drawings or specifications.

J. "Similar" or "Equal" of base bid manufacture: in the Engineer's opinion, equal in materials, weight, size, design, and efficiency of specified product.
K. "Reviewed," "Satisfactory," or "Directed": as reviewed, satisfactory, or directed by or to Architect.

L. "Motor Controllers": manual or magnetic starters (with or without switches), individual pushbuttons or hand-off-automatic (HOA) switches controlling the operation of motors.

1.9 JOB CONDITIONS

A. Examine all drawings and specifications in a manner to be fully cognizant of all work required under this Division.

B. Adjoining work of other Divisions shall be examined for interferences and conditions affecting this Division.

C. Examine site related work and surfaces before starting work of any Section.
   1. Report to Engineer, in writing, conditions which will prevent proper provision of this work.
   2. Beginning work of any Section without reporting unsuitable conditions to Engineer constitutes acceptance of conditions by Contractor.
   3. Perform any required removal, repair or replacement of this work caused by unsuitable conditions at no additional cost to Owner.

D. Connections to existing work.
   1. Verification of existing:
      a. Before submitting bid, become thoroughly familiar with actual existing conditions and systems at the building, and of the existing installations to which connections must be made, including any necessary alterations, and existing building engineering practices and requirements. The intent of the work is shown on the drawings and described herein, and no consideration will be granted by reason of lack of familiarity on the part of the contractor with actual physical conditions, requirements, and practices at the site.
   2. Install new work and connect to existing work with minimum interference to existing facilities.
   3. Temporary shutdowns of existing services:
      a. At no additional charges.
      b. At times not to interfere with normal operation of existing facilities.
      c. Only with written consent of Owner.
   4. Maintain continuous operation of existing facilities as required with necessary temporary connections between new and existing work.
   5. Restore existing disturbed work to original condition.

E. Removal and relocation of existing work.
   1. Disconnect, remove or relocate material, equipment, plumbing fixtures, piping and other work noted and required by removal or changes in existing construction.
   2. Where existing pipes, conduits and/or ducts which are to remain prevent installation of new work as indicated, relocate, or arrange for relocation, of existing pipes, conduits and/or ducts.
   3. Provide new material and equipment required for relocated equipment.
   4. Plug or cap active piping or ductwork behind or below finish.
   5. Do not leave long dead-end branches. Cap or plug as close as possible to active line.
   6. Remove unused piping, ductwork and material.
7. Dispose of removed fixtures and equipment as directed.
8. Turn over removed fixtures and equipment to Owner as directed.

F. If asbestos insulation is found when working in existing areas, immediately stop work and notify Engineer and Owner. Do not restart work until advised in writing by Engineer that it is safe to do so following abatement, encapsulation, etc.

1.10 CLEARANCE FROM ELECTRICAL EQUIPMENT

A. Piping or ductwork:
   1. Prohibited above an area within 5 ft. of:
      a. Transformers.
      b. Motor control centers.
      c. Standby switchgear.
      d. Bus ducts.

1.11 PRODUCT DELIVERY, HANDLING AND STORAGE

A. Check dimensions of access route through the site from delivery point to final location. Where necessary, ship in crated sections of size to permit passing through available space. Dismantle and/or reassemble, and retest equipment too large to pass through available access route to final location in one piece.

B. Ship equipment in original packages, to prevent damaging or entrance of foreign matter.

C. Handle and ship in accordance with manufacturer's recommendations.

D. Replace at no expense to Owner, equipment or material damaged during storage or handling, as directed by Engineer.

E. Tag all items with weatherproof tag, identifying equipment by name and purchase order number.

F. Include packing and shipping lists.

G. Special requirements as specified in individual sections.

1.12 SPECIAL TOOLS

A. Furnish to Owner at completion of work:
   1. One set of any special tools required to operate, adjust, dismantle or repair equipment furnished under any section of this Division.
   2. "Special tools": those not normally found in possession of mechanics or maintenance personnel.
   3. One pressure grease gun for each type of grease required.
      a. With adapters to fit all lubricating fittings on equipment.
      b. Include lubricant for lubricated plug valves.
   4. Tag each item and cross reference in Maintenance Manual.
   5. Turn over to Owner's representative or temporarily secure to unit at Engineer's instruction.
1.13 PROTECTION OF MATERIALS

A. Protect from damage, water, dust, etc., material, equipment and apparatus provided under this Division, both in storage and installed, until Notice of Completion has been filed.

B. Provide temporary storage facilities for material and equipment.

C. Material, equipment or apparatus damaged because of improper storage or protection will be rejected.
   1. Remove from site and provide new, duplicate, material equipment or apparatus in replacement of that rejected.

D. Cover motors and other moving machinery to protect from dirt and water during construction.

E. Protect premises and work of other Divisions from damage arising out of installation of work of this Division.
   1. Repair or replace, as directed by Architect, materials and parts of premises which become damaged as result of installation of work of this Division.
   2. Remove replaced parts from premises.

1.14 REVIEW OF CONSTRUCTION

A. Work may be reviewed at any time by representatives of Engineer.

B. Advise Engineer in writing that work is ready for review at following times:
   1. Prior to concealment of work in walls and above ceilings.
   2. When all requirements of Contract have been completed.

1.15 NOISE REDUCTION

A. Cooperate in reducing objectionable noise or vibration caused by mechanical systems.
   1. To extent of adjustments to specified and installed equipment and appurtenances.

B. Correct noise problems caused by failure to install work in accordance with Contract Documents. Include labor and materials required as result of such failure.

1.16 PERMITS, LICENSES, AND INSPECTION

A. Permits and Licenses:
   1. Secure required permits and licenses including payments of all charges and fees.

B. Inspections:
   1. Obtain certificates of final inspection approval from authorities having jurisdiction, and submit to Engineer before acceptance of the Work

1.17 GUARANTEE

A. Guarantee all materials, equipment, apparatus and workmanship to be free of defective materials and faulty workmanship for period of one year from date of filing of Notice of Completion, unless extended guarantee periods are specified in individual sections.

B. Furnish guarantee covering all work in accordance with general requirements of the Contract.
C. Provide new materials, equipment, apparatus and labor to replace that determined by Engineer to be defective or faulty.

D. This guarantee also applies to services such as Instructions, Adjusting, Testing, Noise, Balancing, etc.

E. Equipment manufacturers shall include extended warranty to give full coverage during warranty period, unless longer period is specified.

F. Manufacturers shall supervise and certify installation of products.

1.18 PRELIMINARY OPERATION

A. Any portion of the system or equipment shall be placed in operation at the request of the Owner prior to the final completion and acceptance of the work. Such operation shall be under the direct supervision of the Contractor, but the expense thereof will be paid separately and distinct from any money paid on account of the Contract.

B. Preliminary operation or payment thereof shall not be construed as acceptance of any part of the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Product Options:
   1. Contractor's Options:
      a. For products specified only by reference standard, select product meeting that standard, by any manufacturer.
      b. For products specified by naming several products or manufacturers, select any one of products and manufacturers named which complies with Specifications.
      c. For products specified by naming one product or manufacturer, use that product or manufacturer.
      d. Wherever catalog numbers and specific brands or trade names are used, they are used to establish standards of quality, utility and appearance required.

2.2 MISCELLANEOUS METAL WORK

A. Access Platforms, Ladders, Guard and Railings:
   1. Under General Construction Work.

B. Supplemental Steel
   1. As required to transfer piping or duct support loads to building structure
   2. Use standard structural shapes.

2.3 PAINTING

A. Manufacturers:
   2. Pittsburgh Plate Glass Co.
3. Pratt and Lambert.
4. Or equivalent

B. Materials:
1. Best grade for its purpose.
2. Deliver in original sealed containers.
3. Apply in accordance with manufacturers instructions.
4. Heat resistant paint for hot piping, equipment and materials.
5. Colors as selected and approved by Owner.

PART 3 - EXECUTION

3.1 CUTTING AND PATCHING

A. All carpentry, cutting and patching to be done under trades doing that work.

B. Provide all carpentry, cutting and patching required for proper installation of material and equipment specified in this Division.

C. Do not cut or drill structural members without consent of Engineer.

3.2 PAINTING

A. Painting of exposed piping and equipment.
   1. Colors coordinated by Mechanical Contractor as directed by Engineer.

B. Painting under this Division:
   1. Uncoated hangers, supports, rods and inserts: dip in zinc chromate primer.
   2. Factory prime coat for following except as noted.
      a. Equipment.
   3. Marred surfaces of prime coated equipment and piping: spot prime coat to match adjacent coat.
   4. Shop prime coat for following, except as noted:
      a. Structural frames.
      b. Platforms.
      c. Ladders.
      d. Railings.

C. General:
   1. Labor, materials and equipment necessary for field painting.
   2. Protect flooring and equipment with drip cloths.
   3. Paint and materials stored in location where directed.
   4. Oily rags and waste removed from building every night.
   5. Furnish each space containing stored painting materials with approved 2-1/2 gallon fire extinguisher.
   6. Wire brush and clean off all oil, dirt and grease areas to be painted before paint is applied.
   7. Mixing:
      a. Mixed and strained as required by manufacturer.
      b. Use thinners only in accordance with manufacturer’s recommendation.
c. Follow printed instructions on paint containers. If none are available, instructions shall be obtained in writing from manufacturer.

8. Workmanship:
   a. No painting or finishing shall be done with:
      1) Dust laden air.
      2) Unsuitable weather conditions.
      3) Space temperature below 60°F.
   b. Pipes being painted: containing no heat and to remain cold until paint is dried.
   c. Paint spread: uniform and proper film thickness showing no runs, sags, crawls or other defects.
   d. Finished surfaces shall be uniform in sheen, color, and texture.
   e. All coats to be thoroughly dry before succeeding coats are applied, minimum 24 hours between coats.
   f. Priming undercoat: slightly different color for inspection purposes.

9. Exposed, uninsulated, ungalvanized sheet metal other than stainless steel and aluminum: Two coats of aluminum paint or alkyd paint color as directed.

10. Exposed, uninsulated, galvanized sheet metal in finished space including mechanical equipment rooms:
    a. One coat galvanized iron primer.
    b. Two coats alkyd oil paint, color as directed.

11. Exposed, insulated piping and equipment covering:
    a. One coat primer sealer.
    b. Two coats alkyd oil paint, color as directed.

12. Paint following with two coats alkyd oil paint, color as directed:
    a. Exposed steel and metal work not furnished with factory-painted finish.
    b. Structural steel supports for piping ductwork and equipment.
    c. Exposed, uninsulated piping.

13. Exposed, uninsulated aluminum sheet metal in finished space:
    a. One coat zinc chromate primer.

D. Finish painting:
   1. Consisting of two finished coats of high gloss medium or long alkyd paint over prime coat.
   2. Submit color shade for approval.
   3. Piping continuously painted in all exposed areas.
   4. Color coding per Owner’s approval.

3.3 CONCRETE WORK

A. On concrete floors, install equipment on concrete housekeeping pads:
   1. Pads 4 in. high except as noted.
   2. Extend 4 in. minimum beyond equipment base on all sides or as noted.
   3. Provide concrete work, including forming and reinforcing
   4. Furnish and locate anchors and anchor bolts.

3.4 CLEANING AND ADJUSTING

A. Brush and clean work prior to concealing, painting and acceptance. Perform in stages if directed.
B. Painted or exposed work soiled or damaged: clean and repair to match adjoining work before final acceptance.

C. Remove debris from inside and outside of materials and equipment.

D. Flush out piping after installation.

E. Adjust valves and automatic control devices.

F. Ensure that traps, wastes and supplies are unobstructed.

3.5 FIELD QUALITY CONTROL

A. Tests:
   1. Perform as specified in individual sections, and as required by authorities having jurisdiction.

B. Provide required labor, material, equipment, and connections.

C. Furnish written report and certification that tests have been satisfactorily completed.

D. Repair or replace defective work, as directed.

E. Pay for restoring or replacing damaged work due to tests, as directed.

3.6 COMMISSIONING

A. The Owner will hire an independent commissioning agent. The Contractor shall make himself and his subcontractors available to assist the agent in his check-out procedure

3.7 TRAINING

A. Provide training by qualified manufacturers' representatives for all equipment installed under this Project.

B. Each training session to be scheduled with Owner in advance.

END OF SECTION
SECTION 15080 - INSULATION

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Principal work in this Section includes labor, materials, equipment and services necessary for a complete and safe installation of mechanical piping insulation.

1.2 QUALITY ASSURANCE

A. Refer to Section 15010 GENERAL PROVISIONS - MECHANICAL.

B. Insulation materials, including jackets, facings, adhesives, coatings, and accessories, shall be fire hazard rated and listed by Underwriters' Laboratory, Inc., using the Steiner Tunnel Test Method for Fire Hazard Classification of Building Materials, Standard UL 723 (ASTM E-84) and NFPA 255.
   1. The Underwriters' Laboratory, Inc. listed Class I flamespread rating shall be a maximum of 25 and the fuel contributed and smoke developed rating shall be a maximum of 50.
   2. Flameproofing treatments which are subject to deterioration from moisture or humidity are not acceptable.

C. Insulation products shall carry ISO 9000/9001/9002 certification or guaranteed to meet the ISO standards.

D. Refer to Section 15010 GENERAL PROVISIONS - MECHANICAL for Guarantee and other Quality Assurance requirements.

1.3 SUBMITTALS

A. Submit product data, schedule, and samples for the following items per the provisions of Division 1 and this Division’s General Provisions:
   1. Product data: Insulation materials, vapor barrier materials, adhesives, fastening devices, and finishes and jacketing.
   2. Schedule: List the work that will be insulated and a description of insulation materials and finishing procedures and a certificate indicating compliance with codes.

1.4 DEFINITIONS

A. Exposed: Piping located in mechanical equipment rooms and in indoor areas which will be visible without removing ceilings or opening access panels.

B. Concealed: Indoor piping which is not exposed.

C. Outdoor: Piping which is exposed to the weather.

D. Underground: Piping which is buried; whereas piping located in a trench below grade is considered concealed.
1.5 REFERENCE STANDARDS

A. Published specifications standards, tests or recommended methods of trade, industry or governmental organizations apply to work in this Section.

B. Comply with all applicable national, state and local codes and refer to Section 15010 GENERAL PROVISIONS - MECHANICAL for additional Reference Standards.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Fiberglass insulation:
   1. Certain Teed Corp.
   2. Johns Manville Corp.
   3. Owens-Corning Fiberglas Corp.
   4. Knauf Fiber Glass
   5. or equivalent

B. Pre-molded fiberglass insulation pipe fittings:
   1. Molded Acoustical Products.
   2. Starr Davis.
   3. ICA-Hamfab, Inc.
   4. or equivalent

C. Calcium silicate insulation:
   1. Johns Manville Corp.
   2. Calsilite Manufacturing Corp.
   3. Pabco Inc.
   4. or equivalent

D. Finishes, adhesives and sealants:
   1. Foster Products Div. of H.B. Fuller Co.
   2. Hardcast, Inc.
   3. Childers Products Co.
   5. or equivalent

E. Weatherproof aluminum jacket:
   1. Pabco, Inc.
   2. General Aluminum Supply Co.
   3. Childers Products Co.
   4. or equivalent

F. Insulating and finishing cement:
   1. Keene Corp.
   2. Insulation Industries, Inc.
   3. Ryder Industries, Inc.
   4. or equivalent
G. Insulating tapes:
   1. Compac Corp.
   2. Nashua Corp.
   3. Fasson.
   4. or equivalent

2.2 PIPE INSULATION MATERIALS

A. Type P-1: Molded fiberglass. The maximum K factor shall be 0.23 at 75ºF mean temperature with a minimum density of 3 pounds per cubic foot. Insulation shall be provided with a factory-applied all service or all purpose jacket consisting of fire retardant laminate of white kraft facing, glass scrim reinforcing and aluminum foil. Insulation shall be similar to Johns Manville Micro-Lok AP 850.

B. Type P-2: Molded calcium silicate. The maximum K factor shall be 0.44 at 300ºF mean temperature with a minimum density of 15 pounds per cubic foot. Deflection at 200 psig shall be less than 5 percent. Insulation shall be furnished without a factory applied jacket. Insulation shall be similar to Johns Manville Thermo-12 Gold.

C. Type P-3: Molded fiberglass fittings. The maximum K factor shall be 0.23 at 75ºF mean temperature with a minimum density of 4 pounds per cubic foot. The insulation shall be similar to ICA Hamfab Molded Fittings.

D. Type P-4: Fiberglass fitting inserts. The maximum K factor shall be 0.23 at 75ºF mean temperature with a minimum density of 1 pound per cubic foot. The insulation shall be similar to ICA-Hamfab 650.

E. Type P-7: Insulating cement. Cement shall have a rock-wool base, be asbestos free and be hydraulic setting. Insulation shall be similar to Insulation Industries - Smooth Cote.

2.3 FINISHES, ADHESIVES, SEALANTS AND JACKETS

A. Type F-2: Vapor barrier coating. The white vapor barrier coating shall have a 31 millimeter dry film thickness with a maximum permeance of 0.05. It shall be applied over 10 x 10 or 20 x 20 mesh white glass, polyester or nylon cloth reinforcing membranes. Coating shall be similar to Foster Tite-Fit 30-35 with UL label.

B. Type F-3: Vinyl acrylic finish. The white vinyl acrylic breather mastic shall have a 51 mil dry film thickness. It shall be applied over 10 x 10 or 20 x 20 mesh white glass, polyester or nylon cloth reinforcing membrane. Mastic shall be similar to Foster GPM Mastic 35-00 with UL label.

C. Type F-4: Aluminum jacketing. Piping up to 4 in. shall have 0.016 in. wall thickness jacketing and piping larger than 4 in. shall have 0.020 in. wall thickness jacketing and longitudinal joints with lock seams.

D. Type F-6: White finishing and insulating cement. One (1) coat shall be applied over hexagonal wire mesh. Cement shall be similar to Insulation Industries - Smooth Cote.
E. Type F-9: Flexible vapor barrier sealant and bedding compound. Compound shall be equal to Foster Foamseal 30-45.

2.4 WIRE, BANDING AND FASTENING DEVICES

A. Wire shall be a minimum 16 gauge copper clad annealed steel. The bands shall be ¾ inch nominal width with wing seals, of minimum thickness as follows:
   1. Aluminum: 0.007 inches; where exposed to weather, 0.020 inches.
   2. Galvanized steel: 0.005 inches.
   3. Stainless steel: 0.010 inches.

B. Staples shall be the outward clinching type of corrosion resistant steel. The weld pins which support and fasten the duct insulation shall be a minimum 1/8 inch diameter with speed washer or integral flange of minimum 1-3/8 inch diameter. Metal lath shall consist of galvanized steel.

C. Insulation tape: Tape shall be UL rated with all service or foil-scrim jacket to match insulation and of width as noted. Tape shall be similar to Compac Corp. UL ASJ or UL FKJ PS Tape.

PART 3 - EXECUTION

3.1 INSULATION SCHEDULE

A. Cold piping system:
   1. Chilled water pipes and Condenser water pipes
   2. Insulation schedule:

<table>
<thead>
<tr>
<th>INSULATION SCHEDULE COLD PIPING SYSTEMS</th>
<th>INDOOR (Chilled Water Pipes)</th>
<th>OUTDOOR (Chilled water &amp; Condenser water pipes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipe Type Finish</td>
<td>P-1</td>
<td>P-1</td>
</tr>
<tr>
<td>Fittings And Valves Type Finish</td>
<td>P-3 or P-4 F-2</td>
<td>P-3 F-4</td>
</tr>
<tr>
<td>Thickness IPS &gt; 1½ inches</td>
<td>1½ inches</td>
<td>2 inches</td>
</tr>
<tr>
<td>Vapor Seal</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

B. Non-insulated piping:
   1. Indoor drains, except as noted.

3.2 INSTALLATION

A. General:
   1. Apply insulation only after piping systems have passed the required pressure and leakage tests.
2. Clean piping surfaces of dust, grease and foreign matter, and dry before application of insulation.
3. Insulation shall not be installed on pipes until they have received a prime coat of paint.
4. All insulation joints shall be butted firmly together and all jackets shall be smoothly and securely installed.
5. Insulate each pipe individually.
6. Do not use multiple pieces of insulation where a full length section will fit.
7. All materials shall be installed in strict accordance with manufacturers’ recommendations.

B. Provide 2 inches minimum longitudinal jacket overlaps. For exposed work, install overlaps toward ceiling or wall. For weatherproof aluminum jackets, position overlaps on side to shed water. For underground piping, place overlaps on side of pipe, turned down. Use circumferential overlaps on weatherproof aluminum jackets.

C. Insulation passing through sleeves or other openings shall be continuous, except where firestop or firesafing materials are required. At penetration of fire or smoke barriers, wrap pipe with rock-wool or calcium silicate insulation, seal jacket seam and seal end joints to adjacent sections of insulation.

D. Unless noted otherwise, insulation for frost-proofed piping shall be the same as specified for the particular service, except that the insulation thickness shall be two (2) times the thickness indicated and oversized to fit over pipe and heating element. Outdoor piping shall be provided with Type F-4 aluminum jacket.

E. Where specified, thickness of insulation exceeds available single layer thickness, install insulation in two (2) layers with joints staggered.

F. Insulate valves, bonnets, fittings, strainers, expansion joints and piping specialties.
   1. For strainers, expansion joints, and accessories requiring servicing or inspection, insulation shall be removable and replaceable without damage, and enclosed within two-piece, No. 18 gauge aluminum covers fastened with cadmium-plated bolts and nuts or snap acting latches.
   2. Insulation shall be of the same thickness as adjacent piping insulation.
      a. In piping systems insulated with fiberglass, secure insulation with wire. For pipes under 3 inches diameter, built-up coating of Type F-6 insulating and finishing cement to match the thickness of adjoining pipe insulation may be used.
         1) Finishes, Type F-1: Apply factory pre-molded cover and seal edges with Type F-9 vapor barrier sealer and fiberglass tape as recommended by the manufacturer.
         2) Finishes, Type F-2 and F-3: Apply uniform layer of finish coating to cover the entire surface of fitting insulation and embed layer of fiberglass tape into wet coating, extending 2 inches over adjoining pipe covering. Apply finish layer of coating over the entire surface.
      b. For above ground piping systems insulated with calcium silicate, secure pre-molded sections of calcium silicate fittings or mitered segments of pipe insulation with wires. Under 3 inches IPS, built up coating of insulating and finishing cement to match the thickness of adjoining pipe insulation may be used, with Type F-2 finish on exposed pipes. For exposed locations only, apply a skim coat of Type F-6 finishing cement to smooth out the surface of the fitting insulation and a coat of Type F-2 finish.
G. Insulate flanges. Insulation sleeve shall be of the same material as the pipe insulation, to cover the flange and overlap the insulation on the adjacent piping. For calcium silicate insulation, provide calcium silicate rings between the sleeve and the pipe insulation.

H. For outdoor locations, provide weatherproof aluminum jacket compatible with the weatherproof jacket on the adjoining pipe insulation.

I. Wiring, banding, and fastening devices: Secure insulation to the piping in accordance with manufacturers’ recommendations.

J. At pipe hangers for fiberglass insulated piping, provide an 18 inch long calcium silicate section continuous with the adjoining pipe insulation and jacket. Insulation protection saddles and shields shall be as specified in Section 15100 PIPING. No hangers shall be embedded in insulation. Saddles shall be filled with insulation of type specified for the service, or filled with insulating cement.

K. Jackets and facings: All staples shall be sealed with Type F-9 vapor barrier sealant. Prior to sealing jackets on services below 35°F, apply 1/16 inch minimum thickness F-9 vapor barrier coating to ends of pipe insulation at butt joints, overlapping inside surface of insulation a minimum of 2 inches. Adhere longitudinal laps if self-sealing laps are not used and as necessary to maintain integrity of the vaporseal. Adhere 3 inch wide joint strip, of same material as facing, at center of each butt joint, if self-sealing butt strips are not used.
   1. Adhesives: Indoor shall be Type F-9. Weatherproof aluminum jacket shall be Type F-4.

L. Apply adhesives and coatings in accordance with the manufacturer’s recommendations.

END OF SECTION
SECTION 15100 - PIPING

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Pipe and pipe fittings for:
   1. Chilled water piping system.
   2. Condenser water piping system
   3. Equipment drains and overflows.

B. Pipe hangers and supports.

1.2 CODES AND STANDARDS

A. Design and performance of components and methods specified herein shall comply with all applicable Federal, State and Local laws, ordinances, regulations and codes, and the latest industry standards from the following organizations including, but not limited to the ones listed below.

1. American Society of Mechanical Engineers ASME
2. American National Standards Institute ANSI
3. American Society for Testing and Materials ASTM
4. American Welding Society AWS
5. Occupational Safety and Health Administration OSHA
6. American Society for Nondestructive Testing ASNT
7. Steel Structures Painting Council SSPC
8. National Fire Protection Association NFPA
9. American Institute of Steel Construction AISC
10. Manufacturers Standardization Society MSS
11. Scientific Apparatus Makers’ Association SAMA
12. Underwriters Laboratories Inc. UL

B. Including, but not limited to the following:
   1. American National Standards Institute

   B16.1 Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800
   B16.4 Cast Iron Threaded Fittings Classes 125 and 250
   B16.3 Malleable Iron Threaded Fittings
   B16.5 Pipe Flanges and Flanged Fittings
   B16.9 Factory-Made Wrought Steel Butt welding Fittings
   B16.11 Forged Steel Fittings, Socket-Welding and Threaded
B16.18  Cast Copper Alloy Solder Joint Pressure Fittings
B16.22  Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
B16.34  Valves – Flanged and Buttwelded
B16.39  Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300
B31    Code for Pressure Piping
B31.1  Power Piping
Z49.1  Safety in Welding and Cutting

2. American Society for Testing and Materials

A 53    Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded Seamless
A 105/105M Standard Specification for Forgings, Carbon Steel for Piping Components
A 106    Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
A 193/A 193M Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
A 194/A 194M Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
A 276    Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes
A 307    Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
B 61 Standard Specification for Steam or Valve Bronze

B 62 Standard Specification for Composition Bronze or Ounce Metal Castings

B 88 Standard Specification for Seamless Copper Water Tube


1.3 QUALITY ASSURANCE

A. Qualification for Welders: Welders performing work under this Contract shall be certified and qualified in accordance with tests prescribed by the National Certified Welding Bureau (NCWB) or by other approved test procedures using methodology and procedures covered in the ASME Boiler and Pressure Vessel Code, Section IX, “Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.”

1. Submit for approval the names, identification, and welder’s assigned number, letter or symbol of welders assigned to this project.

2. The assigned identification symbol shall be used to identify the work of each welder and shall be indelibly stamped immediately upon completion of each weld.

3. Welders shall be tested and certified for all positions.

4. Submit identifying stenciled test coupons made by each operator.

5. Any or all welders may be required to retake welding certification tests without additional expense.

6. When so requested, a welder shall not be permitted to work as a welder on this project until he has been recertified in accordance with NCWB.

7. Recertification of the welder shall be made after the welder has taken and passed the required tests.

8. Where piping 1½ in. and smaller is butt or socket welded, submit three samples of test welds for approval.

B. Qualifications of Radiographic Examiner: Personnel conducting radiographic examinations shall conform to the qualification requirements of the American Society for Nondestructive Testing, Inc. (ASNT) Publication SNT-TC-1A, “Recommended Practice for Personnel Qualifications and Certification.”

1.4 SUBMITTALS

A. Product Data:

1. Piping: Submit manufacturer’s standard technical product data indicating conformance to the stipulated reference specifications, construction materials, construction details, and test and operating pressures. Submit manufacturer’s product data on the following:

   a. Pipe materials.
b. Unions and flanges.
c. Welding fittings.
d. Sleeves and packings.
e. Gaskets.
f. Nuts and bolts.

2. Supports and Anchors: Manufacturer’s catalog data including dimensions and installation instructions for all products proposed. Provide load ratings for all hangers, supports and attachments.

B. Shop Drawings:
   1. Piping: Provide piping layout drawings, drawn to a scale of not less than \( \frac{1}{4} \) in. to 1 ft. (use single line below 2 in. and double line 2 in. and above) showing the proposed layout of piping systems including valves, fittings, equipment, pumps, hangers, grading, high points, low points, drain points, anchors, and expansion devices. Provide shop drawings for the following locations:
      a. Chiller plant.
      b. Mechanical equipment rooms.
      c. Path of interconnection piping
   2. Supports and Anchors: Scale drawings of all specially fabricated supports and supports for all loads exceeding 1000 lbs. Detail all supports from metal decks or concrete floors. Indicate location of hangers, supports, guides and anchors, expansion joints and sleeves.

C. Minimum \( \frac{3}{8} \)-in. scale, double line layout and sections where required for coordination drawings.

D. Submit calculations for supports and anchors upon request.

E. Submit selection calculations upon request.

F. Submit schedule of pipe type and rating for each system.

G. Submit schedule listing type make and model number, size and service for valves, motorized valve operators, flanges, fittings and equipment.

1.5 WARRANTY
   A. Refer to Section 15010 General Provisions-Mechanical.

1.6 REGULATORY REQUIREMENTS
   A. Provide an adequate pipe suspension system in accordance with recognized engineers’ practices, using standard commercially acceptable pipe hangers and accessories.
   
   B. Where applicable codes require supports in excess of specifics herein, the Code shall govern.

1.7 DELIVERY, STORAGE AND PROTECTION:
   A. Piping: Store piping on the project site so as to preclude the entrance of construction dirt and debris into the open ends of piping. Do not install piping fouled with construction dirt.
B. Fittings: Store fittings under cover, protected from construction dirt and rain.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Steel pipe:
   1. USX-US Steel Group.
   2. Bethlehem Steel Corp.
   3. LTV Steel Tubular Products.
   4. Laclede Steel Co.
   5. or equivalent

B. Welding fittings:
   1. Babcock and Wilcox.
   2. Bonney Forge Foundry, Inc.
   3. Ladish Co.
   4. Taylor Co.
   6. or equivalent

C. Flange gaskets:
   1. Crane.
   2. Garlock, Inc.
   4. Manville Corp.
   5. Raybestos Manhattan, Inc.
   6. or equivalent

D. Unions:
   1. Dart.
   2. Bonney Forge Foundry, Inc.
   4. or equivalent

E. Sleeves and packings:
   1. Galvanized sheet steel:
      a. Adjust-o-Crete.
      b. A. M. I. Products.
      c. Or equivalent
   2. Packings:
      a. Thunderline Corp.
      b. Dow Chemical.
      c. Minnesota Mining and Manufacturing Co.
      d. Or equivalent

F. Hangers, Inserts and Supports:
   1. Fee and Mason.
   2. ITT Grinnell Corporation.
G. Pipe Protection and Thermal Hanger Shields:
   1. Pipe Shields, Inc.
   2. Elcen Metal Products Company.
   3. Midland-Ross Corp.: Superstrut.
   4. Uni-Grip.
   5. Kin Line.
   6. or equivalent

H. Expansion Shields:
   1. ITT Phillips Drill Co.: Red Head.
   3. Omark Industries, Inc.
   5. or equivalent

2.2 PIPING

A. Steel pipe shall be black and hot dipped galvanized of weight and wall thickness as noted, in accordance with ASTM specifications as follows:
   1. A 53 Grades A and B: Type E electric resistance welded.

B. Copper tubing:
   1. ASTM B 88, Type L: hard drawn, except as noted.

C. Red brass: ASTM B 43, seamless, annealed, 85% copper IPS.

2.3 FLANGES AND PIPE FITTINGS

A. Steel flanges and pipe fittings shall be in accordance with ASTM A 105 and A 216.

2.4 SERVICES

A. The following pipe applies to systems specified except as noted:
   1. Low-Temperature Water System, not in excess of 100 psig, 40°F to 220°F supply temperature (chilled water and condenser water systems):
      a. Material shall be steel in accordance with ASTM A 53 with wall thickness to 10 in.: Schedule 40; and 12 in. and larger: .375-in. wall thickness.
   2. Instrument piping:
      a. As specified for system piping to which connected.
   3. Atmospheric air vents shall be galvanized steel in accordance with ASTM A 53, Schedule 40.
   4. Refrigerant Relief System (Centrifugal Refrigeration Units) shall be steel, Schedule 40 in accordance with ASTM A 53.
   5. Miscellaneous Drains and Overflow:
      a. To 2 in.: Copper, Type L in accordance with ASTM B 88.
      b. 2½ in. and larger: Galvanized steel, Schedule 40 in accordance with ASTM A 53.
      c. All other piping shall be galvanized steel, Schedule 40 in accordance with ASTM A 53, Grades A or B.
6. Control Air System shall be copper Type L in accordance with ASTM B 88.

2.5 FITTINGS

A. For steel pipe:
   1. To 2 in.:
      a. Steel fittings shall be socket weld ends in accordance with ANSI B 16.11.
   2. For 2½ in. and larger welded:
      a. Butt weld fittings same weight as piping and in accordance with ANSI B 16.9.
      b. Branch connections:
         1) Equal to main and to two pipe sizes smaller, use weld tees.
         2) Three or more pipe sizes smaller than main, but 2½ in. and larger, use Bonney Weld-o-lets.
         3) To 2 in.: Bonney Weld-o-lets, Thread-o-lets, threaded Nip-o-lets, or steel couplings.

B. For copper tubing:
   1. Solder joint shall be wrought copper in accordance with ANSI B16.22 or Bronze castings in accordance with ANSI B16.23.
      a. Solder shall be 95-5 in accordance with ASTM B 32.
      b. For refrigerant piping and where noted, solder shall be silver brazing alloy, similar to Handy and Harman Easy-Flow.
   2. Compression and flared fittings shall be cast brass in accordance with ANSI B16.26.

C. Flanges:
   1. For steel, pipe flanges shall be of matching quality, grade and thickness.
      a. Welded: Welding neck, slip-on, socket welded in accordance with ANSI B16.5, slip-on flanges shall be back welded.
         1) 150-lb. wsp.
   2. Match connecting flange:
      a. Class.
      b. Facing.

D. Flange gaskets shall be one-piece ring type 1/16-in. thick (minimum), except as noted, suitable for temperature, pressure (operating and test) and service of system.
   1. Non-asbestos elastomer for 250°F and under.
   2. Non-asbestos spiral wound 304 stainless steel for above 250°F, similar to Flexitallic.
   3. For joints of dissimilar metals, provide isolating gaskets, sleeves and washers between flanges, bolts and nuts. Gaskets shall be similar to Dupont Teflon.

E. Unions:
   1. For steel pipe:
      a. Malleable iron 300-lb. wsp.
         1) Ground jacket seat: brass-to-iron, black or galvanized to match piping.
      b. A.A.R. malleable iron 300-lb. wsp.
   2. Dielectric Unions:
      a. 2 inches and smaller:
         1) 175 psi WSP.
         2) High temperature gaskets, rated for 375°F.
         3) Similar to EPCO.
      b. 2½ inches and larger:
1) Brass half-union, ANSI, 175 psi WSP, rated for 375°F.
2) To welding flange as hereinbefore specified.
3) Similar to EPCO.

3. Insulating Couplings:
   a. 2 inches and smaller:
      1) Similar to: Walter Vallett Company, V line.
   b. 2½ inches and larger:
      1) Brass half-union, ANSI, 175 psi WSP, rated for 375°F.
      2) To welding flange as hereinbefore specified.
      3) Similar to EPCO.

4. For red brass pipe:
   a. All bronze, 150-lb. wsp, ground joint seat.

2.6 BOLTS AND NUTS

A. Bolts shall be chrome-molybdenum bolt stud in accordance with ASTM A 193 Grade B7 with full length threads in accordance with ANSI B1.1. Threaded length shall be sufficient to project beyond nuts one complete thread when joint is made.

B. Nuts shall be carbon steel in accordance with ASTM A 194, Grade 2. Nuts shall be hexagon heavy series type. Threads shall be the same as for bolts.

2.7 ESCUTCHEONS, FLASHINGS AND SLEEVES

A. Escutcheons:
   1. Provide stamped sheet metal with satin finish chromium plating over copper and deep type to cover projecting sleeves.
   2. For flush fit, use set screws on bare pipe and internal spring on covered pipe.
   3. Grinnell as specified, or Beaton-Corbin or equal:
      a. Fig. 2 for copper tubing.
      b. Fig. 13 for steel pipe.
      c. Polished chrome-plated brass.
   4. Manufacture special escutcheon sizes, when so required, from galvanized steel.

B. Sleeves:
   1. Provide cast iron or steel with or without welded center flange as noted.
   2. Provide No. 20 USSG galvanized iron.
   3. Provide cast iron flashing, Type S with integral center flashing flange, and clamping ring.
   4. Extended sleeves shall be similar to Josam No. 1880.
      a. Flush sleeves shall be similar to Josam No. 1870.
      b. Provide galvanized cast iron flashing type for Dex-O-Tex type waterproofing with integral bottom, flanged, similar to Smith DX-935.
   5. Sleeves of following types as required:
      a. Schedule 40, galvanized steel pipe sleeves.
      b. Adjustable, telescopic metal sleeves:
         1) Adjust-o-Crete or equal.
      c. For insulated piping, sleeve diameter shall not be less than diameter of insulation.

C. Packings:
   1. Through fire-rated floors and partitions (one of the following):
2.8 PIPE HANGERS AND SUPPORTS

A. Model numbers are Superstrut, unless otherwise indicated.

B. Individual Pipe Hangers:
   1. Pipe sizes ½ to 1½ in: carbon steel, adjustable swivel, split ring.
   2. All hangers for pipes 2 inches and larger to be provided with means of vertical adjustment.
   3. Cold pipe all sizes: Clevis hanger, No. C710.

C. Multiple or Trapeze Hangers:
   1. Factory channel:
      a. 12 gauge thick steel.
      b. Single or double section.
      c. Electro-chromate finish.
      d. Strutnuts: Series A-100 or CM-100.
      e. Straps: Series 702.
      f. Other accessories.
      g. No. A-1200 or A-1202.

D. Wall Supports:
   1. Pipe sizes up to 3 inches: Steel bracket No. C738.
   2. Pipe sizes 4 inches and larger: Welded steel bracket C-735.

E. Copper Pipe Support
   1. Carbon steel ring, adjustable, copper plated.

F. Thermal Hanger Shields.
   1. Insulated pipe supports:
      a. Insulated pipe supports shall be supplied and installed by the contractor on all insulated pipe and tubing.
      b. All insulated pipe supports shall be load rated. Load ratings shall be established by pipe support manufacturer based upon testing and analysis in conformance with the latest edition of the following codes: ASME B 31.1, MSS SP-58, MSS SP-69, and MSS SP-89.
   2. Approved insulated pipe support:
      a. Pipe supported on rod hangers:
         1) Equal to pipe shield A1000, A2000, A3000, A4000, and A9000.
      b. Pipe supported on pipe rolls:
         1) Equal to pipe shield A3000, A4000, A5000, A6000, and A8000 to 8400 Series.
   3. Insert to extend one inch beyond metal shield ends on following piping:
      a. Chilled water.
      b. Condenser water.
   4. Shield lengths and gauges per manufacturer's published catalog recommendations.
   5. Similar to Pipe Shields Incorporated.

G. Pipe Isolators:
1. Galvanized steel shell with felt padding.
2. Similar to:

2.9 STRUCTURAL ATTACHMENTS

A. Model Numbers are Superstrut, unless otherwise indicated.

B. Anchor Bolts: Size as specified for hanger rods.

C. Concrete Inserts:
   1. Malleable iron case of [galvanized] steel shell
   2. Expander plug for threaded connection with lateral adjustment
   3. Top slot for reinforcing rods
   4. Lugs for attaching to forms
   5. Size inserts to suit threaded hanger rods.
   6. Place reinforcing steel through insert as recommended by manufacturer for recommended loads.
   7. Equal to No. 452.

D. Beam Clamps:
   1. All with U-568 safety strap or equal.
   2. All with locknuts on:
      a. Set Screw.
      b. Hanger rod.
   3. Bottom flange attachment:
      a. Loading 150 lb. and less: U-563 or equal.
      b. Loading 150 lb. to 300 lb.: U-562 or equal.
      c. Loading more than 300 lb.: U-560 or U-52, 521, or 522, depending on loading, or equal.
   4. Top flange attachment:
      a. Permitted only when bottom flange attachment cannot be used.
      b. Loading 400 lb. and less: M-777 or equal.
      c. Loading more than 400 lb.: M-778 or equal.

E. Welded Beam Attachments:
   1. No. C-780 or equal.

F. Side Beam Brackets:
   1. No. 542. or equal.

G. Hanger Rods:
   2. ANSI B1.1 threads.
   3. Threaded both ends, threaded one end or continuous threaded.

H. Hanger Rod Fixtures:
   1. Turnbuckles:
      a. No. F-112 or equal.
   2. Linked Eye Rod:
a. Rod swivel.
b. No. E-131 or equal.

3. Clevis:
   a. No. F-111 or equal.

I. Expansion Shields:
   2. Stainless steel for corrosive atmospheres.
   3. For normal concrete use:
      a. Self-drilling anchor.
      b. Sleeve anchor.
      c. Stud anchor.
   4. For thin concrete use:
      a. Wedge anchor.
   5. For brick or concrete block use:
      a. Sleeve anchor.
   6. Maximum load safety factors:
      a. Static loads - 4.
      b. Vibratory loads - 8 - 10.
      c. Shock loads - 8 - 10.
   7. Size to suit hanger rods.
   8. ITT Phillips "Red Head" or equal.

J. Steel Deck Inserts:
   1. Factory stud with:
      a. Clip.
      b. Spring.
      c. Coupling.
   2. ITT Phillips "Red-Head" or equal.

K. Miscellaneous Metal:
   1. Steel plate, shapes and bars: ASTM A36.
   3. Bolts and nuts: regular hexagon-head type, ASTM A307, Grade A.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Piping: Install piping approximately as indicated and modify to suit building conditions, to avoid interference with other trades and to maintain access and clearance and to maintain pitch.
   1. Where modifications are required, provide offsets, drains, vents, valves and required pipe and fittings.
   2. Connect equipment in accordance with each manufacturer’s standard details and recommendations, as approved, except as noted, with accessory piping, vents, drains, reliefs and by-passes.
   3. Arrangement:
a. Install piping parallel with or at right angle to walls and other piping, neatly spaced and with plumb risers. Arrange in horizontal groups, each in one plane and maintaining the required slope, insofar as possible.
b. Maintain minimum 1-in. clearance from adjacent work, including insulation, except as noted or approved.
c. Maintain maximum headroom and ceiling height, offset as necessary and coordinate with work of other trades.
d. Do not sleeve structural members without consent of Architect.
e. Install piping concealed above ceilings or in walls unless otherwise indicated.
f. Install no piping in elevator machine rooms, electric rooms and closets and telephone rooms and closets.
g. Copper:
   1) Crimping of copper tubing prohibited.
   2) Isolate copper pipe and tubing from contact with steel.
4. Sloping, Draining, and Air Venting, except as noted:
a. Slope piping as indicated, true to line and grade, and free of traps and air pockets.
   1) Water piping:
      a) Up to 1-in. pipe: 1-in. in 40 ft.
      b) 1¼-in. and larger: 1-in. in 100 ft.
b. Drain connection at low points in water piping and where noted:
   1) In equipment rooms:
      a) Up to 3-in. pipe: ¾-in. gate valve.
      b) 4 in. to 8 in.: 1½-in. gate valve.
      c) 10 in. and larger: 2½-in. gate valve.
   2) Except in equipment rooms: ½-in. drain valve with capped hose connection.
c. Install Manual Air Vents at high points and where water flow direction changes from horizontal to downward.
   1) To 3-in. pipe: Line size air chamber, 12 in. long; ½-in. globe valve.
   2) 4 in. to 8 in.: Line size air chamber, 6 in. long, ½-in. globe valve.
   3) 10 in. and larger: Line size pipe cap, ½-in. globe valve.
d. Provide Automatic Air Vents where indicated.
5. System Description:
   a. Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, unions, and couplings for servicing are consistently provided.
b. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.
c. Use non-conducting dielectric connections whenever jointing dissimilar metals in open systems.
6. Provide reducing fittings for changes in pipe sizes. Bushings will not be permitted.
7. Provide extra heavy pipe for nipples where unthreaded portions of pipe are less than 1½-in. long. Close nipples not permitted.
8. Provide screwed piping with clean threads, cut to exact length and ream after cutting and threading. Apply acceptable compound or teflon tape thread sealant on male threads only. No lamp wick in joints.
9. Close open ends of pipes during construction to prevent entry of debris.

B. Welding:
1. Before proceeding, as required by Owner, submit the following for review and approval:
   a. Proposed procedures conforming to latest revision of:
      1) ANSI B31.1, Code for Pressure Piping, Chapter V.
      2) ANSI Z49.1, Safety in Welding and Cutting.
      3) API code for fuel and other API governed piping.
2. Conform to the welding and welder qualification requirements of the “Quality Assurance” article of this Section.
4. Perform welding in ambient temperature above 0°F.
5. Ream and clean ends of piping free from rust, scale and oxide.
6. Bevel pipe on each end per acceptable procedures.
7. Provide backing rings on hot water over 100 psig.
8. Support piping, align and tack weld making allowance for pipe pitch and insulation. Temporary block piping at hangers.
9. Use welding pipe clamps on piping 4-inch diameter and larger, and verify alignment before welding.
10. Utilize mitered pipe and field fabricated fittings only where noted and where specially permitted.
11. Hammer clean and flush out piping after welding to remove scale, welding slag and other debris.
12. Weld Testing:
    a. Provide radiographic testing on welds per “Section 3.3 Testing”.

C. Pipe Jointing
1. Fittings:
   a. Provide standard, manufacturing fittings in all cases.
   b. Prohibited fittings:
      1) Field fabricated
      2) Bushings on pressure piping
      3) Clamp-on branch connections.
   c. Provide insulating couplings or dielectric unions at all connections of ferrous piping to non-ferrous piping.
   d. Branch connections, steel piping:
      1) Equal to main and to two pipe sizes smaller: weld tees, same weight as piping.
      2) Three or more pipe sizes smaller than main, but 2½ inches and larger: Bonney Weld-o-lets.
      3) To 2 inches and smaller: Bonney Weld-o-lets, Thread-o-lets, threaded Nip-o-lets, or steel couplings.
2. Unions: Provide unions or flanges to render all items in systems easily removable, including:
   a. Valves
   b. Piping specialties
   c. Both sides of pumps and equipment.
3. Pipe Ends:
   a. Perform pipe cutting and end preparation to result in clean ends with full inside diameter.
   b. Grind and ream as necessary.
4. Nipples:
   a. Close nipples not permitted.
b. Provide extra heavy pipe for nipples where unthreaded portion is less than 1½ inch long.

5. Threaded Joints:
   a. Sealed with sealant compounds or teflon tape.
   b. Sealant compounds: John Crane JC-40 or equal Rector Seal.

6. Welded Joints:
   a. Welding of pressure piping shall be done by welders who have been qualified by recognized agency within 6 months prior to date of Contract:
      1) Perform welding in accordance with provisions of latest issue of all applicable codes including:
         a) ASME Boiler Construction Code.
         b) ANSI Code for Pressure Piping.
      2) Standard Procedure Specifications of, and operators qualified by National Certified Pipe Welding Bureau will be considered as compliance with requirements of Specifications.
   b. Where required, peen and wheel-grind welds.
   c. Ends of pipe may be burned for welding:
      1) Grind bevel and remove scale between welding joint.
      2) Ragged edges with metal beads, poor alignment other inferior work will be rejected.
   d. Perform welding with oxyacetylene or electric arc process.

7. Soldered and Brazed Joints:
   a. Use AWS A5.8, BCuP silver/phosphorous/copper alloy solder with melting range 1190°F to 1480°F for copper piping.
   b. Clean surfaces to be jointed, of oil, grease, rust and oxides:
      1) Remove grease from fittings by washing in solution of sodium carbonate and hot water.
      2) Clean socket of fitting and end of pipe thoroughly with emery cloth to remove rust and oxides.

D. Hangers, supports and guides:

1. General:
   a. Assure adequate support for pipe and contents.
   b. Prevent vibration or swaying.
   c. Provide for expansion and contraction.
   d. Supports of wire, rope, wood, chain, strap perforated bar or any other makeshift device not permitted.
   e. Comply with applicable requirements at ANSI B31.1.0 and B31.2 for piping.
   f. Support piping independently so that equipment is not stressed by piping weight of expansion.
   g. Hangers and supports shall have minimum safety factor of five (5), based on ultimate tensile or compressive strength, as applicable, of material used.
   h. Provide copper plated hangers and supports for copper piping.
   i. Prime coat exposed steel hangers and supports:
      1) Hangers and supports located in crawl spaces, pipes shafts and suspended ceiling spaces are not considered exposed.
   j. Where pipe support members are welded to structural building frame, brush clean, and apply one coat of zinc rich primer to welding.

2. Horizontal piping, except as noted:
   a. Adjustable clevis type and rod:
      1) All services at or below 250°F.
b. Trapeze hangers:
   1) Not permitted for:
      a) Steam and condensate piping.
      b) Fire and sprinkler piping.
      c) Chemical waste drain piping.
      d) Piping with different expansion requirements not permitted on common trapeze.
   2) Guide individual pipes on trapezes with 1/4 inch U-bolt or Superstrut 702 pipe clamp.
      a) Install thermal hanger shield at each support point.

c. Threaded steel rods:
   1) 2 inch vertical adjustment with 2 nuts each end for positioning and locking.
   2) Size to 12 inches IPS:

<table>
<thead>
<tr>
<th>Pipe, IPS</th>
<th>Rod</th>
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<tbody>
<tr>
<td>to 2 in.</td>
<td>3/8 in.</td>
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<tr>
<td>2-1/2 to 3 in.</td>
<td>1/2 in.</td>
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<tr>
<td>4 in.</td>
<td>5/8 in.</td>
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<tr>
<td>6 and 8 in.</td>
<td>3/4 in.</td>
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<tr>
<td>10 and 12 in.</td>
<td>7/8 in.</td>
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   3) Size above 12 inches IPS and multiple pipe standards: safety factor of 5 on ultimate strength on area.
   4) For double rod hangers: 1 size smaller than above.

3. Horizontal insulated piping:
   a. Install thermal hanger shields for all types of supports.
   b. See Section 15080: PIPING INSULATION for insulation connection to shields.

4. Install Pipe isolators between hangers and:
   a. Insulated copper tubing.
   b. Wherever any pipe requires sound and vibration isolation.

5. Miscellaneous Steel:
   a. Provide miscellaneous steel members, beams, brackets, etc., for support of work in this division unless specifically included in other divisions.

E. Pipe Support Spacing
1. Maximum spacing for horizontal piping:

<table>
<thead>
<tr>
<th>Type of Pipe</th>
<th>Size</th>
<th>Maximum Spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel</td>
<td>1 in. to 1-1/4 in.</td>
<td>7 ft.</td>
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<tr>
<td></td>
<td>1-1/2 in.</td>
<td>9 ft.</td>
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<td></td>
<td>2 in.</td>
<td>10 ft.</td>
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<td></td>
<td>2-1/2 in.</td>
<td>11 ft.</td>
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<td></td>
<td>4 in.</td>
<td>14 ft.</td>
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<td>5 in.</td>
<td>16 ft.</td>
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<td>6 in.</td>
<td>17 ft.</td>
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<td>8 in.</td>
<td>19 ft.</td>
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<td></td>
<td>10 in.</td>
<td>22 ft.</td>
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<td></td>
<td>12 in.</td>
<td>23 ft.</td>
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<tr>
<td></td>
<td>14 in.</td>
<td>25 ft.</td>
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<tr>
<td></td>
<td>16 in.</td>
<td>27 ft.</td>
</tr>
</tbody>
</table>
2. Spacing Notes:
   a. Additional supports at:
      1) Changes in direction.
      2) Branch piping and runouts over 5 feet.
      3) Concentrated loads due to valves, strainers and other similar items.
      4) At valves 4 inches and larger in horizontal piping.
         a) Support piping on each side of valve.

3. Parallel piping on trapezes:
   a. Maximum spacing to be that of pipe requiring closest spacing.

4. Support standpipes and fire sprinkler piping in accordance with NFPA.

F. Attachment to Structure
1. Concrete:
   a. Use inserts for suspending hangers from reinforced concrete slabs, walls and sides
      of reinforced concrete beams wherever practicable.
   b. Set inserts in position in advance of concrete work.
   c. Provide reinforcement rod in concrete for inserts carrying:
      1) Pipe over 4 in.
   d. Where rod size exceeds 7/8 in. diameter, or where load exceeds insert rating, use
      the inserts with a trapeze type member connecting member below concrete.
   e. Where concrete slabs form finished ceiling, finish inserts flush with slab surface.
   f. Where inserts are omitted install hangers with expansion shields.
   g. Where permitted by structural engineer and regulating agencies expansion shields
      may be used in lieu of inserts:
      1) In bottom of thick slabs.
   h. Pre-Cast Concrete:
      1) Use pre-set inserts.
      2) Where inserts are not available, field drill through beam or joists at locations as
         directed by Architect.
      3) Through bolt side beam bracket to beam or joist.

2. Steel Beam Anchors:
   a. Approved beam or channel clamps.
   b. Do not cut or weld to structural steel without permission of structural engineer.
   c. Other methods as detailed on drawings.

3. Steel Deck Anchors:
   a. Concrete filled: as specified above.
   b. Decking without concrete:
      1) Through rod Support:
         a) Weld to square plate, 1/4 inch thick.
         b) Plate to distribute load over minimum of two full cells.
         c) Coordinate with floor layouts to clear cells with wiring.
4. Support Spreaders:
   a. Install spreaders spanning between structural members when hangers fall between
      them, and hanger load is too great for slab or deck attachment.
   b. Spreaders may be one of methods listed below, or combination of both as required:
      1) Fabricated from structural channel:
         a) End fittings bolted or welded.
         b) Secure to structural members:
            (1) As required by construction.
            (2) As approved by Structural Engineer.
      2) Formed channels with fittings, similar to Superstrut.
      3) Submit manufacturer's calculations for installation.

G. Connections to apparatus:
1. Final connections to apparatus, equipment, automatic control valves: Provide unions or
   flanges between shutoff valve and connection:
   a. Screwed piping to 2 in.: Unions.
   b. Other piping: Flanges.
2. Provide flanged connections to heads of heat exchangers, converters, chillers,
   condensers and locate flanges adjacent to equipment connections and to clear tube pull
   to avoid dismantling of extensive piping for pulling out tube bundle.

H. Escutcheons: Provide at surfaces where exposed piping penetrates walls, ceilings, floors or
   partitions and at fire barrier caulking.
1. "Exposed" means all finished rooms, including storage, janitor and mechanical rooms.
2. Where piping is insulated, escutcheons shall fit insulation outside diameter. For bare
   pipe, provide sleeve minimum ½ inch larger than pipe and pass fittings, as required.

I. Sleeves: Provide for piping through walls, floors and partitions.
1. Type:
   a. Provide galvanized steel pipe:
      1) Integral waterproofed walls and floors:
         a) Welded center flange, buried.
         b) Extending 2 in. above finished floor.
         c) ½-in. projection beyond walls.
         d) Caulked watertight.
      2) Concrete floors and masonry walls:
         a) 2 in. above finished floor.
         b) Flush with ceiling.
         c) ½-in. projection beyond walls.
2. Size: For bare pipe, provide sleeve a minimum ½ in. larger than pipe and pass fittings
   as required. For insulated pipe, except as noted, provide flashing sleeve the same as for
   bare pipe and provide pipe or sheet metal sleeve ½ in. larger than covering.
3. Caulking: Seal openings between sleeves and pipe or pipe insulation. Provide depth of
   caulking the full length of sleeve.
   a. Material for fire barrier: Provide mineral wool or equivalent nonasbestos,
      noncombustible material.
4. Packing through fire rated partitions:
   a. 3M Penetration Sealing Systems (PSS 7909) and 3M Fire Barrier Caulk and Putty.
   b. Dow-Corning LTV Silicone foam.
5. Separate piping through walls, other than concrete walls, from contact with wall
   construction materials.
a. Use non-hardening caulking.
6. Install insulation on piping in walls which require insulation at time of installation.

END OF SECTION
SECTION 15110 - VALVES

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Valves:
   1. High Performance Butterfly valves (Trunnion).
   2. Motorized valve operators.

1.2 QUALITY ASSURANCE

A. Refer to Section 15010: General Provisions-Mechanical.

B. Codes and Standards: Provide valves conforming to the requirements of the following:
   1. Published Specifications’ standards, tests or recommended methods of trade, industry
      or governmental organizations apply to work in this Section.
   2. Comply with all applicable national, state, and local codes and refer to Section 15010:
      General Provisions-Mechanical for additional Reference Standards.
   3. In addition, comply with all standards or associations as specified herein, including, but
      not limited to, the following, as applicable:
      a. American Society for Mechanical Engineers (ASME).
      d. Manufacturers Standardization Society of the Valve and Fitting Industry (MSS).

1.3 SUBMITTALS

A. Submit product data, drawings, test reports, and samples for the following items per the
   provisions of Division 1 and this Division’s General Provisions.
   1. Product Data: Submit manufacturer’s standard technical product data indicating
      conformance to the stipulated reference specifications, construction materials,
      construction details, and test and operating pressures. Submit manufacturer’s product
      data on the following:
      a. Submit schedule listing type, make, and model number, size, and service for valves
         and motorized valve operators.

1.4 GUARANTEES

A. Refer to Section 15010: General Provisions-Mechanical.

1.5 STORAGE AND PROTECTION

A. Storage: Store valves on the project site so as to preclude the entrance of construction dirt
   and debris into the open ends of valves. Do not install valves fouled with construction dirt.

B. Storage of valves: Store valves under cover protected from construction dirt and rain.

C. Provide temporary protective coating on cast iron and steel valves.
1.6 OPERATION AND MAINTENANCE DATA

A. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.7 PROJECT RECORD DOCUMENTS

A. Record actual locations of valves on piping as-built drawings.

B. Provide individually numbered valve tag on all valves; show all valve numbers on as-built plans. See Section 15010: General Provisions-Mechanical.

1.8 EXTRA MATERIALS

A. Provide two repacking kits for each size and valve type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. High performance butterfly (trunnion) valves:
   1. Jamesbury Corp.
   2. Hills-McCanna Co.
   3. Posi-seal international.
   4. DeZurik Corp.
   5. Fisher
   6. or equivalent

B. Motorized valve operators:
   1. E.I.M. Co.
   2. Limitorque Corp.
   3. Rotork Controls Inc.
   4. Fisher Controls.
   5. Auma Actuators, Inc.
   6. Bray
   7. or equivalent

2.2 VALVES, GENERAL

A. Provide valves of same manufacturer for all Mechanical Sections per products in this Section.

B. For copper tubing provide solder-joint valves, flare fittings, or IPS-to-copper adaptor, sized for use with tubing and respective valve.

C. For flanged valves, provide streamline companion flanges, ANSI B16.5, 150 class psi.

D. Provide valve materials suitable for service and temperature of respective systems, especially with respect to discs, plugs, balls, linings, gaskets, and lubricants, etc.

E. Provide chain-operated hand wheels, rustproof chain and chain guide for following valves:
   1. Valves 7 ft. or more above operating floor or platform.
2. Where in-accessible due to other piping, etc.

F. Where applicable, all valves shall meet current Federal Specifications and/or Manufacturers Standardization Society.

2.3 HIGH PERFORMANCE BUTTERFLY VALVES (TRUNNION)

A. High performance butterfly valves (Trunnion):
   1. Provide flange or lug type for connection to ANSI class 150 flanges.
   2. Body shall be cast steel with neck extended to suit insulation thickness
   3. Disc shall be cast steel.
   4. Stem shall be 17-4 ph stainless steel
   5. Wear ring (seat) shall be:
      a. Teflon or urethane with Buna N or Viton backup O ring for ANSI class 150 service
      b. 316 stainless steel wear ring with EPR O ring
   6. Provide non asbestos packing material
   7. Operators:
      a. Valves to 8 inch: Handles with minimum of 10 locking positions and adjustable memory stop
      b. 8 inch and larger: Gear operators with adjustable balance return stops and position indicators
      c. Motor operated valves where noted
   8. Factory leakage test shall be bubble tight to ANSI or WOG pressure rating at corresponding service temperature
   9. Valves similar to following classes, ratings, sizes and Posi Seal International, Inc. figure numbers
      a. WOG class: 200 lb
         1) ANSI rating: 150
         2) Sizes: 2 inch to 24 inch
         3) Figure number: 1144

2.4 MOTORIZED VALVE OPERATORS

A. Mount operators on side or top at factory or at site under manufacturer’s supervision. Provide gear operated single or double reduction. For 90 degree application, adjustable mechanical stops shall prevent travel of more than 90°.

B. Grease or oil lubricated.

C. 208 volt, single phase, 60 hertz.

D. Control circuit: 24 volt or to match existing, transformer as required.

E. Actuators shall be submitted with a chart of published valve torque requirement and published actuator torque outputs. Sizing safety factors must exceed 25%. Actuator shall be rated NEMA 4, 4X, IP65, UL approved. Actuators shall be 208 VAC with a maximum locked rotor current rating of 3 amperes. All motors shall have thermal overload protection and be rated continuous duty. Actuator gear trains shall be of the self-locking non-reversing type. Electrical mechanical solenoid brakes shall not be permitted as the stopping/locking device. All actuators shall have a handwheel manual override device with an automatic power
cut-off switch to prevent the motor from operating when the handwheel is engaged. Mechanical travel stops shall be provided to prevent over travel in the manual mode.

Actuators shall be furnished with 2 sets of open-closed SPDT Form C mechanical limit switches (one set for auxiliary position monitoring). Modulating actuators shall have a solid state, servo amplifier circuit board for precise control of valve position. The servo shall have voltage spike protection with independent adjustment of both open and close speed control and adjustments for zero, span and deadband and shall include LED indicators: Power – yellow; open drive – green; closed drive - red. The servo control shall be configurable for fail last, open or closed upon the loss of control signal and are to have a continuous feedback signal to monitor valve position. The control input signal will be configurable to either, 4-20 mA DC, 0-10 VDC, 2-10VDC or 135 ohm or greater.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Provide valves line size.

B. Pressure rating of valves same as piping in which installed.

C. Install valves with stems upright or horizontal, not inverted.

D. Install valves with cast directional arrows in direction of flow.

E. Install valves to be accessible. Install valves to be removable without separating or lifting piping in which installed. On threaded bodies provide cap screws. Where abutting flanged strainers or similar devices, position valve with respect to device so as to permit removal of bolts.

F. Valves: Provide valves as noted. Provide shutoff valves on inlets and outlets of equipment, on branch connections to mains and as noted. Provide other types at locations as noted.

G. Motorized valve operators: Provide as noted.

H. Locate wheel handles to clear obstructions with hand.

I. Locate equipment shut-off valves to be accessible without climbing over equipment.

J. Piping adjacent to lugged valves to be flanged and removable while valve is in use.

3.2 VALVE APPLICATIONS

A. Use gate or butterfly valves for shut-off and to isolate equipment, parts of systems, or vertical risers.

B. Use globe or butterfly valves for throttling, bypass, or manual flow control services.

C. Use only butterfly valves in chilled and condenser water systems for throttling and isolation service.

D. Use lug or grooved end butterfly valves to isolate equipment.
3.3 FIELD QUALITY CONTROL

A. Test operate valves from closed-to-open-to-closed position while valve is under test pressure.

B. Test valve bonnets for tightness.

C. Check all valves for packing; replace leaking packing.

D. Check all valves for lubricant; service valves which do not operate smoothly with suitable lubricant before placing in operation.

END OF SECTION
SECTION 15150 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions of Contract,” “Special Conditions” and “Division 1 – General Requirements” form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:
   1. Pipe hangers and supports.
   2. Hanger rods.
   3. Flashing.
   4. Equipment curbs.
   5. Sleeves.
   6. Mechanical sleeve seals.
   7. Formed steel channel.
   8. Equipment bases and supports.

B. Related Sections:
   1. Section 03300 - Cast-In-Place Concrete: Execution requirements for placement of concrete housekeeping pads specified by this section.
   2. Section 15100 - Hydronic Piping: Execution requirements for placement of hangers and supports specified by this section.

1.3 REFERENCES

A. American Society of Mechanical Engineers:
   1. ASME B31.1 - Power Piping.
   2. ASME B31.5 - Refrigeration Piping.
   3. ASME B31.9 - Building Services Piping.

B. ASTM International:

C. American Welding Society:
   1. AWS D1.1 - Structural Welding Code - Steel.

D. FM Global:
E. Manufacturers Standardization Society of the Valve and Fittings Industry:
   1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
   2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
   3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

F. Underwriters Laboratories Inc.:
   3. UL 1479 - Fire Tests of Through-Penetration Firestops.
   5. UL - Fire Resistance Directory.

G. Intertek Testing Services (Warnock Hersey Listed):
   1. WH - Certification Listings.

1.4 SYSTEM DESCRIPTION

A. Firestopping Materials: Comply with requirements.

B. Firestop interruptions to fire rated assemblies, materials, and components.

1.5 PERFORMANCE REQUIREMENTS

A. Firestopping Materials: Comply with requirements.

1.6 SUBMITTALS

A. Product Data:
   1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
   2. Firestopping: Submit data on product characteristics, performance and limitation criteria.

B. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.

C. Manufacturer's Installation Instructions:
   1. Hangers and Supports: Submit special procedures and assembly of components.
   2. Firestopping: Submit preparation and installation instructions.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

E. Firestopping Engineering Judgments: For conditions not covered by UL or WH listed designs, submit judgments by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.

1.7 QUALITY ASSURANCE

A. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.
B. Fire Resistant Joints Between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.

C. Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

D. Perform Work in accordance with AWS D1.1 for welding hanger and support attachments to building structure.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

B. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F.

B. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.

C. Provide ventilation in areas to receive solvent cured materials.

1.11 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Acceptable Manufacturers:
   1. Anvil International, Inc.
   2. Carpenter & Paterson Inc.
   3. Creative Systems Inc.
   4. Flex-Weld, Inc.
5. Michigan Hanger Co.
6. Or equal as approved by the Professional.

B. Hydronic Piping:
1. Conform to MSS SP58, MSS SP69, and MSS SP89.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
3. Hangers for Cold Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
5. Hangers for Hot Pipe Sizes 6 inches and Larger: Adjustable steel yoke, cast iron roll, double hanger.
6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 inches and Larger: Steel channels with welded spacers and hanger rods, cast iron roll.
8. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hooks.
10. Wall Support for Hot Pipe Sizes 6 inches and Larger: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
12. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
13. Floor Support for Hot Pipe Sizes 4 Inches and Smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
14. Floor Support for Hot Pipe Sizes 6 inches and Larger: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
15. Copper Pipe Support: Copper-plated, carbon steel ring.

C. Steam and Steam Condensate Piping:
1. Conform to ASME B31.9, MSS SP58, MSS SP69, and MSS SP89.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
3. Hangers for Pipe Sizes 2 to 4 inches: Carbon steel, adjustable, clevis.
4. Hangers for Pipe Sizes 6 inches and Larger: Adjustable steel yoke, cast iron roll, double hanger.
5. Multiple or Trapeze Hangers for Pipe Sizes 4 inches and Smaller: Steel channels with welded spacers and hanger rods.
6. Multiple or Trapeze Hangers for Pipe Sizes 6 inches and Larger: Steel channels with welded spacers and hanger rods, cast-iron roll and stand.
7. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hooks.
8. Wall Support for Pipe Sizes 4 to 5 inches: Welded steel bracket and wrought steel clamp.
9. Wall Support for Pipe Sizes 6 inches and Larger: Welded steel bracket and wrought steel clamp; adjustable steel yoke and cast iron roll.
11. Floor Support for Pipe Sizes 4 inches and Smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
12. Floor Support for Pipe Sizes 6 inches and Larger: Adjustable cast iron roll and stand steel screws, and concrete pier or steel support.
13. Copper Pipe Support: Copper-plated carbon-steel ring.

D. Refrigerant Piping:
1. Conform to ASME B31.5, MSS SP58, MSS SP69, and MSS SP89.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
3. Hangers for Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
5. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hook.
8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

2.2 ACCESSORIES
A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

2.3 FLASHING
A. Metal Flashing: 26 gage thick galvanized steel.
B. Metal Counterflashing: 22 gage thick galvanized steel.
C. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.
D. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

2.4 EQUIPMENT CURBS
A. Manufacturers:
   1. Pate
   2. Thycurb
   3. RPI
   4. Or equal as approved by the Professional.
B. Fabrication: Welded 18 gauge galvanized steel shell and base, mitered 3 inch cant, 1-1/2 inch thick insulation, factory installed wood nailer.

2.5 SLEEVES
A. Sleeves for Pipes through Non-fire Rated Floors: 18 gage thick galvanized steel.
B. Sleeves for Pipes through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.
C. Sleeves for Round Ductwork: Galvanized steel.
D. Sleeves for Rectangular Ductwork: Galvanized steel or wood.
E. Sealant: Acrylic; refer to Section 07 90 00.
2.6 **MECHANICAL SLEEVE SEALS**

A. Acceptable Manufacturers:
   1. Anvil International Model.
   3. Thunderline Link-Seal, Inc. Model.
   4. NMP Corporation Model.
   5. Or equal as approved by the Professional.

B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.7 **FORMED STEEL CHANNEL**

A. Acceptable Manufacturers:
   1. Allied Tube & Conduit Corp.
   2. B-Line Systems
   3. Unistrut Corp.
   4. Or equal as approved by the Professional.

B. Product Description: Galvanized 12 gage) thick steel. With holes 1-1/2 inches on center.

**PART 3 EXECUTION**

3.1 **EXAMINATION**

A. Verify openings are ready to receive sleeves.

3.2 **PREPARATION**

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.

B. Remove incompatible materials affecting bond.

C. Install backing materials to arrest liquid material leakage.

D. Obtain permission from the Professional before using powder-actuated anchors.

E. Obtain permission from the Professional before drilling or cutting structural members.

3.3 **INSTALLATION - PIPE HANGERS AND SUPPORTS**

A. Install in accordance with ASME B31.5, ASME 31.9, MSS SP 58, MSS SP 69, and MSS SP 89.
B. Support horizontal piping as scheduled.

C. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.

D. Place hangers within 12 inches of each horizontal elbow.

E. Use hangers with 1-1/2 inch minimum vertical adjustment.

F. Support vertical piping at every floor.

G. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.

H. Support riser piping independently of connected horizontal piping.

I. Provide copper plated hangers and supports for copper piping.

J. Design hangers for pipe movement without disengagement of supported pipe.

K. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

L. Provide clearance in hangers and from structure and other equipment for installation of insulation.

3.4 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

A. Provide housekeeping pads of concrete, minimum 3-1/2 inches thick and extending 6 inches beyond supported equipment.

B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct supports of steel members. Brace and fasten with flanges bolted to structure.

D. Provide rigid anchors for pipes after vibration isolation components are installed. Refer to Section 23 05 48.

3.5 INSTALLATION - FLASHING

A. Provide flexible flashing and metal counter flashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.

B. Provide curbs for roof installations 14 inches minimum high above top of roof surface. Flash and counter-flash with sheet metal; seal watertight. Attach counter flashing to equipment and lap base flashing on roof curbs. Flatten and solder joints.

C. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.
3.6 INSTALLATION - SLEEVES

A. Exterior watertight entries: Seal with mechanical sleeve seals.

B. Set sleeves in position in forms. Provide reinforcing around sleeves.

C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

D. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.

E. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with firestopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

F. Install chrome plated steel escutcheons at finished surfaces.

3.7 SCHEDULES

A. Copper and Steel Pipe Hanger Spacing:

<table>
<thead>
<tr>
<th>PIPE SIZE Inches</th>
<th>COPPER TUBING MAXIMUM HANGER SPACING Feet</th>
<th>STEEL PIPE MAXIMUM HANGER SPACING Feet</th>
<th>COPPER TUBING ROD DIAMETER Inches</th>
<th>STEEL PIPE HANGER ROD DIAMETER Inches</th>
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<tr>
<td>1/2</td>
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B. Note 1: Refer to manufacturer’s recommendations for grooved end piping systems.
C. Note 2: 20 feet maximum spacing, minimum of one hanger for each pipe section close to joint behind bell. Provide hanger at each change of direction and each branch connection. For pipe sizes 6 inches and smaller, subjected to loadings other than weight of pipe and contents, limit span to maximum spacing for water service steel pipe.

END OF SECTION
SECTION 15170 - MOTORS

Part 1. GENERAL

1.1 WORK INCLUDED

A. Furnish equipment and services necessary for a complete and safe installation in accordance with the contract documents and all applicable codes and authorities having jurisdictions for the following
   1. Electric Motor

1.2 RELATED WORK AND REQUIREMENTS

A. Requirements of GENERAL CONDITIONS, DIVISION NO. 1 and Section GENERAL PROVISIONS FOR HEATING, VENTILATING AND AIR CONDITIONING WORK apply to all work in this Section.

B. Related work in the following Sections:
   1. Section 15735 - Hydronic Pumps
   2. Section 15860 – Cooling Towers

1.3 REFERENCE STANDARDS

A. Published Specifications' standards, tests or recommended methods of trade, industry or governmental organizations apply to work in this Section.

1.4 QUALITY ASSURANCE

A. Refer to Section 15010: GENERAL PROVISIONS, MECHANICAL.

B. Published specifications standards tests or recommended methods of trade industry or governmental organizations apply to work in this Section.

1.5 SUBMITTALS

A. Submit product data and diagrams for the following items per the provisions of Division 1 and this Division’s General Provisions:
   1. Product data: catalog cuts showing dimensions and ratings. Submit guaranteed minimum efficiencies of motors with driven equipment submittal.
   2. Diagrams: wiring diagrams with electrical characteristics and connection requirements for each motor and motor controller supplied under this section and requiring field wiring.

Part 2. PRODUCTS

2.1 BASE BID MANUFACTURERS

A. Motors
   1. General Electric.
   2. Ideal.
   3. Lincoln.
2.2 MOTORS

A. General
   1. In accordance with NEMA, EPAct 2005, IEEE, and ANSI C50 standards, suitable for inverter duty.
   2. Capacity:
      a. As required for non-overloading operation of the driven pump.
   3. Speed: 1750 RPM, unless otherwise indicated.
   4. Enclosure:
      a. Premium Efficiency – “NEMA Premium”.
   5. NEMA locked rotor CODE "G" or better.
   6. Insulation: Class F or H
   7. Service factor for drip-proof enclosure 1.15 minimum.
      a. Motor not to be operated in service factor area unless specifically noted for individual motors.
   8. Type:
      a. 3 phase, NEMA rated for 460V or as scheduled.
   9. Bearings, except as noted:
      a. Ball or roller type.
      b. Grease lubricated:
         1) Pressure type lubricating fittings similar to Alemite.
         2) Keystone pressure relief fittings, extended to accessible locations.
      c. Sealed, permanently lubricated.
   10. Terminal box:
       a. minimum dimensions:

B. Efficiency:
   3. Unless noted otherwise, all motors shall be of high efficiency.
   4. "NEMA Premium Efficiency" ODP & TEFC motors shall have guaranteed minimum efficiencies equivalent to or exceeding the following:

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<th>Number of Poles</th>
<th>ODP</th>
<th>TEFC</th>
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<td>25</td>
<td>91.7</td>
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</table>
3.1 INSTALLATION

A. Where packaged equipment is provided with factory mounted pre-wired control panels and motors, (panels containing starting and control equipment) a single point power connection will be made under Division 26.

B. Where other motor controllers and/or control panels, alarm switches, or control devices are supplied loose for packaged equipment, they will be installed as specified in Division 26. When there are air, water or other fluid connections, they shall be mounted as specified in this Division.

C. Drawings indicate engineers understanding of system electrical requirement. Systems supplied with requirements that differ from that will be supplied at no additional cost to the Owner. Power connections to the motor controller/panel and from the motor controller/panel to the motor(s) will be provided as specified in Division 26.

D. Motor controllers and/or control panels for other equipment supplied under this section, will be installed as specified in Division 26, with power wiring connection as described above.

E. Control wiring, air, water or other fluid connections shall be provided.

3.2 MOUNTING AND ALIGNMENT

A. Mount motor to common pump.

B. Align pump and motor shafts by adjusting wedges or double nuts.

C. Motor Controllers
   1. Refer to Division 26 for Motor Control Centers.

3.3 TESTING

A. Measure insulation resistance of each starter section phase to phase and phase to ground with the starter contacts closed and the protective device open.

B. Measure insulation resistance of each control circuit with respect to ground.
C. Test motor overload units by injecting primary current through overload unit and monitoring trip time.

D. Perform operational tests by initiating control devices to affect proper operation.

3.4 WARRANTY

A. Provide a complete two year warranty from start of beneficial use covering all parts and labor for replacement of parts resulting from manufacturers’ defect.

END OF SECTION
SECTION 15172 - VARIABLE FREQUENCY DRIVES

Part 1. GENERAL

1.1 SCOPE OF WORK

A. Furnish equipment and services necessary for a complete and safe installation in accordance with the contract documents and all applicable codes and authorities having jurisdictions for the following:

1. Variable frequency drives to control Chilled Water and Condenser Water Pump motors as shown on the drawings.

1.2 REFERENCES

B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
C. UL, and cUL Approved
D. IEEE Standard 444 (ANSI-C343)
E. IEEE Standard 519
F. UL 508C (Power Conversion)
G. UL 1995 (Plenum rating)
H. FCC CFR 47 Part 15 Subpart B

1.3 SUBMITTALS

A. Submit product data, drawings and diagrams for the following items:

1. Product data: Manufacturer’s catalog cuts, ratings and installation instructions.
2. Drawings: Scale drawings of assembly.
3. Diagrams: wiring diagrams including all external connections.
4. Technical performance specifications
5. Current harmonic spectrum for the actual VFD proposed (for verification of a harmonic analysis study performed by others).

1.4 OPERATION AND MAINTENANCE DATA

A. Include instructions for starting and operating VFD, and describe operating limits, which may result in hazardous or unsafe conditions.

1.5 QUALIFICATIONS

A. Manufacturer must have a minimum of 20 years of documented experience, specializing in variable frequency drives.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to site, under provisions of Section 01610.
B. Accept VFD on site in original packing. Inspect for damage.
C. Store in a clean, dry space. Maintain factory wrapping, or provide an additional heavy canvas or heavy plastic cover, to protect units from dirt, water, construction debris, and traffic.
D. Handle carefully, in accordance with manufacturer's written instructions, to avoid damage to components, enclosure, and finish.

Part 2. PRODUCTS

2.1 MANUFACTURERS

A. Variable Frequency Drives.
   1. Yaskawa Electric (Basis of Design) Series E7B
   2. Toshiba Series Q9
   3. Cerus Ind. Series P
   4. Or Equivalent

2.2 VARIABLE FREQUENCY DRIVES

A. Description:
   1. Provide enclosed variable frequency drives suitable for operation at the current, voltage, and horsepower indicated on the schedule. Conform to requirements of NEMA ICS 3.1.

B. Ratings
   1. VFD must operate, without fault or failure, when voltage varies plus 10% or minus 15% from rating, and frequency varies plus or minus 5% from rating.
   2. VFD shall be 480 volts, 60 Hz, 3 Phase.
   3. Displacement Power Factor: 0.98 over entire range of operating speed and load.
   4. Operating Ambient Temperature: 14 degrees F to 104 degrees F.
   5. Humidity: 0% to 95% non-condensing.
   6. Altitude: to 3,300 feet, higher altitudes achieved by derating.
   7. Minimum Efficiency: 96% at half speed; 98% at full speed.
   8. Starting Torque: 100% starting torque shall be available from 0.5 Hz. to 60 Hz.
   9. Overload capability: 110% of rated FLA (Full Load Amps) for 60 seconds; 180% of rated FLA, instantaneously.
   10. The VFD must meet the requirements for Radio Frequency Interference (RFI) above 7 MHz as specified by FCC regulations, part 15, subpart J, Class A devices.
   11. Total Harmonic Distortion (THD) compliance:
       Given the information provided by the customer’s electric power single line diagram and distribution transformer data, the VFD manufacturer shall carry out an analysis of the system. The analysis reviews the potential for the proposed equipment, and any existing equipment, to meet IEEE 519 (tables 10.2 and 10.3) recommendations at the Point of Common Coupling (PCC). The result of the analysis shall determine if additional power quality improvement measures should be included in the proposal to meet the THD recommendations of IEEE 519. The PCC shall be at the primary side of the main distribution transformer.
   12. VFDs must have a minimum short circuit rating of 65K amps RMS (100K amps RMS with a DC bus reactor) without additional input fusing.
C. Design

1. VFD shall employ microprocessor based inverter logic, isolated from all power circuits.

2. VFD shall employ a PWM (Pulse Width Modulated) power electronic system, consisting of:
   a. Input Section:
      i. VFD input power stage shall convert three-phase AC line power into a fixed DC voltage via a solid state full wave diode rectifier, with MOV (Metal Oxide Varistor) surge protection.
   b. Intermediate Section:
      i. DC bus as a supply to the VFD output Section shall maintain a fixed voltage with filtering and short circuit protection.
      ii. DC bus shall be interfaced with the VFD diagnostic logic circuit, for continuous monitoring and protection of the power components.
      iii. 30 HP to 150 HP @ 208 VAC, 30 HP to 150 HP @ 240 VAC, and 40 HP to 500 HP 480 VAC, VFDs shall include a DC bus reactor to minimize reflected harmonics.
   c. Output Section
      i. Insulated Gate Bipolar Transistors (IGBTs) shall convert DC bus voltage to variable frequency and voltage.
      ii. The VFD shall employ PWM sine coded output technology to power the motor.

3. The VFD must be selected for operation at carrier frequencies at or above 5 kHz without derating to satisfy the conditions for current, voltage, and horsepower as indicated on the equipment schedule. Exception to this requirement is allowed only for VFDs providing 506 amps or more.

4. VFD shall have an adjustable carrier frequency: The carrier frequency shall have a minimum of six settings to allow adjustment in the field.

5. VFD shall have embedded Building Automation System (BAS) protocols for network communications; Johnson Metasys N2, Siemens System 600 APOGEE, Honeywell and Modbus/Memobus. These protocols shall be accessible via a RS-422/485 communication port.

6. VFD shall have a quick disconnect, removable control I/O terminal block to simplify control wiring procedures.

7. VFD shall include two independent analog inputs. One shall be 0-10 VDC. The other shall be programmable for either 0-10 VDC or 4-20 mA. Either input shall respond to a programmable bias and gain.

8. VFD shall include a minimum of seven multi-function digital input terminals, capable of being programmed to determine the function on a change of state. These terminals shall provide up to 30 functions, including, but not limited to:
   a. Remote/Local operation selection
   b. Detection of external fault condition
   c. Remote Reset
   d. Multi-step speed commands
   e. Run permissive
   f. Floating control

9. VFD shall include two 0-10 VDC or 4-20 mA analog output for monitoring, or "speed tracking" the VFD. The analog output signal will be proportional to output frequency, output current, output power, PI (Proportional & Integral control) feedback or DC bus voltage.

10. VFD shall provide terminals for remote input contact closure, to allow starting in...
the automatic mode.

11. VFD shall include at least one external fault input, which shall be programmable for a normally open or normally closed contact. These terminals can be used for connection of firestats, freezestats, high pressure limits or similar safety devices.

12. VFD shall include two form "A" contacts and one form "C" contact, capable of being programmed to determine conditions that must be met in order for them to change state. These output relay contacts shall be rated for at least 5A at 120 VAC and shall provide up to 18 functions, including, but not limited to:
   a. Speed agree detection.
   b. Low and high frequency detection.
   c. Missing frequency reference detection.
   d. Overtorque/Undertorque detection
   e. Drive Running
   f. Drive Faulted

13. VFD shall include a power loss ride through of 2 seconds.

14. VFD shall have DC injection braking capability, to prevent fan and pump “wind milling” at start or stop, adjustable, current limited.

15. VFD shall have a motor preheat function to prevent moisture accumulation in an idle motor.

16. VFD shall include diagnostic fault indication in selected language, last 10 faults storage and heatsink cooling fans and pumps operating hours.

17. VFD shall have a digital operator with program copy and storage functions to simplify set up of multiple drives. The digital operator shall be interchangeable for all drive ratings.

18. VFD shall include a front mounted, sealed keypad operator, with an English language (or one of 6 additional international languages) illuminated LCD display. The operator will provide complete programming, program copying, operating, monitoring, and diagnostic capability. Keys provided shall include industry standard commands for Hand, Off, and Auto functions.

19. VFD plain language display shall provide readouts of; output frequency in hertz, PI feedback in percent, output voltage in volts, output current in amps, output power in kilowatts, D.C. bus voltage in volts, interface terminal status, heatsink temperature and fault conditions. All displays shall be viewed in an easy-to-read illuminated LCD with International language selectability.

20. VFD unit shall include the following meters to estimate use of energy:
   a. Elapsed Time Meter
   b. Kilowatt Meter
   c. Kilowatt Hour Meter

21. VFD shall include PI control logic, to provide closed loop setpoint control capability, from a feedback signal, eliminating the need for closed loop output signals from a building automation system. The PI controller shall have a differential feedback capability for closed loop control of fans and pumps for pressure, flow or temperature regulation in response to dual feedback signals.

22. An energy saving sleep function shall be available in both open loop (follower mode) and closed loop (PI) control, providing significant energy savings while minimizing operating hours on driven equipment. When the sleep function senses a minimal deviation of a feedback signal from setpoint, or low demand in open loop control, the system reacts by stopping the driven equipment. Upon receiving an increase in speed command signal deviation, the drive and equipment resume normal operation.

23. VFD shall include loss of input signal protection, with a selectable response strategy including speed default to a percent of the most recent speed.
24. VFD shall include electronic thermal overload protection for both the drive and motor. The electronic thermal motor overload shall be approved by UL. If the electronic thermal motor overload is not approved by UL, a separate UL approved thermal overload relay shall be provided in the VFD enclosure.

25. VFD shall include the following program functions:
   a. Critical frequency rejection capability: 3 selectable, adjustable deadbands.
   b. Auto restart capability: 0 to 10 attempts with adjustable delay between attempts.
   c. Ability to close fault contact after the completion of all fault restart attempts.
   d. Stall prevention capability.
   e. "S" curve soft start capability.
   f. Bi-directional "Speed search" capability, in order to start a rotating load.
   g. 14 preset and 1 custom volts per hertz pattern.
   h. Heatsink over temperature speed fold back capability.
   i. Terminal status indication.
   j. Program copy and storage in a removable digital operator.
   k. Current limit adjustment capability, from 30% to 200% of rated full load current of the VFD.
   l. Motor pre-heat capability.
   m. Input signal or serial communication loss detection and response strategy.
   n. Anti "wind-milling" function capability.
   o. Automatic energy saving function.
   p. Undertorque / Overtorque Detection.
   q. Preset speeds

26. VFD shall include factory settings for all parameters, and the capability for those settings to be reset.

27. VFD shall include user parameter initialization capability to re-establish project specific parameters

28. VFD shall include the capability to adjust the following functions, while the VFD is running:
   a. Speed command input.
   b. Acceleration adjustment from 0 to 6000 seconds.
   c. Deceleration adjustment from 0 to 6000 seconds.
   d. Select from 5 preset speeds.
   e. Analog monitor display.

D. Product Options:
   1. Three Contactor Manual Bypass shall be provided when indicated by the schedule. VFD and bypass components shall be mounted inside a common NEMA 1 enclosure, fully pre-wired, and ready for installation as a single UL listed device. Bypass shall include the following:
      a. Input, output, and bypass contactors, to disconnect power to the VFD, when the motor is running in the bypass mode.
      b. 120 VAC control transformer, with fused primary.
      c. Magnetic overload relay, to protect the motor while operating in the bypass mode.
      d. Circuit breaker/disconnect switch, with a pad-lockable through-the-door handle mechanism.
      e. Control and safety circuit terminal strip.
      f. Drive/Bypass selector switch, Hand/Off/Auto selector switch, Normal/Test
selector switch

g. Switch selectable auto transfer to bypass and remote transfer functions.

h. Pilot lights (22 mm LEDs) for "Control Power", "Drive Fault", “Drive Run”, "Bypass Run", “OL/Safety Fault”.
i. Normal/Test selector switch, shall allow testing and adjustment of the VFD, while the motor is running in the bypass mode.

j. Hand/Off/Auto selector switch shall provide the following operation:
   i. Hand Position - The drive is given a start command, operation is via the local speed input (digital operator or speed pot.). If in bypass mode, the motor is running.
   ii. Off Position - The start command is removed, all speed inputs are ignored, power is still applied to the drive. If in bypass mode, the motor is stopped.
   iii. Auto Position - The drive is enabled to receive a start command and speed input from a building automation system. If in bypass mode, the motor start/stop is controlled by the building automation system

k. Annunciation contacts for drive run, drive fault, bypass run and motor OL/safety fault.

l. Damper control circuit with end of travel feedback capability.

m. VFD operator/keypad selection, LCD or LED types.

n. H/O/A control panel selection, Touch pad or rotary switch types.

2. VFD Input MCP circuit breaker/disconnect shall be provided.

3. Engraved cabinet nameplates shall be provided.

E. Additional Options Required:

1. All motors serving a VFD shall be provided with a complete Shaft Grounding Ring, made by Inpro Seal or equivalent. The Inpro Seal or equivalent grounding ring shall come in two pieces and shall be bolted onto the motor by the mechanical contractor.

F. Fabrication:

1. All standard and optional features shall be included in a single NEMA 1, plenum rated enclosure with a UL certification label.

G. Source Quality Control:

1. In-circuit testing of all printed circuit boards shall be conducted, to insure the proper mounting and correct value of all components.

2. All printed circuit boards shall be burned in for 96 hours, at 85 degrees C.

3. Final printed circuit board assemblies shall be functionally tested, via computerized test equipment. All tests and acceptance criteria shall be preprogrammed. All test results shall be stored as detailed quality assurance data.

4. All fully assembled controls shall be functionally tested, with fully loaded induction motors. The combined test data shall then be analyzed, to insure adherence to quality assurance specification. Inspect and production test, under load, each completed VFD assembly. VFD shall have a minimum MTBF (mean time between failure) rating of 28 years (245,280 Hours).

Part 3. EXECUTION

3.1 EXAMINATION
A. Examine areas, surfaces, and substrates to receive VFDs for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFD installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install in accordance with manufacturer's recommendations.

B. Anchor each VFD assembly to steel-channel sills arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and grout sills flush with VFD mounting surface.

C. Controller Fuses: Install fuses in each fusible switch.

D. Coordinate drive equipment with motors supplied under other contracts.

E. Factory representative shall inspect final installation of all drives and connected wiring and make all final adjustments to meet specified performance.

3.3 APPLICATIONS

A. Select features of each VFD to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; and duty cycle of motor, drive, and load.

B. Select rating of controllers to suit motor controlled.

3.4 IDENTIFICATION

A. Provide a nameplate label on each VFD, identifying rated horsepower, full load amperes, model number, service factor and voltage/phase rating.

B. Operating Instructions: Frame printed operating instructions for VFDs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFD units.

3.5 CONTROL WIRING INSTALLATION

A. Install wiring between VFDs and remote devices.

B. Bundle, train, and support wiring in enclosures.

C. Connect hand-off-automatic switch and other automatic-control devices where available.
   1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.
   2. Connect selector switches with control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.6 CONNECTIONS
A. Conduit installation requirements are specified in other Division 26 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.

B. Ground equipment.

C. 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.

3.7 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:
   1. Test insulation resistance for each VFD element, bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

B. Testing: Engage a qualified testing agency to perform the following field quality-control testing:

C. Testing: Perform the following field quality-control testing:
   1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections 7.5, 7.6, and 7.16. 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.

D. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including pre-testing and adjusting VFDs.

E. 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.

F. Manufacturer shall conduct factory tests to assure conformance to specification requirements.

G. All power components shall be run-tested under specified temperature and load conditions.

H. On-site measurements of the harmonic contributions due to the VFDs will be taken by the Owner’s representative to verify compliance with these specifications. Measurements will be taken at the specified point of common coupling with and without the VFD driven motors running. The VFD manufacturer’s representative can participate in the measurements. The VFD manufacturer shall provide, at no cost to Owner, additional harmonic mitigation components required to meet the performance specifications.

3.8 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
B. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 26 Sections.

C. Complete installation and startup checks according to manufacturer's written instructions.

3.9 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.10 CLEANING

A. Clean VFDs internally, on completion of installation, according to manufacturer's written instructions. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

3.11 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain VFDs.

3.12 TRAINING

A. Factory representative shall provide on-site training of operating personnel after the system is fully operational.

B. Provide eight (8) sets of operation and maintenance manuals to owner after completion of startup.

3.13 WARRANTY

A. Three-year warranty from date of shipment. Warranty shall include parts, and labor allowance for repair hours.

END OF SECTION
SECTION 15190 - MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Work in this Section includes furnishing labor, materials, equipment and services necessary for proper labeling and identification of new piping and new equipment. This shall include:
   1. Nameplates.
   2. Tags.
   3. Stencils.
   4. Pipe Markers.

1.2 QUALITY ASSURANCE

A. Refer to Section 15010 GENERAL PROVISIONS – MECHANICAL
B. Refer to Section 09900 PAINTING

1.3 SUBMITTALS

A. Submit product data, drawings, and samples for the following items per the provisions of Division 1 and this Division’s General Provisions:
   1. Product data: Manufacturer’s catalog data, including size, color and materials for all labels or tags proposed for this project.
   2. Drawings: Valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
   3. Samples: Typical nameplates, valve tags, pipe markers and labels made from stencils proposed for use on this project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Seton Nameplate Corporation.
B. Or equal.

2.2 IDENTIFICATION

B. Pipe Markers:
   1. Paint pipe colors to match existing.
C. Equipment Name plates:
   1. Engraved black Lamicoid sheet with white lettering.
   2. Fastened with epoxy cement.
   3. Secure with chrome plated screws.
   4. Inscription: Subject to review, indicating equipment, size and voltage.
PART 3 - EXECUTION

3.1 COLOR CODING

A. Paint new and existing chilled water and condenser water piping. Color coding as follows: Sherwin Williams DTM Acrylic Coating, Gloss (B66-100) as Standard:
   1. Chilled Water Supply Piping: SW 6957 “Undercool”
   2. Chilled Water Return Piping: SW 6959 “Bluechip”

B. Shades shall be consistent throughout the project.

C. Valves, strainer and other appurtenances operating at over 220ºF where bare metal is exposed shall be coated with Silicone Alkyd Aluminum, 7IS30.

3.2 IDENTIFICATION

A. Valve Tags:
   1. On all following valves, except at equipment connections:
      b. Others as required
   2. Indicate normally open or normally closed.
   3. Secure to valve handwheels or stems with brass-beaded chain.

B. Piping Identification:
   1. Before applying identification complete testing, insulation and finish painting.
   2. Identifying piping services per legend on drawings and match existing.
   3. Identification locations:
      a. Locate legends and flow arrows to be readily visible from any reasonable point of observation.
      b. Where two or more pipes run in parallel, place legend and other markers in same relative location.
      c. At eye level: along center line of pipe.
      d. Above eye level: on lower quarter of pipe.
      e. Below eye level: on upper quarter of pipe.
      f. Where view is unobstructed from two directions, apply two sets of stenciling (two sides) visible from each direction.
      g. Locate legend, flow arrow, etc:
         1) At valve locations;
         2) At all points where piping enters leaves partition, wall, floor or ceiling.
         3) At intervals of 20 ft. on straight runs.
   4. Identify piping with snap-on pipe markers as specified herein before.
      a. On piping under 3/4 in. outside diameter use tags similar to valve tags.
   5. Identify piping by stenciled letters. (Required where surface temperature exceeds 180ºF).
      a. Black letters, white background.
      b. Black flow arrows, white background.
      c. Letter and Arrow sizes:
<table>
<thead>
<tr>
<th>OD of Pipe or Pipe and Covering</th>
<th>Letter Size</th>
<th>Length of Flow Arrows</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 1-1/4 in. incl.</td>
<td>1/2 in.</td>
<td>3 in.</td>
</tr>
<tr>
<td>1-1/2 to 2 in. incl.</td>
<td>3/4 in.</td>
<td>3 in.</td>
</tr>
<tr>
<td>2-1/2 to 6 in. incl.</td>
<td>1-1/4 in.</td>
<td>4 in.</td>
</tr>
<tr>
<td>8 and 10 in. incl.</td>
<td>2-1/2 in.</td>
<td>6 in.</td>
</tr>
<tr>
<td>Over 10 in.</td>
<td>3-1/2 in.</td>
<td>6 in.</td>
</tr>
</tbody>
</table>

d. On piping under 3/4 in. outside diameter use tags similar to valve tags.

6. For paint see:
   a. Identify piping as specified hereinabove under Color Coding.
   b. Identify piping by continuously painted color coding as follows: (Prepare description from client's requirement).
   c. Identify piping by: (prepare descriptions from client’s requirements).
   d. Adhesive type markers not permitted.

7. Capped piping for future connections:
   a. Provide legible and durable metal tags indicating symbol identification.

C. Equipment Identification:
   1. Identify each item of mechanical equipment.
   2. Spell out complete name or use symbol on drawings.
   3. Use nameplates as specified above.
   5. Provide for following equipment:
      a. Chillers
      b. Pumps
      c. Motor controllers.
      d. As noted.
   6. Provide manufacturer's nameplates on equipment, identifying:
      a. Manufacturer's name.
      b. Model number.
      c. Size.
      d. Capacity.
      e. Electrical characteristics.
   7. Leave manufacturer's nameplates clean and legible.
   8. Install equipment so that view of nameplates is not obstructed.
      a. If necessary install additional visible nameplates.

D. Existing Identification:
   1. Symbols, colors, and methods of identification shall comply with existing.
   2. Valve and equipment numbers shall supplement existing numbering sequences.

END OF SECTION
SECTION 15200 – COOLING TOWER FILTER SPECIFICATION

PART 1 - GENERAL

1.01 DESCRIPTION

A. SCOPE:
This section specifies a High Efficiency Sand Filtration System rated for 0.5 micron particle removal for the cooling system described below:
Design Condenser Circulation Rate 18,000
Design Temperature Drop Across: 15
Projected Cycles of Concentration: 5
Inlet Pressure: less than 65 PSI

B. OPERATING REQUIREMENTS:
Filter shall operate continuously removing suspended particles from the tower water until either a pressure drop across filter bed of 18 PSI is reached or twenty-four hours has elapsed. At either point filter shall automatically backwash for 5 minutes on each vessel sequentially. After backwash cycle, filter shall automatically return to filtration mode.
Filter shall be capable of field adjustment to utilize either City Water or Tower Water as the backwash source.
To conserve water and minimize load to floor drain, maximum backwash flow rate shall be 12 GPM per square foot of filter surface area.

C. FILTRATION SYSTEM SIZING:
It shall be the responsibility of the filter manufacturer to size the filtration system, based on their published literature, to meet the specification, including section 1.02 C performance criteria. The selection and sizing of the filtration system shall be based on tower operation (evaporation and blowdown). Local air quality, makeup water and tower water chemistry will also be considered.

1.02 QUALITY ASSURANCE

A. Filter shall be designed to provide 0.5 micron filtration by utilizing ultrafine sand with an effective size of not more than 0.16 millimeters.

B. Filter design flow rate shall be greater than 20 GPM per square foot of surface area.

C. Filter shall be sized to remove at least 50% (by count) of the 0.5 micron particles and at least 80 % (by count) of the 2 micron particles typically found in cooling water, within 30 days of startup.

D. Filter system shall be rated for 65 PSIG inlet pressure to filter pump.

E. Tanks shall be #304L Stainless Steel rated for 100 PSIG operating pressure.
F. Manifold shall be Copper
G. System shall be factory assembled and tested for rated pressure and control functions.

1.03 SUBMITTALS
A. Submit system drawings, calculations and product data as follows:
   1. Submit drawings indicating system schematics and component locations.
   2. Submit manufacturer’s installation instructions.
   3. Submit Filtration System Sizing calculations to show compliance with specification, and particularly Section 1.02 C.
   4. Provide Particle Distribution Analysis and calculations from three previous users where the criteria described in this spec (and particularly Section 1.02 C) was met. Include tower tonnage, tower water circulation rate, temperature drop across the tower, filter sand size and filtration rate. Note % of tower water circulation rate being filtered in each case. Include facility name, address, contacts and phone numbers. Analysis shall be on THIRD PARTY LAB letter head.

1.04 OPERATION AND MAINTENANCE DATA
A. Submit operation and maintenance data in a binder.

PART 2 - PRODUCTS

2.01 ACCEPTABLE PRODUCTS
A. AmeriWater.
   Chemworks, Inc,
   Or Equivalent

2.02 GENERAL CONSTRUCTION REQUIREMENTS
A. Filter shall be comprised of #304L Stainless Steel vessel(s) with Type L copper manifold and cast iron circulating pump. The backwash shall be adjustable in the field for either city water or system water. The filter shall be mounted on a Stainless Steel skid.

2.03 COMPONENTS
A. Natural quartz media shall meet AWWA B-100, ANSI, and NSF-61 standards for consistently uniform and chemically inert filter media. Crushed or ground media is not acceptable.

B. Valves shall be Johnson Controls or Equivalent two-piece brass ball type with EPDM stem seals, blowout proof stem design, stainless steel ball and stem, PTFE seats. Valves shall be actuated with individual 24V electric motors on each valve. The drain valve(s) shall be spring return normally closed.

C. Filter shall be equipped with two pressure gauges. The gauges shall be anti flutter and shall have a stainless steel casing, with brass internals. The minimum face size shall be no less than 2-1/2". One gauge marked (IN) shall be connected to the filter pump discharge and the second gauge marked (OUT) shall be connected to the outlet side of the filter.

D. Top inlet distributor shall be Copper. Under drain shall be 316 stainless steel wedge wire screen pipe.

E. Backwash flow control shall be rated for full backwash flow with backwash water from 25 PSIG to 80 PSIG.

F. Filter pump shall be cast iron, close coupled with mechanical seal. Pump motor to be TEFC with a service factor of not less than 1.15.

G. Filter control shall be mounted in a NEMA 4X enclosure and shall contain the following:
   1. An Allen Bradley 1200 Series PLC or Equivalent
   2. A Siemens motor starter or Equivalent and service disconnect.
   3. Two step-down transformers to convert 3-phase power to 115 VAC to operate control components and further convert 115 VAC to 24V for valve actuation.
   4. A pressure differential switch factory set to initiate backwash at 18 PSI differential across the filter bed.
   5. A manual backwash switch, of a momentary contact design, mounted on the outside of the control panel door.
   6. A backwash indicating light for each vessel, pump status light and pump on/off switch mounted on the outside of the control panel door.
   7. A non-resettable backwash counter mounted on the outside of the control panel door to indicate the number of times the filter has backwashed.
   8. PLC shall be programmed to control valve actuation, duration of the backwash cycle, and pump on/off. Backwash shall be initiated by the 24-hour timer, pressure differential switch, or manual backwash button. An internal delay of no less than 15 seconds shall be built into the program timer to avoid false backwashing.
   9. PLC shall also include a set of dry contacts that can be connected to the BMS to monitor backwash frequency.

10. The entire industrial control package shall be UL and cUL listed.
PART 3 - EXECUTION

3.01 INSTALLATION
   A. Place vessels as shown in installation drawing and level. Use manifold as guide for spacing.
   B. Install upper and lower manifolds as per manufacturer’s instructions.
   C. Install piping between manifold and pump(s) if necessary.
   D. Attach control panel to vessel mount.
   E. Connect control wiring to valves.
   F. Connect electrical power to control panel and control to pump(s) according to local electrical codes and wiring diagram supplied by manufacturer.
   G. Install media according to manufacturer’s instructions.

3.02 STARTUP AND TESTING
   A. Startup by factory authorized agent shall be provided.
   B. Submit cooling water particle analysis reports showing count and volume of particles within the following micron size ranges: 0.5 to 1, 1 to 2, 2 to 5, 5 to 10, 10 to 20, and 20 and larger at time of startup.
   C. Submit cooling water particle analysis reports showing count and volume of particles within the following micron size ranges: 0.5 to 1, 1 to 2, 2 to 5, 5 to 10, 10 to 20, and 20 and larger 30 days after startup.
   D. Submit report analyzing results from 3.02 B and C confirming that system meets performance specifications in paragraph 1.02 C.
SECTION 15300 – HEAT TRACING FOR HVAC PIPING

PART 1 GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions of Contract,” “Special Conditions” and “Division 1 – General Requirements” form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. This Section includes piping heat tracing for freeze prevention with the following electric heating cables:
   1. Self-regulating, parallel resistance.

1.3 REFERENCES

A. Institute of Electrical and Electronics Engineers

B. National Electrical Manufacturers Association:
   1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

C. National Fire Protection Association:
   1. NFPA 70 - U.S. National Electrical Code (NEC)

D. Underwriters Laboratories Inc.
   1. UL 746B - Polymeric Materials - Long Term Property Evaluations

1.4 SUBMITTALS

A. Shop Drawings: Include plans, sections, details, wiring diagrams, and attachments to other work. The wiring diagrams shall include power, signal, and control wiring.
   1. The manufacturer shall provide a detailed design and estimate of the heat tracing system. At minimum, the design must provide the following:
      a. Maintain temperature
      b. Line size and insulation
      c. Heat loss for pipe, valves, and supports
      d. Amount and type of heating cable required.
      e. Heating cable service voltage
      f. Heating cable power output at the maintain temperature
      g. Minimum and maximum maintain temperature vs minimum and maximum ambient temperatures
      h. Circuit breaker and transformer sizing

B. Product Data: Submit Rated capacity, length of cable, cable spacing, and electrical power requirements.
C. Field Test Reports: Field quality control test reports shall be submitted.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit start-up instructions, maintenance data, parts lists, controls, and accessories.

1.6 QUALITY ASSURANCE

A. 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.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum ten years documented experience.

B. Installer: Company specializing in performing work of this section with minimum five years experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Follow manufacturer's installation instructions for rigging, unloading, and transporting units.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 WARRANTY

A. Upon completion, the manufacturer shall issue a written warranty, duly authorized, covering the following:
   1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within specified warranty period.
      a. Warranty Period: 5 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Chromalox, Inc.; Wiegard Industrial Division; Emerson Electric Company.
   2. Raychem; a division of Tyco Thermal Controls.
   4. Thermon Manufacturing Co.
   5. Or equal as approved by the Professional.
B. Heating Element: Pair of parallel No. 16AWG, tinned or nickel-coated stranded copper bus wires embedded in crosslinked conductive polymer core, which varies heat output in response to temperature along its length. Terminate with waterproof, factory-assembled nonheating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating.

C. Electrical Insulating Jacket: Flame-retardant polyolefin.

D. Cable Cover: Tinned-copper braid.

E. Maximum Operating Temperature (Power On): 150 deg F.

F. Maximum Exposure Temperature (Power Off): 185 deg F. Maximum Operating Temperature: 300 deg F.

G. The heater shall be sized according to the manufacturer's recommendation for particular pipe size and insulation thickness at the minimum ambient temperature. The minimum ambient temperature shall be -10 degrees F. The heater output rating is to be given in watts per foot at 50 degrees F.

H. Capacities and Characteristics:
   1. Piping Diameter: less than 4”  4” to <24”  24” or above
   2. Maximum Heat Output: 5 W/ft.  8 W/ft.  12.6 W/ft
   3. Volts: 208V.
   4. Phase: single
   5. Hertz: 60
   6. Minimum Circuit Ampacity: 20
   7. Maximum Overcurrent Protection: 30

I. Power Connection, end seal, splice and tee kits components shall be applied in the field per manufacturer's instructions.

2.2 CONTROLS

A. General
   1. Outdoor air thermostat control to prevent operation when outside air temperature is above 40F (adjustable). The control system shall energize each heater cable independently when the pipe temperature drops to 40 degrees F. The system shall indicate an alarm condition when the pipe temperature drops to 35 degrees F.
   2. The system shall provide the user with the option of line-sensing control with a user-selectable dead band, ambient sensing, proportional ambient sensing (PASC), and powerlimiting control modes.
   3. Each heater cable circuit can be individually controlled by an ambient sensing device and a line temperature sensing device. The RTD shall be located in worst case location or on each pipe as indicated on the contract drawings. The RTD shall be provided with armored lead wires to prevent damage. Failure of a temperature sensor shall be indicated at the system monitor panel and shall result in activation of the heater cable. Mechanical thermostats shall not be used.
   4. The monitor system shall provide UL Listed GFI protection for all branch heater cable circuits per NEC 1996 Section 423-22 and does not need to be provided separately. GFI
shall have a 30 mA trip level. Monitor system shall provide High GFI Current warning at 20mA.

5. If more than one circuit is required, a main contactor shall be used
6. Each heater cable including all tees shall be monitored and provide alarms for high and low current.
7. The panels shall be capable of providing audible and visible alarms.
8. Each monitor channel shall have a separate microprocessor and alarm group. Each monitor panel shall be NEMA 4X, UL approved construction and shall be of size and location as indicated on the contract drawings. The panel shall operate off of the heater cable power supply, at that voltage.
9. Each monitor channel shall have autocycling capability for monitoring cable during the entire year. All setpoints and diagnostics shall be stored in non-volatile memory. Alarms shall be provided for memory and SCR failures.
10. The control system shall provide as standard the following alarm outputs:
   a. Dry contact to Building Automation System for common alarm (Low Pipe Temperature, Ground Fault Alarm/Trip, and Loss of Power);
   b. The controller shall support the Modbus communications protocol and be supplied complete with RS-485 communications interface capability to the Building Automation System.

B. Attachment
   1. Per manufacturer’s instructions
      a. Fiberglass tape
      b. Stainless steel straps

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine surfaces and substrates to receive electric heating cables for compliance with requirements for installation tolerances and other conditions affecting performance.
   1. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.
   2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install electric heating cable across expansion, construction, and control joints according to manufacturer's written recommendations using cable protection conduit and slack cable to allow movement without damage to cable.

B. Provide additional cable per the manufacturer’s recommendations at high heat loss locations such as valves, flanges, and instrumentation.

C. Install temperature sensor(s) in worst case location or as indicated by the Professional. Pipe mounted sensors to be located on opposite side of pipe from heater cable. Avoid installation of temperature sensors near vents, steam lines or other heated locations.

D. Electric Heating Cable Installation for Freeze Protection for Piping:
1. Install electric heating cables after piping has been tested and before insulation is installed.
2. Install electric heating cables according to IEEE 515.1.
3. Install insulation over piping with electric cables according to Division 15 Section "HVAC Insulation."
4. Install warning tape on piping insulation where piping is equipped with electric heating cables.

E. Set field-adjustable switches and circuit-breaker trip ranges.

F. Protect installed heating cables, including nonheating leads, from damage.

3.3 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Testing: Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.
   1. Test cables for electrical continuity and insulation integrity before energizing. Subject heater cable to testing using a 2500 VDC megger. Minimum insulation resistance should be 1000 megohms or greater regardless of length.
   2. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.

B. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounting cables.

C. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION
SECTION 15680 - COOLING TOWERS

PART 1 GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions of Contract,” “Special Conditions” and “Division 1 – General Requirements” form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section includes packaged cooling tower with structure, casing, fill and basin, controls, heaters fans, motors and drive equipment, condensing water inlet and outlet with internal distribution and ladder and handrails.

B. Related Sections:
   1. Section 03300 - Cast-In-Place Concrete: Execution requirements for concrete bases specified by this section.
   2. Section 15170 - Common Motor Requirements for HVAC Equipment: Product requirements for electric drive motors for placement by this section.
   3. Section 15150 - Hangers and Supports for HVAC Piping and Equipment: Execution requirements for steel support bases specified by this section.
   4. Section 15100 - Hydronic Piping: Product requirements for condenser water piping for placement by this section.

1.3 REFERENCES

A. American Bearing Manufacturers Association:
   1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
   2. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

C. American Society of Mechanical Engineers:

D. ASTM International:
   1. ASTM A90/A90M - Standard Test Method for Weight Mass of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.

E. Cooling Technology Institute:
   1. CTI - Acceptance Test Code.
   2. CTI 201 - Certification Standard for Commercial Water Cooling Towers.
F. National Electrical Manufacturers Association:
   1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.4 SUBMITTALS

   A. Shop Drawings: Indicate structural steel supports including dimensions and locations for mounting-bolt holes.

   B. Product Data: Submit rated capacities, dimensions, weights and point loads, accessories, required clearances, electrical requirements and wiring diagrams, and location and size of field connections. Submit schematic indicating capacity controls. Submit performance curve plotting leaving water temperature against wet bulb temperature.

   C. Field Test Reports: Indicate compliance with specified performance.

   D. Manufacturer's Certificate: Certify cooling tower performance meets or exceeds specified requirements.

   E. Manufacturer’s Field Reports: Submit start-up report. Indicate compliance with field test.

1.5 CLOSEOUT SUBMITTALS

   A. Operation and Maintenance Data: Submit start-up instructions, maintenance data, parts lists, controls, and accessories.

1.6 QUALITY ASSURANCE

   A. Construction and rating in accordance with CTI Acceptance Test Code and CTI 201.

   B. Performance Ratings: Required performance not less than prescribed by ASHRAE 90.1 when tested in accordance with CTI Acceptance Test Code and CTI 201.

   C. Cooling tower to be Factory Mutual approved and shall be listed in the latest FM approval guide.

1.7 QUALIFICATIONS

   A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum fifteen years documented experience.

   B. Installer: Company specializing in performing work of this section with minimum five years experience.

1.8 DELIVERY, STORAGE, AND HANDLING

   A. Follow manufacturer's installation instructions for rigging, unloading, and transporting units.

   B. Match mark dissembled components. Reinforce, brace and pack for shipment per applicable commerce requirements. Seal open ends subject to detrimental conditions with removable closures.
C. Mark packed materials for identification. Show on shipping invoice, crate, box, carton or component identification, the Department’s purchase order number and consignee’s name and shipping address.

D. Notify Department within 24 hours of shipment of equipment. The following information shall be supplied: shipping date, carrier PRO number, truck number, quantity, weights, items shipped, and estimated time of arrival.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 WARRANTY

A. Upon completion, the manufacturer shall issue a written warranty, duly authorized, covering the following:
   1. The cooling tower structure and internal components shall be warranted against defects in material and workmanship and the systems shall meet operating conditions, capacity, and performance for the greater period of 18 months from the shipment of materials or 12 months from beneficial use by the College. The mechanical equipment and motors shall be warranted for 2 years from beneficial use. If either the unit or accessories fail to meet operating requirements or if failure of a part occurs during this warranty period, rework or replace items to meet the contract requirements at no cost to the College.

B. The College reserves the option to request thermal or sound performance test per CTI Standards throughout the warranty period.

1.11 MATERIALS

A. Provide two sets of any special tools required or recommended by Manufacturer for field maintenance.

PART 2 PRODUCTS

2.1 COOLING TOWERS

A. Manufacturers:
   1. Marley Cooling Tower.
   2. Baltimore Aircoil.
   3. Evapco.
   4. Or equivalent as approved by the Professional.

B. Product Description: factory assembled, sectional, cross-flow design, with fan and motor assemblies, built with pan, casing, fill and drift eliminators.

2.2 STEEL COOLING TOWERS

A. General:
1. Completely factory assembled, piped and wired, requiring no field assembly, with the exception of field installed accessories.

2. Suitable for installation in the space conditions indicated on drawings, including clearance for installation, operation, maintenance, and air flow into and out of tower. Cooling tower manufacturer shall certify tower for space conditions given.

3. The load and location of required cooling tower supports shall be provided by this manufacturer. Manufacturer shall design cooling tower and provide materials necessary for attachment to dunnage steel.

4. Tower design and materials of construction, including fill, shall have a design life expectancy of not less than 10 years for the geographical location and atmospheric conditions of the installation. Towers shall be bolted or with continuously welded basin construction. Spot welded construction is not permitted. Towers shall be designed for wind load as required by BOCA and in accordance with authorities having jurisdiction.

5. Except as noted, all components shall be stainless steel.

6. PVC fill shall be cross-corrugated 20 mil (before forming) thick sheets. Fill shall withstand a continuous 120°F continuous water temp, and a 130°F maximum water temperature. The fill shall be impervious to rot, decay, fungus and biological attack. Maximum flame spread and smoke developed ratings of 25 & 50 respectively.

7. PVC eliminators and louvers shall be 15 mil thick with maximum flame spread and smoke developed ratings of 25 & 50 respectively. Triple-pass drift eliminators shall be used.

8. Fans and drives: Except as noted, airflow shall be manually adjustable in the field through adjustable pitch fan blades. Fans shall be statically balanced in factory and properly supported to prevent damage in shipment and rigging. Drive shall be designed for minimum 150 percent of motor horsepower. Provide stainless steel for fans and drives. Acceptable fan and drives include:
   a. Propeller fans: Cast aluminum. Fan blades shall connect to hubs using stainless steel Grade 8 bolts or approved alternate as approved by Professional.
   b. Gear drives: Right angled type suitable for cooling tower duty, provide oil level indicator and reservoir with fill and drain connections which shall be extended to the fan deck level for access. A five-year warranty shall be provided for gear drives. First five years of oil changes to be provided by manufacturer (including all oil, disposal and labor). Gear drives will not require an external oil pump or require an electric internal pump. Vibration switch to be mounted on or near fan drive and shall disable motor in the event of a trip. All gearbox bearings shall be rated at an L10A service life of 100,000 hours or greater and the gear sets shall have AGMA Quality Class of 9 or greater. The gearbox shall include any modifications to enable operation down to 10% of full speed.

9. Distribution orifices and spray nozzles: Plastic, individually removable for cleaning or replacement, capable of passing a 1/4" sphere (minimum 5/16" opening). Provide stainless steel distribution basin or corrosion resistant plastic distribution system to distribute water evenly over the tower fill. Provide two compartment water basin (or other engineered means) to provide balanced distribution flow across entire out-board face at reduced (33%) flow rate. The water distribution system shall be equipped with a method to operate under variable flow conditions while maintaining a uniform air-side pressure drop through the fill to maximize cooling efficiency and minimize the risk of ice and scale formation in the fill. System must accommodate flow rates down to 33% of design flow.

11. Fan and drive guards: Provide OSHA approved guards and screens around fans, drives and motors as necessary to protect people outside tower from injury due to moving parts. Provide warnings on access doors to caution operations as to hazards of moving parts.

12. Ladders, platforms, hand rails and access doors: Provide for ready access to all components, including balancing valves, hot water distribution basins or nozzles, cold water basin and all components located within it, motor lubrication fittings, gear oil level indicators, oil fill connections, oil drain valves, power band, etc. Gear oil level must be readable from the outside of the cell and/or during operation. Follow local, town, and state codes. Ladders shall extend to within 12" of access level (roof or platform). Ladder to fan deck shall be aluminum, with 1-1/4" steel pipe handrail around fan deck. Ladders, platforms and handrail shall conform to all OSHA requirements, including cages if ladders exceed 20 ft height or if shown on drawings. Provide access doors on both sides of casing and interior platforms to allow access through the interior of one tower cell to the adjacent tower cells. A galvanized steel access door shall be located on both end walls for entry into the cold water basin and fan plenum area. Access doors shall be operable from inside as well as outside the tower. Provide SS internal access walkway and galvanized steel or fiberglass mechanical equipment platform with handrails.

13. Connection points and cooling tower structure shall withstand forces imposed by rigging equipment of 2g horizontal and 3g vertical magnitudes with no compromise to the structural integrity of any components. The calculations shall be performed with the tower in the condition it will be delivered. Eye bolts or other approved means shall be provided for four point rigging of tower as approved by Professional.

14. The complete mechanical equipment assembly for each cell shall be supported by two horizontal steel beams that resist misalignment between the motor and the gear reducer/belt drive system. The mechanical equipment assembly shall be warranted against any failure caused by defects in materials and workmanship for no less than five (5) years following the date of tower shipment. This warranty shall cover the fan, speed reducer, drive shaft and couplings, and the mechanical equipment support. The electric motor shall carry a manufacturer's warranty of at least two years.

B. Double flow, Cross flow, vertical discharge type:

1. Cold water basin: Welded 304 stainless steel for all components, including collection basin bottom and sides, flanged inlet connections as shown on drawings, bolts and nuts. Basin to be set up with bottom supply, return and equalizer connections as shown on the plans. Condenser water headers and distribution system shall be internal to the cooling tower structure with external flanged connections. All connections to system piping to be provided with 150# ANSI flanges. Basin freeboard to be minimum 18.” Provide 2” mechanical float valve per cell for water make-up.

2. Provide single self-balancing bottom inlet piping connection per cell. Internal piping shall be supplied/supported by the manufacturer of schedule 40 PVC piping and shall be self-draining when pump is shut down.

3. Accessories:
   a. Provide fan cylinder or casing extension for overall tower height as shown on drawings,
   b. Vibration switch,
   c. Portable mechanical equipment removal davit with hand winch and cable for use on any of the four cells,
   d. Removable stainless steel covers for hot water basins
   e. Stainless steel air inlet screens.
f. Electric basin heater package per cell consisting of 2@12 KW elements, control panel with contactor, disconnect, transformer, low level sensor and thermostat in NEMA 4X enclosure.

g. ABB ACH 550 style or equivalent VFD in NEMA 1 enclosure with automatic switchover to bypass on loss of drive. Refer to Section 15172.

h. A complete UL listed Variable Speed Drive system in a NEMA 1 indoor enclosure shall be provided. The VFD shall use PWM technology with IGBT switching. VFD output switching signal shall be programmed to not cause mechanical vibration issues with backlash in gearbox teeth or vibration issues associated with long driveshafts. The VFD shall be programmed for variable torque applications and shall catch a fan spinning in the forward or reverse direction without tripping. VFD panel construction shall include a main disconnect with short circuit and thermal overload protection with external operating handle, lockable in the off position for lock-out tag-out safety procedures. A service switch directly ahead of the VFD shall be provided for voltage isolation during VFD maintenance. An integrated full voltage non-reversing bypass starter shall be furnished allowing fan motor operation if VFD has failed. The VFD system shall receive a speed reference signal from the building management system monitoring the tower cold-water temperature. As an option to receiving the speed reference signal from a building management system, the drive must have the capability to receive a 4-20 mA temperature signal from an RTD transmitter. The VFD shall have an internal PI regulator to modulate fan speed maintaining set point temperature. The drive’s panel shall display the set-point temperature and cold-water temperature on two separate lines. The bypass shall include a complete magnetic bypass circuit with the capability to isolate the VFD when in the bypass mode. Transfer to the bypass mode shall be manual in the event of VFD failure. Once the motor is transferred to the bypass circuit the fan motor will run at constant full speed. Operator controls shall be mounted on the front of the enclosure and shall consist of Start and Stop control, Bypass/VFD selection, Auto/Manual selections and manual speed control. To prevent heating problems in the cooling tower fan motor the VFD system shall de-energize the motor once 25% motor speed is reached and cooling is no longer required. The cooling tower manufacturer shall supply VFD start-up assistance and vibration testing throughout the speed range to identify and lockout any natural frequency vibration levels which may exceed CTI guidelines.

i.

C. Performance:

1. Design

<table>
<thead>
<tr>
<th>BASE BID</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Cells</td>
<td>4</td>
</tr>
<tr>
<td>Total Flow, gpm</td>
<td>3,000 per cell</td>
</tr>
<tr>
<td>Entering Water Temp, ºF</td>
<td>100.7</td>
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<tr>
<td>Leaving Water Temp, ºF</td>
<td>85</td>
</tr>
<tr>
<td>Design Inlet Wet Bulb, ºF</td>
<td>78</td>
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<tr>
<td>Max pressure at inlet flange, ft</td>
<td>By Manufacturer</td>
</tr>
<tr>
<td>Maximum Motor HP</td>
<td>100 HP</td>
</tr>
<tr>
<td>Motor HP (Supplied)</td>
<td>By Manufacturer</td>
</tr>
<tr>
<td>Max. Fan Tip Speed</td>
<td>13,000 FPM</td>
</tr>
</tbody>
</table>

The College of New Jersey Chiller Plant Improvement for STEM buildings

Cooling Towers

15680 - 6

Mar, 2015
2. Noise: Airborne noise emitted by the cooling tower with all cells operating at full speed with any noise attenuating devices in place shall not exceed the following sound pressure levels in dBA re. 0.0002 microbar for a free and unobstructed environment. Provide A-weighted and octave band values for each side and top of cooling tower. Maximum values are as follows:
   a. 76dBA at 50 ft from air inlet faces
   b. 71dBA at 50 ft from air discharge
   c. 81dBA at 50 ft from cased (solid) faces

2.3 ELECTRICAL CHARACTERISTICS AND COMPONENTS

   A. Electrical Characteristics: In accordance with Section 26000 and the following:
      1. 480 volts, three phase, 60 Hz.

   B. Motors: In accordance with Section 15170.
      1. Motors shall be TEFC (Totally-Enclosed-Fan-Cooled), NEMA T frame, NEMA F1 assembly.

   C. Disconnect SwitchField installed as shown on plans

PART 3 EXECUTION

3.1 EXAMINATION

   A. Verify support is ready to accept tower.

   B. Verify dimensions of support are as shown on shop drawings.

3.2 INSTALLATION

   A. Install tower on the existing concrete slabs in accordance with manufacturer’s published instructions.

   B. Install condenser water piping with flanged connections to tower. Pitch condenser water supply to tower and condenser water suction away from tower.

   C. Install make-up water piping with flanged or union connections to tower. Pitch to tower.

   D. Install overflow, bleed, and drain, to sump.

   E. Install Work in accordance with all New Jersey codes and standards.
3.3 FIELD QUALITY CONTROL

A. Cleaning: Clean inside of the cooling tower thoroughly before filling with water for start-up. Clean factory finished surfaces. Repair any marred or scratched surfaces with manufacturer’s epoxy or re-galvanizing touch-up paint approved by Department.

B. Test for capacity under actual operating conditions per CTI Standards using an independent testing agency to verify compliance with the performance requirements. The test shall be performed on site after the tower is functional. The Department will notify the manufacturer of the date of the test. Provide supervisory personnel to witness the test.
   1. Should the test indicate failure to fully comply with performance requirements, modify as required and retest to demonstrate specified performance. Submit modifications for approval. Any approved modifications and retesting will be made at no cost to the Department.

C. Sound performance compliance test: Test will be conducted by the Department’s Acoustical Consultant. Test will establish compliance or non-compliance with “Sound design criteria” as specified in Performance Section. Test shall be performed on site after tower is functional. Advise Department and Professional two weeks prior to test date.
   1. Should test fail to meet specified performance, modify as required and retest to demonstrate specified performance. Submit modifications for approval make any modifications as approved or directed at no additional cost to the Department.

3.4 MANUFACTURER’S FIELD SERVICES

A. Supervise rigging, hoisting, and installation; include five eight-hour days per tower.

B. Inspect tower after installation and submit report prior to start-up, verifying installation is in accordance with specifications and manufacturers recommendations.

3.5 ADJUSTING

A. Adjust bleed, control settings and airflow.

3.6 DEMONSTRATION AND TRAINING

A. Demonstrate starting, maintenance and operation of tower.

3.7 SCHEDULES

A. See drawings.

END OF SECTION
SECTION 15685 - PACKAGED ELECTRIC MOTOR DRIVEN CENTRIFUGAL CHILLER

Part 1. GENERAL

1.1 SCOPE OF WORK

A. Furnish one 1,500 ton packaged motor driven, centrifugal chiller F.O.B. to The College of New Jersey, Ewing, NJ with freight prepaid and equipment insured. Chillers shall be shipped in one piece (evaporator, condenser, compressor and motor) and sealed as required for rigging and installation. Chillers shall include but not limited to the following components:
   1. Refrigerant cooler and condenser
   2. Centrifugal compressor
   3. Motor with variable frequency drive
   4. Charge of refrigerant and oil
   5. Controls and instrumentation
   6. Refrigerant side isolation valves for maintenance
   7. Refrigerant detection system

B. Provide supervision by factory-trained personnel for installation of chiller and miscellaneous components installed under this contract.

C. Provide alternate price for breaking down chiller and sealed as required for shipping, rigging and installation.
   1. Additional cost: disassembly of the chiller in the factory
   2. Additional cost: field supervision of field reassembly.
   3. Deduct cost: installation of insulation.

1.2 SUMMARY

A. This specification describes packaged centrifugal chillers driven by an electric motor via a solid state AC Voltage Source PWM Variable Frequency Drives (VFD). This specification applies to new chiller applications

1.3 DEFINITIONS

A. BMS: Building management system.

B. IGBT: Integrated gate bipolar transistor.

C. LAN: Local area network.

D. PID: Control action, proportional plus integral plus derivative.

E. PWM: Pulse-width modulated.

F. VFD: Variable frequency drive.

1.4 QUALITY ASSURANCE
A. Manufacturer shall be specializing in the manufacture of the products specified in this Section with minimum ten years documented experience and minimum five years experience with the model specified in this Section.

B. Unit shall be manufacturer’s standard product, designed and manufactured in accordance with appropriate industry standards, including ASHRAE-90.1-2010.

1.5 SUBMITTALS

A. Product data: Detailed equipment drawings including dimensional information, weight, support details, catalog cuts of components, electric requirements, wiring diagrams and control sequence.

B. Performance data: for full load and part load conditions as indicated hereinafter.

C. Assembly drawings indicating field piping and wiring requirements.

D. Furnish complete wiring diagrams of the centrifugal chiller and required starter interlocks for devices supplied by this vendor and those required and provided by others such as but not limited to components like: pumps, flow switches, refrigerant leak sensors, miscellaneous interlocks, etc. as applicable.

E. For the Variable Frequency Drive
   1. Technical performance specifications
   2. Current harmonic spectrum for the actual VFD proposed (for verification of a harmonic analysis study performed by others).

F. Operation and Maintenance Data
   1. Include start-up instructions, maintenance data, parts lists, controls, and accessories. Include trouble-shooting guide.
   2. Provide eight (8) sets of operation and maintenance manuals to owner after completion of chiller startup.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Units shall be stored and handled in accordance with manufacture’s instructions.

B. The chiller shall be adequately packaged to provide protection from exposure to the elements and damage encountered during normal shipping and sheltered storage.

Part 2. PRODUCTS

2.1 MANUFACTURERS

A. Chillers
   1. Carrier Corp.
   2. McQuay
   3. York International Corp.
   4. Or equivalent
2.2 CHILLER UNIT

A. Design Operating/Performance Data:
   1. Refrigerant: R134a
   2. Chiller nominal capacity: 1500 tons, rated for the following conditions:

<table>
<thead>
<tr>
<th>Condition</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaporator Flow, gpm</td>
<td>3000</td>
</tr>
<tr>
<td>Entering water temp, °F</td>
<td>54</td>
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<tr>
<td>Leaving water temp, °F</td>
<td>42</td>
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<tr>
<td>Max. velocity, ft./sec.</td>
<td>6.5 to 7.5</td>
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<tr>
<td>Number of passes</td>
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<tr>
<td>Condenser Flow, gpm</td>
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<tr>
<td>Entering water temp, °F</td>
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<tr>
<td>Leaving water temp, °F</td>
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<tr>
<td>Max. velocity, ft./sec.</td>
<td>6.5 to 7.5</td>
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<tr>
<td>Number of passes</td>
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<tr>
<td>Motor voltage, V</td>
<td>480</td>
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<tr>
<td>Min. Efficiency, kW/ton</td>
<td>0.6</td>
</tr>
<tr>
<td>Min IPLV Efficiency:</td>
<td>.35</td>
</tr>
</tbody>
</table>

B. Initial charge of oil and refrigerant shall be supplied, shipped in containers and cylinders for field installation.

C. Maximum height of the chiller shall be 11’-8”.

D. Manufacturer's Certification:
   1. Chiller manufacturer shall certify in writing chiller energy input for each of the following load points:
      a. 20 percent of full load at entering condenser water temperature per ARI.
      b. 33 percent of full load at entering condenser water temperature per ARI.
      c. 66 percent of full load at entering condenser water temperature per ARI.
      d. 100 percent of full load at 85 °F entering condenser water temperature
         e. For the conditions listed in Section 2.2.A.2 above.

E. ASME Nameplate:
   1. Evaporator and condenser: when the waterside will contain fluid of 120 gallons or more (including tubes and both water boxes) and the vessel will have an internal pressure exceeding 15 psig, the vessel shall display an A.S.M.E. nameplate which shows pressure and temperature data and the "U" stamp for Section VIII, Division 1 of the ASME Code

2.3 COMPRESSOR

A. Acceptable compressor type:
   1. Single-stage centrifugal type

B. Complete with:
   1. Impeller:
      a. Nonferrous, cast aluminum or approved equivalent material.
b. Dynamically and statically balanced after fabrication and tested to minimum 25 percent overspeed.
c. Sufficiently rigid to prevent any vibration at operating speeds. Operating speed below first critical speed.
d. Maximum impeller speed: 13,000 rpm.

2. Casing: close-grain cast iron or approved equivalent material.

3. Forced-circulation lubricating system with:
   a. Main oil pumps driven either by motor or through gears from compressor shaft. Provide an electric motor driven auxiliary oil pump.

4. Oil pump operation:
   a. Pump shall operate automatically before compressor start and during coast down.
   b. Oil flow must be proven for compressor to run.

5. Oil system complete with:
   a. Pressure-relief valves
   b. Oil piping
   c. Oil cooler: design for use with chilled water, condenser water or directly cooled by refrigerant
   d. Oil filter
   e. Oil reservoir
   f. Information transmitted to control panel:
      1) Oil pressure
      2) Oil temperature
      3) Oil level
   g. Oil heater:
      1) Size to prevent oil from absorbing refrigerant during shutdowns
      2) Thermostatically controlled

6. Automatic capacity control:
   a. Variable inlet guide vanes operating through arc of 90 deg
   b. Vanes:
      1) Stainless steel or nonferrous alloy
      2) Heat-treated stainless steel or nonferrous alloy shafts
      3) Approved-type positive seal where vane operating mechanism transmits motion to linkage

7. Lifting device: eyebolt or approved device to permit lifting compressor.

2.4 GEAR DRIVE (IF REQUIRED)

A. Gear transmission:
   1. Self-aligning type, integral to compressor
   2. Have sufficient capacity to transmit maximum compressor load plus 10% under all operating conditions.
   3. To operate without objectionable noise or vibration
   4. Design and manufacture in accordance with latest American Gear Manufacturers Association (AGMA) standards.

B. Gear:
   1. Double helical type
   2. Gear teeth flooded continuously with filtered oil

C. Bearings:
1. Suitable for both gears and pinions
2. Pressure-lubricated

D. Temperature rise of gears: not to exceed 70 deg F above ambient at full load.

2.5 EVAPORATOR

A. Type: shell and tube. Fouling factor: 0.0001

B. Shell: welded steel construction.
1. Design water side for 150 psi working pressure
2. Test not less than 1.5 times maximum working pressure.
3. Design refrigerant side for 20% over the normal operating pressure but not less than 265 psig.  
   a. Test not less than 1.5 times maximum working pressure.

C. Tubes:
1. Copper:
   a. Minimum 0.028 inch wall thickness measured at the root of fins.
   b. Integral copper fins.
2. Rolled into tube sheets and supports in equal sized holes for all tubes.
3. Removable without affecting tube sheet or causing leakage of adjacent tubes
4. Supports: maximum 5 ft on center

D. Tube sheet:
1. Carbon steel suitable for withstanding working pressure
2. Welded to evaporator shell
3. Intermediate tube sheets to prevent tube vibration. Tubes shall be smooth at the point where they are expanded into the tube sheet.

E. Water boxes:
1. Water boxes shall be marine type unless otherwise stated on the design drawings, with hinged removable covers to permit tube cleaning and replacement. ANSI 150 lb flanged water connections.
2. Vent and drain connections
3. Bolted to shell
4. Tappings for thermometers, control bulbs and gauges

F. Baffles:
1. To prevent direct impingement of liquid on tubes
2. To uniformly distribute liquid refrigerant

G. Eliminators:
1. Nonferrous
2. To prevent liquid refrigerant from entering compressor

H. Refrigerant-charging connection

I. Relief valve:
1. Relief valve and/or rupture disc with piping connection kits.
2. In accordance with requirements of:
a. Authorities having jurisdiction
b. Safety Code for Mechanical Refrigeration, ASHRAE 15

J. Sight glass and/or low level alarm: to indicate liquid refrigerant level
K. Thermometer to indicate refrigerant temperature
L. Water velocity: as indicated in Section 2.2.A.2

2.6 CONDENSER

A. Type: shell and tube.
   1. Fouling factor: 0.00025

B. Shell: welded steel construction.
   1. Design refrigerant side for 20% over normal operating pressure but not less than 265 psig. Test not less than 1.5 times maximum working pressure.

C. Construction, similar to evaporator for:
   1. Tubes - Turbulators not permitted
   2. Tube sheets
   3. Intermediate tube sheet supports
   4. Water boxes with hinged covers

D. Baffles:
   1. To prevent direct impingement of refrigerant gases upon tubes
   2. To uniformly distribute gas refrigerant over length of condenser
   3. Non-corrodible baffle sheet to segregate and collect noncondensable gases for compression purging.
   4. Purge connection: non-corrodible materials

E. Water boxes:
   1. Water boxes shall be marine type unless otherwise stated on the design drawings, with hinged removable covers to permit tube cleaning and replacement. ANSI 150 lb flanged water connections.
   2. Vent and drain connections
   3. Bolted to shell
   4. Tappings for thermometers, control bulbs and gauges

F. Water velocity: maximum 10 ft per second in tubes; minimum 3.5 ft. per second.

2.7 SUPPORTS

A. Provide manufacturer’s standard support kit including neoprene pads for vibration isolation. Indicate locations and sizes of anchor bolts, if required.

2.8 DRIVE MOTOR

A. General
1. In accordance with NEMA, EPAct 2005, IEEE, and ANSI C50 standards, suitable for inverter duty. Motor to be compatible for operation with variable frequency drive.

2. Capacity:
   a. As required for non-overloading operation of the driven chiller.

3. NEMA locked rotor CODE "G" or better.

4. Insulation: Class H

5. Service factor
   a. 1.15 minimum.
   b. Motor not to be operated in service factor.

6. Type:
   a. 3 phase, NEMA rated for 480V service.

7. Bearings, except as noted:
   a. Ball or roller type.
   b. Pressure type grease lubricating fittings similar to Alemite.
   c. Rated life: 100,000 hours.

8. Stator
   a. Temperature rise: 80ºC

9. Terminal box:
   a. Oversize.

10. Motor and pump noise level shall not exceed 86 dBA sound pressure level when measured at 3 ft. in accordance with IEEE Publication 85.

11. Minimum power factor of 86%.

12. Efficiency:
    c. Unless noted otherwise, all motors shall be premium efficiency with a nominal minmu efficiency of 95%.

B. Open type motor:
   1. Open Drive, ODP type enclosure (or as required to meet the noise level criteria). Openings in motor to exposed windings to have protective insect screens. No holes larger than 1/4 inch in diameter shall exist in exterior casings, which separate the room and high voltage components of any type.

2.9 VARIABLE FREQUENCY DRIVE

A. Service Conditions:
   1. Line voltage variations: +10 percent, -10 percent of nominal with full output.
   2. Line frequency variations: ±2 hertz.
   3. Overload capability of up to 130 percent of full drive rating for variable torque loads.
   4. Ambient temperature, continuous, full speed, full load operation: 0ºC to 40ºC.
   5. Storage temperature range of: -5ºC to 50ºC.
   6. No side clearance shall be required for cooling.
   7. Maximum altitude limit: 3,300 feet.
   8. Maximum humidity: 95 percent (non-condensing).
   9. Acceleration at 0.5 G maximum (20-50 Hz). Amplitude at 0.1mm maximum (50-100 Hz).
10. Efficiency in excess of 95 percent at full load/full speed and in excess of 80 percent at half speed on a variable torque load (cubic load).

B. General:
1. Description: NEMA ICS 2, IGBT, PWM, VFD; listed and labeled as a complete unit and arranged to provide variable speed of a NEMA MG 1, Design B, 3-phase, premium-efficiency induction motor by adjusting output voltage and frequency.
2. Design and Rating: Match load type: chillers; and type of connection used between motor and load such as direct or through a power-transmission connection.
3. Output Rating: 3-phase; 6 to 60 Hz, with voltage proportional to frequency throughout voltage range.
4. Drive shall be capable of operating any standard squirrel cage induction motor with load rating within the capacity of the drive. At any time in the future, it shall be possible to substitute a new or rewound motor in the field without requiring modification of the drive.
5. For maintenance purposes, drive shall be capable of starting, stopping and running with stable operation with the motor completely disconnected (no load).

C. Voltage:
1. 460 Volt, 3 phase, 60 Hz.

D. Features:
1. Drive enclosure shall be
   a. NEMA Type 1, unit mounted, metal cabinet with lockable hinged front access door(s), filtered ventilation system, and controls that are mounted, factory wired and tested.
2. Fused, interlocked disconnect switch or input line circuit breaker, externally operated, interlocked with enclosure door. Short circuit interrupting rating of 100,000 amps.
3. Internal 115 VAC control power circuit with transformer and primary and secondary protective fuses.
4. One normally open and one normally closed contact from run relay, wired to terminal for customer use. Contactors to enable control of drive from a BMS for start/stop and load shed operation through remote speed reset.
5. Controlled acceleration and deceleration, separably adjustable, shall be provided from 0.5 to 200 seconds with torque limit override acceleration protection and regeneration protection during deceleration.
6. Drive shall automatically adjust the volts/Hz ratio to the motor in proportion to its load without changing speed in order to conserve the maximum amount of energy.
7. Separately adjustable maximum and minimum frequency limits shall be provided.
8. Low frequency/low voltage start with linearly adjustable ramp up to pre-selected speed.
9. All components shall be accessible from the cabinet door for service.
10. Drive fault alarm contact for remote indication.
11. Automatic reset of drive to receive start command after any normal shutdown, including power outages.
13. Drive shall be constructed with integral protection against all normal transients and surges in the incoming power line, any grounding or disconnecting of the output power line, and any interruption or runaway of the incoming speed reference signal. Protection is defined as a normal shutdown or return to original speed with no component damage.

14. Drive shall protect itself against all phase-to-phase and phase-to-ground faults.

15. Drive shall protect itself against any removal of load.

16. Drive shall employ adjustable torque limit control to override the speed command and decrease the frequency while maintaining the correct volts/Hz ratio whenever the load level surpasses the drive design level.

17. Drive shall protect itself against single-phasing and power outages and shall be insensitive to input phase rotation.

18. Drive shall start into a spinning motor or shut down with no component damage.

19. Drive shall ride through any input power dip of three cycles or less.

20. Drive shall go through an orderly shutdown when the incoming voltage low limit is surpassed.

21. Instantaneous overcurrent trip (IOT) shall continuously monitor peak currents. It shall provide instantaneous shutdown without component failure when high limit setting is surpassed.

22. Torque limit shall be settable from 50 to 100 percent of full drive rating on variable torque loads. When torque limit engages, the output frequency is steadily reduced until the load reduces to the design capacity. At that point, the speed will stabilize. If the load reduces further, the drive shall re-accelerate to the preset speed.

23. Drive shall include line reactors or DC bus chokes of minimum 5% impedance to reduce line noise generated by the drive. The drive manufacturer shall prepare and submit calculations to estimate harmonic distortion levels prior to the installation. Individual or simultaneous operation of the VFD shall not add more than 5 percent total harmonic voltage distortion to the normal bus per IEEE 519, 2010. Maximum allowable total and individual harmonic current distortion limits for each odd harmonic shall not exceed limits as set forth by IEEE 519, 2010. The utility connection shall be the point of common coupling for current distortion. Line notch area shall not exceed 22,800 (V/S) and minimum 5 (Rho) line notch depth. An input AC line reactor or other form of harmonic filter to ensure that this standard is met shall be provided.

24. The VFD must meet the requirements for Radio Frequency Interference (RFI) above 7 MHz as specified by FCC regulations, part 15, subpart J, Class A devices.

25. A digital diagnostic system which monitors its own control functions and displays faults and operating conditions.

26. VFD shall be capable of PID (Proportional, Integral, Derivative) logic, to provide closed-loop setpoint control capability, from a remote reference. In addition, an energy saving sleep function should be used in conjunction with the PID control. The SLEEP function reduces the unnecessary operation of equipment. When the SLEEP function senses a minimal deviation of a sensor (pressure, temperature), the system reacts by removing the run signal from the equipment. Upon receiving an ample sensor signal deviation, the equipment returns the run signal and resumes normal operation.

27. Provisions shall be made for top or bottom entry/exit of incoming line power cables, outgoing load cables and control wiring.
28. Galvanic isolation shall be provided between the VFD’s power circuitry and control circuitry to ensure operator safety and to protect connected electronic control equipment from damage caused by voltage spikes, current surges, and ground loop currents.

E. Protective Features

1. A minimum of Class 20 I2t electronic motor overload protection for single motor applications shall be provided. Overload protection shall automatically compensate for changes in motor speed.

2. Protection against input transients, loss of AC line phase, output short circuit, output ground fault, over voltage, under voltage, VFD over temperature and motor over temperature. The VFD shall display all faults in plain language. Codes are not acceptable.

3. Protect VFD from input phase loss. The VFD should be able to protect itself from damage and indicate the phase loss condition. During an input phase loss condition, the VFD shall be able to be programmed to either trip off while displaying an alarm, issue a warning while running at reduced output capacity, or issue a warning while running at full commanded speed. This function is independent of which input power phase is lost.

4. Protect from under voltage. The VFD shall provide full rated output with an input voltage as low as 90% of the nominal. The VFD will continue to operate with reduced output, without faulting, with an input voltage as low as 70% of the nominal voltage.

5. Protect from over voltage.

6. The VFD shall incorporate a programmable motor preheat feature to keep the motor warm and prevent condensation build up in the motor when it is stopped in a damp environment by providing the motor stator with a controlled level of current.

7. VFD shall include a “signal loss detection” algorithm with adjustable time delay to sense the loss of an analog input signal. It shall also include a programmable time delay to eliminate nuisance signal loss indications. The functions after detection shall be programmable.

8. VFD shall function normally when the keypad is removed while the VFD is running. No warnings or alarms shall be issued as a result of removing the keypad.

9. VFD shall catch a rotating motor operating forward or reverse up to full speed without VFD fault or component damage.

10. Selectable over-voltage control shall be provided to protect the drive from power regenerated by the motor while maintaining control of the driven load.

11. VFD shall include current sensors on all three output phases to accurately measure motor current, protect the VFD from output short circuits, output ground faults, and act as a motor overload. If an output phase loss is detected, the VFD will trip off and identify which of the output phases is low or lost.

12. If the temperature of the VFD’s heat sink rises to 80ºC, the VFD shall automatically reduce its carrier frequency to reduce the heat sink temperature. It shall also be possible to program the VFD so that it reduces its output current limit value if the VFD’s temperature becomes too high.

13. In order to ensure operation during periods of overload, it must be possible to program the VFD to automatically reduce its output current to a programmed value during periods of excessive load. This allows the VFD to continue to run the load without tripping.
14. The VFD shall have temperature controlled cooling fan(s) for quiet operation, minimized losses, and increased fan life. At low loads or low ambient temperatures, the fan(s) may be off even when the VFD is running.

15. The VFD shall store in memory the last 10 alarms. A description of the alarm, and the date and time of the alarm shall be recorded.

16. A molded case circuit breaker with shunt trip and an external-operating handle shall provide branch circuit protection as well as main power disconnection. The circuit breaker shall have a short circuit rating of 100,000 amperes RMS symmetrical interrupting capacity and shall be labeled in accordance with UL Standard 489.

F. Interface

1. The operator interface shall be done at the chiller control panel. It shall be capable of controlling the drive and setting the drive parameters. The panel shall display:
   a. Frequency in Hertz.
   b. Manual or automatic control mode.
   c. Output frequency.
   d. Percent output voltage, or voltage.
   e. Percent output current, or current.
   f. KW.
   g. KWH.

2. The chiller digital keypad or touchscreen shall allow operators to enter exact numerical settings. All setup operations and adjustments will be digital, stored in non-volatile (EEPROM) memory. Analog or potentiometer adjustments are not allowed. Variables stored in EEPROM shall be transferable to new and spare boards. As a standard feature, these variables shall be protected from unauthorized tampering, revision, or adjustment by a personal lockout code.

3. The chiller control panel will allow easy VFD configuration. The parameter that can be adjusted will include:
   a. Output frequency
   b. Programming parameters.
   c. Fault clear/reset.

G. Serial Communication

1. The VFD shall include a standard EIA-485 communications port and capabilities to be connected to the following serial communication protocols at no additional cost and without a need to install any additional hardware or software in the VFD:
   a. Johnson Controls Metasys N2
   b. Modbus RTU
   c. Siemens FLN
   d. Or equivalent

2. Optional communication shall include:
   a. LonWorks Free Topology (FTP)
   b. BACnet MS/TP

3. Monitoring and setting of all operating and fault parameters will be available. A working software demonstration package shall be available upon request.

4. VFD shall have standard USB port for direct connection of Personal Computer (PC) to the VFD. The manufacturer shall provide no-charge PC software to allow complete setup and access of the VFD and logs of VFD operation through the
USB port. It shall be possible to communicate to the VFD through this USB port without interrupting VFD communications to the building management system.

5. The VFD shall have provisions for an optional 24 V DC back-up power interface to power the VFD’s control card. This is to allow the VFD to continue to communicate to the building automation system even if power to the VFD is lost.

H. Chiller Controls
1. Communications between the existing Chiller Controller (CM) and VFD are performed via a Starter Module (SM) interface device. The SM will initiate starter commands such as start/stop of the compressor, pumps, spare alarm, and the shunt trip. The SM also contains logic capable of safely shutting down the chiller if communications with the chiller controller are lost.

2. As a part of the AC harmonic filter, the following digital readouts shall be provided at the chiller control panel. Separate meters for this information shall not be acceptable.
   a. Input KVA
   b. Total power factor
   c. 3 phase input voltage
   d. 3 phase input current
   e. 3 phase input voltage total harmonic distortion (THD)
   f. 3 phase input current total demand distortion (TDD)
   g. Self diagnostic service parameters.

3. The adaptive capacity control logic shall automatically adjust motor speed and compressor pre-rotation vane position independently for maximum part-load efficiency by analyzing information fed to it by sensors supplied and located throughout the chiller.

2.10 MICROPROCESSOR CONTROL CENTER

A. The unit will be furnished complete with a microcomputer control center in a locked enclosure.
   1. The chiller will be controlled through a single panel.
   2. The panel will have the capability to control inlet guide vane position in response to chiller load requirements.
   3. The control center will include a liquid crystal display (LCD) digital display showing all system parameters and detailing operation using a graphical representation of the chiller and its major components. The panel verbiage will be in the English language with numeric data in English or metric units.

B. Keypad or touchscreen: Digital programming of setpoints through a color coded, non-tactile keypad or touchscreen will include:
   1. Leaving chilled liquid temperature
   2. Remote chiller stop and pump manual restart
   3. Data logger

C. Variable Control Operation
   1. Compressor pre-rotation vanes will vary based on leaving chilled water temperature from the evaporator.

D. Security
1. Security access will be provided to prevent unauthorized change of setpoints, to allow local or remote control of the chiller, and to allow manual operation of the pre-rotation vanes and compressor oil pump.

E. Safety & other Shutdowns

1. All safety shutdowns will be annunciated through an alpha numeric display and consist of day, time, cause of shutdown, and type of restart required. Safety shutdowns will include:
   a. Low evaporator pressure
   b. High refrigerant condenser pressure
   c. Auxiliary safety
   d. High discharge temperature
   e. Faulty discharge temperature sensor
   f. High compressor oil temperature
   g. Power failure
   h. Loss of chilled water flow
   i. Low compressor oil pressure
   j. High compressor oil pressure
   k. Evaporator transducer or probe error
   l. Faulty compressor oil pressure transducers
   m. Compressor proximity sensor fault
   n. High speed thrust bearing oil drain temperature
   o. Faulty compressor proximity probe
   p. Open thermocouple probe
   q. Compressor overspeed.
   r. Compressor motor over current- Unit and starter shutdown for motor over current shall be microprocessor initiated.
   s. Compressor motor over voltage and under voltage and starter shutdown for motor over current shall be microprocessor initiated
   t. Insufficient time between compressor motor start and stop
   u. Insufficient time between compressor motor starts
   v. Compressor motor starter failure to transfer to full voltage
   w. Compressor motor starter fault
   x. Manual emergency shutdown

2. Other shutdowns will include:
   a. Low compressor oil temperature
   b. Power failure
   c. Low chilled water temperature
   d. Vanes open
   e. Compressor low differential oil temperatures

3. The safety shutdowns for the VFD will include:
   a. VFD shutdown – requesting fault data
   b. VFD – stop contacts open
   c. VFD – 105% motor current overload
   d. VFD – high phase A, B,C inverter heatsink temp.
   e. VFD – high converter heatsink temperature
   f. harmonic filter – high heatsink temperature
   g. harmonic filter – high total demand distribution

4. The cycling shutdowns for the VFD will include:
   a. VFD shutdown – requesting fault data
   b. VFD – stop contacts open
c. VFD initialization failed  
d. VFD - high phase A,B,C instantaneous current  
e. VFD – phase A,B,C gate driver  
f. VFD – single phase input power  
g. VFD – high DC bus voltage  
h. VFD – pre charge DC bus voltage imbalance  
i. VFD – high internal ambient temperature  
j. VFD – invalid current scale selection  
k. VFD – low phase A, B, C inverter heatsink temp.  
l. VFD – low converter heatsink temperature  
m. VFD – pre-charge - low DC bus voltage  
n. VFD – logic board processor  
o. VFD – run signal  
p. VFD – serial communications  
q. harmonic filter – logic board or communications  
r. harmonic filter – high DC bus voltage  
s. harmonic filter – high phase A, B, C current  
t. harmonic filter – phase locked loop  
u. harmonic filter – precharge – low DC bus voltage  
v. harmonic filter – DC bus voltage imbalance  
w. harmonic filter – 110% input current overload  
x. harmonic filter – logic board power supply  
y. harmonic filter – run signal  
z. harmonic filter – DC current transformer 1  
aa. harmonic filter – DC current transformer 2  

F. The following system operating information will include on a local or remote panel:  
1. Return/leaving chilled water temperature  
2. Return/leaving condenser water temperatures  
3. Evaporator/condenser refrigerant saturation pressures  
4. Differential compressor oil pressure  
5. Percent load  
6. Evaporator/condenser saturation refrigerant temperatures  
7. Compressor discharge temperature  
8. Compressor oil temperature  
9. Operating hours  
10. Number of starts counter  
11. Compressor motor voltage, by phase  
12. Compressor motor power factor  
13. Compressor motor kW  
14. Time between compressor stop and start  
15. Time between compressor starts  
16. Microprocessor, sensor and control failure  
17. Compressor motor starter fault  
18. Condenser pressure  
19. Evaporator pressure  
20. Lubricating oil pressure  

G. Sequence of Operation:  
1. Applying power to the control panel energizes the temperature, pressure, flow and other applicable safety circuits.
2. If all required safeties are satisfied, the chiller can be started by pressing the START button on the chiller control panel (or closing the remote start contacts if in the remote start/stop mode).

3. Once the START button has been pressed, the microprocessor ensures the proper sequencing of the oil pump, etc. to allow compressor start.

4. Once the compressor motor is running at full voltage, the microprocessor activates the capacity control algorithm to meet chilled water setpoint.

5. The chiller is stopped by pressing the STOP button on the chiller control panel (or opening the remote start contracts if in the remote start/stop mode).

6. The oil pump shall have a delayed OFF circuit to provide oil pressure during machine coast down.

7. In auto the oil pump shall be controlled by the microprocessor. In addition to automatic oil pump starting and stopping based on the sequence of operation the microprocessor shall also permit automatic timed pump starting and stopping when the chiller is OFF.

H. Start Interval Timer:
1. Start-to-start timer. To guard against stress or damage to the compressor motor and motor starter the unit shall be provided with a microprocessor or mechanical type variable interval timer, which shall inhibit the chiller from starting for approximately 15 minutes after a previous compressor motor start.

2. Stop-to-start timer. To guard against stress or damage to the compressor motor and motor starter the unit shall be provided with a microprocessor or mechanical type variable interval timer, which shall inhibit the chiller from starting after a compressor motor start. This will allow an organized sequential shutdown prior to restarting.

3. Fixed start-to-start or stop-to-start short cycling protection timers are not acceptable. The user shall have the ability to manually override the start-to-start and stop-to-start timers.

I. RS232 Port Communication
1. The chiller will be provided with an RS-232 port to output all system operating data, shutdown messages, and a record of the last four safety shutdowns to a remote printer (field supplied).

2. The control center will be programmable to provide data logs to the printer at a preset time interval.

3. The final communication protocol will be back net compatible.

J. Building Automation System Interface
1. Through a control center interface and/or hard wired points the system will provide the following:
   a. Remote chiller start/stop
   b. Reset of chilled water temperature
   c. Remote load limit
   d. Status messages indicating chiller is ready to start, chiller is operating, chiller is shutdown on a safety or other shutdowns requiring a manual reset.

2. The chiller control panel will allow it to be connected to the following serial communication protocols at no additional cost and without a need to install any additional hardware or software::
   a. Johnson Controls Metasys N2
b. Modbus RTU  
c. Siemens FLN  
d. Honeywell  
e. Optional communication shall include:  
   1) LonWorks Free Topology (FTP)  
   2) BACnet MS/TP

2.11 POWER PANEL

A. The power panel enclosure will house the following components:
   1. Single point wiring connection for incoming power supply  
   2. Compressor oil pump motor starter with overloads  
   3. Heater relay  
   4. 115VAC, 60 Hz, control supply transformer, supplied in panel.

2.12 CONTROLS

A. Capacity control:
   1. Electronic  
   2. Completely automatic:  
      a. Starting and stopping  
      b. Modulating capacity from 15 percent to 100 percent  
      c. Compressor started unloaded with electric-pneumatic interlock  
      d. Means to prevent excessive cycling of machine

B. Operation: Electric operation of compressor inlet guide vanes from 100 percent load to 15 percent load.

C. Controls permitting manual or automatic operation of oil pump and purge pump.

D. Leaving chilled water temperature controller:
   1. Display chilled water returning and leaving temperatures.  
   2. Range: +35 deg F to +75 deg F.  
   3. Control action:  
      a. Wide band, minimum 150 percent proportional type  
      b. Automatic reset action  
      c. Integral bypass permitting manual control of final control element  
   4. For servicing instrument: manual control during servicing and testing.  
   5. Flush-mounted on main refrigeration control board.

E. Safety controls:
   1. Digital control system will indicate the following:  
      a. Low refrigerant pressure or temperature for water chiller  
      b. Low water temperature for water cooler  
      c. High refrigerant pressure  
      d. Low compressor oil pressure  
      e. Minimum chilled water flow  
      f. Minimum condenser water flow  
      g. High oil temperature  
   2. Operation:  
      a. Units not to start without proper chilled water and condenser water flow.
b. Units to be shut down
   1) Upon reduction below predetermined water flow across chiller or condenser.
   2) Activation of other safety controls furnished with refrigeration machines.

3. Fully automatic system with:
   a. Relays
   b. Piping
   c. Calorimetric-type flow switches in condenser and chilled water lines to respective refrigeration machines.
   d. Other necessary appurtenances

2.13 ISOLATION/RECLAMATION SYSTEMS

A. Refrigerant Isolation System: Provide refrigerant valves with caps for isolation of refrigerant in either the evaporator or the condenser shells. Provide connection for a portable pumping system to moving the refrigerant charge from one vessel to the other.

B. Refrigerant Pump Out / Reclamation Connections: Connections will be factory provided as standard to facilitate refrigerant reclamation or removal required during maintenance or overhaul in accordance with ANSI/ASHRAE 15.

2.14 INSULATION

A. Factory applied, anti-sweat insulation will be attached to the cooler shell, flow chamber, tube sheets, suction connections, and (as necessary) to the auxiliary tubing. The insulation will be a flexible, closed-cell plastic type, ¾ inch thick, applied with vapor-proof cement. The insulation will normally prevent sweating in environments with relative humidities up to 90% and dry bulb temperatures ranging from 50 to 90 degrees Fahrenheit.

2.15 REFRIGERANT DETECTION SYSTEM

A. The monitor shall be capable of being programmed per application for the selected refrigerant gas per area monitored in PPM (parts per million) concentrations.

B. The monitor shall be automatically and continuously monitor for selected multiple refrigerant gases and compare concentrations to user-settable PPM limits per areas monitored for selected gas per area.

C. The monitor shall be of infrared non-dispersive detection type technology with factory calibrated settings for all selected refrigerants.

D. The monitor shall be equipped with three (3) relays, indicator lights and digital readout. (Full range of 4-20mA shall be optional.)

E. The monitor shall allow user to review area settings, including the current gas level reading and time the front face panel.

F. Three alarm levels shall be provided indicating “low alarm”, “main alarm” and “high alarm” conditions. Thresholds for all three alarms are to be individually field adjustable.
G. There shall be three (3) relays in the monitor unit. Three (3) relays shall be available for customer connections. All relays shall be rated at: 120 VAC at 5AMP.

1. **LOW ALARM**: The Low Alarm relay connection shall be provided for the addition of an audible or visual warning device. This relay will “energize” in the event that an area’s Low Alarm level has been exceeded.

2. **MAIN ALARM**: The Main Alarm relay connection shall be provided for the addition of an audible or visual warning device. This relay will “energize” in the event that an area’s Main Alarm level has been exceeded or a system fault or malfunction has been detected.

3. **HIGH ALARM**: The High Alarm relay connection shall be provided for the addition of an audible/visual warning device and an exhaust ventilation fan. This relay shall “energize” in the event an area’s High Alarm level has been exceeded.

H. Unit power consumption shall be less than 45 Watts maximum 120 volts AC.

I. Unit must automatically purge with fresh air for calibration verification after each area monitored and shall have field mounted tubing to clean air source.

J. Program access to be denied by key lock and pass code to prevent unauthorized personnel from disabling the device.

K. Program will automatically reset to full function settings after power interruption.

L. In the event of a malfunction, the type of fault shall be displaced on the LCD display.

M. The monitor will have a warranty period of one (1) year from the date of shipment from the manufacturer covering defects in material and workmanship.

N. Access to the inside of the enclosure shall be provided through a security key lock device positioned on the monitor front panel. Wiring connections shall be through electrical knock-out ports located on the bottom and side of the enclosure.

O. The monitor system shall require no periodic maintenance other than periodic checking and replacement of filters. Periodic checking or adjustments of the unit shall be accomplished by one person at the unit location.

P. The monitor shall be of the sample draw type with an internal pump and filters to draw gas samples to the monitor from a maximum of 250 feet from each monitoring area. The system shall provide visual alarm indication when preset levels are exceeded. Relay outputs for the purpose of external alarms or control shall be provided.

Q. Fittings suitable for the connection of \( \frac{1}{4} \)” O.D. tubing shall be provided on the side of the enclosure of the main monitor unit for the purpose of connecting the air sample and fresh air lines.

R. The refrigerant monitor shall be ETL listed, or equivalent, for the United States and conform to UL Standards 3101-1-U.S. and CAN/CSA C22.2 No.1010.1.

S. The monitor shall have a remote display capable of being mounted in a separate location (min 100 ft.) from the monitor and used in addition to the standard unit display.
1. The remote display can also be used to control the device
2. Information on gas concentration and alarm levels at the monitor shall be available on the display.
3. The remote display shall have a horn and strobe beacon.

T. The monitor shall be capable of interfacing with the site BMS through an Ethernet connection.

2.16 TESTING

A. Test: the manufacturer will perform a factory single point full load performance test.
   1. The manufacturer will notify the owner in advance of time and date of test.
   2. The owner or his representative will witness the factory testing.
   3. Test results are subject to Engineer’s approval.
   4. Provide remedial measures as required, should the chillers fail the performance test. Repeat the performance test after remedial work.

2.17 TOOLS AND CABINET

A. Provide a complete set of tools for servicing and maintenance of unit and typical spare parts in lockable storage cabinet. Include 1 year supply of spare leak detection filters and calibration gases (if so required for calibration).

Part 3. EXECUTION

3.1 INSTALLATION

A. Provide factory trained technician for field supervision of chiller installation.

3.2 START-UP

A. Start up: Provide factory trained technician for:
   1. Evacuation
   2. Charging
   3. Start-up and commissioning
   4. Ten days minimum per unit, inclusive of instruction period
   5. Upon completion and acceptance of installation, provide services of competent instructor for period of two eight-hour days, to properly acquaint authorized Owner’s representative with details as to enable them to obtain maximum efficiency in plant operation. Training dates shall be coordinated a minimum of 2 weeks in advance with Owner. Include O & M manuals for training courses; include training syllabus at time of training notification.
   6. Obtain written acceptance for each instruction day from Owner’s representative.

B. On-site measurements of the harmonic contributions due to the VFDs will be taken by the Owner’s representative to verify compliance with these specifications. Measurements will be taken at the specified point of common coupling with and without the chillers running. The chiller manufacturer’s representative can participate in the measurements.

3.3 WARRANTY
A. Two year parts and labor warranty for complete unit including VFD.

B. Provide alternate five year warranty for parts and labor for complete unit including VFD from date of shipping.

END OF SECTION
PART 1. GENERAL

1.01 WORK INCLUDED

A. Provide 1 plate and frame heat exchangers including all accessories and trim as specified.

B. Delivery of equipment specified. The College may require the manufacturer to store the equipment at no additional cost to the College until the College is ready to accept delivery. The College shall give 10 business days prior notice of equipment delivery.

C. Provide heat exchanger with tight fitting removable covers at all connection points and as required so as to preclude the entrance of construction dirt and debris into the open ends of exchanger during shipping, rigging and storage.

D. Include startup of the Heat Exchanger.

1.02 CODES AND STANDARDS

A. Design and performance of components and methods specified herein shall comply with all applicable Federal, State and Local laws, ordinances, regulations and codes, and the latest industry standards including, but not limited to the ones listed below.

- American Society of Mechanical Engineers: ASME
- American National Standards Institute: ANSI
- American Society for Testing and Materials: ASTM
- American Welding Society: AWS
- Steel Structures Painting Council: SSPC
- National Fire Protection Association: NFPA
- American Institute of Steel Construction: AISC
- Manufacturers Standardization Society: MSS
- Air Conditioning and Refrigeration Institute: ARI
- American Society of Heating, Refrigeration and Air Conditioning Engineers: ASHRAE
- Underwriters Laboratories Inc.: UL

1.03 SUBMITTALS:

A. Refer to Appendix A for submittal requirements.

1.04 QUALITY ASSURANCE

A. Published Specifications, standards, tests or recommended methods of the trade industry or governmental organizations as they apply to work in this Section.
B. The manufacturer shall employ and certify such quality assurance measures as are necessary to ensure that the work conforms to the Specifications herein.

C. The Manufacturer shall have manufactured units of similar size, nature, and intent that have operated successfully for a period of not less than three (3) years.

D. All workmen performing work as described herein shall be skilled workers of the trade involved.

E. Perform factory or field performance testing as specified in Part 2.

F. The supplier shall certify that all materials or components used in the heat exchangers shall not contain PCBs, asbestos, or lead paint.

1.05 WARRANTY

A. The equipment manufacturer’s warranty shall be provided to The College of New New Jersey and shall extend for a period of one (1) year from issuance of the Certificate of Final Completion.

B. Such warranty shall be submitted to the College in advance for the College’s approval as to form and substance of such warranty. Such approval shall be at the sole discretion of the College. Such warranty, at a minimum, shall cover any defects in material and workmanship and include labor to replace or repair the defective part.

1.06 EXTRA MATERIALS:

A. Provide two sets of replacement gaskets.

B. Provide two sets of wrenches for disassembly of plate type heat exchangers.

C. Provide operations and maintenance manuals.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. Heat Exchangers, Plate & Frame Type. (List of manufacturers or approved equal):

1. Tranter
2. APV
3. Bell & Gossett, ITT.
4. Alfa Laval
5. Polaris

2.02 DESIGN CRITERIA

A. Sizing:
The College of New Jersey Plate and Frame Heat Exchanger
Chiller Plant Improvement for STEM buildings 15730-2 Mar, 2015
<table>
<thead>
<tr>
<th>Quantity</th>
<th>1</th>
<th>Number</th>
</tr>
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<td>6024</td>
<td>\times 10^3\text{BTU/HR}</td>
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</table>

<table>
<thead>
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<th>Cold Side (Condenser Water)</th>
<th>Units</th>
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<tr>
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<td>3000</td>
<td>GPM</td>
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<tr>
<td>Inlet Temperature</td>
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<td>46</td>
<td>Deg. F</td>
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<tr>
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<td>50</td>
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</tr>
<tr>
<td>Design Pressure</td>
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<td>150.0</td>
<td>PSIG</td>
</tr>
</tbody>
</table>

B. Provide 10\% extra heat transfer surface than required for the above performance.

C. General:

1. The exchanger design, materials and fabrication shall conform to Section VIII Division 1 of the ASME Code.
2. The materials of all components shall be compatible for use with river water / salt water / brackish water.
3. The exchanger shall have one-piece inter-plate gaskets made of materials suitable for the given fluids and process conditions. Channel plate ports to be double gasketed to prevent mixing or cross-contamination of hot side and cold side fluids.
4. The exchanger shall be counter flow or cross flow design to optimize thermal heat transfer and cost.
5. The exchanger shall be rated with fouling allowance required for the process duty.
6. Nozzle velocities shall not exceed 20 fps for liquids.
7. Plates shall be designed to withstand full maximum differential pressure without any pressure on the adjacent plates.
8. Minimum thickness of plates shall be 0.70 mm.
9. All heat transfer surfaces must be accessible for mechanical cleaning.
10. Frame capacity must be able to accommodate at least 20\% additional plates.
11. The heat exchanger will be capable of being blow down and allow for hose connection to reverse flush cleaning. Fittings for reverse flush shall be integral with the inlet and outlet between the flanges and the main plate.
12. Units shall be affixed with the ASME code stamp. Provide with manufacturer’s stainless steel nameplate stamped with model number, pressure and performance rating.
13. Provide insulated removable cover with quick install/release straps and fastening system. The straps and fastening system shall be stainless steel. The cover shall include a silicone coated jacket on both sides of the insulation.

2.03 FABRICATION

A. Plates:

1. Titanium.
2. Identical surface patterns.
3. With water distributing flow directors.
4. Designed to eliminate cross contamination.
5. Number each plate.

B. Gaskets:
1. One piece nitrites butyl rubber or EPDM.
2. Gaskets shall be provided with mechanical retainers.

C. Frame:
2. Painted with baked epoxy enamel.

D. Guide bars:

E. Pipe Connections:
1. 150 PSI ANSI rated weld neck flange type.
2. Size and location as scheduled (see Section 2.02.A of this Specification)

2.04 TESTING

A. Assembled exchanger shall be hydrostatically tested at 1.5 times full design pressure. Pressure shall be held without additional pumping for a minimum of two (2) hours with less than a 5% loss in pressure. Each circuit shall be tested independently.

B. Submit factory test reports to the Authority (refer to Appendix A).

2.05 SHIPPING:

A. Ship fully assembled.

B. With protective shroud.

PART 3. EXECUTION

3.01 INSTALLATION

A. Installation of the Heat exchangers will be by others.

3.02 COMMISSIONING

A. The plate and frame heat exchanger shall be commissioned by the installing contractor. The manufacturer will provide support for the commissioning and startup process including providing copies of factory tests and providing startup assistance during the commissioning and testing of the equipment.

END OF SECTION
SECTION 15730

PLATE AND FRAME HEAT EXCHANGERS

APPENDIX A

SUBMITTAL REQUIREMENTS

A. Submit manufacturer’s standard technical product data indicating conformance to the stipulated reference specifications, construction materials, construction details, preventative maintenance data, and test and operating pressures. Submit manufacturer’s product data on the following:
   1. Performance.
   2. Pipe materials.
   3. Flanges.
   4. Welded fittings.
   5. Plates.
   7. Nuts and bolts.
   8. Casing.
   10. Thermal cover.
   11. Complete assembly.
   12. Drain and vent assemblies.

C. Provide scaled shop drawings detailing dimensions of units, housekeeping pad/support details and piping connections; include maintenance space requirements 2 weeks ARO.

D. Submit factory test reports upon completion of the factory testing.
SECTION 15735 - HYDRONIC PUMPS

PART 1 GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions of Contract,” “Special Conditions” and “Division 1 – General Requirements” form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:
   1. Vertical in-line pumps.

B. Related Sections:
   1. Section 15170 - Common Motor Requirements for HVAC Equipment: Product requirements for motors for placement by this section.
   2. Section 15110 - General-Duty Valves for HVAC Piping: Product requirements for valves used in hydronic piping systems.
   3. Section 15100 - Hydronic Piping: Execution requirements for connection to pumps specified by this section.
   4. Section 03330 – Cast in Place Concrete

1.3 REFERENCES

A. National Electrical Manufacturers Association:
   1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

B. Underwriters Laboratories Inc.:
   1. UL 778 - Motor Operated Water Pumps.

1.4 PERFORMANCE REQUIREMENTS

A. Provide pumps to operate at system fluid temperatures indicated on Drawings without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

1.5 SUBMITTALS

A. Product Data: Submit certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements. Submit also, manufacturer model number, dimensions, service sizes, and finishes.

B. Manufacturer's Installation Instructions: Submit application, selection, and hookup configuration with pipe and accessory elevations. Submit hanging and support requirements and recommendations.
C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit installation instructions, servicing requirements, assembly views, lubrication instructions, and replacement parts list.

B. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of Project.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 EXTRA MATERIALS

A. Furnish one set of mechanical seals for each pump pumps.

PART 2 PRODUCTS

2.1 VERTICAL IN-LINE PUMPS

A. Manufacturers:
   1. Bell & Gossett
   2. Taco
   3. Aurora
   4. Or Equivalent as approved by the Professional.

B. Type: Vertical, single stage, close coupled, radial or horizontally split casing, for in-line mounting, for 175 psig working pressure.

C. Casing: Cast iron, with suction and discharge gage port, casing wear ring, seal flush connection, drain plug, flanged suction and discharge.

D. Impeller: Bronze, fully enclosed, keyed directly to motor shaft or extension.

E. Shaft: Carbon steel with stainless steel impeller cap screw or nut.
F. Shaft Sleeve: Aluminum bronze.

G. Seal: Carbon rotating against stationary ceramic seat, 225 degrees F maximum continuous operating temperature.

H. Electrical Characteristics and Components:
   1. Motors: In accordance with Section 15170. 1750 rpm unless specified otherwise.
   2. Wiring Terminations: Furnish terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

PART 3 EXECUTION

3.1 INSTALLATION

   A. Provide pumps to operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

   B. Install long radius reducing elbows or reducers between pump and piping. Support piping adjacent to pump so no weight is carried on pump casings. For close coupled or base mounted pumps, install supports under elbows on pump suction and discharge line sizes 4 inches and over.

   C. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump so no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 4 inches and larger.

   D. Provide air cock and drain connection on horizontal pump casings.

   E. Provide drains for bases and seals.

   F. Check, align, and certify alignment of base mounted pumps prior to start-up.

   G. Install base mounted pumps on concrete housekeeping base, with anchor bolts, set and level, and grout in place. Refer to Section 03300.

   H. Lubricate pumps before start-up.

3.2 FIELD QUALITY CONTROL

   A. Inspect for alignment of base mounted pumps.

END OF SECTION
SECTION 15900 – INSTRUMENTATION & CONTROL

Part 1. GENERAL

1.1 SECTION INCLUDES

   A. 1.2 Products Furnished but not Installed Under This Section
   B. 1.3 Products Installed but not Furnished Under This Section
   C. 1.4 Products not Furnished or Installed but Integrated with the Work of this Section
   D. 1.5 Related Sections
   E. 1.6 Description
   F. 1.7 Approved Control System Manufacturing Contractors
   G. 1.8 Quality Assurance
   H. 1.9 Codes and Standards
   I. 1.10 Submittals
   J. 1.11 Warranty
   K. 1.12 Ownership of Proprietary Material

1.2 WORK INCLUDED

   A. Furnish equipment and services necessary for a complete and safe installation in accordance with the contract documents and all applicable codes and authorities having jurisdictions for the following
      1. Thermometers and thermometer wells.
      2. Pressure gages and pressure gage taps.
      3. Temperature and pressure receiver gauges and transmitters.
      4. Top-ins (Pete's Plug).
      5. Full Bore Magmeter.
      6. Control Valves
      7. Control Hardware

   B. Scope:
      1. The controls contractor shall provide all necessary material and labor to provide a fully functional system in accordance with the contract documents and sequence of operations. Furnish all labor, materials, equipment, and service necessary for a complete and operating temperature control system, utilizing a high-speed, peer-to-peer network of Direct Digital Controls, routers, repeaters, and electronic interfaces and actuation devices, as shown on the drawings and as described
herein. All existing control systems, not being replaced under this contract shall remain in place and be extended to incorporate the new systems. The system shall be based on industry standard LonTalk® protocol as provided by Honeywell International branch facility. Drawings are diagrammatic only. Equipment and labor not specifically referred to here or on the plans, which are required to meet the functional intent, shall be provided without additional cost to the Owner. Performance and capabilities are based on the Honeywell Building Solutions Facility Management System (FMS).

2. Defined controls shall be integrated into the existing Honeywell International Enterprise Building Integrator (EBI) package as. Provide, under this contract, EBI system expansion, point assignment and programming required to provide all new control points to the existing EBI and energy manager system. Provide all new graphics and point assignments required to provide a complete integrated EBI system.

3. Work described in this section shall be installed, wired, circuit tested, and calibrated by factory-certified and employed technicians qualified for this work and in the regular employment of the temperature control system manufacturer. Installing office shall have a minimum of ten years of installation experience with the manufacturer and shall provide documentation in submittal package verifying longevity of the installing company's relationship with the manufacturer. Supervision, calibration, and checkout of the system shall be performed by the employees of the local factory-owned temperature control contracting field office. Supplier shall have an in-place support facility within 25 miles of the site with technical staff, spare parts inventory, and all necessary test and diagnostic equipment. The Facility Management System (FMS) shall be an extension to the existing Honeywell International EBI system. Provide all system expansion labor including all necessary programming and graphics required to integrate new control system into existing EBI system

4. The FMS building management and control functions to be provided include:
   a. Building management and control
   b. Monitoring and control of controllers, remote devices, and programmable logic controllers, including sensors, actuators, and environmental delivery systems (room climate control, lighting systems, electrical systems, etc)
   c. Operator interface to allow general supervision of room controls
   d. Data collection and historization
   e. Alarm management
   f. Trending
   g. Report generation
   h. Network integration
   i. Data exchange and integration with a diverse range of other computing and facilities systems using industry-standard techniques

1.3 APPROVED CONTROL SYSTEM MANUFACTURING CONTRACTORS

A. The following are the approved control system contractors and manufacturers:
B. The manufacturing contractors shall use only products corresponding to the product line listed.

C. The list of manufacturers above applies to client and server software, programming, controller software, computer-generated custom application programming, general purpose controllers, and unitary controllers.

1.4 QUALITY ASSURANCE

A. Refer to General Provisions-Mechanical.

B. Comply with applicable portions of American Society of Mechanical Engineers (ASME) and Instrument Society of America (ISA) standards pertaining to construction and installation of meters and gages.

C. Design Criteria: The drawings indicate types, sizes, capacities, ranges, profiles, connections, and dimensional requirements of meters and gages are based on the specific manufacturer types and models indicated. Meters and gages having equal performance characteristics by other manufacturers may be considered, provided that deviations do not change the design concept or intended performance as judged by the Architect.

D. Manufacturer contracting qualifications:
   1. Bids by wholesalers, independent contractors, or franchised dealers shall not be acceptable.
   2. All work described in this section shall be installed, wired, circuit tested, and calibrated by factory-certified technicians qualified for this work and in the direct employment of the temperature control system manufacturer.
   3. The FMS contractor shall have a full service facility within 25 miles of the project that is staffed with engineers trained in integrating interoperable systems and technicians fully capable of providing LonWorks™ instructions and routine emergency maintenance service on all system components.
   4. The FMS contractor shall maintain a UL monitoring center manned 24 hours a day, 7 days a week, 365 days a year by company personnel capable of continuous monitoring of environmental conditions in various areas throughout the building. This monitoring center shall have certified energy managers and HVAC experts on staff, and it cannot be an answering service.
   5. Contractor shall provide 100 percent of all services with company personnel. No portion of services can be subcontracted to others without express written permission of the Owner; with such permission, all specifications, terms, and conditions specified herein shall be the responsibility of the prime Contractor.
   6. Mechanical equipment manufacturers desiring to provide DDC-type controls as factory-mounted equipment shall provide a separate bid for their products, less all controls, actuators, valve assemblies, and sensors, which are specified to be provided by the FMS Contractor.
7. The ATC Contractor shall be certified by the State of New Jersey, Department of the Treasury, Division of Construction, Trenton, New Jersey. A copy of this certification shall be part of the bid package and shall include the following information:
   a. Class 043- Control Systems (HVAC): 10 million dollars

1.5 RELATED SECTIONS

A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are a part of this specification and shall be used in conjunction with this section as a part of the Contract documents. Consult them for further instructions pertaining to this work. The Contractor is bound by the provisions of Division 0 and Division 1.

1.6 CODES AND STANDARDS

A. All work, materials, and equipment shall comply with the rules and regulations of all codes and ordinances of the local, state, and federal authorities. Such codes, when more restrictive, shall take precedence over these drawings and specifications. As a minimum, the installation shall comply with the current editions in effect 90 days prior to receipt of bids of the following codes:
   1. National Electric Code (NEC)
   2. Uniform Building Code (UBC)
      a. Section 608, Shutoff for Smoke Control
      b. Section 403.3, Smoke Detection Group B Office Buildings and Group R, Division 1 Occupancies
      c. Section 710.5, Wiring in Plenums
      d. Section 713.10, Smoke Dampers
      e. Section 1106, Refrigeration Machinery Rooms
      f. Section 1107, Refrigeration Machinery Room Ventilation
      g. Section 1108, Refrigeration Machinery Room Equipment and Controls
      h. Section 1120, Detection and Alarm Systems
   3. Uniform Mechanical Code (UMC)
   5. Unitary controllers, intelligent sensors, and intelligent actuators shall conform to the appropriate LonMark™ functional profile configurations based on intended use and shall be so labeled.

1.7 SUBMITTALS

A. Submit shop drawings and product data for all hardware, software, and installation required per the provisions of Division 1 and this Division’s General Provisions within 12 weeks of contract award:
   1. Product data:
      a. Manufacturer’s installation instructions.
      b. Manufacturer’s descriptive literature, operating instructions, operating range, total range and maintenance and repair data.
c. Substitutions: Submit requests for substitution in accordance with provisions of Division 1.
d. Performance Data/curves.
e. Wiring Diagrams.

2. No work may begin on any segment of this project until submittals have been successfully reviewed for conformity with the design intent.

3. All drawings shall be prepared on a CAD system that produces drawing files compatible with AutoCAD Release 12 or higher and be provided on magnetic or optical disk and as full-size 11” x 17” drawings.

4. When a manufacturer’s cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means.

5. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements.

6. Each submitted piece of literature and drawings shall clearly reference the specification and drawing that the submittal is to cover.

7. Central system hardware and software:
   a. Riser diagrams of wiring between existing Honeywell International EBI and all control panels.
   b. List of the color graphic screens to be provided. For each screen, provide a conceptual layout of pictures and data and show or explain which other screens can be directly accessed.

8. Controlled systems:
   a. A schematic diagram of each controlled system. The schematics shall have all control points labeled with point names shown or listed. The schematics shall graphically show the location of all control elements in the system.
   b. A schematic wiring diagram for each controlled system. Each schematic shall have all elements labeled. Where a control element is the same as that shown on the control system schematic, it shall be labeled with the same name. All terminals shall be labeled.
   c. Instrumentation list for each controlled system. Each element of the controlled system shall be listed in table format. The table shall show element name, type of device, manufacturer, model number, and product data sheet number.
   d. A mounting, wiring, and routing plan-view drawing. The drawing shall be done in 1/4 in. scale. The design shall take into account HVAC, electrical, and other systems’ design and elevation requirements. The drawing shall show the specific location of all concrete pads and bases and any special wall bracing for panels to accommodate this work.
   e. A complete description of the operation of the control system, including sequences of operation. The description shall include and reference a schematic diagram of the controlled system.
   f. A point list for each system controller, including both inputs and outputs (I/O), point number, the controlled device associated with the I/O point, and the location of the I/O device. Also included will be software points and alarm points.

9. Quantities of items submitted shall be reviewed, but are the responsibility of the contractor.
10. A description of the proposed process, along with all report formats and checklists to be used in Part 3: “Control System Demonstration and Acceptance.”

11. For LonWorks and LonMark devices, supply external interface (XIF) documentation and appropriate LonMark™ profiles indicating conformance to the LonMark Interoperability Standards.

B. Schedules:
   1. Within [one month] of contract award, provide a schedule of the work indicating the following:
      a. Intended sequence of work items
      b. Start dates of individual work items
      c. Duration of individual work items
      d. Planned delivery dates for major material and equipment, and expected lead times
      e. Milestones indicating possible restraints on work by other trades or situations
   2. Provide monthly written status reports indicating work completed and revisions to expected delivery dates. An updated project schedule shall be included.

C. Project record documents: Upon completion of installation, submit [three] copies of record as-built documents. Documents shall be submitted for approval prior to final completion and shall include:
   1. Project record drawings. Shall be as-built versions of the submittal shop drawings. Provide one set of magnetic media, including CAD, .DWG, or .DXF drawing files.
   2. Testing and commissioning reports and checklists. Completed versions of all reports and checklists, along with all trend logs, used to meet the requirements of Part 3: “Control System Demonstration and Acceptance.”
   3. Certification of the pressure test required.
   4. Operation and Maintenance (O & M) Manual. This shall include as-built versions of the submittal product data. In addition to the information required for submittals, the O & M Manual shall include:
      a. Names, addresses, and 24-hour telephone numbers of contractors installing equipment and the control systems, and the service representatives of each.
      b. Operator’s manual with procedures for operating the control systems, including logging on and off, alarm handling, producing point reports, trending data, overriding computer control, and changing set points and other variables.
      c. One set of programming manuals with a description of the programming language (including syntax), statement descriptions (including algorithms and calculations used), point database creation and modification, program creation and modification, and use of the editor.
      d. Engineering, installation, and maintenance manual(s) that explain how to design and install new points, panels, and other hardware; preventive maintenance and calibration procedures; how to debug hardware problems; and how to repair or replace hardware.
      e. A listing and documentation of all custom software created using the programming language, including the set points, tuning parameters, and
object database. One set of magnetic or optical media containing files of the software and database shall also be provided.

f. One set of magnetic or optical media containing files of all color graphic screens created for the project.

g. A list of recommended spare parts with part numbers and suppliers.

h. Complete original issue documentation, installation, and maintenance information for all third-party hardware provided, including computer equipment and sensors.

i. Complete original issue diskettes for all software provided, including operating systems, programming language, operator workstation software, and graphics software.

j. Licenses, guarantees, and warranty documents for all equipment and systems.

k. Recommended preventive maintenance procedures for all system components, including a schedule of tasks (inspection, cleaning, calibration), time between tasks, and task descriptions.

D. Training Required for operation and manuals: Contractor shall provide a course outline and training manuals for all training classes at least six weeks prior to the first class. The Engineer may modify any or all of the training course outline and training materials to meet the needs of the Owner. Review and approval by the Engineer shall be completed at least three weeks prior to the first class.

1.8 WARRANTY

A. Warrant all work as follows:

1. Labor and materials for the control system specified shall be warranted free from defects for a period of 24 months after final completion and acceptance. Control system failures during the warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to the Owner. The contractor shall respond to the Owner’s request for warranty service within 24 hours during normal business hours.

2. All work shall have a single warranty date, even when the Owner has received beneficial use due to an early system start-up. If the work specified is split into multiple contracts or a multiphase contract, then each contract or phase shall have a separate warranty start date and period.

3. At the end of the final start-up, testing, and commissioning phase, if equipment and systems are operating satisfactorily to the Engineer, the Engineer shall sign certificates certifying that the control system’s operation has been tested and accepted in accordance with the terms of this Specification. The date of acceptance shall be the start of warranty.

4. Exception: Contractor shall not be required to warrant reused devices, except for those that have been rebuilt or repaired. Contractor shall warrant all installation labor and materials, however, and shall demonstrate that all reused devices are in operable condition at the time of the Engineer’s acceptance.

B. Service all work as follows: Provide warranty service in accordance with the warranty section of this Specification. In addition, provide scheduled maintenance on all control system apparatus, including valves, dampers, linkages, control panels, interfaces, direct digital
control systems, OWSs, PCs, software, and application programs. Maintenance shall consist of:

1. Scheduled preventive maintenance (p.m.) visit twice a year to audit system performance. Each p.m. visit shall include exercising each control loop and control sequence for performance. A log of each loop tested and each control sequence verified shall be reviewed with the Owner.

2. Provide emergency service for parts and labor on an as-needed basis. Response to an emergency call shall be four hours maximum on Monday-Friday and eight hours maximum on holidays and weekends.

3. Provide remote-service diagnostic monitoring from the nearest service location. At the request of the Owner, a service diagnostic call will be made to troubleshoot and resolve (if possible) any reported system complaints. The Owner will provide a dedicated telephone line or Internet connection to the system.

4. Contractor shall have the ability to provide verification of completed work order or preventive maintenance within one hour of the completion of that service or maintenance action. A paperless version is preferred and may be required.

5. Contractor shall have the ability to receive service requests via an Internet web site or a centralized call center. E-mail requests are not acceptable.

6. Contractor shall have the ability to digitally capture customer signature for authorization of work and work completed; that signature is digitally recorded for verification reasons but will not be used again for any other purpose.

1.9 PROJECT RECORD DOCUMENTS

A. Accurately record actual locations of instrumentation.

1.10 SPECIAL REQUIREMENTS

Only if Required

1.11 ENVIRONMENTAL REQUIREMENTS

A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

1.12 OWNERSHIP OF PROPRIETARY MATERIAL

A. Project-developed software and documentation shall become the property of the Owner. These include, but are not limited to:

1. Project graphic images
2. Record drawings
3. Project database
4. Project-specific application programming code
5. All documentation

Part 2. PRODUCTS

2.1 SECTION INCLUDES
A. 2.2 Materials

B. 2.3 Communications

C. 2.4 Operator Interface

D. 2.5 Controller Software

E. 2.6 General Purpose Controllers

F. 2.7 Unitary Controllers

G. 2.8 Input and Output Interface

H. 2.9 Power Supplies and Line Filtering

I. 2.10 Auxiliary Control Devices

J. 2.11 Wiring and Raceways

K. 2.12 Fiber Optic Cable System

2.2 MATERIALS

A. All products used in this project installation shall be new and currently under manufacture and shall have been applied in similar installations for a minimum of two years. This installation shall not be used as a test site for any new products unless explicitly approved by the Owner's representative in writing. Spare parts shall be available for at least five years after completion of this contract

2.3 MANUFACTURERS

A. Thermometers:
   1. Weksler Instruments Corp.
   2. Moeller Instrument Co.
   3. Palmer Instruments, Inc.
   5. Trerice Co.
   6. Weiss Instruments, Inc.
   7. Or Equivalent

B. Pressure gauges:
   1. Weksler Instruments Corp.
   2. Dresser Industries Inc. (Ashcroft).
   3. H. O. Trerice Co.
   4. Weiss Instruments, Inc.
   5. Or Equivalent

C. Electronic temperature, pressure and flow receiver gauges and transmitters:
   1. Rosemount.
   2. Or Equivalent
D. Water flow meters, Magmeter type:
   1. Rosemount
   2. Omega
   3. Or Equivalent.

2.4 Thermometers, Temperature Sensors and Wells

A. Thermometers:
   1. Provide 4-1/2" inches diameter gauge for pipe or equipment mounted type, with black finished cast aluminum with flangeless back, and threaded black enamel cast aluminum ring with gasketed glass face, 316 stainless steel bulb, stainless steel brushed precision movement and micrometer adjustment on needle. Accuracy shall be +/- 1% scale range.

   2. Stem length for nominal pipe sizes:
      a. Below 4 in.: 3-1/2 in. stem, elbow mounted.
      b. 4-8 in.: 3-1/2 in. stem.
      c. 10-14 in.: 6 in. stem.
      d. 16-20 in.: 9 in. stem.
      e. 24 in.: 12 in. stem.
      f. 30 in.: 15 in. stem.

   3. Thermometer temperature ranges:
      a. Condenser water: 30-180 f, 2 deg increments.
      b. Chilled water: 30-180 f, 2 deg increments.


B. Temperature Transmitters:
   1. Provide Manufacturer Rosemount sensor Model 644 or equivalent, factory calibrated to an accuracy of plus or minus 0.3 deg F over the entire operating span.

   2. The assembly shall consist of a 100 or a 1000 OHM Plantinum RTD and a solid-state, 4-wire, 4-20 ma transmitter contained in a housing suitable for pipe mounting. The transmitter shall be compatible with the temperature element and the DDCP. The assembly shall be factory calibrated to an accuracy of plus or minus 0.3 deg F over the entire operating span, as noted.

      a. Aluminum field mounted housing with npt conduit connection and integral LCP display in Fahrenheit (minimum four digits with minimum one digit at 1/10 of a degree). Digits height minimum 0.4 inches.

      b. Direct sensor mounting. Where not physically possible use optional mounting bracket for remote mounting.

      c. Spring loaded single element temperature sensor depth to match thermal well.

      d. Sensor shall be compressed 0.5" when fully inserted.

      e. Acceptable manufacturers: Rosemount, Fisher, Honeywell inc

C. Sensor Wells:
   a. Material: 304 stainless steel
   b. Tapered shank
   c. External thread: 3/4" npt
   d. 3000# thread-o-let with 3/4" npt
2.5 Pressure Gauges:
A. Provide 4-1/2" inches diameter gauge for pipe or equipment mounted type, with black finished cast aluminum with flangeless back, and threaded black enamel cast aluminum ring with gasketed glass face, provide type 316 stainless steel bourdon tube, stainless steel brushed precision movement and micrometer adjustment on needle.
B. Accuracy shall be +/- one percent full scale range. Provide ball valve provide solid front type similar to Weksler model AA 44-A or equivalent.
C. Pressure gauge ranges in psig shall be as follows:
   1. Condenser water: 0-100. figure intervals 10 psi, minor divisions 1 psi increments.
   2. Chilled water: 0-160. figure intervals 20 psi, minor divisions 2 psi increments.
   3. City water connection: 0-100. figure intervals 10 psi, minor divisions 1 psi increments.
D. Acceptable manufacturers:
   1. Ashcroft instrument div.,
   2. Dresser industries, inc.,
   3. Helicoid gauge div.,
   4. H.O. Trerice co.,
   5. Weiss son, inc.
   6. Weksler instruments corp.
   7. Or equivalent
E. 3000# thread-o-let with 1/2" npt
F. Provide 1/2" ball type isolation valve
G. Provide pressure snubbers 303 stainless steel filter type

2.6 Pressure/Differential Pressure Transmitters:
A. The assembly shall consist of a 100 or a 1000 ohm gauge pressure transmitter 4-20 ma transmitter contained in a housing suitable for pipe mounting. the assembly shall be factory calibrated to an accuracy of plus or minus 0.1% over the entire operating span, as noted.
B. Aluminum field mounted housing with npt conduit connection and integral LCD display in psig (minimum 4 digits with minimum one digit at 1/10 of a psig). Digits height minimum 0.4 inches.
C. Direct sensor mounting. Where not physically possible use optional mounting bracket for remote mounting.
D. 3000# thread-o-let with 1/2" NPT
E. 316 stainless steel isolation diaphragm and wetted parts silicone fluid fill
F. Provide 1/2" ball type isolation valve
G. Acceptable manufacturers: Rosemount, Fisher, Honeywell inc or equivalent

2.7 FLOW METERS
A. **Full Bore Magmeter:**
   1. Suitable for measuring water flows at system operating pressures and temperatures.
   2. Isolated analog output (4-20mA) for flow rate and two programmable pulse outputs.
   3. Electromagnetic sensing (no moving parts).
   4. Empty Pipe Detector.
   5. Unit shall be equipped with a multifunction user interface and graphic display.
   6. Input Power: Standard:- 90 – 265 VAC and 35mA, Optional:- 18 – 63 VDC, 15 – 45 VAC and 300 mA.
   7. Liquid temperature range: 32˚F – 140˚F (Plypropylene liner), 23˚ - 175˚F (Ebonite Liner), -4˚ - 212˚F (PTFE liner)
   8. Ambient temperature range: -4˚ - 140˚F.
   9. Maximum operating pressure: 280 - 580 psig depending on liner material and flange rating.
   10. Unit shall be factory wet-calibrated with certification.
   11. Accuracy: ± 0.4% at 3.3 – 33ft/sec, ± 0.8% at 1 – 3.3 ft/sec, ± 0.0075 ft/s at less than 1 ft/sec.
   12. Unit installation and removal shall require system shutdown.
   13. Connections shall be either of ANSI Class 150 Flange, ANSI Class 300 Flange or Wafer.
   15. Use 18-22 AWG shielded cable for electrical connections.

2.8 **PRESSURE/TEMPERATURE TEST STATION**

A. **Test station:**
   1. Solid brass.
   2. Perforated core of Neoprene or Nordel.

B. **Color-coded, marked and gasketed cap.**

C. **Rated for 1000 psig.**

D. **Furnish one 1/8 in. OD probe:**
   1. Pressure gauge adaptor.

E. **Furnish one 5-in. stem pocket testing thermometer:**
   1. 0 to 1000°F for chilled water.
   2. 50 to 3000°F for hot water.

F. **Peterson Engineering Co.'s "Pete's Plug" or equal.**

2.9 **PRESSURE GAGE TAPS**

A. **Gage Cock:** Tee or lever handle, brass for maximum 150 psig

B. **Needle Valve:** [Brass] [Steel] [Stainless Steel] for maximum 150 psig

C. **Pulsation Damper:** Pressure snubber, brass with 1/4 inch connections

D. **Syphon:** [Steel, Schedule 40,] [Brass,] [Iron,] [Stainless Steel,] [Bronze,] 1/4 inch angle or straight pattern
2.10 TEST PLUGINS

A. Test Plug: 1/4 inch or 1/2 inch [brass] [stainless steel] fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with [neoprene core for temperatures up to 200 degrees F] [Nordel core for temperatures up to 350 degrees F] [Viton core for temperatures up to 400 degrees F]

B. Test Kit: Carrying case, internally padded and fitted containing [one] [two] [2-1/2 inch] [3-1/2 inch] diameter pressure gages, [one] [two] gage adapters with 1/8 inch probes, two [one inch] [1-1/2 inch] dial thermometers

2.11 COMMUNICATIONS

A. Control products provided for this project shall utilize a LonWorks internetwork. Communication involving control components (i.e., all types of controllers and operator interfaces) shall conform to EIA standard 709.1, the LonTalk™ protocol.

B. Contractor shall provide a dedicated Ethernet LAN, communication media, connectors, repeaters, hubs, and routers necessary for the internetwork operation not specified elsewhere in Section 15xxx, but required to provide the specified Section 159xx functionality. All new controllers shall communicate directly with the existing Campus wide Honeywell International system.

C. Communication services over the internetwork shall result in operator interface and value passing that is transparent to the internetwork architecture as follows:
   1. Connection of an operator interface device to any one controller on the internetwork will allow the operator to interface with all other controllers as if that interface were directly connected to the other controllers. Data, status information, reports, system software, custom programs, etc., for all controllers shall be available for viewing and editing from any one controller on the internetwork.
   2. All database values (e.g., objects, software variables, custom program variables) of any one controller shall be readable by any other controller on the internetwork. A controller shall automatically perform this value passing when a reference to an object name not located in that controller is entered into the controller’s database. An operator or installer shall not be required to set up any communication services to perform internetwork value passing.

D. Time clocks in all controllers shall be automatically synchronized daily via the internetwork. An operator change to the time clock in any controller shall be automatically broadcast to all controllers on the internetwork.

E. The internetwork shall have the following minimum capacity for future expansion:
   1. The system shall have the capacity to support greater than 90 separate communications links to networks of control devices.
   2. The system shall be capable of supporting a minimum of 40 simultaneous operator workstation connections using TCP/IP local area network (LAN) subject to hardware capacity on the server.
3. The system size shall be expandable to at least [two] times the number of hardware and software input and output points required for this project or 60,000 points, whichever is greater.

2.12 OPERATOR INTERFACE

A. System software:
   1. System graphics: Operator interface shall be graphically oriented and allow for efficient communication of operational data and abnormal conditions. Graphics shall support at least 65,000 colors at a minimum 1024 x 768 pixel resolution. It shall provide a consistent framework for viewing of information. Critical areas (such as alarm icons) shall be visible at all times. A predefined area on the screen shall provide operator messaging, and this area shall be visible at all times. A set of standard displays for configuration and navigation around the FMS system shall be provided with every system and not require any engineering. FMS shall also have an unlimited number of custom (facility-specific) displays created to meet the needs of the specific facility.

B. Operator functions: The following functions shall be performed through the existing Honeywell EBI operator interface:
   1. Display and control field equipment.
   2. Acknowledge alarms on a priority basis.
   3. Initiate report printing.
   4. Archive and retrieve event logs.
   5. View intranet or information from the Internet in a secure environment.
   6. View ActiveX documents.
   7. Use ActiveX controls.
   8. Change own password.
   9. Monitor data communications channels.
  10. Configure system parameters.
  11. Assign control confirmation messages to individual points.

C. The following standard system displays shall be included as part of the system. In the case of the trend and group displays, configuration of these displays shall only require entry of a point name to completely configure the display. The alarm summary, event summary, point detail, communications status, and system status shall not require any configuration. Systems where standard graphical displays, showing all parameters for each system point, do not exist shall not be acceptable.
   1. Alarm summary display
   2. Event summary display
   3. Point detail template displays (for each point in the database)
   4. Trend set template displays
   5. Group control and group trend template displays
   6. Communications status displays
   7. System status displays
   8. Operator scratch-pad display
   9. Face plates for all common point types
  10. Configuration displays
D. Provide system status displays on the main operator workstation that display the following information:

1. Points in alarm condition pending acknowledge command
2. Points that remain in an alarm state, but which have been acknowledged
3. Communication failures
4. Printer status
5. Operator workstations status
6. Communication links status
7. Controller status

E. Provide system with the following full screen administrative displays:

1. Master system menu
2. Report summary
3. Alarm summary
4. Event summary
5. Display summary
6. System parameters configuration
7. Operator workstation configuration
8. Area assignment
9. Time schedule assignment
10. Holiday assignment
11. History assignment
12. Push-button assignment
13. Operator definition
14. Operator message board
15. Events archive and retrieval
16. Time period summary and configuration
17. Point detail for every configured point

F. Configuring time schedules shall be done through the existing EBI graphical user interface where the operator selects the appropriate time span from a calendar. It shall be possible to specify time schedules for the control of all FMS points. A large number of individual points shall be controlled by a single time schedule. A single time schedule shall define the control to any combination of day and time, e.g., Monday-Friday 7:00 to 18:00, Thursday 7:00 to 22:00, and Saturday-Sunday 9:00 to 14:00. The existing EBI system time schedule shall provide override for holidays or special occasions. Where the control device supports an internal time schedule program, the FMS shall upload, display, modify, and download the control device time schedules. Support for the control device time schedules shall be in addition to the FMS time schedules. Systems where times and days shall be manually entered are not acceptable.

2.13 CONTROLLER SOFTWARE

A. Furnish the following application software for building control and energy management. All software applications shall reside and operate in the system controllers. Editing of applications shall occur at the operator workstation.

B. Local system security:
1. User access shall be secured using individual security passwords.
2. Passwords shall restrict the user to one of four levels of access as assigned by the
   system manager.
3. User log-on and log-off attempts shall be recorded.
4. The system shall protect itself from unauthorized use by automatically logging
   off five minutes following the last keystroke.

C. Scheduling: Provide the capability to schedule each object or group of objects in the
controller system. Controllers shall have a minimum of 20 schedules. Each schedule shall
consist of the following:

1. Daily schedule: Provide daily schedules that are the basic building blocks for any
   of the following time schedules. Using daily schedules, user shall enter the
   switching times with the desired setpoints and switching conditions for the data-
   points. When preparing a daily schedule and assigning the name, there is initially
   no specific relationship to a particular day in the week. The modular structure of
   the time schedule shall make it possible for the user to establish various different
   daily schedules, keep them in a library, and include them in the weekly schedule.
   The user shall be free to extend the list of daily schedules to meet his/her special
   requirements. The repeated use of the same daily schedule shall also be possible
   (for example, the same daily schedule can apply from Monday to Friday in the
   weekly schedule). Changes in a daily schedule shall be immediately effective in
   the weekly and annual schedules, as well as in the special day list.

2. Weekly schedule: Provide a separate weekly schedule that shall be generated for
   each time schedule. The weekly schedule defines which daily schedule is to be
   used for which weekday. A daily schedule is assigned to each day of the week
   (Monday to Sunday). It shall also be possible to assign the same daily schedule to
   several weekdays. The weekly schedule, as defined, shall automatically be
   copied for each week in the annual schedule. If a change is made to a weekday in
   a weekly schedule, this change shall affect the weekday in every week of the
   year. If a daily schedule is entered directly in the annual schedule, this daily
   schedule shall have priority over the daily schedule from the weekly schedule.
   The definition of a weekly schedule forms the basis of the annual schedule.

3. Annual schedule: Provide an annual schedule that is structured like a calendar
   and consists of successive weekly schedules. It provides an overview of which
   daily schedules are valid on which calendar days. If the daily schedule in a
   weekly schedule does not apply on a particular calendar date, another daily
   schedule can be entered for it directly in the annual schedule. The annual
   schedule starts on the current day. Each day, the time frame shifts one day. Days
   added at the end shall automatically be assigned the daily schedule from the
   weekly schedule. This ensures that every day is assigned a daily schedule. Entries
   in the annual schedule shall therefore be made only if a daily schedule differing
   from the one selected is to be used. An undefined daily schedule to be inserted in
   the annual schedule can be defined in the daily schedule.

4. Holiday schedule: Provide one holiday day list that shall exist per time schedule.
   The list shall make a number of holidays and special days available to which a
   daily schedule can be assigned. This daily schedule will then apply to this
   holiday or special day every year. The date of floating holidays shall be
   calculated automatically by the controller. If no daily schedule is entered on
   certain holidays, the special day list is not taken into account on this day. Provide
   capability for 24 holidays and special days.
D. System coordination: Provide a standard application for the proper coordination of equipment. This application shall provide the operator with a method of grouping together equipment based on function and location. This group may then be used for scheduling and other applications.

E. Digital alarms: Each digital object shall be set to alarm based on the operator-specified state. Provide the capability to automatically and manually disable alarming.

F. Analog alarms: Each analog object shall have two maximum limits (limit max 1) and limit max two 2), and two minimum limits (limit min 1) and (limit min 2).

G. Totalizer alarms: Each totalizer object shall be set to alarm based on a pulse input signal interval that, if exceeded, triggers an alarm signal. The alarm signal text shall be permanently programmed and needs no input from the user.

H. Alarms shall be selectable as critical or non-critical. Critical alarms shall be transmitted as high priority.

I. System alarms: Operating errors that occur in a control unit or during communication with other controllers shall be recognized and displayed by the computer module. These alarm signals can relate, for example, to a defective module, the need to change the buffer battery (data protection), or the presence of one digital output module too many (maximum 10). These alarm signal texts are preprogrammed. They are always critical alarms.

J. Alarm reporting: The operator shall be able to determine the action to take in the event of an alarm. Alarms shall be routed to the appropriate workstations based on time and other conditions. An alarm shall be able to start programs, print, be logged in the event log, generate custom messages, and display graphics.

K. Remote communication: The system shall have the ability to dial out in the event of an alarm. The system shall incorporate standard modem units so that modems can be connected for communications via public telephone network or via TCP/IP networks. The controller shall allow direct connection of analog modem, ISDN terminal adapter, or TCP/IP modem with data transmission rates of up to 38.4 Kbaud. In addition, wireless data communication via GSM 900 MHz network shall be supported.

L. Maintenance management: The system shall monitor equipment status and generate maintenance messages based upon user-designated run-time, starts, calendar date limits, and alarm. System shall also display hours since serviced for the targeted digital object.

M. Sequencing: Provide application software based upon the sequences of operation specified to properly sequence chillers, boilers, and pumps.

N. EPID control: An EPID (enhanced proportional-integral-derivative) algorithm with additional features shall be supplied. The algorithm shall calculate a time-varying analog value that is used to position an output or stage a series of outputs. The enhanced features shall include a built-in start-up ramp, direct-reverse action selection, integral recalculation to
prevent windup below minimum and above maximum, and an auxiliary input for limit applications and integral reset. The controlled variable, set point, and PID gains shall be user-selectable.

O. Staggered start: This application shall prevent all controlled equipment from simultaneously restarting after a power outage. The order in which equipment (or groups of equipment) is started, along with the time delay between starts, shall be user-selectable.

P. Energy calculations:
1. Provide software to allow instantaneous power (e.g., kW) or flow rates (e.g., L/s [gpm]) to be accumulated and converted to energy usage data.
2. Provide an algorithm that calculates a sliding window average (e.g., rolling average). The algorithm shall be flexible to allow window intervals to be user-specified (e.g., 15 minutes, 30 minutes, and 60 minutes).
3. Provide an algorithm that calculates a fixed window average. A digital input signal will define the start of the window period (e.g., signal from utility meter) to synchronize the fixed window average with that used by the utility.

Q. Anti-short cycling: All digital output objects shall be protected from short cycling. This feature shall allow minimum on time and off time to be selected.

R. On and off control with differential: Provide an algorithm that allows a digital output to be cycled based on a controlled variable and set point. The algorithm shall be direct acting or reverse acting and incorporate an adjustable differential.

2.14 GENERAL PURPOSE CONTROLLERS

A. General. Provide an adequate number of 16-bit microprocessor general purpose controllers to achieve the performance specified in the Part 1 Article on “System Performance” and where shown on the drawings. Each of these panels shall meet the following requirements.
1. The FMS shall be composed of one or more independent, standalone, microprocessor-based building controllers to manage the global strategies described in the System Software section.
2. The building controller shall be programmable and have sufficient memory to support its operating system, database, and application requirements.
3. As a back-up, store DDC application programs and data files on non-volatile EEPROM or Flash memory to allow simple and reliable changes.
4. Data shall be shared between networked building controllers using a peer-to-peer communication mechanism at a speed of 78k baud minimum.
5. The operating system of the building controller shall manage the input and output communication signals to allow distributed controllers to share real and virtual object information for integration and interoperation with other devices on the LonWorks network.
6. Controllers that perform scheduling shall have a 30-day, battery-back, real-time clock.
7. Provide controller-based trending permitting historical values to be stored in the controller. Both time-based and value-hysteresis-based trending shall be supported.
8. The building controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:
   a. Assume a predetermined failure mode, and
   b. Generate an alarm notification.

9. Two basic GPC types may be installed: modular or fixed I/O. Both GPC types shall be LonWorks® and LonMark® Association compliant.
   a. The first of these shall provide a modular hardware design that allows for optimum adaptation of the I/O mix to the plant to be controlled. The modular hardware design shall allow for installation of distributed I/O modules remote from the GPC.
   b. The second type shall have a fixed input and output hardware configuration for use with small applications or to provide control for distributed I/O modules.

B. Communication: The design of the HVAC FMS system communications network shall consist of two layers. The controller peer-to-peer communication layer shall consist of a network of general purpose controllers and unitary controllers as necessary to accomplish the Sequences of Operations defined in the Drawings, and operator workstations. The peer-to-peer network shall utilize EIA standard 709.1, the LonTalk™ communications technology for interoperability with third-party devices, or equal communications standard. The LAN shall consist of standard protocols for TCP/IP communications over Ethernet and Token Ring. Where necessary or desired, LonTalk™ packets may be encapsulated into TCP/IP messages to take advantage of existing infrastructure or to increase network bandwidth. Any such encapsulation of the LonTalk™ protocol into IP datagrams shall conform to existing LonMark™ guidelines for such encapsulation and shall be based on industry-standard protocols.
   1. All communications shall be via twisted pair wires, shielded where required, except where 900 MHz direct sequence wireless spread spectrum technology is utilized.
   2. DDC microprocessor failures shall not cause loss of communications of the remainder of any network.
   3. All networks shall be peer-to-peer supporting sensor sharing, global application programs, and bus-to-bus communications in a true peer-to-peer token-passing manner.
   4. For reliability, maintainability, and performance, primary communications busses shall be extendible to 3000 feet without active hubs, links, or repeaters.
   5. Error detection, correction, and retransmission shall be used to guarantee data integrity.

C. Environment: Controller hardware shall be suitable for the anticipated ambient conditions.
   1. Controllers used outdoors or in wet ambient conditions shall be mounted within waterproof enclosures and shall be rated for ambient temperature operation at –40 degrees C to +65 degrees C (–40 degrees F to +150 degrees F) and ambient humidity of 5 to 93 percent RH non-condensing. Controllers used in conditioned space shall be mounted in dust-proof enclosures and shall be rated for ambient temperature operation at 0 degree C to +50 degrees C (32 degrees F to +122 degrees F) and humidity of 5 to 93 percent RH noncondensing.

D. Operator interface: A local operator interface keypad and display shall be provided for each controller where indicated on the drawings. The keypad shall be provided for
interrogating and editing data. The display shall be used for displaying data in text, table, and graph formats. A system security password shall be available with three levels of password protection to prevent unauthorized use of the keypad and display. Automatic sign-off shall occur after five minutes of inactivity. Operator interface shall have bus-wide interrogation capability. If the manufacturer does not provide this keypad and display, provide a portable operator terminal at indicated locations and supply [three] spare units.

E. Controller shall support manual overrides and provide colored status LED’s to distinguish analog and digital outputs, changing status, and analog output signal strength.

F. Serviceability: Provide CPU diagnostic LEDs for normal, system error, transmit, receive, ground loop, LonWorks service, and communications bus transmit and receive. Provide power supply module diagnostic LEDs for power supply normal, watchdog, and battery. All wiring connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.

G. Memory: The building controller shall maintain all BIOS and programming information in the event of a power loss for at least 30 days. Battery-backed systems shall monitor battery status under load and, if an abnormal condition is detected, the controller shall generate an alarm notification.

H. Immunity to power and noise: Controller shall be able to operate at 90 percent to 110 percent of nominal voltage rating and shall perform an orderly shutdown below 80 percent nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft).

2.15 UNITARY CONTROLLERS

A. General: Unitary DDC controllers (UCs) shall be standalone, EEPROM-based, configured to perform the sequences specified, and I/O selected for the application. All unitary DDC controllers (UCs) shall be LonMark-approved products and shall support the LonMark Functional Profile for the given application. UCs shall be tested and listed under UL916 for computing devices. UC enclosures shall be flame retardant, compact plastic conforming to UL94-V5 for plenum mounting or plated steel. UCs shall be CE approved and meet FCC Part 15 class B requirements. UCs shall be configured for DIN rail mounting, using industry-standard clip-on adapters, or for direct panel mounting. Each ASC shall be capable of standalone operation and shall continue to provide control functions without being connected to the network. Each ASC will contain sufficient I/O capacity to control the target system.

B. Communication: The unitary controller shall communicate with other devices on the internetwork using EIA standard 709.1, the LonTalk™ protocol, as the common communication protocol with a minimum transmission speed of 78Kbaud. A twisted-pair cable utilizing T-Taps, star, and mixed topologies on the same network shall support this network. The free topology transceiver (FTT) network shall not be polarity sensitive. Network media shall be Level IV, 22AWG, twisted-pair wire, and shall conform to UL Category 4 for high-speed networks. Cable shall be supplied in plenum and non-plenum-rated versions. Network length shall not exceed 1640 ft without the addition of Echelon LonWorks repeater achieving an additional length of 3280 ft. For lengths in excess of
3280 ft, a daisy chain wiring scheme can be employed; using a repeater, this length can be extended to 10,000 ft. Lengths in excess of 10,000 ft will not be allowed. Repeater bus topologies shall include bus segments of 60 nodes unless routers are utilized. Systems communicating at slower speeds shall not exceed 30 nodes per segment to ensure adequate global data and alarm response times.

C. Environment: The hardware shall be suitable for the anticipated ambient conditions.
   1. Controllers used outdoors or in wet ambient conditions shall be mounted within waterproof enclosures and shall be rated for ambient temperature operation at -40 degrees C to +65 degrees C (-40 degrees F to +150 degrees F) and ambient humidity of 5 to 95 percent RH noncondensing.
   2. Controllers used in conditioned space shall be mounted in dust-proof enclosures and shall be rated for ambient temperature operation at 0 degree C to +50 degrees C (32 degrees F to +122 degrees F) and humidity of 5 to 95 percent RH noncondensing.

D. Serviceability: Each UC shall be provided with face-mounted LED type annunciation to continually display its operational mode—power, normal, or in an alarm state. As an alternative to the face-mounted integral LED, the control contractor shall provide relay-driven pilot lights mounted at the UC location, which shall provide the specified annunciation. UCs shall be configured for DIN rail mounting, using industry-standard clip-on adapters, or for direct panel mounting. Each controller shall be designed with onboard jacks for quick commissioning and troubleshooting with a portable programming tool.

E. Immunity to power and noise: Controllers shall be able to operate at 90 percent to 110 percent of nominal voltage rating and shall perform an orderly shutdown below 80 percent. Operation shall be protected against electrical noise of 5-120 Hz and from keyed radios up to 5 W at 1 m (3 ft).

F. Transformer: Power supply for the ASC shall be rated at a minimum of 125 percent of ASC power consumption and shall be of the fused or current-limiting type.

G. Provide a distributed input and output module that connects sensors and actuators onto the Echelon field bus network for use with a LonWorks general purpose controllers (GPCs) and unitary DDC controllers (UC). LonWorks controllers shall be configured to read and command these points as required or specified. These distributed I/O modules shall use a Neuron® chip and an FTT-10A free topology transceiver for communication on a LonWorks bus, and comply with LonMark Application Layer Guidelines V3.2. I/O. The device shall have extended operating temperature rating from -40 degrees F to +150 degrees F, so it can be mounted directly in a wiring cabinet of monitored appliances. The I/O device shall include a temperature wall module connection that may be used in applications where the wall module shall sense temperature, control set point temperature, control occupied and unoccupied, or control fan speed.

H. Provide a distributed input and output module that connects sensors and actuators onto the Echelon field bus network for use with a LonWorks general purpose controllers (GPCs) and unitary DDC controllers (UC). LonWorks controllers shall be configured to read and command these points as required or specified. These distributed I/O modules shall use a Neuron® chip and an FTT-10A free topology transceiver for communication on a
LonWorks bus, and comply with LonMark Application Layer Guidelines V3.2. I/O. Module shall support software configurable manual overrides and provide corresponding feedback. These same modules shall also be equipped with colored status LED’s to distinguish analog and digital outputs, changing status, defective hardware and analog output signal strength. Overrides shall continue to operate even if the CPU is not working.

2.16 INPUT AND OUTPUT INTERFACE

A. Hardwired inputs and outputs may tie into the system through general purpose, custom application, or unitary controllers.

B. All input points and output points shall be protected such that shorting of the point to itself, to another point, or to ground will cause no damage to the controller. All input and output points shall be protected from voltage up to 24 V of any duration, such that contact with this voltage will cause no damage to the controller. Inputs and outputs shall be arranged on interchangeable modules or circuit boards to allow the replacement of a damaged module or board without replacing the entire controller.

C. Digital inputs shall allow the monitoring of on and off signals from remote devices. The digital inputs shall provide a wetting current of at least 12 mA to be compatible with commonly available control devices, and shall be protected against the effects of contact bounce and noise. Digital inputs shall sense “dry contact” closure without external power (other than that provided by the controller) being applied.

D. Totalizer input points: This type of point shall conform to all requirements of digital input points, and also accept up to 15 pulses per second for pulse accumulation.

E. Analog inputs for GPCs shall be minimum 12-bit resolution and allow the monitoring of low-voltage (0 to 10 VDC), current (0 to 20 mA), negative temperature coefficient (NTC), and resistance to detector (RTD). Analog inputs shall be compatible with and field-configurable to commonly available sensing devices. To prevent thermal loading, RTDs and thermistors shall be scanned rather than have continuous power applied.

F. Inputs shall be electrically isolated from their associated field points.

G. Digital outputs shall provide for on and off operation, or a pulsed low-voltage signal for pulse width modulation control. Outputs shall be selectable for either normally open or normally closed operation.

H. Analog outputs shall be minimum 8-bit resolution and provide a modulating signal for the control of end devices. Outputs shall provide either a 0 to 10 VDC or a 4 to 20 mA signal as required to provide proper control of the output device. Analog outputs on general purpose or custom application controllers shall have status lights and a two-position (Auto and Manual) switch and manually adjustable potentiometer with feedback for manual operation. Analog outputs shall not exhibit a drift of greater than 0.4 percent of range per year.

I. Tri-State outputs: Provide tri-state outputs (two coordinated digital outputs) for control of three-point floating-type electronic actuators without feedback. Use of three-point
floating devices shall be limited to zone control and terminal unit control applications (VAV terminal units, duct-mounted heating coils, zone dampers, radiation). Control algorithms shall run the zone actuator to one end of its stroke every 24 hours for verification of operator tracking.

J. System point capacity: The system size shall be expandable to at least [two] times the number of hardware and software input and output points required for this project or 12,000 points, whichever is greater. Additional controllers (along with associated devices and wiring) shall be all that is necessary to achieve this capacity requirement. The operator interfaces installed for this project shall not require any hardware additions or software revisions in order to expand the system.

K. Spare I/O Points: At each controller location, provide spare points equal to 15 percent of total I/O points at that location or 2 AI, 2 AO, 2 DO and 2 DI, whichever is greater.

2.17 POWER SUPPLIES AND LINE FILTERING

A. Control transformers shall be UL and CSA Listed. Furnish Class 2 current-limiting type or furnish over-current protection in both primary and secondary circuits for Class 2 service per NEC requirements. Limit connected loads to 80 percent of rated capacity

1. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0 percent line and load combined, with 100-microsecond response time for 50 percent load changes. Unit shall have built-in over-voltage and over-current protection and shall be able to withstand a 150 percent current overload for at least three seconds without trip-out or failure.
   a. Unit shall operate between 0 degree C and +50 degrees C [32 degrees F and +120 degrees F]. EM/RF shall meet FCC Class B and VDE 0871 for Class B and MIL-STD 810C for shock and vibration.
   b. Line voltage units shall be UL Recognized and CSA approved.

B. Power line filtering:
   1. Provide transient voltage and surge suppression for all workstations and controllers, either internally or as an external component. Surge protection shall have the following at a minimum:
      a. Dielectric strength of 1,000 volts minimum
      b. Response time of 10 nanoseconds or less
      c. Transverse mode noise attenuation of 65 dB or greater
      d. Common mode noise attenuation of 150 dB or better at 40 Hz to 100 Hz

2.18 AUXILIARY EQUIPMENT

A. Relays:
   1. Control relays shall be UL Listed plug-in type. Contact rating, configuration, and coil voltage suitable for application. Honeywell R4228/8228.
   2. Time delay relays shall be UL Listed solid-state plug-in type with adjustable time delay. Delay shall be adjustable ±200% (minimum) from set point shown on plans. Contact rating, configuration, and coil voltage suitable for application. Provide NEMA 1 enclosure when not installed in local control panel.

B. Override timers:
1. Override timers shall be spring-wound line voltage UL Listed, contact rating and configuration as required by application. Provide 0-to-6-hour calibrated dial unless otherwise specified; suitable for flush mounting on control panel face, located on local control panels or where shown.

2. Acceptable manufacturers: Honeywell, ST6008 series, Paragon, or approved equal.

C. Current transmitters:
   1. AC current transmitters shall be self-powered combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 4 to 20 mA two-wire output. Unit ranges shall be 10 A, 20 A, 50 A, 100 A, 150 A, and 200 A full scale, internal zero and span adjustment, and ±1 percent full-scale accuracy at 500 ohm maximum burden.
   2. Transmitter shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA Recognized.
   3. Unit shall be split-core type for clamp-on installation on existing wiring.

D. Current transformers:
   1. AC current transformers shall be UL and CSA recognized and completely encased (except for terminals) in approved plastic material.
   2. Transformers shall be available in various current ratios and shall be selected for ±1 percent accuracy at 5 A full scale output.
   3. Transformers shall be fixed-core or split-core type for installation on new or existing wiring, respectively.

E. Voltage transmitters:
   1. AC voltage transmitters shall be self-powered single loop (two-wire) type, 4 to 20 mA output, with zero and span adjustment.
   2. Ranges shall include 100 to 130 VAC, 200 to 250 VAC, 250 to 330 VAC, and 400 to 600 VAC full-scale, adjustable, with ±1 percent full-scale accuracy with 500 ohm maximum burden.
   3. Transmitters shall be UL/CSA Recognized at 600 VAC rating and meet or exceed ANSI/ISA S50.1 requirements.

F. Voltage transformers:
   1. AC voltage transformers shall be UL and CSA recognized, 600 VAC rated, complete with built-in fuse protection.
   2. Transformers shall be suitable for ambient temperatures of +4 degrees C to +55 degrees C [+40 to +130 degrees F] and shall provide ±0.5 percent accuracy at 24 VAC and a 5 VA load.
   3. Windings (except for terminals) shall be completely enclosed with metal or plastic material.

G. Power monitors:
   1. Power monitors shall be three-phase-type furnished with three-phase disconnect and shorting switch assembly, UL Listed voltage transformers, and UL Listed split-core current transformers.
   2. They shall provide a selectable rate pulse output for kWh reading and a 4 to 20 mA output for kW reading. They shall operate with 5 A current inputs with a
maximum error of ±2 percent at 1.0 power factor or ±2.5 percent at 0.5 power factor.

H. Current switches:
   1. Current-operated switches shall be self-powered, solid-state with adjustable trip current. The switches shall be selected to match the current of the application and output requirements of the DDC system.

I. Pressure transducers:
   1. Transducers shall have linear output signal. Zero and span shall be field-adjustable.
   2. Transducer sensing elements shall withstand continuous operating conditions of positive or negative pressure 50 percent greater than calibrated span without damage.
   3. Water pressure transducer shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Transducers shall be complete with 4 to 20 mA output, required mounting brackets, and block and bleed valves.
   4. Water differential pressure transducer shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Over-range limit (differential pressure) and maximum static pressure shall be 300 psi. Transducer shall be complete with 4 to 20 mA output, required mounting brackets, and five-valve manifold.

J. Differential-pressure-type switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA 1 enclosure, with scale range and differential suitable for intended application, or as shown.

2.19 WIRING AND RACEWAYS

A. General: Provide copper wiring, plenum cable, and raceways as specified in the applicable sections of Division 16.

B. All insulated wire to be copper conductors, UL labeled for 90C minimum service.

2.20 FIBER OPTIC CABLE SYSTEM

A. Optical cable: Optical cables shall be duplex 900 mm tight-buffer construction designed for intra-building environments. The sheath shall be UL Listed OFNP in accordance with NEC Article 770. The optical fiber shall meet the requirements of FDDI, ANSI X3T9.5 PMD for 62.5/125mm.

B. Connectors: All optical fibers shall be field-terminated with ST type connectors. Connectors shall have ceramic ferrules and metal bayonet latching bodies.

Part 3. EXECUTION

3.1 INSTALLATION
A. Install in accordance with manufacturer's instructions.
B. Coil and conceal excess capillary on remote element instruments.
C. Provide instruments with scale ranges selected according to service with largest appropriate scale.
D. Install gages and meters in locations where they are easily read from normal operating level.
E. Chilled and heating water at exit of equipment rooms.
F. Headers to central equipment.
G. Return main for each circuit of hot water systems.
H. Install thermometer sockets adjacent to controls system thermostat, transmitter, or sensor sockets. [Where thermometers are provided on local panels, duct or pipe mounted thermometers are not required.]
I. As noted.

3.2 EXAMINATION
A. The project plans shall be thoroughly examined for control device and equipment locations. Any discrepancies, conflicts, or omissions shall be reported to the Architect and Engineer for resolution before rough-in work is started.
B. The Contractor shall inspect the site to verify that equipment may be installed as shown. Any discrepancies, conflicts, or omissions shall be reported to the Engineer for resolution before rough-in work is started.

A. The Contractor shall protect all work and material from damage from its work or employees, and shall be liable for all damages thus caused.
B. The Contractor shall be responsible for its work and equipment until finally inspected, tested, and accepted. The Contractor shall protect any material that is not immediately installed. The
Contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.4 COORDINATION

A. Site:
   1. Where the mechanical work will be installed in close proximity to, or will interfere with, the work of other trades, the Contractor shall assist in working out space conditions to make a satisfactory adjustment. If the Contractor installs its work before coordinating with other trades, so as to cause any interference with the work of other trades, the Contractor shall make the necessary changes in its work to correct the condition without extra charge.
   2. Coordinate and schedule work with all other work in the same area, or with work that is dependent upon other work, to facilitate mutual progress.

B. Submittals: Refer to “Submittals” Article in Part 1 of this Specification for requirements.

C. Test and balance:
   1. The Contractor shall furnish all tools necessary to interface to the control system for test and balance purposes.
   2. The Contractor shall provide training in the use of these tools. This training will be planned for a minimum of four hours.
   3. In addition, the Contractor shall provide a qualified technician to assist in the test and balance process, until the first 20 terminal units are balanced.
   4. The tools used during the test and balance process will be returned at the completion of the testing and balancing.

D. Coordination with controls specified in other sections or divisions: Other sections and divisions of this Specification include controls and control devices that are to be part of or interfaced to the control system specified in this section. These controls shall be integrated into the system and coordinated by the Contractor as follows:
   1. All communication media and equipment shall be provided as specified in Part 2: “Communication” of this Specification.
   2. Each supplier of a control product is responsible for the configuration, programming, startup, and testing of that product to meet the sequences of operation described in this section.

3.5 GENERAL WORKMANSHIP

A. Install equipment, piping, and wiring raceway parallel to the building lines (i.e., horizontal, vertical, and parallel to walls) wherever possible.

B. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.

C. Install all equipment in readily accessible locations as defined by Chapter 1, Article 100, Part A of the National Electric Code (NEC).

D. Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.
E. All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility, and be executed in strict adherence to local codes and standard practices.

3.6 FIELD QUALITY CONTROL

A. All work, materials, and equipment shall comply with the rules and regulations of applicable local, state, and federal codes and ordinances as identified in Part 1 of this Specification.

B. Contractor shall continually monitor the field installation for code compliance and quality workmanship.

C. Contractor shall have work inspected by local or state authorities having jurisdiction over the work.

3.7 PRESSURE - TEMPERATURE TEST STATIONS

A. Provide at:
   1. Inlets and outlets of:
      a. Chillers.
      b. Hot water boilers.
      c. Heat exchangers.
   2. Adjacent to each bulb for:
      a. Controllers.
      b. Remote temperature indication.
      c. Recording thermometers.
   3. As indicated otherwise on drawings.

3.8 PRESSURE GAUGES

A. Install pressure gages with pulsation dampers. Provide [gage cock] [needle valve] to isolate each gage. [Provide syphon on gages in steam systems.]

B. For new equipment, provide in water piping at:
   1. Inlets and outlets of:
      a. Chiller (condenser and evaporator).
      b. Heat exchanger circuits.
      c. Hot water boiler.
   2. Pumps at:
      a. Suction and discharge, between shutoff valves and pump.
      b. Condenser water pump inlet: compound type if subject to negative pressures.
   3. At condenser water inlet to cooling tower.
   4. At discharge of:
      a. Condensate pump.
      b. Boiler feed pump.
      c. De-aerator feed (transfer) pump.
   5. Expansion tanks.
   6. Pressure tanks.
   7. Standpipe, highest point.
8. Standpipe and sprinkler water supply connection.
10. As indicated otherwise on drawings.

C. Pete's Plug -- supply thermometer and gauge kits.

D. Valved outlets for pressure gauges:
   1. In cooling and heating water supply and return for coil assemblies.
   2. Equipment not listed to receive permanent thermometers or pressure gauge.
   4. As noted.

3.9 FLOW METERS

A. Installation shall be per manufacturer’s recommendations.

3.10 TEST PLUGS

A. Locate test plugs
   1. Adjacent to thermometers and thermometer sockets.
   2. Adjacent to pressure gages and pressure gage taps
   3. Adjacent to control device sockets
   4. Where indicated.

3.11 WIRING

A. All control and interlock wiring shall comply with national and local electrical codes and
   Division 16 of this specification. Where the requirements of this section differ with those
   in Division 16, the requirements of this section shall take precedence.

B. All NEC Class 1 (line voltage) wiring shall be UL Listed in approved raceway per NEC and
   Division 16 requirements.

C. All low-voltage wiring shall meet NEC Class 2 requirements. (Low-voltage power circuits
   shall be sub-fused when required to meet the Class 2 current limit.)

D. All wiring in mechanical, electrical, or service rooms—or where subject to mechanical
   damage—shall be installed in raceway at levels below 3m [10ft].

E. Do not install Class 2 wiring in raceway containing Class 1 wiring. Boxes and panels
   containing high-voltage wiring and equipment may not be used for low-voltage wiring
   except for the purpose of interfacing the two (e.g., relays and transformers).

F. Do not install wiring in raceway containing tubing.

G. Where Class 2 wiring is run exposed, wiring is to be run parallel along a surface or
   perpendicular to it, and neatly tied at 3m [10 ft] intervals.
H. Where plenum cables are used without raceway, they shall be supported from or anchored to structural members. Cables shall not be supported by or anchored to ductwork, electrical raceways, piping, or ceiling suspension systems.

I. All wire-to-device connections shall be made at a terminal block or terminal strip. All wire-to-wire connections shall be made at a terminal block or wire nut at junction box.

J. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.

K. Maximum allowable voltage for control wiring shall be 120v. If only higher voltages are available, the contractor shall provide step-down transformers.

L. All wiring shall be installed as continuous lengths, with no splices permitted between termination points.

M. Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations.

N. Size of raceway and size and type of wire shall be the responsibility of the Contractor, in keeping with the manufacturer’s recommendation and NEC requirements, except as noted elsewhere.

O. Include one pull string in each raceway 2.5 cm [1"] or larger.

P. Use coded conductors throughout with different colored conductors.

Q. Control and status relays are to be located in designated enclosures only. These enclosures include packaged equipment control panel enclosures, unless they also contain Class 1 starters.

R. Conceal all raceways, except within mechanical, electrical, or service rooms. Install raceway to maintain a minimum clearance of 15 cm [6"] from high-temperature equipment (e.g., steam pipes or flues).

S. Secure raceways with raceway clamps fastened to the structure and spaced according to code requirements. Raceways and pull boxes may not be hung on flexible duct strap or tie rods. Raceways may not be run on or attached to ductwork.

T. Adhere to Division 16 requirements where raceway crosses building expansion joints.

U. Install insulated bushings on all raceway ends and openings to enclosures. Seal top end of all vertical raceways.

V. The contractor shall terminate all control and interlock wiring, and shall maintain updated wiring diagrams with terminations identified at the job site.

W. Flexible metal raceways and liquid-tight, flexible metal raceways shall not exceed 1m [3 ft] in length and shall be supported at each end. Flexible metal raceway less than 1/2 in.
electrical trade size shall not be used. In areas exposed to moisture—including chiller and boiler rooms—liquid-tight, flexible metal raceways shall be used.

X. Raceway shall be rigidly installed, adequately supported, properly reamed at both ends and left clean and free of obstructions. Raceway sections shall be joined with couplings (per code). Terminations shall be made with fittings at boxes, and ends not terminating in boxes shall have bushings installed.

3.12 COMMUNICATION WIRING

A. The contractor shall adhere to the items listed in the “Wiring” Article in Part 3 of the Specification.

B. Follow manufacturer’s installation recommendations for all communication cabling.

C. Do not install communication wiring in raceway and enclosures containing Class 1 or other Class 2 wiring.

D. Maximum pulling, tension, and bend radius for cable installation, as specified by the cable manufacturer, shall not be exceeded during the installation.

E. Contractor shall verify the integrity of the entire network following the cable installation. Use appropriate test measures for each particular cable.

F. When a cable enters or exits a building, a lightning arrester shall be installed between the lines and ground. The lightning arrester shall be installed according to the manufacturer’s instructions.

G. All runs of communication wiring shall be unspliced lengths when that length is commercially available.

H. All communication wiring shall be labeled to indicate origination and destination data.

I. Grounding of coaxial cable shall be in accordance with NEC regulations Article on Communication Circuits, Cable and Protector Grounding.

3.13 FIBER OPTIC CABLE SYSTEM

A. Maximum pulling tensions as specified by the cable manufacturer shall not be exceeded during installation. Post-installation residual cable tension shall be within the cable manufacturer’s specifications.

B. All cabling and associated components shall be installed in accordance with manufacturer’s instructions. Minimum cable and unjacketed fiber bend radii as specified by the cable manufacturer shall be maintained.

3.14 IDENTIFICATION OF HARDWARE AND WIRING

A. All wiring, cabling, and tubing within factory-fabricated panels shall be labeled within 5 cm [2"] of termination with DDC address or termination number.
B. Identify control panels with minimum 1 cm [1/2"] letters on laminated plastic nameplates.

C. Manufacturers' name plates and UL or CSA labels are to be visible and legible after equipment is installed.

D. Identifiers shall match record documents.

3.15 CONTROLLERS

A. General purpose controllers and custom application controllers shall be selected to provide a minimum of [10 percent] spare I/O point capacity for each point type found at each location. If input points are not universal, [10 percent] of each type is required. If outputs are not universal, [10 percent] of each type is required. A minimum of one spare is required for each type of point used.
   1. Future use of spare capacity shall require providing the field device, field wiring, point database definition, and custom software. No additional controller boards or point modules shall be required to implement use of these spare points.

3.16 PROGRAMMING

A. Provide sufficient internal memory for the specified sequences of operation and trend logging. There shall be a minimum of [25 percent] of available memory free for future use.

B. Point naming and point value: System point names and values shall be of sufficient size to allow flexibility in design, allowing easy operator interface without the use of a written point index or cryptic alphanumeric shorthand.
   1. Point ID is used to designate the location of the point within the building, such as mechanical room, wing, or level, or the building itself in a multi-building environment. Point ID shall be a minimum of 40 characters in length.
   2. Point descriptors shall be a minimum of 132 characters.
   3. Point states shall be a minimum of 8 characters in length.
   4. Point engineering units shall be a minimum of 6 characters in length.
   5. Point values shall be a minimum of 15 characters in length with a variable decimal point.

C. Software programming:
   1. Provide programming for the system and adhere to the sequences of operation provided. Imbed into the control program sufficient comment statements to clearly describe each section of the program.
      a. Graphic-based:
         1) Shall provide actions for all possible situations.
         2) Shall be documented in the form of a logic flowchart.
      b. Text based:
         1) Shall provide actions for all possible situations.
         2) Shall be modular and structured.
         3) Shall be commented.
      c. Parameter-based:
         1) Shall provide actions for all possible situations.
         2) Shall be documented.
D. Operator interface:
   1. Standard graphics: Provide graphics for all mechanical systems and floor plans of the building. This includes each chilled water system, hot water system, chiller, boiler, air handler, and all terminal equipment. Point information on the graphic displays shall dynamically update. Show on each graphic all input and output points for the system. Also show relevant calculated points such as set points.
   2. Show terminal equipment information on a "graphic" summary table. Provide dynamic information for each point shown.
   3. The contractor shall provide all the labor necessary to install, initialize, start up, and troubleshoot all operator interface software and their functions as described in this section. This includes any operating system software, the operator interface database, and any third-party software installation and integration required for successful operation of the operator interface.

3.17 CONTROL SYSTEM CHECKOUT AND TESTING

A. Startup testing: All testing listed in this Article shall be performed by the Contractor and shall make up part of the necessary verification of an operating control system. This testing shall be completed before the Owner’s representative is notified of the system demonstration.
   1. The Contractor shall furnish all labor and test apparatus required to calibrate and prepare for service all instruments, controls, and accessory equipment furnished under this Specification.
   2. Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight.
   3. Enable the control systems and verify calibration of all input devices individually. Perform calibration procedures per manufacturers' recommendations.
   4. Verify that all digital output devices (relays, solenoid valves, two-position actuators and control valves, and magnetic starters) operate properly and that the normal positions are correct.
   5. Verify that all analog output devices (I/Ps, actuators) are functional, that start and span are correct, and that direction and normal positions are correct. The Contractor shall check all control valves and automatic dampers to ensure proper action and closure. The Contractor shall make any necessary adjustments to valve stem and damper blade travel.
   6. Verify that the system operation adheres to the Sequences of Operation. Simulate and observe all modes of operation by overriding and varying inputs and schedules. Tune all DDC loops and optimum start and stop routines.
   7. Alarms and interlocks:
      a. Check each alarm separately by including an appropriate signal at a value that will trip the alarm.
      b. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.
      c. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action.

3.18 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE
A. Demonstration:
   1. Prior to acceptance, the control system shall undergo a series of performance
tests to verify operation and compliance with this Specification. These tests shall
occur after the Contractor has completed the installation, started up the system,
and performed its own tests.
   2. As each control input and output is checked, a log shall be completed showing
the date, technician's initials, and any corrective action taken or needed.

B. Acceptance:
   1. The system shall not be accepted until all forms and checklists completed as part
of the demonstration are submitted and approved as required in Part 1:
   “Submittals.”

3.19 CLEANING

   A. The Contractor shall clean up all debris resulting from its activities daily. The Contractor
shall remove all cartons, containers, and crates under its control as soon as their contents
have been removed. Waste shall be collected and placed in a designated location.

   B. At the completion of work in any area, the Contractor shall clean all of its work and
equipment, keeping it free from dust, dirt, and debris.

   C. At the completion of work, all equipment furnished under this Section shall be checked for
paint damage, and any factory-finished paint that has been damaged shall be repaired to
match the adjacent areas. Any cabinet or enclosure that has been deformed shall be
replaced with new material and repainted to match the adjacent areas.

3.20 TRAINING

   A. Provide a minimum of 24 hours of training.

END OF SECTION
SECTION 15950 - SEQUENCE OF OPERATIONS FOR CHILLER PLANT CONTROLS

PART 1 GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions of Contract,” form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section includes sequence of operation for:
   1. Central Chiller Plant Systems

B. Related Sections:
   1. Section 15900 - Instrumentation and Control: For equipment, devices, and system components to implement sequences of operation.

1.3 SUBMITTALS

A. Shop Drawings: Indicate mechanical system controlled and control system components.
   1. Label with settings, adjustable range of control and limits. Submit written description of control sequence.
   2. Submit flow diagrams for each control system, graphically depicting control logic.
   3. Submit draft copies of graphic displays indicating mechanical system components, control system components, and controlled function status and value.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of components and set points of controls, including changes to sequences made after submission of shop drawings.

PART 2 EXECUTION

2.1 CENTRAL PLANT

A. General
   1. The control sequence covers the equipment installed under this contract as well as existing equipment as applicable.
   2. Provide an H-O-A switch for each pump, valve motor, fans etc. where not already provided in the MCC/DDC panel. In "Hand" position, the pumps shall be manually started/stopped locally from the starters. In "Auto" position, the pumps shall be under control of BMS and start/stop remotely in accordance with the control sequence.
   3. Motor operated valves shall be capable of indicating valve positions at BMS.
   4. Modulating valves shall be “Fail-in-last-position” unless noted otherwise.
5. Provide a Local/Remote switch at the variable frequency drive for each variable speed pump. In “Local” position, the drive speed shall be manually adjustable at the variable frequency drive. In “Remote” position, the drive speed shall be automatically adjusted by the BMS.

B. BMS System Setup:
1. Provide software “System Enable” to activate/deactivate the BMS control sequence.
2. Provide software enable to activate/deactivate individual chiller, chilled water pumps, condenser water pumps and cooling tower fans. In “enable” mode, the equipment will be under the control of BMS based on the normal control sequence. In “Manual” mode the equipment will be started or stopped locally at the equipment starter. All safety interlocks shall remain in effect in the manual mode.
3. All ATC control points, both hardware and software, shall be accessible (read/write) from the existing Honeywell Enterprise Building Integrator (EBI) system. The controls vendor shall provide all necessary software and hardware, including BACnet/IP routers and all required programming to allow communication between the building system controllers and the campus wide EBI system.
4. Assign start/stop sequence for the chiller, chilled water pumps, cooling towers, condenser water pumps and make up unit pumps. The sequence shall rotate the lead/lag assignments based on weekly schedule.
5. The chilled water and condenser water system shall be designed for a fully “automated” operation as described in the sections below.

C. General Description
The central chiller plant is comprised of four centrifugal chillers (CH-1, CH-2, CH-3 & CH-5) and one plate and frame heat exchanger HX-1. The new cooling tower CT-1 is designed to operate majority of the time throughout the year and the existing tower CT-2 will be operated only during high load and upon demand. The heat exchanger is designed to provide free cooling and pre cooling based on the weather and cooling load conditions described in later sections.

D. Chillers/Towers Matrix
The tower cells and condenser water pumps shall operate for given chillers based on following matrix.

<table>
<thead>
<tr>
<th>Chiller(s)</th>
<th>Tons</th>
<th>CW Flow GPM</th>
<th>CW Pump</th>
<th>Cooling Tower Cells</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chiller 1</td>
<td>&lt;=2,000</td>
<td>6,000</td>
<td>CWP 1 + CWP2</td>
<td>Cell 1 + Cell 2 + Cell 3 + Cell 4</td>
</tr>
<tr>
<td>Chiller 1 + Chiller 2</td>
<td>2,000-4,000</td>
<td>12,000</td>
<td>CWP 1 + CWP 2 + CWP 3 + CWP 4</td>
<td>Cell 1 + Cell 2 + Cell 3 + Cell 4 + Cell 5 + Cell 6 + Cell 7</td>
</tr>
<tr>
<td>Chiller 1 + Chiller 2 + Chiller 3</td>
<td>4,000 – 5,500</td>
<td>16,500</td>
<td>CWP 1 + CWP 2 + CWP 3 + CWP 4 + CWP 5 +</td>
<td>Cell 1 + Cell 2 + Cell 3 + Cell 4 + Cell 5 + Cell 6 +</td>
</tr>
</tbody>
</table>
### E. System Off (When “Cooling System Off” switch is activated):

1. All chillers (CH-1 through CH-5) and pumps (P-1 through P-6 & CWP-1 through CWP-7) are de-energized.
2. CHW flow control valves (FCV-1 through FCV-4) for the chiller are in closed position.
3. Chilled water flow control / differential pressure bypass valve (FCV-05) in open position.
4. Valves MV-01 and MV-02 are in open position.
5. Cooling tower flow control valves (FCV-21 thru FCV-24) and isolation valves (MV-25 thru MV-30) are in closed position. Cooling tower fans are off.
6. Cooling tower bypass valves are in closed position.
7. Heat Exchanger valves MV-02 and MV-03 are in closed position.

### F. System ON

1. The chilled water and condenser water flow control valves for the lead operating chiller shall open.
2. The control valve/isolation valve for the tower water cells shall open. The cells to be operated are based on Section D.
3. After a delay of 30 seconds, corresponding CT fan shall start and operate to maintain the CWS temperature setpoint. The CWS set point is based on Section G.
4. The chilled water pump shall operate to maintain system DP. The condenser water pump shall operate at full speed.
5. The differential bypass valve FCV-05 shall be open.
6. After the minimum flow through the lead chiller is verified and all permissive check items are satisfied, the chiller shall start automatically and operate to maintain the leaving temperature set point (42°F, adjustable from BAS).
7. After a time delay of 30 seconds, the differential bypass valve FCV-05 shall modulate to keep minimum flow or close if minimum flow through the chiller is satisfied.
8. The next chiller will come on after the load percentage on lead chiller reaches 90%. The flow control valve for the lag chiller shall open slowly and fully in 3 minutes. The operating chillers shall operate at the same load percentage per Section G-4.
9. If more than two chillers are operating, upon a decrease in cooling demand to below 50% (adjustable) capacity of all operating chillers for 5 minutes (adjustable), the lag chiller and corresponding cooling tower cells and CW pumps shall shutdown. See Section D for chiller-tower sequence.
10. Upon further decrease in cooling demand to below 35% (adjustable) capacity of two operating chillers for 5 minutes (adjustable), the lag chiller shall shutdown. Corresponding cooling tower cells and CW pumps shall shut down.

G. Chilled Water Flow Control
1. The chiller plant is modified to operate as variable primary pumping system during which all primary chilled water pumps CHP-1 through CHP-6 remain closed. The primary pumps bypass valves MV-01 & MV-02 shall open. The decoupler valve FCV-05 shall remain closed. The secondary chilled water pumps P-1 through P-6 shall operate to maintain the chilled water flow per following sequence.
2. The differential pressure from buildings Bliss, New Art and Armstrong buildings shall be considered. The maximum value of dP of these three buildings shall be used against the set point (20 psi & adjustable) to control the speed of the secondary pumps.
3. When the lead pump speed reaches over 95% for over 5 minutes, the next pump shall turn on automatically. When there are two or more pumps running, the pumps shall modulate synchronously to maintain DP.
4. Each operating chiller’s flow control valve shall modulate to maintain chilled water load percentage per following sequence.
   a. When the only lead chiller is operating, the control valve shall remain 100% open.
   b. When the lag chiller comes on per manufacturer recommended chiller start-up process, the control valve of the lag chiller shall be 100% open initially.
   c. The total cooling load shall be calculated based on operating chillers flow and temperature. The cooling load percentage shall be calculated from the total cooling load and the total capacity of the operating chillers.
   d. Keeping the valve of the chiller with lower load percentage 100% open, the control valve of the another chiller shall modulate to maintain all operating chillers at the calculated load percentage.

5. The minimum flow setpoint for all chillers shall be per manufacturer.
6. If the chiller flow is less than the minimum flow, the DP bypass valve / flow control valve FCV-05 shall open and modulate to maintain minimum flow through the chiller. Under no circumstance shall the chiller operate at the chilled water flow rate lower than the minimum flow setpoint.
7. When any of the operating chiller(s) is at the maximum flow per manufacturer as measured by corresponding flow meter, the operating CHW pumps speed shall stop modulating upward.
8. During the peak load condition in future once future loads are added to the plant, if the secondary pumps cannot provide enough pressure to the building, the Operator shall operate the plant in Primary-Secondary pumping system as follows.
   a. Primary pumps MV-01 & MV-02 shall close.
   b. The primary pumps CHP-1 through CHP-6 are operated per existing sequence depending on number of chillers operated.
   c. The minimum flow bypass valve FCV-05 shall remain closed.
   d. The secondary pumps shall operate to maintain the differential pressure set point per above sequence 2.
9. During peak load conditions in future, if the secondary pumps cannot provide enough flow to the buildings even after operating the plant in primary-secondary
pumping mode, the building pumps shall be operated in the buildings where the flow is not met.

H. Cooling Tower and Condenser Water Pump Operation

1. With lead chiller (CH-1 or 2) in operation, the condenser water pumps and the cooling tower cells shall be operated to maintain per Section D.

2. CWP shall modulate to maintain total design flow of operating chillers as measured by CW flow meters. If the flow meters are not installed, the flows shall be derived based on differential pressure transmitters across the chillers.

3. Each operating cooling tower’s flow control valves of CT-1 (FCV-21, FCV-22, FCV-23 and FCV-24) shall modulate to maintain cooling tower flow setpoint. Cooling tower flow setpoint shall be equal to average condenser water flow of enabled cooling towers. The cooling tower flow setpoint shall be adjusted at time interval of every 5 minutes (adjustable). If the flow meters are not installed, the flow control valves shall be adjusted as balancing valves to allow flow to be balanced on all operating cells.

4. The fans of operating cells of CT-1 shall modulate automatically to maintain the CW supply temperature setpoint.
   a. During startup, the setpoint shall be WB + 7°F.
   b. After half an hour, the fan shall modulate down at a rate of 5% every 10 minutes (adjustable) until the CWS temperature rises by at least 1°F. The temperature recorded before the increase of 1°F will become the new CWS temperature setpoint.
   c. After half an hour, perform the following:
      ▶ If outside air WB decreases by at least 2°F (adjustable), repeat sequence 4-b.
      ▶ If CWS temperature rises by at least 2°F (adjustable), modulate the fan speed up at a rate of 5% every 10 minutes (adjustable) until the CWS temperature drops by 1°F. This temperature will become the new CWS temperature setpoint.
   d. Repeat sequence 4-c every hour.
   e. If the fan reaches its minimum speed and CWS setpoint is achieved, the fan shall stop with CW flowing over the fill. With the increase in CWS, repeat sequence 4-c

5. The fans of CT-2 are constant speed fans. The fans shall stage on when the cells are operated.

6. At lower condenser water temperatures, CT-1 shall be operated and CT-2 shall remain OFF. The electric chiller head pressure control modulating signal shall override the position of condenser water flow control valve. If the head pressure control signal is engaged, the CW flow control valve shall throttle down to decrease the CW flow to maintain the head pressure control. The condenser water pumps shall modulate down to keep the CW flow control valve fully open. When the head pressure control signal returns to its minimum value, the condenser water pumps shall return to their normal operation.

I. Free Cooling/Pre Cooling
1. Free Cooling
   a. Free Cooling will be enabled when outdoor air wet bulb temperature is below 42°F (adjustable).
   b. Free Cooling Heat Exchanger will be operated and all chillers will be shut down during free cooling.
   c. All chilled water valves and condenser water valves of the chillers are closed.
   d. The condenser water valves and bypass valves of CT-2 are closed. Only CT-1 cells shall be operated.
   e. The system shall be run in variable primary pumping system during free cooling. Primary pumps CHP-1 through CHP-6 are shut down. All building pumps shall remain OFF. The secondary pumps are operated to maintain dP across building per Section G-2. Primary pumps bypass valves MV-01 & MV-02 shall open.
   f. The HX shall be operated per following sequence
      1) The CHW valves MV-04 & FCV-06 shall open. and CW flow control valve for the HX shall remain 100% open. The CW valve FCV-09 shall open.
      2) The pre-cooling valve MV-03 shall remain closed.
      3) One CWP shall operate.
      4) Two cells of CT-1 shall operate.
      5) The CT fans shall modulate the maintain the CWS set point of : CHW set point- 2 (HX approach)
   g. Free Cooling shall be operated to maintain chilled water supply temperature set point of 44-48 °F (adjustable).

2. Pre Cooling
   a. An indicator shall alarm the operator when to enable the heat exchanger as the conditions are appropriate for pre cooling.
      1) When Free Cooling is enabled and HX leaving chilled water temperature rises by 2°F above setpoint or cooling load is higher than the capacity of two HXs, pre cooling is enabled.
      2) When Mechanical cooling is enabled and the predicted HX leaving chilled water temperature is 2 degree lower than the return chilled water temperature, pre cooling is enabled.
      3) If the HX cannot reduce the return chilled water temperature by 2°F, pre cooling is disable.
   b. Predicted HX chilled water leaving temperature
      \[ PHXLWT = T_{WB} + PA_{HX} + PA_{CT} \]
      \[ PA_{HX} = DA_{HX} \times PLR_{HX} \]
      \[ PA_{CT} = M \times (DT_{WB} - T_{WB}) + DA_{CT} \]

where:
T_WB = Current wet bulb temperature
PA_HX = Predicted heat exchanger approach
PA_CT = Predicted cooling tower approach
DA_HX = Design heat exchange approach=2F
PLR_HX = Predicted heat exchanger part-load ratio (current chilled water
HX flow/design chilled water HX flow)
DT_WB = Design wet bulb temperature=78F
DA_CT = Design cooling tower approach temperature = 15F
M = Slope developed from empirical plant data= -0.01, operator adjustable
and field verified

c. When pre cooling is enabled, pre cooling valve MV-03 is opened and valve
MV-04 is closed.
d. The electric chiller CH-3 or CH-5 shall be operated in pre-cooling mode.
e. Only 1 chiller is sufficient during free cooling mode. The chiller shall be
operated based on chiller operation sequence described in earlier sections.
f. Three CW pumps are operated during precooling mode. The CW control
valve for HX and chiller shall modulate to maintain the design flow rate.
g. The electric chiller shall be loaded at a minimum of 25% load percentage.
h. Disable pre cooling if the heat exchanger is not reducing the chilled water
return temperature by at least 2°F.

J. Cooling Tower Freeze Protection
For deicing on Cooling Tower -1 during free cooling operation, the fan of one of the
operating cells shall be operated in reverse mode and at a minimum speed for 15 minutes
when the outside wet bulb temperature is less than 35°F. The fan shall resume its normal
operation after 15 minutes. The fan shall come to a complete stop before operating in
opposite direction. The process shall be repeated every 2 hours.

Once the reverse mode operation of one cell is completed and the fan resumes its normal
operation, the same deicing process shall be repeated for another operating cell. Cooling
Tower-2 shall not be operated during free cooling mode.

If the tower sump water temperature reaches 40°F or below, the basin heating system gets
activated and will heat the sump water to maintain at or above 40°F. The system shall
indicate an alarm condition when the pipe temperature drops to 35°F.

K. Heat Tracing Operation
Outdoor air thermostat controls to prevent operation when outside air temperature is above
40F (adjustable). The control system shall energize each heater cable independently to
maintain the pipe temperature at 40F (adjustable) when the pipe temperature drops to 40
degrees F. The system shall indicate an alarm condition when the pipe temperature drops to
35 degrees F. Refer to Section 15300 Heat Tracing for HVAC Piping

L. Refrigerant Leak Detection System

1. Upon detecting refrigerant leak (high level alarm), the following shall take place
automatically:
a. MER Exhaust Fan shall shut down.
b. An alarm shall be activated at existing BMS.
c. The associated strobes and horns inside and outside the plant will be activated.
d. Refrigerant exhaust system damper shall open.
e. Refrigerant exhaust fan system shall start.

2. Refrigerant Exhaust Switch Control for fan; Upon activation of the refrigerant exhaust system switch, the following shall take place automatically:
   a. MER Exhaust Fan (if any) shall be shut down
   b. An alarm shall be activated at existing BMS
   c. The associated strobes and horns inside and outside the plant will be activated
   d. Refrigerant exhaust system damper shall open
   e. Refrigerant exhaust fan system shall start

3. Upon deactivation of switch, the reverse shall happen.

M. Display

1. Chilled Water System - The BMS shall monitor and display as a minimum the following:
   a. Chilled water set point.
   b. Chiller on/off status.
   c. Chilled water in/out temperature.
   d. Chilled water flow through each chiller
   e. Plant total chilled water flow
   f. Chiller evaporator and condenser differential pressure.
   g. Chiller evaporator and condenser max and min DP settings.
   h. Condenser water in/out temperature.
   i. Condenser water flow through each chiller
   j. Chiller tonnage
   k. Electric demand for the electric chillers
   l. Steam demand for the steam turbine chillers
   m. Chiller efficiency in kW/Ton or lbs/ton-hr.
   n. All operating parameters available in chiller control panel via a data link (coordinate with chiller manufacturer).
   o. Chilled water pump command, status, speed, DP, power and reset (each)
   p. Condenser water pump command, status, speed, DP, power and reset (each)
   q. Cooling tower fan command, status, speed, power and reset (each)
   r. Cooling tower sump level
   s. Condenser water flow to each cooling tower
   t. All VFD operating parameters available via BACNET for pumps and fans.
   u. Cooling tonnage for the plant.
   v. Plant chilled water supply and return temperature
   w. Plant efficiency in kW/Ton (Chillers, Cooling Towers, Chilled Water Pumps and Condenser Water Pumps)
x. All available points from switch gear power meters
y. Expansion tank pressure
z. City water make-up unit flow (totalized)
aa. Make-up unit pump command, status and reset (each)
bb. Make-up unit tank level
cc. Each building load (BTU)
dd. Each building flow
e. Each building temperature in / out
ff. Each building differential pressure (DP)
gg. Condenser water make-up flow (totalized)
hh. Condenser water blow down flow (totalized)
ii. Chemical treatment domestic water flow (totalized)
jj. Sand filter domestic water backwash flow (totalized)
kk. Outside air temperature (both Wet Bulb and Dry Bulb)

N. Safety & Alarms

1. Chilled Water System
   a. An alarm shall be activated at BMS (visual) upon any of the following conditions:
      ➢ Chiller supply water temperature high (each chiller)
      ➢ Chiller CHW flow high / low
      ➢ Chiller CW flow high / low
      ➢ Chiller common alarm, chiller failure and chiller reset (each chiller)
      ➢ Chilled water pump failure
      ➢ Condenser water pump failure
      ➢ Cooling tower CW supply temperature high / low
      ➢ Cooling tower sump alarm – overflow, high high, high, low, low low and pump cut off.
      ➢ Make-up unit tank high / low alarm.
      ➢ Cooling tower dump indication.
      ➢ Cooling tower fan vibration
      ➢ Heat trace common alarms
      ➢ Any flow control / isolation / pressure sustaining valve failure

   b. If the chiller, cooling tower fan, or pumps fails to start upon command the lag unit shall start automatically and an alarm shall be activated at the BMS.
      If the lag equipment fails to start after failure of the lead unit, the entire chiller plant shall shut down automatically and an alarm shall be activated at the BMS.

   c. Upon the following conditions, chiller shall shut down automatically in accordance with the normal shutdown sequence, and visual and audible (refrigerant leak only) alarm shall be activated at the central station:
      i. Violation of chiller manufacturer’s standard safety controls (common alarm).
      ii. Refrigerant leak indicated by the plant refrigerant monitoring system (high level).
 iii. Activation of the plant emergency break-glass switches / pushbuttons installed by electrical.

2. Refrigerant Leak Detection System - Refrigerant low, main and high level alarm
3. Sand Filter System common alarms
4. Chemical Treatment System common alarms

O. Building Pressure Control
1. All building have control valves either in the main chilled water return pipes or in chilled water supply pipes.
2. The control valves in the pipes shall modulate to maintain the differential pressure across the buildings to be no more than 30 psi (adjustable)

END OF SECTION
SECTION 17010: COMMISSIONING

PART 1 - GENERAL

1.1 COMMISSIONING PROCESS

A. Commissioning activities are the responsibility of the owner's Commissioning Authority (CA), DLB Associates.

1. The commissioning plan is the vehicle by which the commissioning process is planned, executed and documented.
2. Draft and final versions of the commissioning plan for this project shall be produced by the commissioning authority.

B. The commissioning authority and the construction manager are responsible for producing the final commissioning plan, with all necessary commissioning sequences.

1. The construction manager is responsible for obtaining from contractors all documentation related to the commissioning effort and submitting it to the commissioning authority.
2. The Commissioning Authority will be responsible for incorporating the documentation the final version of the commissioning plan.

C. All system and equipment start up, check out and pre-functional testing will be conducted by the respective manufacturers and contractors, and observed by the Construction Manager (CM) and Commissioning Authority.

D. Functional and integrated testing shall be performed by the contractors and directed, witnessed, and verified by the commissioning authority.

E. This specification is to be used in conjunction with all other contract documents.

1. Any discrepancies or conflicts shall be identified and the Owner and Construction Manager shall be notified in writing.
2. A clarification will then be issued to the appropriate parties and entities.

F. The commissioning process will involve the participation of representatives from the Owner, Engineer of Record, Commissioning Authority, Construction Manager, contractors, testing and balancing firms, and major equipment suppliers.

1. The Contractor’s lead individual for each trade, who will actually perform or supervise the work, is to be designated by the Construction Manager as the representative to the Commissioning Authority. The designated representative for each trade will be responsible for providing direction and supervision of all other like tradesman involved in the conduct of commissioning activities.
2. The Commissioning Authority (DLB Associates), retained by the Owner, shall have responsibility for coordinating each step of the commissioning process.
3. The Commissioning Authority is not authorized to release, revoke, alter, or expand the requirements of the Contract Documents, approve or accept any portion of the Work, or perform any of the duties of the Construction Manager or contractors.

G. MEP system pre-installation checks, installation, check, test, and start-up, testing and balancing, preparation of O&M manuals, and operator training are the responsibility of the Construction Manager and MEP Contractors.

1. The Commissioning Authority shall observe and verify the proper completion of these activities as prerequisites for the conduct of follow-on commissioning activities.
2. The commissioning process does not relieve contractors from the obligation of completing all specified Work in a satisfactory and fully operational manner. Nor does the commissioning process relieve any obligation resting with the trades for operation and maintenance manuals and training.
3. The work included in the commissioning process involves a complete and thorough evaluation of the operation and performance of all components, systems, and sub-systems specified in Divisions 15 and 26.

H. Commissioning work for the Construction Manager and for Division 15, 26, and 17 contractors shall include but not be limited to:

1. Documenting the construction process.
2. Reporting on the project schedule, including designated commissioning activities to the Owner.
3. Providing and coordinating equipment startup procedures, including manufacturer’s recommendations and checklists for review by the CM and CA.
4. Checking, test and start-up of equipment to be performed by the contractor in the presence of the CA.
5. Coordinating on Functional Test Scripts to ensure that all required test equipment is provided and adequate personnel are sourced for testing.
6. Performing functional tests while Commissioning Authority directs test steps.
7. Testing, adjusting, and balancing hydronic systems.
8. Cooperating with the Commissioning Authority.
9. Providing qualified personnel for participation in commissioning tests, including seasonal testing if required after the initial testing.
10. Attend Commissioning Coordination Meetings during the construction process and participate in commissioning scheduling and coordination process.
11. Attend and actively participate in Integrated Systems Test (IST) coordination and preparation meetings.
12. Provide equipment and personnel as called for in the Integrated Test Script required to successfully execute the IST.
13. Providing equipment, materials, and labor, as necessary, to correct construction and/or equipment deficiencies found during commissioning.
14. Providing operation and maintenance manuals and as-built drawings to the Commissioning Authority for verification.
15. Provide Training Documentation for Review to the CM and CA, and obtain approval of the adequacy of such training plans prior to the conduct of such training. Provide for a minimum of two weeks’ time for the coordination and approval process.
16. Providing on-site and off-site training and demonstrations for systems specified.
I. Timely and accurate documentation is essential for the commissioning process to be effective. Documentation required as part of the commissioning process shall be provided to the Commissioning Authority by the Construction Manager and shall include, but not be limited to:

1. Pre-start and start-up procedures.
2. Training agenda and materials.
3. As-built records.
4. Field Commissioning reports.
5. Operational and Maintenance (O&M) manuals.

1.2 FUNCTIONAL PERFORMANCE TESTING

A. Detailed functional and integrated testing to determine whether a system performs in accordance with the Design Intent and Contract Documents shall be executed on all installed Division 15 and 26 equipment and systems to ensure that operation and performance conform to the Contract Documents. Functional performance tests shall be supervised, witnessed, and verified by the Commissioning Authority.

B. Functional testing is preceded by both contractor and Commissioning Authority checks and tests. Once a system has passed all functional performance tests, it will be eligible for acceptance by the Engineer of Record and turnover to the Owner.

C. The following checks and tests precede functional performance testing, and are the responsibility of the appropriate contractor:

1. Pre-Installation Check Sheets - are to be completed for all materials and equipment that shall be inspected for damage or for compliance with an approved submittal upon arrival from the supplier. Pre-installation check sheets are supplied and completed by the appropriate manufacturer, contractor representative and submitted for the record.
2. Installation (Pre-Start) Checklists - are comprised of a full range of checks developed to determine that a system is installed correctly. Installation check sheets are supplied and completed by the appropriate manufacturer, contractor foreman and submitted for the record.
3. Check, Test, Start (Pre-functional) Checklists - are comprised of a full range of checks and tests to determine that all components, equipment, systems and interfaces between systems operate in accordance with contract documents.
   a. This includes all operating modes, interlocks, control responses, and specific responses to abnormal or emergency conditions.
   b. Check, test, and start-up check sheets are supplied and completed by the appropriate manufacturer, contractor foreman and copies submitted to the Construction Manager and Commissioning Authority for the record.
1.3 ROLES AND RESPONSIBILITIES

A. Owner shall:

1. Advise the Commissioning Authority with respect to changes in building occupancy or usage, Commissioning Authority's scope, Permitting (Authority having Jurisdiction) levied requirements or program milestone changes.
2. As desired, witness and attend any and all commissioning meetings and testing.
3. Assign project management and maintenance personnel, and schedule them to participate in meetings and training sessions as follows:
   a. Construction Phase coordination meetings.
   b. Training session at initial placement of major equipment.
   c. Maintenance orientation and inspection.
   d. Piping and ductwork testing and flushing verification meetings.
   e. Procedural meetings for Testing, Adjusting and Balancing.
   f. Attendance and participation in Integrated System Testing.
   g. Final review at acceptance meeting.
   h. On-site classroom training.
4. Monitor and advise the Commissioning Authority in all aspects of commissioning.
5. Ensure that the Commissioning Authority addresses seasonal, deferred, and deficiency issues.
6. Approve the completion of commissioned work.
7. As notified by the Commissioning Authority and advised by the Engineer of Record, review and accept each system successfully commissioned.

B. Commissioning Authority shall:

2. Prepare the first draft of the Commissioning Plan. Include lists of all participants for commissioning events, where available by name, firm and trade specialty.
3. Prepare the Final Commissioning Plan within 60 days following the approval of the Draft Commissioning Plan.
4. Develop and revise the Commissioning Plan as necessary throughout construction.
5. Review, as necessary, contractor submittals and perform static inspections of installations.
6. Spot check, as necessary, contractors' pre-functional checklists.
7. Spot check, as necessary, contractors' start-up reports.
8. Write, supervise, witness, and verify functional performance tests.
9. Observe and verify control system functional testing and approve for use by TAB contractor. Approve TAB execution plan prior to balancing. Spot check, as necessary, air and water systems balancing.
10. Assemble written verification that training was conducted in a satisfactory manner.
11. Schedule and conduct commissioning meetings and document with meeting minutes.
12. Develop the commissioning requirements and all related testing verification and quality control measures. Interface with the Construction Manager to develop a commissioning schedule. Maintain commissioning documentation required in the Commissioning Plan.
13. Provide the Owner with a Commissioning Report addressing the adequacy of the installed systems and equipment with respect to Contract Documents and the Design Intent. Outstanding commissioning and warranty issues will be identified in the report.

14. Develop detailed functional testing forms and Integrated Testing Procedures and Forms for each system and piece of equipment installed on the project.

15. Review equipment warranties to ensure that Owner's responsibilities are defined clearly.

16. Recommend systems to the Owner as substantially complete and ready for beneficial occupancy.

17. Oversee the development and compilation of the O&M Manual, Including operating procedures for normal, failure, and emergency operation.


19. Be available for one year after substantial completion to monitor warranty period.

20. Ensuring that the Basis of Design and the Design Intent are carried out.

21. Assisting the design professional in responding to requests for information.

22. Preparing pre-installation checklists to be filled out by the contractor.

23. Preparing installation checklists to be filled out by the contractor.

24. Preparing functional tests.

25. Present during factory witness testing.

26. Develop a full commissioning specification defining roles and responsibilities of all parties involved in the commissioning process.

C. Architect and Engineer of Record shall:

1. Provide the Basis of Design documents, as approved by Owner, to the Commissioning Authority and Construction Manager for use in developing the Commissioning Plan, systems manual, and operation and maintenance training plan.

2. Provide Design Documentation for focused reviews by the Commissioning Authority.

3. Respond to the Commissioning Authority's comments regarding the Basis of Design and Focused Design Reviews.

4. Attend commissioning coordination meetings as necessary.

5. Attend training sessions, as necessary, in operation and maintenance of systems, subsystems, and equipment.

6. Attend testing meetings as necessary.

7. Attend demonstrations of operation of systems, subsystems, and equipment as necessary.

8. Performing static inspections.

D. Construction Manager shall:

1. Include the cost of commissioning in buys from trade contractors.

2. Coordinate master schedule of MEP trades to confirm start date of each functional performance test. Furnish construction documents, addenda, change orders, and approved submittals and shop drawings related to commissioned equipment to the Commissioning Authority.

3. Certify systems ready for functional performance testing on a Certificate of Readiness provided by the Commissioning Authority. The Construction Manager shall not permit a contractor to begin functional testing without the signature of the Commissioning Authority, which shall be affixed to the Certificate of Readiness. The Owner and
Commissioning Authority are the sole arbiters of system readiness. Costs shall be apportioned as follows:

a. The cost for Owner personnel and the Commissioning Authority to reschedule a functional performance test, made necessary because an item certified by a signatory to the Certificate of Readiness to be ready is found incomplete or faulty, shall be charged to the responsible party.

b. For a deficiency identified during functional testing, not identified during the static installation inspection, the Owner through the Commissioning Authority shall direct re-testing of the equipment once at no charge for their time. All costs for subsequent retesting shall be charged to the responsible party.

c. Items left incomplete by a contractor, and later causing deficiencies or delays during functional testing may result in back charges to the responsible party.

d. Assign representatives with expertise and authority to act on behalf of the Construction Manager, and cause each contractor to assign representatives with expertise and authority to act on their own behalf, and schedule them to participate in and perform commissioning activities including, but not limited to, the following:
   1) Participate in construction-phase commissioning coordination meetings.
   2) Install the Work.
   3) Participate in maintenance orientation and inspection.
   4) Provide labor for implementing functional and integrated testing under the supervision of the Commissioning Authority.
   5) Participate in operation and maintenance training sessions.
   6) Participate in final review at acceptance meeting.
   7) Certify that Work is complete and systems are operational according to the Contract Documents, including calibration of instrumentation and controls.
   8) Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
   9) Review and approve final commissioning documentation.
  10) Acting through contractors, cause subcontractors to assign representatives with expertise and authority to act on their own behalf, and schedule them to participate in and perform commissioning activities including, but not limited to, the following:
       a) Participate in construction-phase commissioning coordination meetings.
       b) Install the Work.
       c) Provide labor for implementing functional testing under the supervision of the Commissioning Authority.
       d) Participate in maintenance orientation and inspection.
       e) Participate in procedures meeting for testing.
       f) Participate in final review at acceptance meeting.
       g) Provide schedule for operation and maintenance data submittals, equipment startup, and testing through the contractor and Construction Manager to the Commissioning Authority for incorporation into the commissioning plan. Update schedule on a weekly basis throughout the construction period.
       h) Provide information through the contractor and Construction Manager to the Commissioning Authority for developing construction-phase commissioning plan.
       i) Participate in training sessions for Owner's operation and maintenance personnel.
j) Provide updated Project Record Documents through the contractor and Construction Manager to the Commissioning Authority on a daily basis.

k) Gather and submit operation and maintenance data for systems, subsystems, and equipment through the contractor and Construction Manager to the Commissioning Authority, as specified.

l) Provide technicians who are familiar with the construction and operation of installed systems and who shall develop specific test procedures and participate in testing of installed systems, subsystems, and equipment.

E. Plumbing, HVAC, BAS, and Electrical contractors shall:

1. Include and itemize the cost of commissioning participation in the contract price with an estimated breakdown of hours for meetings and functional testing. Included in this estimate shall be the costs for outside testing agencies and factory-trained manufacturer's technicians.

2. Neither commence functional testing nor permit any sub-contractor, supplier, or manufacturer to begin functional testing until so directed by the Construction Manager, who in turn must have obtained written authorization to begin functional testing from the Commissioning Authority.

3. Provide unit pricing for the following:
   a. (1) Reliable Power Meter (RPM) Power Analysis Recorder or equivalent
   b. (1) Astromed Dash 4 Chart Recorder or equivalent
   c. (1) Fluke Model 87 Digital Multi-meter
   d. (1) Fluke 600A clamp-on current probe
   e. Thermo-graphic Infrared Camera and operator (must be an infrared camera with the ability to make sample thermo-grams to establish a baseline recording of all major electrical equipment)
   f. Attend 4-hour monthly commissioning meetings
   g. Labor for all major system classifications. Provide matrix for foreman, journeyman, and technician at daily, weekly, and monthly durations.

4. Provide a qualified commissioning supervisor, who shall be responsible for scheduling, supervising, and coordinating the startup, testing and commissioning activities.

5. Perform commissioning duties during construction, acceptance, and warranty periods as follows:

F. During the Construction Phase of the work, all contractors and major system equipment vendors shall:

1. Attend Commissioning Scoping meetings and additional commissioning meetings as required throughout the commissioning process. These meetings may be scheduled by system or by trade at the discretion of the Commissioning Authority. These commissioning meetings will be monthly during early construction and increase in frequency to weekly or daily prior to and during functional performance testing, at the sole discretion of the Commissioning Authority. Contractor shall assure that all subcontractors who have commissioning responsibilities attend the Commissioning Scoping meeting and other commissioning meetings, as appropriate, during the construction process.

2. Report in writing through the Construction Manager to the Commissioning Authority at least as often as commissioning meetings are scheduled concerning the status of his activities as they affect the commissioning process, the status of each discrepancy.
identified, the pre-functional, functional and Integrated testing process, explanations of any disagreements with the identified deficiencies, and proposed resolution and schedule.

3. Provide through the Construction Manager to the Commissioning Authority normal cut sheets and shop drawing submittals of equipment to be commissioned.

4. Provide documentation through the Construction Manager to the Commissioning Authority for development of pre-installation, installation, check, test, and start-up, and functional and integrated performance testing procedures, prior to normal O&M manual submittals when practical. This documentation shall include detailed manufacturer installation, start-up, operating, troubleshooting and maintenance procedures; full details of any owner-contracted tests; fan and pump curves; full factory testing reports, if any; and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified. In addition, the installation, start-up and checkout materials actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory-trained manufacturer's field technicians shall be submitted to the Commissioning Authority. The Commissioning Authority may request further documentation necessary for the development of functional performance testing and the commissioning process. This data request may be made prior to normal submittals.

5. Develop and submit through the Construction Manager to the Commissioning Authority, for review prior to equipment or system startup, a complete check, test, and start-up plan using manufacturer's start-up procedures. The Commissioning Authority may conduct its own pre-functional testing check in parallel with the contractor's.

6. Provide a copy of the O&M manuals and submittals of commissioned equipment, through the Construction Manager to the Commissioning Authority for review.

7. Assist in clarifying the proposed operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.

8. Review the Commissioning Authority's proposed functional and integrated performance test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.

9. Prepare for the Construction Manager a preliminary schedule for Division 15, 26 and Division 17 commissioning activities for use by the Commissioning Authority and shall update the schedule as appropriate. Acting through the Construction Manager, the contractor shall notify the Commissioning Authority during the commissioning meetings when commissioning activities not yet performed or not yet scheduled will delay construction.

10. Refrain from functional performance testing until so authorized by the Construction Manager, who in turn must have obtained written authorization to begin functional testing from the Commissioning Authority. No activity may be invoiced as functional testing until so authorized.

11. Correct current Architect/Engineer punch list and Commissioning Authority deficiency items before functional and integrated performance testing can begin. Air and water TAB shall be completed with discrepancies and problems remedied before functional testing of the respective air or water related systems.

12. Review the functional and integrated tests and forms provided by the Commissioning Authority, and provide support to the functional testing process. Contractor shall operate systems in accordance with the Commissioning Authority's requirements, open and close disconnect switches, and switch normal and emergency power requirements as directed by the Commissioning Authority, as applicable by trade jurisdiction.
13. Provide labor to perform functional and integrated testing for all equipment, under the supervision of the Commissioning Authority, when so directed by the Construction Manager and document functional testing for all commissioned equipment as required by the Commissioning Authority, providing a copy of all documentation through the Construction Manager to the Commissioning Authority.

14. Report in writing through the Construction Manager to the Commissioning Authority, at least as often as commissioning meetings are being scheduled, concerning the status of each outstanding deficiency identified during commissioning, pre-functional and functional performance testing. Report shall include description of the identified discrepancy, explanations of any disagreements, and proposals and schedule for correction of the discrepancy.

G. During the Acceptance Phase of the work, the Division 15 contractors shall:

1. Put all equipment and systems into operation and continuing the operation during each working day of the test and balance and commissioning effort, as required.

2. For a given system, have all required pre-functional tests of equipment and associated controls completed and approved by the Commissioning Authority prior to beginning the test and balance process.

3. Provide a qualified technician(s) to operate the controls as required to assist the TAB contractor in performing TAB, or provide sufficient training for TAB to operate the system without assistance.

4. Include cost of sheaves and belts that may be required to obtain required equipment performance, as measured by the test and balance effort.

5. Provide test holes in ducts and plenums where directed by TAB to allow air measurements and air balancing. Provide an approved plug.

6. Provide temperature and pressure taps according to the Construction Documents for TAB and commissioning testing. Patch piping insulation where removed for ultrasonic flow metering installation by TAB contractor.

7. Provide skilled technicians to execute starting and operation of equipment.

8. Test and verify the performance of equipment under full and partial loads, as well as simulating seasonal and upset conditions. The contractor shall be prepared to operate different components of various systems (example, chilled water and hot water systems to generate loading strategies) during the functional testing.

9. Correct deficiencies (differences between specified and observed performance) as interpreted by the Commissioning Authority and Architect/Engineer.

10. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequence of operation to as-built conditions.

11. Maintain on site redline as built drawings and produce final "As-built" drawings for all project drawings and contractor-generated coordination drawings. List and clearly identify on the as-built drawings the locations of all airflow stations and sensor installations that are not equipment mounted.

12. Provide specified training of the Owner's operating personnel in accordance with the Commissioning Authority's overview and outline.

13. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

14. Provide updated diagrammatical logic for all TAB adjustments to the system.

15. Provide as-built documents for TAB contractors review 3 months prior to commencement of TAB work.
16. BMS contractor to modify as-built and "initial values" (power-up defaults) to correspond to changes identified by TAB contractor.

H. During the Acceptance Phase of the work, the Division 26 contractors shall:

1. Put all equipment and systems into operation and continue the operation during each working day of the test and commissioning effort, as required.
2. Provide NETA-certified representative to demonstrate performance of electrical components to Construction Manager, Architect/Engineer, and Owner. Commissioning Authority shall independently verify that all performance tests have been conducted in accordance with agency and NETA standards as outlined in the specifications. Commissioning Authority may independently test receptacles and lighting controls systems in accordance with the specifications. This independent testing does not relieve the contractor from their responsibilities as set forth in the specifications.
3. Provide skilled technicians to execute starting and operation of equipment.
4. Provide skilled technicians to assist the Commissioning Authority in independently verifying the results of insulation resistance and megger testing. This does not relieve the contractor from their responsibilities in regards to the specifications.
5. Operate different components of systems under full and partial loads as well as seasonal and simulated upset conditions, providing load banks as needed to satisfy test conditions. The Commissioning Authority is to approve in writing the quantity, capacity, and location of load banks.
6. Correct deficiencies as interpreted by the Commissioning Authority and the Architect/Engineer.
7. Prepare O&M manuals according to the Contractor Documents, including clarifying and updating the original sequence of operation to as-built conditions.
8. Maintain on site redline as-built drawings and produce final "As-built" drawings for all project drawings and contractor-generated coordination drawings. List and clearly identify on the as-built drawings the locations of all ATS and sensor installations that are not equipment mounted.
9. Provide specified training of the Owner's operating personnel in accordance with the Commissioning Authority's overview and outline.
10. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.
11. Operate all equipment including but not limited to, UPS Systems, emergency power and automatic transfer switch devices for verification by the Commissioning Authority. This shall include blackout testing as well as light level verification and emergency power verification testing. This does not relieve the contractor from their required testing requirements as directed in the specification.
12. Provide as-built wiring diagrams for all systems involved in the commissioning process.
13. Warranty Period. All contractors and equipment vendors shall:
14. Be available during seasonal or deferred functional performance testing conducted by the CA, according to the specifications.
15. Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

I. The Testing and Balancing (TAB) contractor shall:
1. Submit to the Commissioning Authority, six weeks prior to the starting of the T&B, the qualifications of the site technician(s) for the project, including three (3) names of contractors and facility managers of recent projects on which the personnel were in charge. The Owner and Commissioning Authority will approve the site technician(s) for this job.

2. Review, three months prior to the start of the TAB, the Commissioning Authority's TAB plan and approach for each system. The plan shall include:
   a. Certification that the TAB contractor has reviewed the construction documents and the systems with the design engineers and contractors to sufficiently understand the design intent for each system.
   b. An explanation of the intended use of the building control system.
   c. All field check-out sheets and logs to be used that lists each piece of equipment to be tested adjusted and balanced with the data cells to be gathered for each.
   d. Final test report forms to be used during this process.
   e. Detailed step by step procedures for TAB work for each system and issue: terminal flow calibration, diffuser proportioning, branch and sub-main proportioning, total flow calculations, rechecking diversity issues.
   f. Air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of each of the test procedures, parameters and formulas to be used.
   g. Details of how total flow will be determined.
   h. The identification and types of measurement instruments to be used and their most recent calibration date. Instruments are to be calibrated not earlier than 30 days prior to commencement of TAB work in which the instrument is employed.
   i. Specific procedures that will ensure that both air and watersides will be operating at the lowest possible pressure at the point where the system will satisfy conditions specified in the Contract Documents.
   j. Confirmation that the TAB contractor understands the outside air ventilation criteria under all conditions and how this will be measured during normal, economizer and unoccupied conditions.
   k. Proposed selection points for traverse measurement locations on the as-built documents. Review the placement of the HVAC measurement devices for proper straight runs and accuracy.
   l. Dry tests of all transmitters connected to air flow measuring stations and 20% of transmitters connected to VAV boxes. Prior to balancing, and using an independent signal generator, impose signals in 10% increments from 0% to 120% of transducer range, recording results.
   m. Plan for formal progress reports including scope and frequency
   n. Plan for formal deficiency reports including scope and frequency.
   o. Attend commissioning meetings as directed by the Commissioning Authority and the Construction Manager.

3. Submit written report of discrepancies, deficit or uncompleted work by others, contract interpretation requests and list of completed tests to the Commissioning Authority at least once per week.

4. Communicate in writing to the controls contractor and the Commissioning Authority all set-point and parameter changes made or problems and discrepancies identified during the TAB process that would affect the control loop system set-up and operation

5. Inspect system readiness for testing and balancing prior to the pre-balancing conference. After the TAB plan is accepted and two-weeks prior to TAB work, the commissioning Authority shall conduct a pre-balancing conference. The TAB contractor shall prepare a list of deficiencies and uncompleted work that will affect the
TAB process. This list shall be submitted to the Commissioning Authority and the
Construction Manager.
6. Review the projected schedule and provide, in writing, to the Commissioning Authority
and Construction Manager an explanation of delays in the schedule and a description of
items requiring completion prior to the TAB work.
7. Submit a written statement of completion of work prior to submitting the TAB Report.
The CA Authority shall then conduct independent verification of 10% of air and water
end-devices for acceptance. The TAB contractor shall provide a mechanic to assist the
Commissioning Authority in this verification and shall include this in the scope and
price of the Work.
8. Submit the TAB Report to the Commissioning Authority for review and comment. All
data contained shall be re-verified in the field by the Commissioning Authority. A
minimum of ten percent of the airflow readings shall be verified by the Commissioning
Authority using with testing equipment and Labor provided by the TAB Contractor.
All selection points shall be random. Total airflow shall be verified on all mains in the
supply and the exhaust ducts.

1.4 COMMISSIONING TEST EQUIPMENT

A. All standard testing equipment required for the mechanical, electrical, plumbing, controls, and
TAB shall be provided by the contractor responsible for the equipment or system being tested.

B. The Commissioning Authority shall perform its own system verification and performance
testing.

1. The Construction Manager, through selected subcontractors, shall provide calibrated
equipment as required to conduct power quality metering for functional and integrated
system testing.
2. Special equipment, tools, and instruments only available from a specific vendor, or
specific to a piece of equipment, and required for the functional and integrated testing
of that equipment, shall be provided by the contractor.
3. Proprietary test equipment and software required by any manufacturer for
programming or start-up, whether specified or not, shall be provided by the
manufacturer of the equipment.
   a. Manufacturer shall provide, at no additional cost, test equipment along with
      qualified technician(s) as required, to demonstrate its use and assist in the
      commissioning process as needed.
   b. Proprietary test equipment and software shall become the property of the Owner
      upon successful completion of the commissioning process as required in the
      Contract Documents.

1.5 COMMISSIONING DOCUMENTATION

A. Index of Commissioning Documents: The Commissioning Authority shall prepare an index to
include storage location of each document.

B. Basis of Design Document: A document, prepared by the Engineer recording concepts,
calculations, decisions, and product selections used to meet the Owner's Program Requirements
and to satisfy applicable regulatory requirements, standards, and guidelines. The document
includes both narrative descriptions and lists of individual items that support the design process.
C. Commissioning Plan: A document, prepared by the Commissioning Authority, outlining the schedule, allocation of resources, and documentation requirements of the commissioning process.

D. Performance Testing Checklists: The Commissioning Authority, with assistance from the Engineer of Record, Construction Manager, Equipment Manufacturers and contractors, shall develop performance testing checklists for each system, subsystem, or equipment including interfaces and interlocks, and include a separate entry, with space for comments, for each item to be tested. Prepare separate checklists for each mode of operation and provide space to indicate whether the mode under test responded as required. Provide space for testing personnel to sign off on each checklist. Each checklist, regardless of system, subsystem, or equipment being tested, shall include, but not be limited to, the following:

1. Name and identification code of tested item.
2. Test number.
3. Time and date of test.
4. Indication of whether the record is for a first test or retest following correction of a problem or issue.
5. Dated signatures of the person performing test and of the witness, if applicable.
6. Individuals present for test.
7. Deficiencies.
8. Issue number, if any, generated as the result of test.

E. Certificate of Readiness: Certificate of Readiness shall be signed by the Construction Manager and each relevant Contractor, Subcontractor(s), Installer(s), and the Commissioning Authority certifying that systems, subsystems, equipment, and associated controls are ready for functional and integrated testing. Completed pre-functional checklists signed by the responsible contractors shall accompany this certificate.

F. The Commissioning Authority shall record test data, observations, and measurements on test checklists. Photographs, forms, and other means appropriate for the application shall be included with data. The Commissioning Authority shall compile test and inspection reports and test and inspection certificates and include them in systems manual and commissioning report.

G. Corrective Action Documents: The Commissioning Authority shall document corrective action required for systems and equipment that fail tests. Include required modifications to systems and equipment and revisions to test procedures, if any. Retest systems and equipment requiring corrective action and document retest results. Verify intent to prevent unnecessary retests.

H. Issues Log: The Commissioning Authority shall prepare and maintain a commissioning issues log that describes design, installation, and performance issues that are at variance with the Owner's Program Requirements, Basis of Design, and Contract Documents. Identify and track issues as they are encountered, documenting the status of unresolved and resolved issues.

I. Commissioning Report: The Commissioning Authority shall document results of the commissioning process including unresolved issues and performance of systems, subsystems, and equipment. The commissioning report shall indicate whether systems, subsystems, and equipment have been completed and are performing according to the Owner's Program Requirements, Basis of Design, and Contract Documents. The Commissioning Report shall include but not be limited to the following:
1. A compilation of lists and explanations from the Architect/Engineer, Construction Manager, and contractors of substitutions; compromises; variances in the Basis of Design, and Contract Documents; record of conditions; and, if appropriate, recommendations for resolution. This report shall be used to evaluate systems, subsystems, and equipment and shall serve as a future reference document during Owner occupancy and operation. It may also include a recommendation for accepting or rejecting systems, subsystems, and equipment.

2. Basis of Design documentation.

3. Commissioning plan.

4. Testing plans and reports.

5. Corrective modification documentation.

6. Issues log.

7. Completed test checklists.

8. Listing of off-season test(s) not performed and a schedule for their completion.

1.6 SUBMITTALS

A. The Commissioning Authority shall submit hard copies and electronically formatted information of the commissioning plan. Test Checklists, Functional and Integrated Report Forms: The Commissioning Authority shall submit sample checklists and forms to the Construction Manager for review and comment. The Commissioning Authority shall submit Certificates of Readiness.

B. The Commissioning Authority shall compile and submit test and inspection reports.

C. The Commissioning Authority shall compile and submit corrective action documents.

D. The Commissioning Authority shall submit hard copies and electronically formatted copies of the final commissioning report.

1.7 QUALITY ASSURANCE

A. Instructor Qualifications: Each manufacturer will be represented by factory-authorized service representatives, experienced in training, operation, and maintenance procedures for installed systems, subsystems, and equipment.

B. Test Equipment Calibration: All parties engaged in performance testing will comply with test equipment manufacturer's calibration procedures and intervals. Recalibrate test instruments immediately whenever instruments have been repaired following damage or dropping. Affix calibration tags to test instruments. Instruments shall have been calibrated within six months prior to use.

1.8 COORDINATION

A. Coordination Meetings: The Commissioning Authority shall conduct commissioning coordination meetings to review progress on the commissioning plan, to discuss scheduling conflicts, and to discuss upcoming commissioning process activities. Meetings will increase in frequency to weekly and daily as commissioning activities increase. The Construction Manager and Contractors shall attend these meetings.
B. Pre-testing Meetings: The Commissioning Authority shall conduct pretest meetings of the commissioning team to review startup reports, pretest inspection results, testing procedures, testing personnel and instrumentation requirements, and manufacturers' authorized service representative services for each system, subsystem, equipment, and component to be tested. The major equipment suppliers’ factory technical representative shall attend these meetings as required.

C. Testing Coordination: The Commissioning Authority shall coordinate sequence of testing activities to accommodate required quality-assurance and control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting. Schedule times for tests, inspections, obtaining samples, and similar activities.

D. Manufacturers' Field Services: The Construction Manager shall coordinate services of manufacturers' field services.

1.9 REFERENCES

A. The following references offer guidelines to the commissioning process and should be applied as appropriate:

4. ASHRAE Guideline 0-2005 The Commissioning Process
5. ISO 9001/9002 Quality Assurance plans for manufacturers of major systems

1.10 OPERATION AND MAINTENANCE TRAINING REQUIREMENTS

A. Training Preparation Conference: Before operation and maintenance training, the Commissioning Authority shall convene a training preparation conference to include Owner's operation and maintenance personnel, the Construction Manager, and relevant contractor and subcontractors as well as Major Equipment Vendor Factory Representatives as required.

1. Review the Owner's Program Requirements and Basis of Design.
2. Review installed systems, subsystems, and equipment.
3. Review instructor qualifications.
4. Review instructional methods and procedures.
5. Review training module outlines and contents.
6. Review course materials (including operation and maintenance manuals).
7. Inspect and discuss locations and other facilities required for instruction.
8. Review and finalize training schedule and verify availability of educational materials, instructors, audiovisual equipment, and facilities needed to avoid delays.
9. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

B. The Construction Manager shall be responsible for training coordination and scheduling of required training and for ensuring that all required training is completed.
C. The Commissioning Authority shall oversee the content and adequacy of the training of Owner personnel.

D. Acting through trade contractors, and with assistance from the Commissioning Authority, the Construction Manager shall:

1. Prepare and submit a syllabus describing an overview of the program, describing how the program will be conducted, when and where meetings are to be held, names and company affiliations of lecturers, description of contents and outline for each lecture, and recommended reference material and outside reading. Obtain direction from the Owner on which operating personnel shall be instructed in each system. Proposed training schedules, materials, and lesson plans shall be submitted to the Commissioning Authority for review of the content and adequacy of the training of Owner personnel for commissioned equipment or systems.

2. Provide the Commissioning Authority with training plan 30 days before the planned training.

3. Provide designated Owner personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of equipment.

E. Training shall normally start with classroom sessions followed by hands-on training on each piece of equipment. Instruction is to be provided by factory-trained manufacturer's technicians. Sales Representatives are not considered qualified instructors.

F. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.

G. The appropriate trade or factory-trained manufacturer's technician shall provide the instruction on each major piece of equipment. This person is not the startup technician for the piece of equipment, the installing contractor or manufacturer's Sales Representative, but a factory-trained technician. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment is required. More than one party may be required to execute the training.

H. The controls contractor shall attend sessions other than the controls training, for each type of equipment controlled by the BAS, to discuss the interaction of the BAS as it relates to the equipment being discussed.

I. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.

END OF SECTION
SECTION 260000 – ELECTRICAL SUMMARY & SCOPE OF WORK

PART 1 - GENERAL

1.1 SUMMARY

A. The Electrical Contractor (E.C.) shall provide all of the electrical components for a complete integrated chiller plant including all appurtenances, in accordance with the intent of these specifications, the accompanying drawings (jointly referenced as the “Contract Documents”) for a complete and working chiller plant expansion upon completion.

B. This Section includes the following:
   1. Work covered by the Contract Documents
   2. Scope of Work
   3. Shop Drawings and Related Sections of Specifications
   4. Drawings
   5. Works Under Other Contracts
   6. Use of Premises
   7. Work restrictions
   8. Specification formats and conventions
   9. Environmental Conditions
   10. Protection
   11. Product Handling
   12. Compliance with Codes, Standards and Regulations

C. Electrical Contractors bidding on this project shall provide qualifications and resume of successful construction of similar installations. The Electrical Contractor shall be qualified and as such provide qualified personnel on this project. The Foreman and project manager assigned to the winning bid for the E.C. shall have extensive experience in medium voltage switchgear work and be familiar with all construction means and methods.

D. It is expected successful electrical contractor is experienced in this type of plant installation including all proper tooling and dies and molds, means and methods, rigging, components, and appurtenances required for a complete installation. The design documents dictate intent and all major components required for a complete installation only. It is the contractor’s responsibility to provide all proper bolts, connectors, grounding straps, splices, insulators, supports for conduits, terminations, jumpers, and all other appurtenances for a complete and working system. These appurtenances shall be included as part of the E.C.’s bid and change orders will not be granted for such items.
E. At the time of this bid shop drawings of all major equipment have not yet been received; therefore dimensions of major components such as paralleling switchgear may slightly differ from drawings. The engineer has worked with vendors to obtain preliminary dimensions and weights of equipment. It shall be the E.C.’s responsibility to review shop drawings as they are obtained and make minor modifications including shifts in location, etc as required to accommodate these as-built equipment dimensions. Change orders will not be granted for minor dimensional deviations from bid drawings.

1.2 SCOPE OF WORK COORDINATION

A. The Design Documents (Drawings and Specifications) are complementary to each other and dictate the intent and all major components required for a complete installation as regards to the scope of work. All electrical items that are necessary to satisfy the intent and scope included in the Design Documents (Drawings and Specifications), such as Good General and Engineering Practices shall be considered as part of the Scope of Work, and as such, shall be included as part of the E.C.’s bid, and change orders will not be granted for such items.

B. Should there be a discrepancy between the Design Documents (Drawings and Specifications) the following shall apply:
   1. During the bidding process:
      a. The bidding Electrical Contractor or Vendor shall notify the engineer for a written resolution; the resolution from the Engineer will be final.
      b. The bidding Electrical Contractor or Vendor shall notify the Engineer for a written clarification, or a qualification shall be included in its bid documents.
      c. Change orders will not be granted for discrepancies that have not been qualified by the bidding Electrical Contractor during the bid process.

   2. During construction:
      a. The awarded Electrical Contractor or Vendor shall notify the Engineer of the discrepancy prior to installation. The Engineer will provide a preferred resolution from content in either the Drawings or Specifications and shall be situation specific. The resolution from the Engineer will be final and change orders will not be granted to the Electrical Contractor or Vendor.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. Project Identification: Chiller Plant Improvements for STEM buildings
   1. Project Location: Ewing, New Jersey

B. Owner: The College of New Jersey
   1. Owner's Representative: TBD

C. Construction Managers/Builders: TBD
   1. Representative: TBD
D. Regional Characteristics (Weather Conditions, Altitude, Seismic, etc.)

1. Specific for project location; Ewing, New Jersey

1.4 SCOPE OF WORK - GENERAL PROVISIONS

A. The Electrical Contractor (E.C.) shall provide a complete integrated distributed generation plant, in accordance with the intent of these specifications, the accompanying drawings (jointly referenced as the “Contract Documents”), Utility requirements, Construction Managers/Builders requirements and all Owner rules and requirements associated with this project. The work shall include, but not be limited to the following:

1. Complete conduit and wiring system including all appurtenances for final connections to new equipment within the scope of work, as defined by the contract documents. This shall include, but not be limited to: all junction boxes, back boxes, wiring devices, switches, receptacles, telecommunications wiring, transformers, switchgear, distribution panelboards, medium voltage switchgear, generators, generator radiators, underground electrical distribution, motor control centers, contactors and starters.
   a. Lockable disconnects shall be furnished within the motor control center, therefore, no local motor disconnects shall be provided, unless otherwise shown on the drawings.

2. Unless otherwise noted as “pre-purchase”, provide all electrical distribution equipment, overhead electrical distribution, underground conduits, ductbanks, handholes, communications wiring, etc and all appurtenances.

3. The electrical contractor shall be responsible for all final power, controls and communications terminations, complete installation of the equipment per manufacturer's instructions, installation of shipper loose items, temporary physical and element protection during construction, temporary wiring for heaters and control power, conduit and wire, shipping splits bolting and connections, and standby assistance during commissioning for all owner purchased equipment: Note: Actual commissioning (including final check of the terminations, start-up and testing of equipment) will be performed by the manufacturer's representative.

4. All conduit and wiring run above grade shall be galvanized rigid steel conduit outdoors; EMT indoors, unless otherwise noted.

5. All conduits terminated in a junction box or enclosure shall be provided with conduit bushing; grounding bushings on metal conduits.

6. Underground conduit with stub-ups exposed to ambient: All 15kV, 5kV, 600V, low voltage power and controls conduit underground shall be Schedule 40 PVC, unless otherwise noted. Transition to rigid steel conduit below grade with rigid steel 90 degree
fittings and rigid steel stub above final grade and slabs, unless otherwise noted. All conduits shall be equipped with pull strings and mud caps on both ends during backfill.

7. Underground conduit with stub-ups inside an enclosure: All 15kV, 5kV, 600V, low voltage power and controls conduit underground shall be Schedule 40 PVC, unless otherwise noted; Provide PVC 90 degree fitting and PVC stub up above final grade and/or slab, unless otherwise noted. All conduits shall be equipped with pull strings and mud caps on both ends during backfill.

8. Underground conduit for Communications Service Entrance: entire run for conduit underground and stub-ups shall be Schedule 40 PVC, unless otherwise noted. All conduits shall be equipped with pull strings and mud caps on both ends during backfill.

   a. All ends of Communications Service Entrance conduits shall be provided with conduit bushing.

9. Unless otherwise indicated on the drawings, depth for underground conduit shall conform to the following:

   a. MV and HV conduits: 36-inches below final grade
   b. 600V conduits: 24-inches below final grade
   c. Communications and controls: 12-inches below final grade, maintaining a minimum separation of 12-inches (lateral and vertical) from MV, HV and 600V conduits.

10. All conduit, power and control wiring, including all final control terminations with proper connections, and all final connections, including all connections as shown on shop drawings, including, but not be limited to the following:

   a. Pad Mounted Liquid Filled Transformers
   b. Cooling Tower and all associated pumps/control panels
   c. Chiller and all associated pumps/control panels
   d. Existing Fire Alarm System
   e. Existing Building Management System
   f. Existing Ethernet Panel
   g. Detectors, Sensors and control equipment
   h. Existing Telephone panel

11. Provide coordination drawings integrated with other trades. Provide all as-built documentation and close out documents as required by the project close out procedures at the completion of the project. Refer to Specification 260001 Electrical Close-Out.

12. All work shall be in accordance with the 2014 NEC, or the local adopted edition of the National Electrical Code (NEC), National Electrical Safety Code (NESC), Utility requirements, Owner requirements, Utility interconnect agreements and all applicable local codes and regulations. Provide all project documentation as required by Owner and Utility.
13. Provide temporary lighting and power. Electrical contractor shall provide a temporary engine generator for the duration of the project for all temporary construction power requirements. Provide generator sized to support all construction activities. E.C shall provide fuel, generator capacity, and manpower to run, in addition to the construction lighting and power, 24/7 operation of switchgear heaters and controls. Provide alternate for a temp service from Utility and/or owner’s existing electric system.

14. Provide all conduits, plywood backboards and ground and final terminations as required by communications vendor for the telephone, Ethernet and SCADA systems. Coordination and costs of the service being brought to the site will be by the owner.

15. Provision of a complete grounding system and all appurtenances as required by the contract documents. All below grade components of the grounding grid including but not limited to: #4/0 ground grid, and all interconnections to equipment as shown and described in contract documents and coordinated with “backfill construction sequence”. All connections shall be exothermal welds.

16. Installation of a complete underground Electrical Service. - Provide all electrical underground distribution equipment, underground conduits, duct-banks, hand-holes, etc, and all appurtenances for a complete and working system. Refer to Utility, Construction Managers/Builders and all Owner rules, requirements and standards. The E.C. shall coordinate all of the installation with Utility, Construction Managers/Builders and the Owner. The electrical contractor is responsible for furnishing and installing all electrical service appurtenances, as required by the contract documents and specifications listed.

17. Secure all electrical permits as required.

18. Install and connect to equipment (e.g. PLC cabinet, Owner Ethernet, Relaying Cabinet, etc.), and terminate all control wiring and appurtenances.

19. Provide thorough final cleaning of all electrical equipment including vacuuming and wiping down of all interior sections including bus bars, C/B’s, sheet metals, etc.

20. All electrical equipment including controls panels shall be UL listed. Where equipment cannot be listed; a third party inspection may be required to satisfy local requirements.

21. EC shall coordinate shutdown time for tie-ins to existing electrical systems with owner. EC shall be responsible for coordination of all lock-out/tag-out procedures for all parties during the shutdown.

22. E.C. shall be responsible for coordination of all lock-out tag-out procedures for all parties. All lock-out tag-out procedures shall require a minimum of two locks for each point. E.C. shall provide all lock-out tag equipment.

23. The E.C. shall provide a Project Manager, all required Project Management, and representation at job meetings. E.C. shall maintain a schedule electronically in Microsoft Project or Primavera as requested by the Construction Manager and update at his request.

24. All of the electrical work shall be new and provided by the E.C., unless otherwise noted, e.g.: "Existing" for existing installation, "By Others" for work provided by others than the E.C., etc.
25. Complete conduit (with pull strings fish wires) system including all appurtenances for final connections to new equipment within the scope of work, as defined by the contract documents. This shall include, but not be limited to: all junction boxes, back boxes, hand holes and underground electrical distribution.

26. The contractor shall verify all dimensions and conditions before proceeding with the work and shall notify the engineer of any discrepancies prior to commencing with the work. Existing electrical equipment that interferes with new arrangement shall be removed, reinstalled, relocated, rerouted, extended or abandoned as required, to suit the new arrangement. The electrical contractor is responsible for reviewing and coordinating with the documents of all trades. For locations of all mechanical equipment refer mechanical and civil plans.

B. Equipment Testing / Commissioning / Start-up

1. Contractor will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

2. E.C. shall provide full time assistance for third party testing work and Utility.

3. E.C. shall provide full time assistance for third party testing, commissioning and start-up work for the different pieces of equipment.

4. E.C. shall provide (40 Hours) Foreman and Journeyman for standby startup support for testing through startup.

C. Site Work

1. The E.C. shall include excavation with his bid. The E.C. shall coordinate details with the Owner and Construction Manager/Builder.

2. The E.C. shall include concrete encasement in underground duct banks; concrete encasement shall be provided where shown in the electrical drawings. The E.C. shall coordinate details with the Owner and Construction Manager/Builder.

3. The E.C. shall be responsible for all underground electrical work on the site: raceway system (conduit and underground boxes) and conductors.

4. Provide neat and orderly jobsite at all times. Electrical trash produced by E.C. shall be disposed of daily in dumpsters; coordinate with the Owner.

5. The contractor shall verify all dimensions and conditions at the site before proceeding with the work. It shall be the responsibility of the contractor to verify field conditions at the site and notify the engineer of any discrepancies prior to commencing with the work.

6. Existing electrical equipment that interferes with new arrangement shall be removed, reinstalled, relocated, rerouted, extended or abandoned as required, to suit the new arrangement.

7. E.C. shall be responsible for receiving, unloading, rigging, handling and final installation (including bolting to pads, per equipment manufacturer's recommendations) of Owner-furnished items at Project site.
1.5 **SCOPE OF WORK - SPECIFIC PROVISIONS**

A. The electrical Scope of Work includes improvements by this E.C. to an existing Chiller Plant.

B. Provision of a complete 15kV, 5kV and 600V aboveground and underground electrical distribution, as required by the contract documents. Provide all appurtenances for a complete operational and working system. E.C. shall provide new underground and above ground raceway system (conduits, hand holes and pull boxes); 15kV and 5kV conductors terminated at both ends (terminations by this E.C.); 600V branch feeders terminated in two-hole compression lugs (lugs by this E.C.); 600V, 300V, DC controls and communications wiring with final connections and terminations. E. C. shall coordinate details with Owner and Construction Manager's / Builders.

C. Medium Voltage Work; shall be provided by the E.C.; refer to the electrical drawings.
   1. Medium Voltage point of connection shall be at the existing co-gen 4160V switchgear (new cable, accessories and terminations by E.C.) (E.C. shall coordinate final location and installation details with the Owner in the field); refer to electrical drawings.
   2. Provide new pad mount transformers (T-1) and (T-2).
   3. Provide new overhead/underground 5kV electrical service (conduits and conductors) from the existing co-gen 4160V switchgear to the new pad mount transformer (T-1).
   4. Provide new overhead/underground 5kV electrical service (conduits and conductors) from the new pad mount transformer (T-1) to the new pad mount transformer (T-2).
   5. Provide new current transformers and relays in existing co-gen 4160V switchgear as indicated on the electrical drawings.

D. Low Voltage Work; shall be provided by the E.C.; refer to the electrical drawings.
   1. Low voltage point of connections shall be at the new pad mount transformer (T-1) and new pad mount transformer (T-2).
   2. Provide new Power Distribution Unit (PDC-1) with distribution Motor Control Center (MCC-PDC) and provide new underground 480V electrical service (conduits and conductors) from the transformer (T-2) to the new distribution Motor Control Center (MCC-PDC) in PDC-1; distribution Motor Control Center (MCC-PDC) furnished with PDC-1.
   3. Provide 480V electrical services (conduits and conductors) from the distribution Motor Control Center (MCC-PDC) to equipment.
   4. Provide 480V electrical service (conduits and conductors) from the distribution Motor Control Center (MCC-PDC) to new dry type transformer (T-3) pre-wired by the PDC-1 manufacturer.
   5. Provide new 208/120V electrical service (conduits and conductors) from dry type transformer (T-3) to panelboards RP-1 pre-wired by the PDC-1 manufacturer.
   6. Provide 120V circuits from panelboard RP-1 to Site Lighting via the lighting contactor (LC-1); site light lighting contactor provided by E.C.
7. Provide 120V circuits from panelboard RP-1 to lighting system; refer to electrical drawings.
8. Provide 120V circuits from panelboard RP-1 to Site Receptacles.
9. Provide 120V circuits from panelboard RP-1 to equipment.
10. On all motor circuits fed from Variable Frequency Drives (VFD), provide cables specifically rated for the applications, e.g.: VFD cables.
11. Provide a complete and operational lighting system including, but not limited to: lighting fixtures, lighting switches, outlet boxes, lighting control system, raceway system (conduit and boxes) and wiring; refer to the Drawings.
12. Provide a complete and operational receptacle and power distribution system including, but not limited to: wiring devices, outlet boxes, control system, raceway system (conduit and boxes) and wiring; refer to the Drawings.
13. Provide a complete and operational internal communications system including, but not limited to: wiring devices, outlet boxes, raceway system (conduit and boxes) and wiring; refer to the Drawings.
14. Provide all raceway, wiring and terminations for Analog/Digital Controls, communications, and network as shown in the contract documents, unless otherwise noted.
15. All of the electrical installation shall conform to rules and regulations from NFPA and the local power utility company.
16. Provide new underground communications service conduits, unless otherwise noted.
17. Provide new Hand Holes for underground electrical installation, as shown on the Drawings and as required to suit to field conditions, unless otherwise noted.
18. Provide new Pull Boxes for overhead electrical installation, as shown on the Drawings and as required to suit to field conditions. The new Pull Boxes shall be adequate for the location and shall be sized per NEC.
19. Provide the services of a manufacturer’s service technician to program existing VFC drives for new monitoring points; see specification 262923 for additional information.
20. Provide fire alarm devices and fire alarm circuits and testing of fire alarm system with new fire alarm circuits as shown on the drawings.
21. Provide new owner meter(s) and metering circuits as shown on the drawings. E.C. shall subcontract out meter work to Converge Company.

E. All conduit and wiring run above grade shall be galvanized rigid steel conduit outdoors; EMT indoors, unless otherwise noted.

F. Provision of a complete grounding and lightning protection system and all appurtenances as required by the contract documents. All below grade components of the grounding grid including but not limited to: #4/0 ground grid, and all interconnections to equipment as shown and described in contract documents and “backfill construction sequence”. All connections shall be exothermal welds. All underground conductors shall be copper. All above grade components
of the lightning protection system shall be aluminum; transition from copper to aluminum not less than 18-inches from grade.

1. Provide lightning protection to PDC building and Cooling Towers as shown on the drawings.
2. Provide grounding connections to all above ground (stainless steel) mechanical piping

1.6 DRAWINGS AND SPECIFICATIONS

A. The drawings indicate general arrangements and approximate sizes and relative locations of principle materials to be provided. Drawings are diagrammatic and are a graphic representation of contract requirements to best available standards at the scale required.

B. All references made to any typical item in the singular number shall apply equally to as many identical items that the work may require.

1.7 SPECIFICATION FORMATS AND CONVENTIONS

A. Specification Format: The Specifications are organized into Divisions and Sections using the 26-division format and CSI/CSC's "Master Format" numbering system.

1. Section Identification: The Specifications use Section numbers and titles to help cross-referencing in the Contract D

2. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete because all available Section numbers are not used. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of Sections in the Contract Documents.

B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.

2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.

   a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

   b. The terms "This Contractor", "The Contractor", "The Electrical Contractor", "The Electrical Trade Contractor", "Electrical Contractor", "E.C." shall mean the
Contractor or Contractors performing the Electrical Trades Contract Work in Division 26 and Division 27 of the Project Specifications.

c. The word "Others", "Other Contractor", "Other Trade Contractor" shall mean the contractor or contractors performing Trade Contract Work in Divisions of the Project Specifications other than Division 26 and Division 27.

d. The word "Furnish", unless otherwise specified, shall mean supply, deliver, off load on site, store in place in an on-site location as directed by the Project Engineer and obtain a receipt for material or equipment delivered. Equipment, devices, material with factory finishes and insulated wire shall be stored indoors in a dry location.

e. The words "Install" in relation to material or equipment not furnished in Division 26/27, shall mean sign for and transport to final location, install, connect, adjust, test, operate and perform any additional work, in conjunction with the furnishing Trade, necessary to make ready for final acceptance.

f. The word "Connect" in relation to material or equipment not installed in place in Division 26/27 shall mean connect, adjust, test, operate and perform any additional work, in conjunction with the installing trade, necessary to make ready for final acceptance.

g. The word "Provide" shall mean furnish, install, connect, adjust, test, operate and perform any additional work necessary to make ready for final acceptance.

h. "Approval", "approved", refers to acceptance by Owner's representative, code enforcing authority, or utility inspecting authority.

i. "Required" expressed or implied requirements of Specifications or Drawings, or of referenced applicable codes.

j. "Drawings" refers to the Contract Drawing(s). Does not include Shop Drawings.

1.8 SHOP DRAWINGS AND RELATED SECTIONS OF SPECIFICATIONS

A. Submit shop drawings in accordance with special conditions and as indicated below and in subsequent sections of this division. Assume responsibility for quantities and correct mounting details. All shop drawings submitted must have a filled out subcontractors approval stamp on them, prior to submitting to the engineer. All shop drawings submitted shall be stamped “Division 26” for easy processing. In addition to the following list, submit other shop drawings as may be requested by engineer:

1. Section 260513 – Medium Voltage Cables
   a. 5kV Cable
   b. Splices and Terminations

2. Section 260519 – Conductors and Cables
   a. Building Wire
   b. Power Wiring
   c. Control Wiring
d. Splices and Connectors

3. Section 260523 – Control-Voltage Electrical Power Cables
   a. Control Cables

4. Section 260526 – Grounding & Bonding
   a. Ground Conductors
   b. Ground Rods
   c. Ground Bus
   d. Cadweld Connectors
   e. Exothermic Weld Kits
   f. Irreversible Grounding Connectors
   g. Bonding Jumpers

5. Section 260529 – Hangers and Supports for Electrical Systems
   a. Structural Supports (Manufactured Supports, Fabricated Supports)
   b. Bridle Rings and Supports
   c. Seismic Restraints
   d. Underground Duct Supports

6. Section 260533 – Raceways, Boxes and Cabinets
   a. Conduits (PVC, EMT, IMC, RGS, RGS-PVC Coated, LFMC)
   b. Junction and Pull Boxes
   c. Cabinets
   d. Enclosures

7. Section 260543 – Underground Ducts and Utility Structures
   a. Conduit and Duct (PVC)
   b. Electrical Man-holes and Hand-holes (Precast, Cast-In-Place)
   c. Underground Duct Spacers and Supports

8. Section 260553 – Electrical Identification
   a. Markers
   b. Tape
   c. Tags
   d. Labels
   e. Nameplates

9. Section 261219 – Pad-Mounted, Liquid-Filled, Medium-Voltage Transformers

10. Section 262213 – Dry Type Transformers
a. Dry Type Transformers
11. Section 262416 – Panelboards
12. Section 262419 – Motor Control Center
13. Section 262726 – Wiring Devices
   a. Receptacles
   b. Lighting Switches
   c. Faceplates and Covers
14. Section 264113 – Lightning Protection for Structures
   a. Air Terminals
   b. Conductors
   c. Attachments
15. Section 265113 – Interior Lighting
   a. Fixtures
   b. Lamps
   c. Ballasts
   d. Control
   e. Supports
   f. Seismic Restraints
16. Section 265623 – Exterior Lighting
   a. Fixtures
   b. Lamps
   c. Ballasts
   d. Control
   e. Supports
   f. Seismic Restraints
17. Section 261300 – Medium-Voltage Switchgear
   a. New Components
   b. Wiring diagrams for all new work
18. Section 263111 – Digital, Addressable Fire-Alarm System
   a. System smoke detectors
19. Section 271500 – Communications Horizontal Cabling
   a. Cable(s) for low voltage wiring

1.9 OWNER-FURNISHED PRODUCTS

A. Owner will furnish products indicated. The Work includes providing support systems to receive;
   1. Owner's equipment and making electrical connections
   2. Owner will arrange for and deliver Shop Drawings, and Product Data.
3. Owner will arrange and pay for delivery of Owner-furnished items according to the Construction Schedule from E.C.

4. After delivery, E.C. will inspect delivered items for damage, notify the owner of any damage, and coordinate replacements with the manufacturer. Owner will provide the E.C. with the contact information of all suppliers of equipment to be supplied. The E.C. shall coordinate and define with the suppliers a delivery schedule, which shall be submitted prior to mobilization. The E.C. will adhere to this schedule and coordinate and adjust labor and equipment necessary to receive equipment.

5. If Owner-furnished items are damaged, defective, or missing, Owner will arrange for replacement.

6. Owner will arrange for manufacturer's field services and for delivery of manufacturer's warranties to E.C.

7. Owner will furnish E.C. the earliest possible delivery date for Owner-furnished products. Using Owner-furnished earliest possible delivery dates, E.C. shall designate delivery dates of Owner-furnished items in the Construction Schedule from the E.C.

8. E.C. shall review Shop Drawings, Product Data, and Samples and return them to Engineer noting discrepancies or anticipated problems in use of product.

9. E.C. is responsible for assistance during receiving, unloading, rigging, and handling Owner-furnished items at Project site.

10. E.C. is responsible for protecting Owner-furnished items from damage during storage and handling, including damage from exposure to the elements.

11. If Owner-furnished items are damaged as a result of operations from E.C., E.C. shall repair or replace them.

1.10 WORK UNDER OTHER CONTRACTS

A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract. Coordinate the Work of this Contract with work performed under separate contracts.

1.11 USE OF PREMISES

A. General: Contractor shall have full use of premises for construction operations, including use of Project site, during construction period. Contractor's use of premises is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

B. Use of Site: Limit use of premises to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Owner Occupancy: Allow for Owner occupancy of Project site.

2. Driveways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
a. Schedule deliveries to minimize use of driveways and entrances.
b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

1.12 WORK RESTRICTIONS

A. Coordinate on site work hour requirements with the owner’s representative prior to start of construction.

1.13 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 so 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 installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."

D. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

1.14 ENVIRONMENTAL CONDITIONS

A. Provide effective protection for all material and equipment against damage that may be caused by environmental conditions. Do not work when conditions of temperature in area or moisture on materials or substrates are not in accordance with material manufacturer’s conditions for installation.

1.15 PROTECTION

A. Provide effective protection against damage for all material and equipment, including pre-purchased, during shipment and storage at the project site. Place stored conduit on dunnage with appropriate weather cover and caps on exposed ends.
B. Close conduit openings with temporary metal or plastic caps.

C. Provide effective protection against damage and weather conditions, including covering of cable ends, for all installed cable which will be terminated on a later time.

1.16 PRODUCT HANDLING

A. Have materials delivered to site. Unload and store materials in allotted location and protect from damage. Deliver materials to their point of installation.

B. Deliver materials to project site in manufacturer’s original unopened containers with manufacturer’s name and product identification clearly marked thereon.

C. COMPLIANCE WITH CODES, STANDARDS AND REGULATIONS

1. Provide equipment that is in conformance with these specifications and applicable requirements of the following:
   a. Latest applicable edition of the National Electrical Code (NEC). NOTE: All references to the NEC in these specifications shall be interpreted to mean the current edition of the code.
   b. Local Inspection Agency.
   c. Local and/or State Building Codes.
   d. Owner Standard Requirements.
   e. Local Exchange Carrier.
   f. American National Standards Institute (ANSI)
   g. National Electrical Manufacturers Association (NEMA)
   h. National Electrical Safety Code (NESC)
   i. Institute of Electrical and Electronics Engineers (IEEE)
   j. Insulated Cable Engineers’ Association (ICEA)
   k. Underwriters Laboratories, Inc. (UL)
   l. Factory Mutual (FM)
   m. Occupational Safety and Health Administration (OSHA)
   n. International Building Code (IBC)
   o. International Electrical Testing Association (NETA)

1.17 SUBSTITUTIONS

A. Wherever possible, several makes of materials, fixtures and devices have been specified. The Bid shall be predicated upon the use of materials, etc., as specified, or approved by the Owner.
B. A list of material and equipment, including the name of the manufacturer, which the bidder proposes to install, shall be submitted to the Owner for approval. All items so listed shall conform to the Specifications. No substitution shall be accepted unless approved in writing by the Owner.

1. When proposing a substitution, an official submittal for the substitution of that specific material shall be presented for evaluation.
2. A submittal for the evaluation of a substitution shall include all applicable data to allow the proper evaluation, e.g. calculations, layout, characteristics, etc.
3. A submittal for the evaluation of a substitution shall be presented as a whole, thus, partial submittal shall not be accepted.

1.18 OPERATIONS AND MAINTENANCE MANUALS

A. Provide to the owner, manufacturer's catalogues, technical and test data sheets, final approved shop drawings, installation instructions, maintenance procedures, operating instructions, servicing and repair instructions and parts lists with ordering information.

1. Include protective device settings and fuse sizes, characteristic curves, single line diagrams, control diagrams, electric and key interlocking diagrams and miscellaneous systems diagrams.
2. Include safe, step by step, procedures for start-up and shut down, inspection and testing.
3. Check for accuracy of data by actual comparison with equipment and systems installed and correct as needed.
4. Index and assemble manuals. Binders shall not be greater than 3-1/2 inches thick and shall be adjustable to permit secure compact binding. Each binder cover shall be stamped with the proper title and identification submitted for approval before the manuals are assembled and submitted. Include index tabs and typed table of contents in each binder.
5. Provide a separate binder or group of binders for each equipment and systems. Submit proposed groupings for approval prior to assembly.
6. The manuals shall be processed in the same manner as Shop Drawings.

1.19 SUBSTANTIAL COMPLETION

A. The E.C. will be responsible for the completion of the Work by the Substantial Completion Date defined for the project. The Project Scope shall be considered substantially complete according to the following definition: ELECTRICAL SYSTEM READY TO ENERGIZE.

B. Electrical

1. All power, lighting, control equipment, circuitry, systems, etc., complete, cleaned, tested and functional. Megger readings submitted and approved.
2. List of fuses and overload heaters approved. Proper size fuses and overload heaters installed.
3. All equipment protective devices set and functionally tested according to the System Coordination Study.

4. All personnel and equipment protection devices set and functionally tested.
   a. E-stops
   b. Warning Lights and/or Beacons
   c. Power Shut-Down devices
   d. Life Safety protection devices (where required) and/or stand alone Smoke Detectors

5. All standby power systems tested and operational including batteries fully charged. Battery chargers (power supplies) tested and functional.

6. All equipment and devices have been identified per the Contract Documents.
   a. Equipment Designation Nameplates
   b. Personnel Safety and Warning Labels
   c. Arc Flash Labels

7. At least one (1) set of as built drawings available for switching and troubleshooting.

8. All interlocks tested and keys available to Owner.

9. All electrical areas restricted to authorized personnel only.

10. All spare parts (fuses, overload heaters, etc.) per Contract Documents available to Owner.

11. All temporary power circuitry, conduit, etc. removed.

12. All electrical equipment cleaned per the Contract Documents.
   a. Surfaces completely and neatly cleaned, free of glue or oily substances
   b. No trash nor foreign materials located inside the equipment
   c. Interior completely vacuum cleaned

13. All unused openings closed.

C. Instrumentation

1. All wiring and tubing installed; equipment and field instruments installed, calibrated, documented and functionally tested.

2. All control valves and automated on/off valves installed, calibrated where required, documented and operationally tested.

3. All safety relief devices (valves/rupture discs) installed and operational. All gags or blanks removed. Any required documentation complete.

4. All tubing and signal/control wiring dressed and secured.

5. Control panels installed, tested, cleaned up and dressed out.

6. I/O panels installed, tested, cleaned up and dressed out.

7. All control loops tested for functionality per loop sheets and P&ID's.

8. All intrinsically safe systems checked for proper system grounding.
9. All interfacing control circuits (instrumentation/control to MCC) to be checked for continuity and functionality for loop sheets and P&ID's.

10. All certification reports completed and submitted.

1.20 ELECTRICAL CLOSE-OUT

A. Refer to Specification 260001 Electrical Close-Out.

PART 2 - PRODUCTS

2.1 PAINTING

A. Exposed Paint Materials:

1. Ferrous metals: No. 1009 Gray metal primer, as manufactured by Tnemec Co., Inc.

PART 3 - EXECUTION

3.1 LOCATION OF MATERIALS

A. Locate all conduits, outlets and other materials to result in proper operation of the building and to avoid conflicts with the work of other trades.

1. Obtain required location information sufficiently in advance of installation time to allow uninterrupted progress of the work.

2. Check all layouts of equipment with shop drawings of all trades to determine rough-in requirements. Coordinate all work with other trades.

3. Do not scale the electrical drawings for exact locations. Refer to appropriate trade for actual location of equipment.

4. Exercise proper judgment to secure a neat arrangement of conduit, piping ductwork and other materials and to overcome local interferences to best advantage of the project.

B. Where physical interferences cannot be resolved readily, consult with the owner and engineer, prepare dated, dimensioned drawings correcting the interferences. Obtain written approval of engineer for such changes and distribute the drawings to all parties involved as directed by the engineer.

C. Comply with NECA 1.

D. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
E. 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.

F. 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.

G. Right of Way: Give to raceways and piping systems installed at a required slope.

H. FIRESTOPPING
   1. Apply fire-stopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Provide UL Listed Firestop Systems by HILTI or Crouse-Hinds.
   2. Provide fire sealant putty/caulk around all conductors after pulling and terminating.

3.2 PROGRESS OF THE WORK

A. Locate all conduits, outlets and other materials to result in proper operation of the building and to avoid conflicts with the work of other trades.
   1. Obtain required location information sufficiently in advance of installation time to allow uninterrupted progress of the work.
   2. Check all layouts of equipment with shop drawings of all trades to determine rough-in requirements. Coordinate all work with other trades.
   3. Do not scale drawings for exact locations.
   4. Exercise proper judgment to secure a neat arrangement of conduit, piping ductwork and other materials and to overcome local interferences to best advantage of the project.

B. Where physical interferences cannot be resolved readily, consult with the owner and engineer, prepare dated, dimensioned drawings correcting the interferences. Obtain written approval of engineer for such changes and distribute the drawings to all parties involved as directed by the engineer.

3.3 INSPECTION AND CERTIFICATION

A. Obtain and deliver a final, Certification of approval from the Electrical Inspection Agency. Make delivery to engineer for transmittal to the owner upon completion of the work and before final payment. Pay all charges made by the inspection authority and include their cost in the bid.

B. At the end of the project, the E.C. shall provide the owner with a letter of certification stating that the construction has been completed in compliance with the requirements of the Contract Documents.
3.4 WARRANTY
   
   A. Provide one year on all parts and labor after Substantial Completion.

END OF SECTION 260000
SECTION 260001 - ELECTRICAL CLOSE-OUT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. The Electrical Contractor (E.C.), at the end of the project, shall provide the owner with all of the manuals, documents and certifications herein included in this section. Close-Out Documents shall be provided with (1) set of electronic copy and (2) sets of hard copies.

1. Index, assemble and bind all of the manuals, documents and certifications. Binders shall not be greater than 3-1/2 inches thick and shall be adjustable to permit secure compact binding. Each binder cover shall be stamped with the proper title and identification. Include index tabs and typed table of contents in each binder. Provide bookmarked table of contents at beginning of document.

2. Provide a separate binder or group of binders for each major category of equipment and systems; miscellaneous unrelated systems may be incorporated in the same binder.

3. Binders shall include, but not be limited to:

   a. Action Submittals.
   b. Closeout Submittals.
   c. Operations and Maintenance Materials Submittals.
   d. Warranties
      1) Conform to Section 260000 Electrical Summary and Scope of Work, paragraph 3.3 Warranty.
      2) Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file.
      3) Provide additional copies of each warranty to include in operation and maintenance manuals.
   e. Punch List.
   f. Spare Parts List.
   g. Substantial Completion checklist.

4. Submit a list of binders, proposed groupings and sample for approval before assembling.

B. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final completion procedures.
3. Warranties.
4. Final cleaning.
5. Repair of the Work.

1.3 ACTION SUBMITTALS

A. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
B. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.
B. Certificate of Insurance: For continuing coverage.
C. Certificate of Installation: Electrical construction is in compliance with the Contract Documents. Refer to Section 260000 Electrical Summary and Scope of Work, paragraph 3.2 Inspection and Certification.
D. Red-line as-built markups.
E. All electrical permits, as required.
F. Project Staff
   1. Electrical construction company
   2. Project Manager
   3. Field Engineer
   4. Field Superintendent
G. Project Schedule
   1. Electronic copy of Project Schedule in Microsoft Project or Primavera, as requested by the Construction Manager.
   2. Electronic copy of Project Schedule in PDF format.
   3. Hard Copies
H. Shop Drawings

In addition to the following list, submit other shop drawings as requested during the project. Refer to Section 260000 Electrical Summary and Scope of Work, paragraph 1.5 Shop Drawings and Related Sections of Specifications.
1.5 OPERATIONS AND MAINTENANCE MATERIALS SUBMITTALS

A. Schedule of Operations and Maintenance Materials Items: For maintenance material submittal items specified in other Sections.

B. Provide to the owner, manufacturer's catalogues, technical and test data sheets, final approved shop drawings, installation instructions, maintenance procedures, operating instructions, servicing and repair instructions and parts lists with ordering information.

1. Include protective devices (circuit breakers and fuses ratings), characteristic curves, single line diagrams, control diagrams, electric and key interlocking diagrams and miscellaneous systems diagrams.

2. Include protective devices settings: "Design" settings and "As Left" settings. Provide a hard copy and an electronic copy in native format for each of the protection relay.

3. Include safe, step by step, procedures for start-up and shut down, inspection and testing.

4. Check for accuracy of data by actual comparison with equipment and systems installed and correct as needed.

1.6 SPARE PARTS

A. Submit Manufacturer and Contractor recommended spare parts and tools for equipment devices, materials and system incidentals provided under this Contract.

B. Include descriptions, catalogue sheets, parts numbers, ordering forms and quantities recommended.

C. The manufacturer shall recommend in a separate list the minimum quantity of spare parts, their respective costs and delivery time in weeks required, for the equipment furnished.

1.7 SUBSTANTIAL COMPLETION

A. The E.C. shall be responsible for the completion of the Work by the Substantial Completion Date defined for the project in the Project Schedule. The Project Scope shall be considered substantially complete in conformance with Section 260000 Electrical Summary and Scope of Work, paragraph 1.17 Substantial Completion.

1.8 FINAL ACCEPTANCE

A. Final acceptance by the Owner for any portion of the Work shall be contingent on the following:

1. Replacement of burned out lamps.
2. Replacement of devices or materials found to be defective.
3. Torque bus and cables connections to proper pressure.
4. Rust removal and touch up painting.
5. Schedules, identifying tags and plates complete and in place.
6. Equipment and fixtures cleaned and interiors vacuumed.
7. Locks and catches operational with hinged members properly aligned.
8. Correction of excessive noise conditions caused by vibration.
9. Guarantees and warranties delivered.
10. Other requirements, as stipulated in the Specifications, including release of claims, waiver of liens, etc.
11. Marked up as built drawings.
12. Manufacturer’s operation and maintenance manuals and as-built wiring diagrams.

1.9 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prior to requesting inspection for Substantial Completion, the E.C. shall prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of (10) days prior to requesting inspection for Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to the Construction Managers / Builders. Label with manufacturer's name and model number where applicable.
   a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section.
   b. Schedule of Spare Parts Items: Prepare and submit schedule of spare parts items, including name and quantity of each item and name and number of related Specification Section.

5. Submit test/adjust/balance records.
6. Submit sustainable design submittals, as required.
7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
C. Procedures Prior to Substantial Completion: Complete the following a minimum of (10) days prior to requesting inspection for Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
6. Advise Owner of changeover in heat and other utilities.
7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
9. Complete final cleaning requirements, including touchup painting.
10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
11. Provide the owner with a Substantial Completion Check List. The Substantial Completion Check List shall be based on all of the items included in the corresponding section of specification 260000 Electrical Summary and Scope of Work, and shall indicate all of the items completed. After evaluation of the itemized list, the owner reserves the right to perform the inspection for Substantial Completion.

D. Inspection for Substantial Completion: Submit a written request for inspection to determine Substantial Completion minimum of (10) days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Construction Managers / Builders will proceed with inspection. Construction Managers / Builders will prepare the Certificate of Substantial Completion after a successful inspection or will notify Contractor of items, either on Contractor's list or additional items identified, that must be completed or corrected before certificate will be issued.

1. Re-inspection: E.C. shall request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for final completion.

1.10 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:

1. Submit a final Application for Payment.
2. Certified List of Incomplete Items: Submit certified copy of Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by the Construction Managers / Builders. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.

B. Inspection for Final Completion: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, the Construction managers / Builders will proceed with inspection. Construction managers / Builders will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Final Re-inspection: Request final re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.11 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

B. Include construction items that are not in conformance with the project documents.

C. Include construction items that are required for conformance with the project documents.

1.12 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Construction Managers / Builders for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Partial Occupancy: Submit properly executed warranties within (15) days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
   
   a. Remove snow and ice to provide safe access to building.
   b. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
   c. Sweep concrete floors broom clean in unoccupied spaces.
   d. Remove labels that are not permanent.
   e. Wipe surfaces of electrical equipment and materials. Remove excess lubrication.
   f. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
   g. Leave Project clean and ready for occupancy.

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.

B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.

C. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.

   1. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.

D. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
E. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 260001
SECTION 260005 – DRAWING COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the requirements for coordination drawings to be prepared and submitted for approval for the Generating Facility infrastructure, but not limited to, the following:

1. The prime contractor shall be responsible for enforcing the coordination requirements set forth in this specification and shall coordinate the sharing of information as required for coordination.

2. Coordination Drawings for the Electrical, Mechanical and Gas Piping Contractors in accordance with approved shop drawings.

3. Coordination of all underground utilities and distribution.

4. Coordination between trades of other contracts performing work in the same building.

5. It is the intent of this specification section to require coordination of the installation of all MEP system components to be installed within, including all underground work, the Generating Facility. Failure to properly coordinate the installation of each trades work shall be the responsibility of each contractor and extra costs to move/modify/change work completed due to lack of coordination shall be the respective contractor’s responsibility.

B. Each contractor shall participate in coordination requirements.

1.3 DEFINITIONS

A. ADDENDUM: Modifications or changes to the requirements of the Bidding Documents, which shall apply to the Work with the same meaning and force as if they had been included in the original documents.

B. BIDDING DOCUMENTS: Any and all of the Electrical Documents issued for BIDDING PROCESS of a specific project.

C. BULLETIN: Modifications or changes to the requirements of the Contract Documents, which shall apply to the Work with the same meaning and force as if they had been included in the original documents.

D. CONTRACT DOCUMENTS: Any and all of the Electrical Documents used for awarding an implementation of a specific project.
E. ELECTRICAL DOCUMENTS: Electrical Design Documents (Drawings and Specifications) issued as part of a specific project.

F. MODIFICATION TO ELECTRICAL DOCUMENTS: Wherever an Addendum or a Bulletin modifies a portion of a paragraph of the Specifications or a portion of any Drawings, the remainder of the paragraph and drawing shall remain in force. The Electrical Drawings, Project Specifications and any other applicable document(s) are to be complementary, and whatever is called for by either shall be binding as if called for by all of them. Each part of the work shall be complete as related to the other, and there shall be no omission in the work even though each and every item may not be specified.

G. REQUEST FOR INFORMATION (RFI): Request from Contractor seeking interpretation or clarification of the Contract Documents.

H. SCOPE OF WORK: Any and all of the Electrical Design Documents issued for a specific project. The Electrical Design Documents and Good General and Engineering Practices shall be considered as part of the Scope of Work

1.4 COORDINATION

A. Coordination: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its operations with operations, included in different Sections, which depend on each other for proper installation, connection, and operation.

1. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair and to avoid interferences between each trades installation.

2. Make adequate provisions to accommodate items scheduled for later installation.

3. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical, electrical and fire protection.

1.5 SUBMITTALS

A. Coordination drawings shall be initiated by the electrical contractor and prepared in AutoCAD. After the electrical contractor has shown all their work, the files shall be shared with the Mechanical Contractor for inclusion of their work. Final coordination drawings shall be submitted to the owner and engineer for review and approval.

1. Coordination drawings shall include but not be limited to:
   a. Underground (Both within building and yard)
   b. Above ceiling
   c. Stub up locations and Equipment pads
   d. Roof (where required)
   e. Electrical rooms (elevations and plan views)
B. Coordination Drawings: Prepare Coordination Drawings for all underground utilities and separate drawings for the Generating Facility Infrastructure including, but not limited to electrical conduit, lighting, power distribution equipment, mechanical duct work, ceiling return air diffusers, detectors, etc. to avoid interferences and provide maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.

1. For underground coordination drawings, indicate burial depth of all conduits, ductbanks, mechanical piping, etc.

2. Content: Project-specific information, drawn accurately to scale. Do not base Coordination Drawings on reproductions of the Contract Documents or standard printed data. Include the following information, as applicable:
   a. Indicate functional and spatial relationships of components of the MEP systems.
   b. Indicate dimensions on coordination drawings based on approved shop drawing submittals. Make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to engineer/owner for resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

3. Sheet Size: No larger than 30 by 40 inches (750 by 1000 mm).

4. Number of Copies: Submit three (3) opaque copies of final submittal to owner and engineer.

C. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.

1. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

2. The key named person shall be required to attend a minimum of three coordination meetings with all other subcontractors to discuss coordination before finishing drawings. Additional meeting will be at the discretion of the owner; per his satisfaction of the progress of coordination.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION 260005
SECTION 260500 - BASIC ELECTRICAL MATERIALS AND METHODS

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. This Section includes the following:
      1. Electrical equipment coordination and installation.
      2. Common electrical installation requirements.

1.3 DEFINITIONS
   B. EPDM: Ethylene-propylene-diene terpolymer rubber.
   C. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS
   A. Product Data: For each type of product indicated.

1.5 QUALITY ASSURANCE
   A. Test Equipment Suitability and Calibration: Comply with NETA ATS, "Suitability of Test Equipment" and "Test Instrument Calibration."

1.6 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 so 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 installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."

D. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch (1.3- or 3.5-mm) thickness as indicated and of length to suit application.

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Through-Penetration Firestop Systems."

2.3 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Available Manufacturers:

   a. Advance Products & Systems, Inc.
2. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.


4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating, Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. 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.

D. 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.

E. Right of Way: Give to raceways and piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Through-Penetration Firestop Systems."

C. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

D. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

E. Rectangular Sleeve Minimum Metal Thickness:
1. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side greater than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).

2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches (1270 mm) and 1 or more sides equal to, or greater than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

F. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

G. Cut sleeves to length for mounting flush with both surfaces of walls.

H. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

I. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed or unless seismic criteria require a different clearance.

J. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

K. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint.

L. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials.

M. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

N. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

O. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

A. Install to seal underground, exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
3.4 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Provide UL Listed Firestop Systems by HILTI or Crouse-Hinds.

B. Provide fire sealant putty/caulk around all conductors after pulling and terminating.

3.5 FIELD QUALITY CONTROL

A. Inspect installed sleeve and sleeve-seal installations and associated firestopping for damage and faulty work.

END OF SECTION 260500
SECTION 260513 - MEDIUM-VOLTAGE CABLES

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.
   B. Reference Codes and Standards
      2. IEEE-404, “IEEE Standard for Cable Joints for Use With Extruded Dielectric Cable Rated 5000 - 138000 V and Cable Joints for Use With Laminated Dielectric Cable Rated 2500 - 500000 V.”
      3. IEEE-48, “IEEE Standard Test Procedures and Requirements for AC Cables Terminations 2.5kV through 765kV.”

1.2 SUMMARY
   A. This Section includes cables and related splices, terminations, and accessories for medium-voltage electrical distribution systems.

1.3 DEFINITIONS
   B. MV: Medium Voltage system, 5kV through 15kV (nominal).

1.4 SUBMITTALS
   A. Data sheets on splices and terminations.
   B. Test Reports: Indicate results of cable DC hi-pot test with terminations and splices installed in tabular form and in plots of current versus voltage for incremental voltage steps, and current versus time at 30 second intervals at maximum voltage.
   C. Test Reports: Terminations. Manufacturer shall provide a test report demonstrating design-proof testing per IEEE 48. Manufacturer shall provide a test report demonstrating accelerated and real-time testing of weathering resistance including track and U.V. resistance as well as termination stability with time, temperature, and stress variation.
   D. Test Reports: Splices. Manufacturer shall provide a test report demonstrating design-proof testing according to IEEE 404, and water submersion testing according to ANSI C119.2.
E. Test Reports: Manufacturer shall provide an independent agency test report demonstrating qualification of terminations and splices to the load cycling requirements of MV-105 specifications for 105C continuous operation and 140C emergency operation.

F. Manufacturer's Instructions: Manufacturer shall provide illustrated step-by-step instructions describing installation on cable construction specified in Section 260513.

G. Product Data: For each type of cable indicated. Include splices and terminations for cables and cable accessories.

H. Cable Compatibility Statement: Statement from cable manufacturer stating the splices and/or terminations are compatible with the power cable.

I. Warranty: 20-year warranty on medium voltage (5kV – 35kV) power cable splices and terminations.

J. Qualification Data of Installer: MV Power Certified Contractor statement from cable accessory manufacturer.

K. Material Certificates: For each cable and accessory type, signed by manufacturers.

L. Source quality-control test reports.

M. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. Installer: Engage a cable splicer, trained and certified by splice material manufacturer, to install, splice, and terminate medium-voltage cable – MV Power Certified Contractor.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the Inter-National 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 Inter-National Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

C. Source Limitations: Obtain cables and accessories through one source from a single manufacturer.

D. 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.

E. Comply with IEEE C2 and NFPA 70.
1.6 PROJECT CONDITIONS

A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
   1. Notify owner no fewer than two days in advance of proposed interruption of electric service.
   2. Do not proceed with interruption of electric service without owner’s written permission.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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. Cables:
      a. Kerite Co. (The); Hubbell Incorporated.
      b. Okonite Company (The).
      c. Pirelli Cables & Systems NA.
   2. Cable Splicing and Terminating Products and Accessories:
      a. Raychem Corp.; Telephone Energy and Industrial Division; Tyco International Ltd.
      b. 3M; Electrical Products Division.
      c. Elastimold.

2.2 CABLES

A. Cable Type: MV-105 Shielded power cable for 5 kV.
   1. 140 degrees C Emergency Rating/250 degrees C Short Circuit Rating
   2. Comply with UL 1072, AEIC CS 8, ICEA S-93-639, and ICEA S-97-682.
   4. Conductor size/Capacity: As noted on drawings.
      a. Voltage rating: 5kV
      b. Insulation Thickness: 133 percent insulation level.
   6. Shielding: Tape Shield
7. Cable Jacket: Sunlight-resistant PVC.

2.3 SOLID TERMINATIONS

A. Shielded-Cable Terminations: Comply with the following classes of IEEE 48. Insulation class is equivalent to that of cable. Include shield ground strap for shielded cable terminations.

B. The kits shall be factory-engineered for the application and shall consist of a single piece of high permittivity, high resistivity, heat-shrinkable stress control tubing, exterior heat-shrinkable tubing and skirts (for outdoor applications) fabricated of UV stable, non-tracking (per ASTM D2303) materials, and heat-activated sealant to prevent ingress of moisture and contaminants. Terminations shall be Raychem model HVT-Z or engineer-approved equal.

C. Medium voltage cable terminations shall be qualified to class 1, IEEE-48 standards and shall be capable of properly terminating medium voltage MV-105 cables. Terminations shall be tested by a third party agency to meet the performance requirements of the MV-105 standards with 105°C continuous operating temperature / 140°C emergency operating temperature.

D. Multi-conductor terminations shall provide a heat-shrinkable breakout boot, factory coated with sealant to seal the outer jacket and/or armor termination point. Each kit shall include heat-shrinkable re-jacketing tubing to prevent corrosion and shifting of the shielding layers between the end of the sealing booth and the phase termination installation point. If grounding / ground check wires are included, heat-shrinkable tubing shall be provided to seal and protect these wires also.

E. The point of connection between the terminal lug of the termination and the bus bar shall be insulated after the lug is bolted to the bus. The insulating kits shall be pre-engineered to provide the appropriated amount of insulation and shall be qualified to ANSI-C37.20. Kit type Tyco/Raychem HVBC or engineer-approved equal.

2.4 MEDIUM VOLTAGE POWER CABLE SPLICES

A. Medium voltage in-line splices shall be fully compatible with cables and shall contain all necessary components to reinstate primary cable insulation, semi-con shielding, metallic shielding and grounding systems, and overall jacket to the equivalent of the cable itself. Splices shall be of a uniform cross-section and shall consist of heat-shrinkable radiation cross-linked material. The semi-conducting layer shall be bonded to the underlying insulating layer to ensure no air gaps between the layers. Raychem type Tyco / HVS-C or engineer-approved equal.

B. Medium voltage wye splices shall be fully compatible with cables and shall contain all necessary components to reinstate primary cable insulation, semi-con shielding, metallic shielding and grounding systems, and overall jacket to the equivalent of the cable itself. Splices shall be of a uniform cross-section and shall consist of heat-shrinkable radiation cross-linked material. The semi-conducting layer shall be bonded to the underlying insulating layer to ensure no air gaps between the layers. Tyco / Raychem type HVSY-1520S.

C. Medium voltage cable splices shall be qualified to IEEE-404 standard, shall be qualified to the water submersion tests described in ANSI-C119.2, and shall meet all requirements of MV-105 cables.
D. Pre-molded or hand-taped splices are not allowed.
E. The splice shall be re-jacketed with a heavy wall, heat-shrinkable, sealant-lined sleeve to provide a waterproof hot-melt adhesive seal.

2.5 SEPARABLE INSULATED CONNECTORS

A. Description: Modular system, complying with IEEE 386, with disconnecting, single-pole, cable terminators and with matching, stationary, plug-in, dead-front terminals designed for cable voltage and for sealing against moisture.
B. Terminations at Distribution Points: Modular type, consisting of terminators installed on cables and modular, dead-front, terminal junctions for interconnecting cables.
C. Dead-Break Cable Terminators: Elbow-type unit with 600-A continuous-current rating; designed for de-energized disconnecting and connecting; coordinated with insulation diameter, conductor size, and material of cable being terminated. Include test point on terminator body that is capacitance coupled.
D. Tool Set: Shotgun hot stick with energized terminal indicator, fault-indicator test tool, and carrying case.

2.6 ARC-PROOFING MATERIALS

A. Tape for First Course on Metal Objects: 10-mil thick, corrosion-protective, moisture-resistant, PVC pipe-wrapping tape.
B. Arc-Proofing Tape: Fireproof tape, flexible, conformable, intumescent to 0.3 inch thick, compatible with cable jacket.
C. Glass-Cloth Tape: Pressure-sensitive adhesive type, 1/2 inch wide.

2.7 SOURCE QUALITY CONTROL

A. Test and inspect cables according to NEMA WC8 before shipping.
B. Test strand-filled cables for water-penetration resistance according to ICEA T-31-610, using a test pressure of 5 psig.
C. Provide Factory Reel Test Data.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Termination and splice installers shall be Tyco MV Power certified splicers or engineer-approved equal.
B. Termination and splice installers shall have a minimum of 3 years documented experience in the installation of medium voltage splices and terminations.

C. Prior to installation of cable accessories, installers shall be trained by splice/termination factory personnel. Factory personnel may also be present at the initial cable accessory job site installation if requested by the Engineer.

D. Splice and termination manufacturer shall have a minimum of 10 years experience in the manufacture and installation of medium voltage splices and terminations.

E. Install cables according to IEEE 576.

F. Pull Conductors: Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
   1. Where necessary, use manufacturer-approved pulling compound or lubricant that will not deteriorate conductor or insulation.
   2. Use pulling means, including fish tape, cable, rope, and basket-weave cable grips that will not damage cables and raceways. Do not use rope hitches for pulling attachment to cable.

G. Install medium voltage feeders in raceway. Exposed installations shall be parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.

H. In manholes, handholes, pull boxes, junction boxes, and cable vaults, train cables around walls by the longest route from entry to exit and support cables at intervals adequate to prevent sag.

I. Install terminations at ends of conductors and seal multiconductor cable ends with standard kits.

J. Seal around cables passing through fire-rated elements.

K. Install fault indicators on each phase where indicated.

L. Ground shields of shielded cable at terminations, splices, and separable insulated connectors. Ground metal bodies of terminators, splices, cable and separable insulated-connector fittings, and hardware.

M. Identify cables according to Division 26 Section 260553 "Electrical Identification."

N. All terminations and splices shall be installed per the manufacturers’ installation instructions.

3.2 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Perform the following field tests and inspections and prepare test reports:
   1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS section 7.3.3. Certify compliance with test parameters.
2. After installing medium-voltage cables and before electrical circuitry has been energized, test for compliance with requirements.

3. Perform DC hi-pot testing of each conductor in accordance with the applicable NEMA specifications and IEEE-400. Apply test voltage in at least eight (8) increments to maximum test voltage. Record leakage current at each voltage increment, allowing time for charging current decay.

4. For Service Cables: Test Results – The manufacturer shall maintain a record of the test results (tests as prescribed in AEIC CS8−00 and ICEA S−94−649−1997) for a period of at least 3 years. The test results shall be furnished to the buyer, when requested.

C. Remove and replace malfunctioning units and retest as specified above.

3.3 WARRANTY

A. The manufacturer shall warrant that the cable furnished under this Specification conforms to this Specification and will be free from defects in material, design, and workmanship for 40 years.

B. All terminations and splices performed by MV Power-certified installers warrant a 20-year guarantee.

C. The manufacturer agrees to replace (i.e., supply new cable to the delivery point specified in the original order) in the event of the following:

   1. Any length of cable found defective in material or workmanship during the installation of the cable or during inspection at the manufacturer’s facility.

   2. Any length of cable failing during normal and proper use, which shows defects in material, manufacture or workmanship, provided in each case that immediate written notice of each failure is given to the manufacturer, and said manufacturer is given all reasonable opportunity to inspect such failure.

D. All replacements by the manufacturer shall be made free of charge FOB at the delivery point called for in the original order.

E. Lengths of cable which have been replaced under this Specification shall become the property of the manufacturer, and shall be returned to him at his expense.

END OF SECTION 260513
SECTION 260519 - CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary
      Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY
   A. This Section includes the following:
      1. Building wires and cables rated 600 V and less.
      2. Connectors, splices, and terminations rated 600 V and less.
      3. Sleeves and sleeve seals for cables.
   B. Related Sections include the following:
      1. Division 26 Section 260529 "Hangers and Supports for Electrical Systems".
      2. Division 26 Section 260553 "Electrical Identification".
      3. Division 26 Section 260513 "Medium-Voltage Cables" for single-conductor and
         multiconductor cables, cable splices, and terminations for electrical distribution systems
         with 2001 to 35,000 V.

1.3 DEFINITIONS
   A. EPDM: Ethylene-propylene-diene terpolymer rubber.
   B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS
   A. Product Data: For each type of product indicated.
   B. Qualification Data: For testing agency.
   C. Provide field test reports indicating and interpreting test results relative to compliance
      with performance requirements of testing standard.

1.5 SUBSTITUTIONS
   A. Wherever possible, several makes of materials, fixtures and devices have been specified. The
      project shall use material as specified, or approved by the Owner.
B. A list of material and equipment, including the name of the manufacturer, which the E.C. proposes to install, shall be submitted to the Owner for approval. All items so listed shall conform to the Specifications. No substitution shall be accepted unless approved in writing by the Owner.

1. When proposing a substitution, an official submittal for the substitution of that specific material shall be presented for evaluation.
2. A submittal for the evaluation of a substitution shall include all applicable data to allow the proper evaluation, e.g. calculations, layout, characteristics, etc.
3. A submittal for the evaluation of a substitution shall be presented as a whole, thus, partial submittal shall not be accepted.

1.6 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 (NETA) 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.

1.7 COORDINATION

A. Coordinate layout and installation of cable with other trades.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alcan Products Corporation; Alcan Cable Division.
3. General Cable Corporation.
4. Senator Wire & Cable Company.
5. Southwire Company.

B. All conductors shall be Copper Conductors: Comply with NEMA WC 70.
C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN-2.

D. Single phase circuits: All single phase 120V and single phase 277V circuits shall have a dedicated neutral conductor for each phase conductor.

E. Bare stranded copper for grounding equipment and copper bus bars in equipment rooms.

2.2 CONNECTORS AND SPLICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. AFC Cable Systems, Inc.
   2. O-Z/Gedney; EGS Electrical Group LLC.
   3. 3M; Electrical Products Division.
   4. Tyco Electronics Corp.
   5. Elastimold
   6. ISLCD

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.
   1. All 600V power cables shall utilize long barrel two holes compressions crimp lugs.

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. Control Circuits: Copper. Stranded, unless otherwise noted. Contractor shall refer to equipment shop drawings for specific wiring requirements.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Exposed Feeders: Type THHN-THWN, single conductors in raceway.

B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-THWN, single conductors in raceway.

C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
D.  Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.

E.  Class 1 Control Circuits: Type THHN-THWN, in raceway.

F.  Class 2 Control Circuits: Type THHN-THWN, in raceway.

3.3  INSTALLATION OF CONDUCTORS AND CABLES

A.  Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B.  Splices shall not be permitted unless cable exceeds roll length in new installation.

C.  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.

D.  Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E.  Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F.  Support cables according to Division 26 Section 260529 "Hangers and Supports for Electrical Systems".

G.  Identify and color-code conductors and cables according to Division 26 Section 260553 "Electrical Identification."

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 6 inches of slack.

3.5  MOTOR TERMINATIONS

A.  All shall be made using bolted type connectors. Terminals shall be insulated with a minimum of three (3) half (1/2) lapped layers of Plymouth “Slip-Knot” rubber tape or equal protected with a minimum of two (2) half (1/2) lapped layers of Scotch No. 33 plastic tape.
3.6  FIRESTOPPING

   A.  Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 7 Section "Through-Penetration Firestop Systems."

3.7  FIELD QUALITY CONTROL

   A.  Testing Agency: Owner will engage a qualified 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 all feeder and branch conductors for compliance with requirements.
       2.  Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification section 7.3.2. 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 260523 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. UTP cabling.
   2. STP Cabling
   3. RS-232 cabling.
   4. RS-485 cabling.
   5. Low-voltage control cabling.
   7. Identification products.

1.2 DEFINITIONS

A. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.

B. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel section.

C. EMI: Electromagnetic interference.

D. IDC: Insulation displacement connector.

E. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).

F. Low-Low Voltage: Circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

G. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).

H. RCDD: Registered Communications Distribution Designer.

I. Solid-Bottom or Nonventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal side rails, and a bottom without ventilation openings.
J. Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.

K. UTP: Unshielded twisted pair.

L. STP: Shielded twisted pair.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Maintenance Data: For wire and cable to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.
   1. Test each pair of UTP cable for open and short circuits.

PART 2 - PRODUCTS

2.1 PATHWAYS

A. Support of Open Cabling: NRTL labeled for support of Category 5e cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
   1. Support brackets with cable tie slots for fastening cable ties to brackets.
   2. Lacing bars, spools, J-hooks, and D-rings.
   3. Straps and other devices.

B. Conduit and Boxes: Comply with requirements in Section 260533, "Raceways and Boxes for Electrical Systems".

2.2 BACKBOARDS

A. Description: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches.
2.3 UTP CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Belden CDT Inc.; Electronics Division.
   2. Belkin.
   3. 3M.
   4. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

B. Description: 100-ohm, four-pair UTP.
   1. Comply with ICEA S-90-661 for mechanical properties.
   2. Comply with TIA/EIA-568-B.1 for performance specifications.
   3. Comply with TIA/EIA-568-B.2, Category 5e.
   4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
      a. Communications, General Purpose: Type CM or Type CMG.
      b. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
      c. Communications, Riser Rated: Type CMR, complying with UL 1666.
      d. Communications, Limited Purpose: Type CMX.
      e. Multipurpose: Type MP or Type MPG.
      f. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
      g. Multipurpose, Riser Rated: Type MPR, complying with UL 1666.

2.4 UTP CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   2. Dynacom Corporation.
   3. Hubbell Premise Wiring.
   4. Leviton Voice & Data Division.
   5. Molex Premise Networks; a division of Molex, Inc.
   6. Panduit Corp.
   7. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

B. UTP Cable Connecting Hardware: IDC type, using modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of the same category or higher.
C. Connecting Blocks: 110 style for Category 5e or 66 style for Category 5e. Provide blocks for the number of cables terminated on the block, plus 25 percent spare; integral with connector bodies, including plugs and jacks where indicated.

2.5 RS-232 CABLE

A. Standard Cable: NFPA 70, Type CM.
   1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned-copper conductors.
   2. Polypropylene insulation.
   3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
   4. PVC jacket.
   5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned-copper drain wire.

B. Plenum-Rated Cable: NFPA 70, Type CMP.
   1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned-copper conductors.
   2. Plastic insulation.
   3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
   5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned-copper drain wire.

2.6 RS-485 CABLE

A. Standard Cable: NFPA 70, Type CM or Type CMG.
   1. Paired, two pairs, twisted, No. 16 AWG, stranded (7x30) tinned-copper conductors.
   2. PVC insulation.
   3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
   4. PVC jacket.
   5. Flame Resistance: Comply with UL 1581.

B. Plenum-Rated Cable: NFPA 70, Type CMP.
   1. Paired, two pairs, No. 16 AWG, stranded (7x30) tinned-copper conductors.
   2. Fluorinated ethylene propylene insulation.
   3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
4. Fluorinated ethylene propylene jacket.

2.7 LOW-VOLTAGE CONTROL CABLE

A. Paired Cable: NFPA 70, Type CMG.
   1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
   2. PVC insulation.
   3. Unshielded.
   4. PVC jacket.
   5. Flame Resistance: Comply with UL 1581.

B. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.
   1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
   2. PVC insulation.
   3. Unshielded.
   4. PVC jacket.
   5. Flame Resistance: Comply with NFPA 262.

C. Paired Cable: NFPA 70, Tray Cable
   1. Two pair, twisted, No. 16 AWG, stranded (7x24) bare-copper conductors.
   2. PVC insulation.
   3. Shielded.
   4. PVC jacket.
   5. UL Flame Test: UL 1685 UL loading.

2.8 CONTROL-CIRCUIT CONDUCTORS

A. Class 1 Control Circuits: Stranded copper, Type THHN-THWN in raceway, complying with UL 83.

B. Class 2 Control Circuits: Stranded copper, Type THHN-THWN, in raceway and power-limited tray cable, in cable tray, complying with UL 83.
2.9 IDENTIFICATION PRODUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Brady Corporation.
   2. Panduit Corp.

B. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

C. Comply with requirements in Section 260553 "Electrical Identification."

2.10 SOURCE QUALITY CONTROL

A. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.

B. Factory test UTP cables according to TIA/EIA-568-B.2.

C. Cable will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 INSTALLATION OF PATHWAYS

A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A-7.

B. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.

C. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for installation of conduits and wireways.

D. Install manufactured conduit sweeps and long-radius elbows if possible.

E. Pathway Installation in Equipment Rooms:
   1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed or in the corner of room if multiple sheets of plywood are installed around perimeter walls of room.
   2. Install cable trays to route cables if conduits cannot be located in these positions.
   3. Secure conduits to backboard if entering room from overhead.
   4. Extend conduits 4 inches above finished floor.
5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

F. Backboards: Install backboards with 96-inch dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

3.2 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:
   2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
   3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
   4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
   5. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
   6. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
   7. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
   8. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:
   2. Install 110-style IDC termination hardware unless otherwise indicated.
   3. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.

D. Installation of Control-Circuit Conductors:
   1. Install wiring in raceways. Comply with requirements specified in Section 260533 "Raceways and Boxes for Electrical Systems".

E. Open-Cable Installation:
   1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.

3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

F. Installation of Cable Routed Exposed under Raised Floors:
1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Coil cable 72 inches long shall be neatly coiled not less than 12 inches in diameter below each feed point.

G. Separation from EMI Sources:
1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
5. Separation between Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 12 inches.

3.3 CONTROL-CIRCUIT CONDUCTORS

A. Minimum Conductor Sizes:
1. Class 1 remote-control and signal circuits (typically 120V), #14 AWG.

2. Class 2 low-energy, remote-control, and signal circuits (typically 100VA or less under 30V), #16 AWG.

3. Class 3 low-energy, remote-control, alarm, and signal circuits (typically 0.5VA through 100VA above 30V), #12 AWG.

3.4 FIRESTOPPING

A. Comply with requirements in Division 7 "Through-Penetration Firestop Systems."

B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.5 GROUNDING

A. For data communication wiring, comply with ANSI-J-STD-607-A and with BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. For low-voltage wiring and cabling, comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.6 IDENTIFICATION

A. Identify system components, wiring, and cabling according to TIA/EIA-606-A. Comply with requirements for identification specified in Section 260553 "Electrical Identification."

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Visually inspect UTP cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568-B.1.

2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

3. Test UTP cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not after cross connection.

   a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy.
specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

C. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.

D. End-to-end cabling will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 260523
SECTION 260526 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Refer to Division 26 Section 260000 "Electrical Summary & Scope of Work" for grounding work completed under separate contract. This section pertains to all new work shown on contract documents.

B. This Section includes methods and materials for grounding systems and equipment, plus the following special applications:
   1. Underground distribution grounding.
   2. Common ground bonding with lightning protection system.

C. In addition to the Grounding and Bonding listed in this specification section and the drawings; the Electrical Contractor (E.C.) shall provide an allowance in his bid for additional 10% materials and labor of the Grounding system for additional connections as directed by the Engineer or Authority Having Jurisdiction (AHJ) in the field.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:
   1. Test wells.
   2. Ground rods.
   3. Ground rings.
   4. Grounding arrangements and connections for separately derived systems.

C. Qualification Data: For testing agency and testing agency's field supervisor.

D. Operation and Maintenance Data: For grounding to include the following in emergency, operation, and maintenance manuals:
   1. As-built drawings of the grounding system.
2. Instructions for periodic testing and inspection of grounding features at test wells based on NETA MTS.

1.4 SUBSTITUTIONS

A. Wherever possible, several makes of materials, fixtures and devices have been specified. The project shall use material as specified, or approved by the Owner.

B. A list of material and equipment, including the name of the manufacturer, which the E.C. proposes to install, shall be submitted to the Owner for approval. All items so listed shall conform to the Specifications. No substitution shall be accepted unless approved in writing by the Owner.

1. When proposing a substitution, an official submittal for the substitution of that specific material shall be presented for evaluation.
2. A submittal for the evaluation of a substitution shall include all applicable data to allow the proper evaluation, e.g. calculations, layout, characteristics, etc.
3. A submittal for the evaluation of a substitution shall be presented as a whole, thus, partial submittal shall not be accepted.

1.5 QUALITY ASSURANCE

A. 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.

B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with Specifications; provide products by one of the following Manufacturers:
1. Harger Lightning and Grounding
2. Erico
3. Burndy
4. Ilsco
5. Thomas and Betts
6. Heary Brothers
2.2 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:
   4. Bonding Cable: No.6AWG, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
   5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
   6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

C. Bare Grounding Conductor and Conductor Protector for Wood Poles:
   1. No. 4 AWG minimum, soft-drawn copper.
   2. Conductor Protector: Half-round PVC or wood molding. If wood, use pressure-treated fir or cypress or cedar.
   3. Conform to owner requirements in addition to listed requirements above.

D. Grounding Bus: Rectangular bars of annealed copper, 1/4 by 3 inches in cross section, unless otherwise indicated; with standoff insulators.

2.3 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

B. Above ground bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
   1. Pipe Connectors: Clamp type, sized for pipe.

C. Above Ground Irreversible Compression Connectors: Compression connectors and tool kits used as recommended by the manufacturer for specified wire types/sizes and application.

D. Underground Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

E. Underground Irreversible Compression Connectors: Compression connectors and tool kits used as recommended by the manufacturer for specified wire types/sizes and application.

   1. The use of Underground Irreversible Compression Connectors shall be allowed subject to acceptability of an itemized cost breakdown comparison supporting this option as a cost effective solution.
2.4 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel, sectional type; 3/4 inch by 10 feet (19 mm by 3 m) in diameter.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.

B. Underground Grounding Conductors: Install bare copper conductor, No. 4/0 AWG minimum.
   1. Unless otherwise noted on drawings, bury at least 36 inches (600 mm) below grade.
   2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.

C. Grounding Bus: Install in rooms housing service equipment, and elsewhere as indicated.
   1. Install bus on insulated spacers 1 inch (25 mm), minimum, from wall 6-12 inches (150 mm) above finished floor, unless otherwise indicated.
   2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, down to specified height above floor, and connect to horizontal bus.

D. Conductor Terminations and Connections:
   1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
   2. Underground Connections: Exothermic Welded connections, except at test wells and as otherwise indicated.
   3. Connections to Ground Rods at Test Wells: Bolted connectors.

3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.
3.3 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits. Using conduit is not an acceptable method of equipment grounding.

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.
   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 the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

D. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
   2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

3.4 INSTALLATION

A. Grounding Conductors: 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. Common Ground Bonding 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.

C. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or 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. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and Utility Structures," and shall be at least 12 inches (300 mm) deep, with cover.

1. Test Wells: Install at least one test well for each service, unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

E. 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 any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

F. 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, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a 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 a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
4. Bond all Gas Processing Piping where it transitions above Grade to Stainless Steel pipe.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Perform the following tests and inspections and prepare test reports:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.
a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

b. Perform tests by fall-of-potential method according to IEEE 81.

3. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

4. Provide point to point measurements, continuity measurements for all electrical equipment and boxes accessible above grade.

C. Report measured ground resistances that exceed 5 ohms.

D. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION 16060
SECTION 260529 – HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

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. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.

2. Seismic restraints.

   a. Provide attachment devices, anchor bolts, and seismic restraints that are required for seismic compliance for all equipment, apparatus, conduit and raceways, and other components of the specified systems required by reference codes and standards.

   b. Provide seismic bracing for all electrical systems as per current edition of applicable Building Code.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. LFMC: Liquidtight Flexible Metallic Conduit

D. PVC-RGS: PVC coated rigid galvanized steel.

E. RMC: Rigid metal conduit.

F. Seismic Restrain Attachment Devices: elements used to securely support equipment and/or raceway into the structure; raceway larger than 1-inch.

G. Transverse Bracing: Restraints applied to limit motion perpendicular or angular to the centerline of the supported raceway or raceway system.

H. Longitudinal Bracing: Restraints applied to limit motion along the centerline of the supported raceway or raceway system.

I. Systems for Life Safety:
1. All systems involved and/or supporting fire protection and smoke exhaust systems.
2. All systems involved with and/or connected to emergency power supply, including generators, transfer switches, transformers and all circuits supporting fire protection, smoke evacuation and/or emergency lighting systems.

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

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.

C. Electrical components shall be listed and labeled by UL, ETL, CSA, or other approved, nationally recognized testing and listing agency that provides third party certification follow-up services.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: 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. Allied Tube & Conduit.
      b. Cooper B-Line, Inc.; a division of Cooper Industries.
      c. ERICO International Corporation.
      d. GS Metals Corp.
      e. Thomas & Betts Corporation.
      f. Unistrut; Tyco International, Ltd.
   2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
   3. Channel Dimensions: Selected for applicable load criteria.
B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. 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.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened Portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Hilti Inc.
      2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      3) MKT Fastening, LLC.
      4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated 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. 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.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.

4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.

5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.

6. Toggle Bolts: All-steel springhead type.


G. Conduit Sealing Bushings: Factory fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit, or tubing passing through concrete floors and walls.
Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws.

H. Seismic Restrain Isolator - Type SCB (Where Required by Codes or Standards)
   1. Multiple metal cable or steel strut type with approved fastening devices to equipment and structure. System to be field bolted to deck or overhead structural members using two sided beam clamps or appropriately designed inserts for concrete.

2.2 FABRICATED SUPPORTING DEVICES
   A. Shop or field fabricated supports assembled from U channel components.
   B. Steel brackets: fabricated of angles, channels, and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.
   C. Pipe Sleeves: Provide pipe sleeves of one of the following:
      1. Sheet Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate sleeves from the following gage metal for sleeve diameter noted.
         a. 3 inch and smaller: 20 gauge.
         b. 4 inch to 6 inch: 16 gauge.
         c. Over 6 inch: 14 gauge.
      2. Steel Pipe: Fabricate from schedule 40 galvanized steel pipe.

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, IMC, and RMC as scheduled in NECA 1, where its’ Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
   C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with slotted steel or other 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 two-bolt conduit clamps.
D. Material to match raceway. Refer to Division 26 Section 260533 “Raceways, Boxes and Cabinets, Paragraph 3.1

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, IMC, 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. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
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 attached to substrate.
9. Do not drill structural steel.
10. Do not weld conduit. Pipe straps or items other than threaded studs to structures.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.
3.3 INSTALLATION OF FABRICATED METAL SUPPORTS
   A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
   B. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 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. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.5 SEISMIC RESTRAINTS (Where Required by Codes or Standards)
   A. All floor-mounted equipment whether isolated or not shall be snubbed, anchored, bolted or welded to structure to comply with requirements of these specifications. All equipment shall be positively attached to the structure.
   B. All suspended equipment and apparatus shall be two or four point independently braced with Type SCB restraints, installed taut for non-isolated equipment and slack with 1/2-inch cable deflection for isolated equipment. Suspending rods shall be braced as necessary to restrain against angular motion.
   C. All suspended cable tray(s), bus duct and conduit shall be restraint Type SCB.
   D. For all trapeze-supported conduits, the individual conduits shall be transversely and vertically restrained to the trapeze support at each restraint location.
   E. For overhead supported components, overstress of the building structure must not occur. Bracing shall occur from flanges of structural beams, upper truss chords in bar joists, or cast in place inserts or drilled and shielded inserts in concrete structures.
   F. All non-isolated floor or wall mounted equipment shall use restraint Type SCB.
   G. Where base anchoring of equipment is insufficient to resist seismic forces, restraint Type SCB shall be located above the component’s center of gravity to suitably resist seismic forces specified. Vertically mounted tanks and up-blasted tubular centrifugal fans, horizontal tanks, or similar equipment, may require this additional restraint.
   H. A rigid conduit supporting system shall not be braced to dissimilar parts of building on two dissimilar building systems that may respond in a different mode during an earthquake.
END OF SECTION 260529
SECTION 260533 – RACEWAYS, BOXES AND CABINETS

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. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
B. Related Sections include the following:
   1. Refer to Section 260000 "Electrical Summary & Scope of Work" for grounding work completed under separate contract. This section pertains to all new work shown on contract documents.
   2. Division 26 Section 260543 "Underground Ducts and Utility Structures" for exterior ductbanks, handholes, and underground utility construction.

1.3 DEFINITIONS
A. EMT: Electrical metallic tubing.
B. ENT: Electrical nonmetallic tubing.
C. LFMC: Liquid-tight flexible metal conduit.
D. RGS: Rigid Galvanized Steel
E. IMC: Intermediate Metal Conduit
F. PVC: Poly-Vinyl Chloride
G. RNC: Rigid Nonmetallic Conduit
H. PVC-RGS: PVC Coated Rigid Galvanized Steel

1.4 SUBMITTALS
A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.
   1. Custom enclosures and cabinets.
   2. For handholes and boxes for underground wiring, including the following:
      a. Duct entry provisions, including locations and duct sizes.
      b. Frame and cover design.

C. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items
   are shown and coordinated with each other, based on input from installers of the items involved:
   1. Structural members in the paths of conduit groups with common supports.
   2. HVAC and plumbing items in the paths of conduit groups with common supports.

1.5 QUALITY ASSURANCE

A. 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.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the
   following:
   1. AFC Cable Systems, Inc.
   3. O-Z Gedney; a unit of General Signal.

B. Rigid Steel Conduit: ANSI C80.1.

C. EMT: ANSI C80.3.

D. FMC: Zinc-coated steel

E. LFMC: Flexible steel conduit with PVC jacket.

F. Fittings for Conduit (Including all Types and Flexible and Liquid-tight), EMT, and Cable:
   NEMA FB 1; listed for type and size raceway with which used, and for application and
   environment in which installed.
2. Fittings for EMT: Steel or die-cast, compression type.

G. Joint Compound for Rigid Steel Conduit: Explosion-proof compound listed for use in conduit connector assemblies, and compounded for use to form an explosion-proof seal around each conductor. Compound shall be designed to restrict the passage of gases, vapors and flames through the sealing fitting. Compound shall be Crouse-Hinds CHICO X sealing compound.

2.2 NONMETALLIC CONDUIT AND TUBING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. AFC Cable Systems, Inc.
   2. Lamson & Sessions; Carlon Electrical Products.
   3. RACO; a Hubbell Company.
   4. Thomas & Betts Corporation.
   5. Carlon

B. RNC: Schedule 40 PVC, unless otherwise indicated.

C. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.

2.3 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap-on covers.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Thomas & Betts Corporation.
      c. Wiremold Company (The); Electrical Sales Division.

2.4 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
   2. EGS/Appleton Electric.
   3. Hoffman.
5. O-Z/Gedney; a unit of General Signal.
6. RACO; a Hubbell Company.
7. Thomas & Betts Corporation.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, aluminum, Type FD, with gasketed cover.

D. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

E. Cabinets:
   1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
   2. Hinged door in front cover with flush latch and concealed hinge.
   3. Key latch to match panelboards.
   4. Metal barriers to separate wiring of different systems and voltage.
   5. Accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
   1. Exposed Conduit: rigid steel conduit.
   2. Concealed Conduit, Aboveground: Rigid steel conduit.
   4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
   6. High corrosive areas: PVC coated rigid galvanized steel; acceptable alternate: PVC Schedule 80 as permitted by NFPA 70.
   7. Hazardous Areas: comply with requirements from NFPA 70, Article 500.

B. Comply with the following indoor applications, unless otherwise indicated:
   1. Exposed, Not Subject to Physical Damage, Non-Hazardous Locations: EMT.
   2. Exposed, Not Subject to Severe Physical Damage, Non-Hazardous Locations: EMT.
   3. Exposed, Subject to Physical Damage, Hazardous Locations: RGS.
   4. Exposed, Subject to Severe Physical Damage, Hazardous Locations: RGS.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
6. Damp or Wet Locations: Rigid steel conduit.
7. Raceways for Concealed General Purpose Distribution of Optical Fiber or Communications Cable: EMT.
8. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, nonmetallic in damp or wet locations.
9. High corrosive areas: PVC coated rigid galvanized steel; acceptable alternate: PVC Schedule 80 as permitted by NFPA 70.
10. Hazardous Areas: comply with requirements from NFPA 70, Article 500.

C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.
   1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings with ground bushings, unless otherwise indicated.

3.2 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B. Comply with installation depths indicated in detail 3 on drawing E5.01.

C. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

D. Complete raceway installation before starting conductor installation.

E. Support raceways as specified in Division 26 Section 260529 "Hangers and Supports for Electrical Systems."

F. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

G. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.

H. Raceways Embedded in Slabs:
   1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
   2. Change from Type EPC-40-PVC to rigid steel conduit before rising from above grade.
I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating grounding type lock nut bushings to protect branch feeder conductors, including conductors smaller than No. 4 AWG. On conductors larger than No. 4/0 AWG or main feeders, use grounding type terminal connector bushings.

K. Drain fitting shall be installed at low point and a breather fitting at the high point of all outdoor exposed conduit runs.

L. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.

M. Raceways for Optical Fiber and Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:
   1. 3/4-Inch (19-mm) Trade Size and Smaller: Install raceways in maximum lengths of 50 feet (15 m).
   2. 1-Inch (25-mm) Trade Size and Larger: Install raceways in maximum lengths of 75 feet (23 m).
   3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
   4. Utilize manufacturer long sweep radius elbows.

N. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
   1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
   2. Where otherwise required by NFPA 70.

3.3 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
   1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
   2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.
END OF SECTION 260533
SECTION 260543 - UNDERGROUND DUCTS AND UTILITY STRUCTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.


C. Shop drawings of each specific piece of equipment to be installed for coordination of all power and control/SCADA conduit entries.

1.2 SUMMARY

A. This Section includes the following:
   1. Conduit, ducts, and duct accessories for direct-buried and concrete-encased duct banks and in single duct runs.
   2. Manholes, handholes and boxes.
   3. Electric utility material and installation requirements.
   4. Telecommunications provider standard specifications.

B. Products provided under this section include pulling eyes, cable stanchions, cable arms, and insulators.
   1. Furnish materials complete with associated fasteners, packaged with protective covering for storage and with identification labels clearly describing contents.
   2. It shall be the responsibility of the contractor to take all necessary precautions to ensure the safety of all existing structural elements during all phases of his work.
   3. No materials, cranes, trucks or any other construction loads shall cross over or be positioned until the contractor has determined the adequacy of that structure to carry the intended load without damage or overstress.

1.3 DEFINITIONS

A. RNC: Rigid nonmetallic conduit.

B. Duct: Electrical conduit and other raceway, either metallic or nonmetallic, used underground, embedded in earth or concrete.
C. Duct Bank: Two or more conduits or other raceway installed underground in the same trench or concrete envelope.

D. Handhole: An underground junction box in a duct or duct bank.

1.4 SUBMITTALS

A. Product Data: For the following:
   1. Duct-bank materials, including separators and miscellaneous components.
   2. Ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
   3. Accessories for manholes, handholes, boxes, and other utility structures.
   4. Warning tape.
   5. Warning planks.

B. Shop Drawings for Precast or Factory-Fabricated Underground Utility Structures: Include plans, elevations, sections, details, attachments to other work, and accessories, including the following:
   1. Duct entry provisions, including locations and duct sizes.
   2. Reinforcement details.
   3. Frame and cover design and manhole frame support rings.
   4. Ladder details.
   5. Grounding details.
   6. Dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
   7. Joint details

C. Shop Drawings for Factory-Fabricated Handholes: Include dimensioned plans, sections, and elevations, and fabrication and installation details, including the following:
   1. Duct entry provisions, including locations and duct sizes.
   2. Cover design.
   4. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

D. Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures.
   1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.
   2. Drawings shall be signed and sealed by a qualified professional engineer.
E. Product Certificates: For concrete and steel used in precast concrete manholes and handholes, as required by ASTM C 858.

F. Inspection report for factory inspections, according to ASTM C 1037.

G. Source quality-control test reports.

H. Record documents: Show dimensioned locations of underground ducts and handholes.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firm experienced in manufacturing underground precast concrete utility structures of types and sizes required and similar to those indicated for this project. Firm must have a record of successful in-service performance.

B. Comply with ANSI C2.

C. Comply with NFPA 70.

D. Listing and Labeling: Provide products specified in this section that are listed and labeled.
   1. The terms “Listed” and “Labeled”: As defined in the National Electrical Code, Article 100.

1.6 DELIVERY, STORAGE, AND HANDLING

A. All materials and equipment delivered to the site shall be stored at locations approved by the owner. Contractor shall be responsible for their proper care and protection, and shall protect and be responsible for any damage to these materials.

B. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

C. Store precast concrete and other factory fabricated underground utility structures at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.

D. Lift and support precast concrete units only at designated lifting or supporting points.

1.7 COORDINATION

A. Coordinate layout and installation of ducts, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.

B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations
from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by construction manager

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Furnish cable-support stanchions, arms, insulators and associated fasteners in quantities equal to 5 percent of quantity of each item installed.

PART 2 - PRODUCTS

2.1 CONDUIT


B. RNC: NEMA TC 2 Type EPC-40-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.2 NONMETALLIC DUCTS AND DUCT ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ARNCO Corp.
   2. Carlon Electrical Products; Lamson & Sessions Company.
   3. Certainteed Products Corp.; Pipe & Plastic Group

B. Duct Accessories:
   1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.
   2. Warning Tape: Underground-line warning tape specified in Division 26 Section 260553 "Electrical Identification."

2.3 HANDHOLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Quazite, or equivalent.
B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.

C. The enclosures shall be designed to be installed flush to grade with the cover fitting flush to the box.

D. The enclosures shall be of a stackable design for greater installation flexibility.

E. All covers shall be equipped with a minimum of two stainless steel lockdown mechanisms.

F. All enclosure covers will have some type of recessed access point to allow removal of the cover with a hook. The access points will be placed in such a location to allow for the greatest amount of leverage and safety possible.

G. Enclosures shall be designed and suitable for installation and use through a temperature range of -40 deg F to 140 deg F.

H. A certified copy of all test reports must be signed and stamped by a registered professional engineer and submitted prior to shipment of products.

2.4 MANHOLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Manufacturers approved by Electric Utility Company.


2.5 WATERPROOFING FOR CONCRETE STRUCTURES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. CCW-525 or CCW-703 Liquid-Applied Waterproofing Membrane as manufactured by Carlisle Coatings & Waterproofing Incorporated, 900 Hensley Lane, Wylie, Texas 75098, Phone: (800) 527-7092 Fax: (972) 442-0076.
   2. Or equivalent.

2.6 SOURCE QUALITY CONTROL

A. Test and inspect precast concrete utility structures according to ASTM C 1037.

B. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of manholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
1. Strength tests of complete boxes and covers shall be by either an independent testing agency or the manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.

2. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

2.7 CONSTRUCTION MATERIALS

A. Mortar: Conform to ASTM C 270, type M, except for quantities less than 2.0 cu.ft., where packaged mix complying with ASTM C 387, type M may be used.

B. Concrete:
   1. Strength: 3000 psi minimum 28 day compressive strength.
   3. Provide concrete red dye for all ductbanks.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine site to receive ducts for compliance with installation tolerances and other conditions affecting performance of the underground ducts. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Comply with installation depths indicated in detail 3 on drawing E5.01.

3.2 UNDERGROUND DUCT APPLICATION

A. Ducts for Electrical Cables Over 600 V: RNC, NEMA Type EPC-80-PVC, in concrete-encased duct bank, unless otherwise indicated. Comply with Electric Utility Company Standard (if applicable).

B. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated.

C. Underground Ducts for Telephone, Communications, Controls, or Data Utility Service Cables: RNC, NEMA Type EPC-80-PVC, installed in direct-buried duct bank, unless otherwise indicated. Comply with Telecommunications Provider and Electric Utility standards (if applicable).

3.3 UNDERGROUND ENCLOSURE APPLICATION

A. Manholes: Precast concrete.
1. Units Located in Roadways and Other Deliberate Traffic Paths by Heavy or Medium Vehicles: H-20 structural load rating according to AASHTO HB 17.

2. Units Not Located in Deliberate Traffic Paths by Heavy or Medium Vehicles: H-10 load rating according to AASHTO HB 17.

B. Handholes and Boxes, Including Telephone, Communications, and Data Wiring:

1. Enclosures, boxes and covers are required to conform to all test provisions of the most current ANSI/SCTE 77 “Specification For Underground Enclosure Integrity” for Tier 22 applications. When multiple “Tiers” are specified the boxes must physically accommodate and structurally support compatible covers while processing the highest Tier rating. All covers are required to have the Tier level rating embossed on the surface. In no assembly can the cover design load exceed the design load of the box. All components in an assembly (box & cover) are manufactured using matched surface tooling. Independent third party verification or test reports stamped by a registered Professional Engineer certifying that all test provisions of this specification have been met are required with each submittal.

3.4 EARTHWORK

A. Provide all excavation, trenching, backfill, tools, apparatus, shoring and necessary staging.

B. All excavation shall be unclassified and all material encountered, regardless of types of hardness, including rock or old foundations, shall be removed to accommodate the work.

C. Excavation and Backfill: Do not use heavy-duty, hydraulic-operated, compaction equipment where damage could result.

D. Provide pumping equipment to remove all water from trenches and other excavations. Discharge water only at suitable drainage points.

E. All backfill under walks, roads, driveways, pipes, ducts, conduits, handholes, and other specialties shall be compacted to 95 percent AASHO modified density. Test of compaction shall be conducted for each 16 inches of fill or fraction thereof, one test for each 2,000 sq.ft. or less. Copy of test results shall be forwarded to engineer before surfaces are restored.

F. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

G. 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.

H. Backfill shall be clean earth and shall be free from rocks, frozen earth, debris, and foreign materials. Backfill shall be deposited in uniform layers not over 6 inches thick and each layer shall be mechanically tamped before the next layer is applied up to final 4 inches of top soil.
I. Where existing underground services are involved, excavation shall be performed with hand tools. The contractor shall be responsible for all damage to existing utilities.

3.5 DUCT INSTALLATION

A. Feeder raceway banks shall be encased in a concrete envelope not less than 3 inches thick all around the outside limits of the raceway group and shall not be less than 3 inches between any surface of raceway. The top of the enclosing concrete envelope shall not be less than 36 inches below finished grade. Concrete envelopes shall be reinforced at all points by #4 reinforcing rods in each corner of the envelope with vertical cross ties on 3 foot centers.

B. Install nonmetallic conduit and duct as indicated according to manufacturer’s written instructions.

C. Slope: Pitch ducts a minimum slope of 1:300 down toward handholes and away from buildings and equipment. Slope ducts from a high point in runs between two handholes to drain in both directions.

D. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches, both horizontally and vertically, at other locations, unless otherwise indicated.

E. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.

F. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches (250 mm) o.c. for 5-inch (125-mm) ducts, and vary proportionately for other duct sizes.
   1. Begin change from regular spacing to end-bell spacing 10 feet (3 m) from the end bell without reducing duct line slope and without forming a trap in the line.
   2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole.
   3. Grout end bells into structure walls from both sides to provide watertight entrances.

G. Building Entrances: Make a transition from underground duct to rigid steel conduit without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Follow appropriate installation instructions below.
   1. Concrete Encased Ducts: Install reinforcing in duct banks passing through disturbed earth near buildings and other excavations. Coordinate duct bank with structural design to support duct bank at wall without reducing structural or watertight integrity of building wall.
   2. Waterproofed Wall and Floor Entrances: Install a watertight entrance-sealing device with the sealing gland assembly on the inside. Anchor device into masonry construction with 1
or more integral flanges. Secure membrane waterproofing to the device to make permanently watertight.

H. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.

I. Pulling Cord: Install 100-lbf-test nylon cord in ducts, including spares.

J. Concrete-Encased Ducts: Support ducts on duct separators.
   1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, and secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches between tiers. 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.
   2. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
      a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
      b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing rod dowels extending 18 inches into concrete on both sides of joint near corners of envelope.
   3. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.
   4. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
   5. Stub-Ups: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
      a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
      b. Stub-Ups to Equipment: For equipment mounted on concrete bases, extend steel conduit horizontally a minimum of 12”-24” inches above top of finished concrete. Install insulated grounding bushings on terminations at equipment.

K. Direct-Buried Duct Banks:
   1. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
2. Space separators close enough to prevent sagging and deforming of ducts, with not less than 4 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches between tiers.

3. Excavate trench bottom to provide firm and uniform support for duct bank.

4. Install backfill as required. Provide metallic warning tape above all ductbanks. Refer to Section 260553.

5. After installing first tier of ducts, 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 inches over ducts 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.

6. Set elevation of bottom of duct bank below the frost line.

7. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
   a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
   b. Install insulated grounding bushings on terminations at equipment.

3.6 INSTALLATION OF NON-CONCRETE HANDHOLES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by the manufacturer.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: Set such that cover surface will be flush with finished grade.

D. Install handholes and boxes with bottom below the frost line.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.

F. Field-cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
3.7 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

A. Precast Concrete Handhole and Manhole Installation:
   1. Comply with ASTM C 891, unless otherwise indicated.
   2. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.
   3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch (25-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

B. Elevations:
   1. Manhole Roof: Install with rooftop at least 15 inches (380 mm) below finished grade.
   2. Manhole Frame: Set frames flush with finished grade.
   3. Install handholes with bottom below the frost line.
   4. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade.

C. Manhole Access: Circular opening in manhole roof; sized to match cover size.
   1. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.
   2. Install chimney, constructed of precast concrete collars and rings to support frame and cover and to connect cover with manhole roof opening. Provide moisture-tight masonry joints and waterproof grouting for cast-iron frame to chimney.

D. Waterproofing: Apply waterproofing to exterior surfaces of concrete manholes. After ducts have 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.

E. Hardware: Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.

F. Fixed Manhole Ladders: Arrange to provide for safe entry with maximum clearance from cables and other items in manholes.

G. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inches (98 mm) for manholes and 2 inches (50 mm) for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

H. Warning Sign: Install "Confined Space Hazard" warning sign on the inside surface of each manhole cover.
3.8 GROUNDING

A. Ground underground ducts and utility structures according to Division 26 Section 260526 "Grounding and Bonding."

B. Grounding Bushings: Provide grounding for bushings on all conduits entering/leaving switchboard/switchgear enclosures and ductbanks. Provide insulated ground wire from grounding bushings to ground bus of switchboard/switchgear.

3.9 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:
   1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
   2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
   3. Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Division 26 Section 260526 "Grounding and Bonding."

B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.10 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION 260543
SECTION 260553 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

B. In addition to signage listed in this spec; the E.C. shall provide all signage required by PPL Electric Utilities requirements.

1.2 SUMMARY

A. This Section includes the following:
   1. Identification for conductors and communication and control cable.
   2. Warning labels and signs.
   3. Instruction signs.
   4. Equipment identification labels.
   5. Miscellaneous identification products.

1.3 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

1.4 QUALITY ASSURANCE


B. Comply with NFPA 70.


1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.2 WARNING LABELS AND SIGNS


B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.

C. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.

D. Metal-Backed, Butyrate Warning Signs: 1/4-inch grommets in corners for mounting. Nominal size, 7 by 10 inches. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 10 by 14 inches.

E. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

2.3 EQUIPMENT IDENTIFICATION LABELS

B. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.4 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.
   2. Tensile Strength: 50 lb, minimum.
   3. Temperature Range: Minus 40 to plus 185 deg F.

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 APPLICATION

A. Accessible Raceways and Metal-Clad Cables More Than 600 V: Identify with "DANGER-HIGH VOLTAGE" in black letters at least 2 inches high, with snap-around labels. Repeat legend at 10-foot maximum intervals.

B. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, snap-around, color-coding bands:
   1. Fire Alarm System: Red.
   4. Mechanical and Electrical Supervisory System: Green and blue.
   5. Telecommunication System: Green and yellow.
   6. Control Wiring: Green and red.

C. Power-Circuit Conductor Identification: For primary and secondary conductors No. 1/0 AWG and larger in pull and junction boxes, manholes, and handholes use color-coding conductor tape. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.

D. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use color-coding conductor tape. Identify each ungrounded conductor according to source and circuit number.
   1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
   2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.

F. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceway.

G. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
   1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
      a. Power transfer switches.
      b. Controls with external control power connections.
   2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.

H. Instruction Signs:
   1. Operating Instructions: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
   2. Emergency Operating Instructions: Install instruction signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.

I. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
   1. Labeling Instructions:
      a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where 2 lines of text are required, use labels 2 inches high.
b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.

c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.

2. Equipment to Be Labeled:

a. Panelboards, electrical cabinets, and enclosures.
b. Access doors and panels for concealed electrical items.
c. Electrical switchgear and switchboards.
d. Transformers.
e. Emergency system boxes and enclosures.
f. Motor-control centers.
g. Disconnect switches.
h. Enclosed circuit breakers.
i. Motor starters.
j. Push-button stations.
k. Power transfer equipment.
l. Contactors.
m. Remote-controlled switches, dimmer modules, and control devices.
n. Battery racks.
o. Power-generating units.
p. Voice and data cable terminal equipment.
q. Monitoring and control equipment.
r. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.

3.2 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
F. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

G. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.

1. Color shall be factory applied or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.

2. Colors for 208/120-V Circuits:
   a. Phase A: Black.
   b. Phase B: Red.
   c. Phase C: Blue.

3. Colors for 480/277-V Circuits:
   b. Phase B: Orange.
   c. Phase C: Yellow.

4. Colors for 24VDC 2-wire ungrounded DC circuits:
   a. Supply: Red
   b. Return: Black
   c. Equipment Ground: Green

5. Colors for 24VDC 2-wire grounded DC Circuits:
   a. Supply: Red
   b. Grounded Return: White
   c. Equipment Ground: Green

6. Colors for 48VDC 2-wire ungrounded DC circuits:
   a. Supply: Blue
   b. Return: Brown
   c. Equipment Ground: Green

7. Colors for 48VDC 2-wire grounded DC Circuits:
   a. Supply: Blue
   b. Grounded Return: White
   c. Equipment Ground: Green

8. Colors for 125VDC 2-wire ungrounded DC circuits:
   a. Supply: Orange
b. Return: Gray
c. Equipment Ground: Green

9. Colors for 125VDC 2-wire grounded DC Circuits:
   a. Supply: Orange
   b. Grounded Return: White
   c. Equipment Ground: Green

10. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

H. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

I. Painted Identification: Prepare surface and apply paint according to Division 09 painting Sections.

END OF SECTION 260553
SECTION 260800 – INDEPENDENT ELECTRICAL TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes requirements for electrical field testing and inspecting. General requirements include the following:

1. Independent electrical testing agency shall be a direct subcontractor of the Prime Contractor. A subcontractor of the electrical contractor is not acceptable. NETA Accredited Companies bidding on this project shall provide qualifications and resume of successful testing of similar installations. The NETA Accredited Companies shall be qualified and as such provide qualified personnel on this project. The Project manager assigned to the winning bid for the NETA Accredited Company shall have extensive experience in relay and medium voltage work and be familiar with all testing means and methods.

2. Qualifications of testing agency and their personnel. Include resume of assigned relay technician to demonstrate extensive experience in programming and testing of relays shown on drawings E4.02.

3. Suitability of test equipment.


5. Coordination requirements for testing and inspecting.

6. Reporting requirements for testing and inspecting.

B. In addition to this testing; any additional testing required by the utility shall be part of the NETA testing firms Scope of Work.

1.2 DEFINITIONS


1.3 SUBMITTALS

A. Test Reports: Submit test report as specified in Part 3 – Execution.

1.4 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, and that is acceptable to authorities having jurisdiction.
1. The testing organization shall be an independent, third party entity which can function as an unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers of equipment or systems being evaluated.

2. The testing organization shall be regularly engaged in the testing of electrical equipment devices, installations, and systems.

3. The testing organization shall use technicians who are regularly employed for testing services.

4. An organization having a designation of “NETA Accredited Company” issued by the International Electrical Testing Association meets the above criteria.

5. The testing organization shall submit appropriate documentation to demonstrate that it satisfactorily complies with these requirements.

B. Testing Personnel

1. Technicians performing these electrical tests and inspections shall be trained and experienced concerning the apparatus and systems being evaluated. These individuals shall be capable of conducting the tests in a safe manner and with complete knowledge of the hazards involved. They must evaluate the test data and make a judgment on the serviceability of the specific equipment.

2. Technicians shall be certified in accordance with ANSI/NETA ETT-2000, Standard for Certification of Electrical Testing Personnel. Each on-site crew leader shall hold a current certification, Level III or higher, in electrical testing.

C. Test Equipment Suitability: Comply with NETA ATS, Section 5.2.

D. Test Equipment Calibration: Comply with NETA ATS, Section 5.3.

1.5 SCOPE OF TESTING

A. A third party testing agency shall test the following per the specifications in each section and industry standards with properly calibrated equipment. The third party testing agency shall be responsible for reports to be issued to the client/engineer.

1. 260526 - Grounding and Bonding system shall be tested per Section 7.13 - “Grounding Systems” per NETA “Acceptance Testing Specifications”-2009. Testing shall include but not be limited to:
   a. Point to point testing for all equipment to ground grid, each test well, and each piece of electrical equipment. Point to Point testing shall be for all new equipment and existing equipment (existing generators, existing outdoor electrical equipment, and existing fence).
   b. 3 point fall of potential test for multiple points from switchgear and ground grid minimum 100 points.

2. 260519 - Conductors and Cables shall be meggar tested per Section 7.3.2 - “Cables; Low Voltage, 600V maximum” of NETA “Acceptance Testing Specifications”-2009.
a. Control wiring 50 Volts or less shall not be required to be tested by the Independent testing contractor.

3. 260513 - Medium Voltage Cables shall be tested per Section 7.3.3 - “Cables; Medium and High Voltage” of NETA “Acceptance Testing Specifications”-2009.
   a. Include 15kV and 5kV cables.

4. 261219 Pad Mounted Liquid Filled Transformers shall be tested per Section 7.2.2 - “Liquid Filled Transformers” of NETA “Acceptance Testing Specifications”-2009. This shall include oil samples for a starting base line.

5. 261300 – Medium Voltage Switchgear. Existing Switchgear Section that is being modified shall be tested using all applicable tests to the standard per NETA “Acceptance Testing Specifications”-2009 including but not limited to:
   a. Section 7.1: Switchgear and Switchboard Assemblies.
   b. Section 7.6.1.3: Circuit Breakers; Air Medium Voltage.
   c. Section 7.10: Instrument Transformers.
   d. Include all Relay testing and calibration per the coordination study. Relays shall be field calibrated and tested to NETA “Acceptance Testing Specifications” Section 7.9. The relays shall be tested with Omicron or similar test unit to the settings provided in the coordination study. Note: Relays shall be completely field/bench programmed by Independent Testing Firm; i.e. – Engineer will not provide relays settings files in the software version of that particular relay. Independent testing agent shall write any custom equations required for relay to function with Engineers scope of work. Relays shall include all functional and loop checks including lockouts, etc.

6. Metering; calibrate and program customer metering; set up waveform capture and communications outputs.

7. Set all overloads, circuit breakers, and fusing and calibrate vfd’s per coordination study.

8. 262416 - Panelboards shall be tested using all applicable tests per NETA “Acceptance Testing Specifications”-2009.
   a. Section 7.1: Switchgear and Switchboard Assemblies. Meggar bus of panels only.
   b. Section 7.6.1.1: Circuit Breakers; Air Insulated-Case/Molded Case. Primary current injection is not required.

9. 262419 – Motor Control Center shall be tested using all applicable tests per NETA “Acceptance Testing Specifications” – 2009
   a. Section 7.16.1.1: Motor control Centers- Low Voltage.

10. 262213 - Dry Type Transformers shall be tested using all applicable tests per Section 7.2.1.1 NETA “Acceptance Testing Specifications”-2009.
PART 3 - EXECUTION

3.1 TESTS AND INSPECTION

A. Independent NETA testing agency shall provide all labor, materials, and lifts, etc. as required to perform testing. NETA testing firm will have the ability to utilize construction power for testing; however will be required to provide any spider boxes, DC power sources, and extension cables and labor for hookup to temporary sources.

B. Upon successful bid the NETA Testing agency shall provide dedicated project manager and collaborate with Engineer and EC to provide a testing schedule. Project Manager shall be required to attend all meetings as required by engineer at no additional costs to project.

C. Test and Inspection Reports: Provide a written report for the following:
   1. Manufacturer’s written testing and inspecting instructions.
   2. Calibration and adjustment settings of adjustable and interchangeable devices involved in tests.
   3. Tabulation of expected measurement results made before measurements.
   4. Tabulation of “as-found” and “as-left” measurement and observation results.
   5. Electrical tests: Refer to each section listed above for required tests.
   6. Provide calibration certificates for each piece of test equipment used.
   7. Comply with NETA ATS Section 5.4.
   8. Label each piece of Equipment with test sticker including date of test.
   9. Install Arc Flash labels as provided by Electrical Engineer.
  10. Maintain a set of red line drawings with any field changes. Submit to Engineer upon completion of testing; with noted changes that remain.
  11. Complete all paperwork required by utility.

D. Re-Test: Correct deficiencies identified by tests and observations and completely retest failed components or equipment. Verify by the system tests that the total assembly meets the specified requirements.

3.2 SITE SUPPORT

A. Provide two days additional site assistance manpower and testing equipment during commissioning and initial start up to assist in troubleshooting and verifications of wiring. Break out in bid.

END OF SECTION 260800
SECTION 261219 – PAD MOUNTED LIQUID FILLED TRANSFORMERS

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. This Section includes the installation of the following types of pre-purchased transformers with medium voltage primaries:
   1. Pad-mounted, liquid-filled transformers.

B. This equipment will be furnished by others. It is the E.C.’s responsibility to receive, store, protect, rig, set in place, and make all final connections to this equipment prior to start-up.

C. Refer to Division 26 Section 260000 “Electrical Summary & Scope of Work”.

1.3 DEFINITIONS


1.4 SUBMITTALS

A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, location of each field connection, and performance for each type and size of transformer indicated.
   1. Weight and dimension shop drawings showing locations of conduit stub-ups are due two weeks after receiving a P.O.

B. Shop Drawings: Diagram power and control.

C. Coordination Drawings: Floor plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
   1. Underground primary and secondary conduit stub-up location.
   2. Dimensioned concrete base, outline of transformer, and required clearances.
   3. Ground grid and grounding cable locations.
D. Manufacturer Seismic Qualification Certification: Submit certification that transformer assembly and components will withstand seismic forces defined in Division 26 Section 26 05 48 "Electrical Supports and Seismic Restraints." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Qualification Data: For testing agency.

F. Source quality-control test reports.

G. Follow-up service reports.

H. Operation and Maintenance Data: For transformer and accessories to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent testing 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. Comply with IEEE C2.


D. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

A. Service Conditions: IEEE C37.121, usual service conditions with the exception of ambient temperature.

B. Environmental Limitations: Rate equipment for continuous operation at indicated ampere ratings at project location (Ewing, NJ) for the following conditions:
1. Average Low at project location
2. Record Low at project location
3. Average High at project location
4. Record High at project location
5. Altitude above sea level specific to project location
6. Seismic Requirements specific to project location

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

B. Coordinate installation of louvers, doors, spill retention areas, and sumps. Coordinate installation so no piping or conduits are installed in space allocated for medium-voltage transformers except those directly associated with transformers.

1.8 DELIVERY DATE

A. Delivery of the transformer(s) shall be by the contractor. Delivery to site shall be no later than date specified by owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Asea Brown Boveri (ABB)
   2. Cooper Industries; Cooper Power Systems Division.
   3. Approved equal.

2.2 PAD-MOUNTED, LIQUID-FILLED TRANSFORMER 1


B. Insulation Temperature Rise: 55/65 deg C when operated at rated kVA output in a 30 deg C ambient temperature. Transformer shall be rated to operate at rated kilovolt ampere in an average ambient temperature of 30 deg C over 24 hours with a maximum ambient temperature of 40 deg C without loss of service life expectancy.
C. Full-Capacity Voltage Taps: Four 2.5 percent taps, 2 above and 2 below rated high voltage; with externally operable tap changer for de-energized use and with position indicator and padlock hasp.

D. High-Voltage (primary) Terminations and Equipment: 200A Load Break inserts with feed through for lightning arrestors. Provide parking stand for each bushing well.

E. Accessories:
   1. Drain Valve: 1 inch (25 mm), with sampling device.
   2. Dial-type thermometer. Provide alarm contacts.
   3. Liquid-level gauge with alarm contacts.
   4. Pressure-vacuum gauge with alarm contacts.
   5. Pressure Relief Device: Self-sealing with an alarm contact.

F. Low-Voltage (secondary) Terminations and Equipment:
   1. Provide NEMA spade terminals on secondary side of transformer with enough holes to terminate the required number of parallel conductors per phase as indicated on drawing “Electrical Single-Line Diagram.”
      a. Spade bushings to accommodate LV conductor termination as indicated on 1-line
      b. Spade Supports

2.3 PAD-MOUNTED, LIQUID-FILLED TRANSFORMER

A. Ratings: The ratings of the transformers shall be as follows:
   1. Transformers Qty 1
      a. kVA Rating: 1500/1680kVA at a 55/65 deg C rise winding temperature
      b. Impedance: 5.75%
      c. HV: 4,160V DELTA
      d. HV BIL: 60kV
      e. HV De-energized Taps: +/- 2 - 2-1/2% full capacity
      f. LV: 480/277V WYE with X0 bushing
      g. LV BIL: 30kV
      h. Frequency: 60Hz
      i. Windings: Aluminum
      j. Provide with DOE 2010 Efficiency Standards
      k. Step down Application
      l. Bayonet with integral cartridge fuse x 3
m. Parallel oil-immersed partial range current limiting fuse x 6
n. 2-position 300 amp LBOR transformer switch
o. (3) 10kV lightning arrestors
p. UL listed
q. FM approved fluid shall be equal to Cooper Envirotex® FR3 fluid or ABB Biotemp (natural ester) (less flammable, bio-degradeable).

2. Transformers Qty 1
   a. kVA Rating: 1000/1120kVA at a 55/65 deg C rise winding temperature
   b. Impedance: 5.75%
   c. HV: 4,160V DELTA
   d. HV BIL: 60kV
   e. HV De-energized Taps: +/- 2 - 2-1/2% full capacity
   f. LV: 480/277V WYE with X0 bushing
   g. LV BIL: 30kV
   h. Frequency: 60Hz
   i. Windings: Aluminum
   j. Provide with DOE 2010 Efficiency Standards
   k. Step down Application
   l. Bayonet with integral cartridge fuse x 3
   m. Parallel oil-immersed partial range current limiting fuse x 6
   n. 2-position 300 amp LBOR transformer switch
   o. UL listed
   p. FM approved fluid shall be equal to Cooper Envirotex® FR3 fluid or ABB Biotemp (natural ester) (less flammable, bio-degradeable).


C. Insulation Temperature Rise: 55/65 deg C when operated at rated kVA output in a 30 deg C ambient temperature. Transformer shall be rated to operate at rated kilovolt ampere in an average ambient temperature of 30 deg C over 24 hours with a maximum ambient temperature of 40 deg C without loss of service life expectancy.

D. Full-Capacity Voltage Taps: Four 2.5 percent taps, 2 above and 2 below rated high voltage; with externally operable tap changer for de-energized use and with position indicator and padlock hasp.

E. High-Voltage (primary) Terminations and Equipment: 200A Load Break inserts. Provide parking stand for each bushing well.
F. Accessories:
   1. Drain Valve: 1 inch (25 mm), with sampling device.
   2. Liquid-level gauge with alarm contacts.
   3. Pressure Relief Device: Self-sealing with an alarm contact.

G. Low-Voltage (secondary) Terminations and Equipment:
   1. Provide NEMA spade terminals on secondary side of transformer with enough holes to
terminate the required number of parallel conductors per phase as indicated on drawing
   “Electrical Single-Line Diagram.”
      a. Spade bushings to accommodate LV terminations as indicated on 1-line
      b. Spade Supports

2.4 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each transformer, mounted
   with corrosion-resistant screws. Nameplates and label products are specified in Division 16
   Section "Electrical Identification."

2.5 SOURCE QUALITY CONTROL

A. Factory Tests: Perform design and routine tests according to standards specified for
   components. Conduct transformer tests according to IEEE C57.12.90.

B. Factory Tests: Perform the following factory-certified tests on each transformer:
   1. Resistance measurements of all windings on rated-voltage connection and on tap extreme
      connections.
   2. Ratios on rated-voltage connection and on tap extreme connections.
   4. No-load loss at rated voltage on rated-voltage connection.
   5. Excitation current at rated voltage on rated-voltage connection.
   7. Induced potential.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for medium-voltage
   transformers.
B. Examine roughing-in of conduits and grounding systems to verify the following:
   1. Wiring entries comply with layout requirements.
   2. Entries are within conduit-entry tolerances specified by manufacturer and no feeders will have to cross section barriers to reach load or line lugs.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and that requirements in Division 26 Section 26 05 26 "Grounding and Bonding" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install transformers on concrete bases.
   1. Anchor transformers to concrete bases according to manufacturer's written instructions, seismic codes at project location, and requirements in Division 26 Section 26 05 29 "Electrical Supports and Seismic Restraints."
   2. Concrete bases are constructed by contractor
   3. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   4. Tack-weld or bolt transformers to channel-iron sills embedded in concrete bases. Install sills level and grout flush with floor or base.

B. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.

3.3 IDENTIFICATION

A. Identify field-installed wiring and components and provide warning signs as specified in Division 26 Section 26 05 53 “Electrical Identification.”

3.4 CONNECTIONS

A. Ground equipment according to Division 26 Section 26 05 26 "Grounding and Bonding."

B. Connect wiring according to Division 26 Section 26 05 19 "Conductors and Cables."
3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect and adjust field-assembled components and equipment installation, including connections. Report results in writing.

B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
   1. After installing transformers but before primary is energized, verify that grounding system at substation is tested at specified value or less.
   2. After installing transformers and after electrical circuitry has been energized, test for compliance with requirements.
   3. Perform visual and mechanical inspection and electrical test stated in NETA ATS 7.2.2. Certify compliance with test parameters.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

D. Test Reports: Prepare written reports 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 actions taken to achieve compliance with requirements.

3.6 INSPECTION

A. All equipment furnished shall be subject to Owner's inspection. Owner shall be notified at least three (3) calendar weeks in advance of date equipment is ready for shipment.

3.7 SHIPMENT

A. All equipment shall be suitably crated and protected for handling and shipment to the job site. Each shipping section shall be equipped with lifting lugs. Size of shipping section shall be given on approved drawings.

B. Impact recorders shall be included in all shipments involving power transformers. For rail shipment, one (1) impact recorder shall be provided and shall be mounted to record in the direction of greatest probable impact. For truck shipment, two (2) impact recorders shall be provided. One (1) shall be mounted to measure impacts in the vertical direction and one (1) shall be mounted to record in the direction of greatest probable impact in the horizontal direction.
C. Any accessories or components, which will be shipped separately, shall be listed by the manufacturer as to the contents of the package. Any such accessories, which would be damaged by exposure to the weather, shall be shipped in weatherproof packages or, if not weatherproof packages, shall be clearly marked, "Store Out Of the Weather".

3.8 EQUIPMENT MANUFACTURER'S FIELD SUPERVISION

A. Manufacturer shall include a separate cost for field engineering services as described below:

1. General Requirements:
   a. The services of the manufacturer's qualified field engineer are required to supervise, in the future, critical phases of installation; inspect, check, adjust, test and operate the equipment just prior to and/or at the time the equipment is energized and placed in service and to instruct Owner's authorized personnel in the safe and proper operation and maintenance of the equipment prior to final acceptance by the Owner or Owner's duly authorized representative.
   b. Specific Requirements: The services of the manufacturer's qualified engineer shall be required specifically for, but not necessarily limited to, the following:
      1) Those inspections, checks, adjustments, tests, operations, etc., normally recommended and conducted by the equipment manufacturer.
      2) Necessary additional work recommended by the equipment manufacturer.
      3) Tests as required by the Owner.
      4) Instruction as required by the Owner.

3.9 OWNER ACCEPTANCE

A. The Owner's acceptance of this equipment shall be contingent upon the equipment satisfactorily meeting the specifications and tests stipulated herein, satisfactory start up, the Owner's final instructions and delivery of the required instruction books.

END OF SECTION 261219
SECTION 261300 - MEDIUM-VOLTAGE SWITCHGEAR

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. This Section includes modifications to existing metal-clad, circuit-breaker switchgear with the following optional components, features, and accessories:
   1. Analog instruments.
   2. Relays.
   3. Control battery system.
   4. Mimic bus.

1.3 DEFINITIONS


B. GFCI: Ground-Fault Circuit Interrupter.

1.4 SUBMITTALS

A. Product Data: For each type of switchgear and related equipment, include the following:
   1. Rated capacities, operating characteristics, furnished specialties, and accessories for individual circuit breakers.
   2. Time-current characteristic curves for overcurrent protective devices, including circuit-breaker relay trip devices.

B. Shop Drawings: For each type of switchgear and related equipment, include the following:
   1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show method of field assembly and location and size of each field connection. Include the following:
      a. Tabulation of installed devices with features and ratings.
      b. Outline and general arrangement drawing showing dimensions, shipping sections, and weights of each assembled section.
      c. Drawing of cable termination compartments showing preferred locations for conduits and indicating space available for cable terminations.
d. Floor plan drawing showing locations for anchor bolts and leveling channels.
e. Current ratings of buses.
f. Short-time and short-circuit ratings of switchgear assembly.
g. Nameplate legends.
h. Mimic-bus diagram.

2. Wiring Diagrams: For each type of switchgear and related equipment, include the following:
   a. Power, signal, and control wiring.
   b. Three-line diagrams of current and future secondary circuits showing device terminal numbers and internal diagrams.
   c. Schematic control diagrams.
   d. Diagrams showing connections of component devices and equipment.
   e. Schematic diagrams showing connections to remote devices.

C. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around switchgear where piping and ducts are prohibited. Show switchgear layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Identify field measurements.

D. Samples: Representative portion of mimic bus with specified finish. Manufacturer's color charts showing colors available for mimic bus.

E. Qualification Data: For testing agency.

F. Source quality-control test reports.

G. Field quality-control test reports.

H. Operation and Maintenance Data: For switchgear and switchgear components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
   1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
   2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.5 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. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of switchgear and are based on the specific system indicated.

D. 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.

E. Comply with IEEE C2.

F. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchgear, including clearances between switchgear and adjacent surfaces and other items. Comply with indicated maximum dimensions.

G. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Construction Manager and Owner no fewer than two days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Construction Manager's and/or Owner's written permission.

1.6 COORDINATION

A. Coordinate layout and installation of switchgear and components with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required clearances for workspace and equipment access doors and panels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified or equivalent.
2.2 COMPONENTS

   1. Potential Transformers: Secondary voltage rating of 120 V and NEMA accuracy class of 0.3 with burdens of W, X, and Y.
   2. Current Transformers: Burden and accuracy class suitable for connected relays, meters, and instruments.

B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems, listed and labeled by an NRTL, and with the following features:
   1. Inputs from sensors or 5-A current-transformer secondaries, and potential terminals rated to 600 V.
   2. Switch-selectable digital display with the following features:
      a. Phase Currents, Each Phase: Plus or minus 1 percent.
      b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
      c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
      d. Three-Phase Real Power: Plus or minus 2 percent.
      e. Three-Phase Reactive Power: Plus or minus 2 percent.
      f. Power Factor: Plus or minus 2 percent.
      g. Frequency: Plus or minus 0.5 percent.
      h. Integrated Demand, with Demand Interval Selectable from 5 to 60 Minutes: Plus or minus 2 percent.
      i. Accumulated energy, in megawatt hours, plus or minus 2 percent; stored values unaffected by power outages for up to 72 hours.
   3. Communications module suitable for monitoring of meter quantities and functions. Interface communication and metering requirements according to Section 260913 "Electrical Power Monitoring and Control."
   4. Mounting: Display and control unit that is flush or semiflush mounted in instrument compartment door.

C. Relays: Comply with IEEE C37.90, integrated digital type; with test blocks and plugs.

D. Control Power Supply: Wire to Existing Control Power Supply matching existing Charge/Trip/Close scheme.

E. Control Wiring: Field installed by switchgear manufacturer, complete with bundling, lacing, and protection; and complying with the following:
   1. Flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.
   2. Conductors sized according to NFPA 70 for duty required.
2.3 IDENTIFICATION

A. Materials: Refer to Section 260553 "Identification for Electrical Systems." Identify units, devices, controls, and wiring.

B. Mimic Bus: Continuous mimic bus applied to front of switchgear, arranged in single-line diagram format, using symbols and lettered designations consistent with approved final mimic-bus diagram.

1. Mimic-bus segments coordinated with devices in switchgear sections to which applied, to produce a concise visual presentation of principal switchgear components and connections.
2. Medium: Painted graphics, as approved.
3. Color: Contrasting with factory-finish background; selected by Owner.

2.4 SOURCE QUALITY CONTROL

A. Prepare equipment for shipment.

1. Provide suitable crating, blocking, and supports so equipment will withstand expected domestic shipping and handling shocks and vibration.
2. Weatherproof equipment for shipment. Close connection openings to prevent entrance of foreign material during shipment and storage.

PART 3 - EXECUTION

3.1 EXAMINATION

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Section 260553 "Identification for Electrical Systems."

B. Diagram and Instructions:

1. Frame under clear acrylic plastic on front of switchgear.
   a. Operating Instructions: Update existing printed basic instructions for switchgear, including control and key-interlock sequences and emergency procedures.
   b. System Power Riser Diagrams: Depict power sources, feeders, distribution components, and major loads.

3.3 CONNECTIONS

A. Cable terminations at switchgear are specified in Section 260513 "Medium-Voltage Cables."
B. Tighten bus joints, electrical connectors, and terminals according to manufacturer's published torque-tightening values.

C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260513 "Medium-Voltage Cables."

3.4 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:
   1. Test insulation resistance for each switchgear bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:
   1. Inspect switchgear, wiring, components, connections, and equipment installation. Test and adjust components and equipment.
   2. Assist in field testing of equipment including pretesting and adjusting of automatic power factor correction units.

C. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

D. Perform the following field tests and inspections and prepare test reports:
   1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS for the existing switchgear section that is being modified. Certify compliance with test parameters. Perform NETA tests and inspections for each of the following NETA categories:
      a. Switchgear.
      b. Circuit breakers.
      c. Protective relays.
      d. Instrument transformers.
      e. Metering and instrumentation.
      f. Ground-fault systems.
      g. Battery systems.
      h. Surge arresters.
      i. Capacitors.
2. Functional tests of all new relays, instruments, meters, and control devices by application of secondary three-phase voltage to voltage circuits and injection of current in current transformer secondary circuits.

3. Functional test of all control and trip circuits connected to new switchgear components. Connect test devices into circuits to simulate operation of controlled remote equipment such as circuit-breaker trip coils, close coils, and auxiliary contacts. Test proper operation of relay targets.

E. Remove and replace malfunctioning units and retest as specified above.

F. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform infrared scan of each switchgear. Remove front and rear panels so joints and connections are accessible to portable scanner.

1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchgear 11 months after date of Substantial Completion.
2. Instrument: Use an infrared-scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
3. Record of Infrared Scanning: Prepare a certified report that identifies switchgear checked and that describes infrared-scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Set field-adjustable, protective-relay trip characteristics

3.6 CLEANING

A. On completion of installation, inspect interior and exterior of switchgear. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair damaged finishes.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchgear.

END OF SECTION 261300
SECTION 262213 – DRY TYPE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 125 kVA.
   1. Distribution transformers.

1.3 SUBMITTALS

A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Technical certification sheets.
   3. Conduit entry/ext locations.
   4. Transformer ratings, including:
      a. Voltage ratings: Primary and Secondary
      b. Continuous current ratings: Primary and Secondary.
      c. Basic Impulse Level for windings over 600V.
      d. Continuous kVA rating.
      e. Impedance (at rated kVA).

C. Qualification Data: For testing agency.

D. Source quality-control test reports.

E. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.
1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each transformer type through one source from a single manufacturer.

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 IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:

1. Ambient Temperature: Not exceeding 104 deg F (40 deg C).

B. Seismic Requirements: Seismic Zone for Project Location.

1.7 COORDINATION

A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases.

B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

2. Siemens Energy & Automation, Inc.
3. Square D; Schneider Electric.

2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Cores: High grade Grain-oriented, non-aging silicon steel with high magnetic permeability, and low hysteresis and eddy-current losses. Maximum magnetic flux densities shall be substantially below the saturation point. The transformer core volume shall allow efficient transformer operation at 10% above the highest tap voltage. The core laminations shall be tightly clamped and compressed.

C. Coils: Continuous windings without splices except for taps.
   1. Internal Coil Connections: Brazed or pressure type.
   2. Coil Material: Aluminum.

D. Transformers shall be designed for continuous operation at rated kVA for 24-hours-a-day, 365 days-a-year operation, with normal life expectancy as defined in ANSI C57.96.

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NEMA ST 20, and list and label as complying with UL 1561.

B. Cores: One leg per phase.

C. Enclosure: Ventilated, NEMA 250, Type 2.
   1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
   2. Enclosure shall be made of heavy-gauge steel. All transformers shall be equipped with a wiring compartment suitable for conduit entry, and large enough to allow convenient wiring. The maximum temperature of the enclosure shall not exceed 90 degrees C at rated transformer output and maximum ambient conditions. The core of the transformer shall be grounded to the enclosure.
   3. Transformers installed outdoors shall be manufactured with a NEMA 250, type 3R enclosure.

D. Transformer Enclosure Finish: Comply with NEMA 250.
   1. Finish Color: ANSI 61 gray weather resistant enamel.

E. Taps for Transformers: Two 2.5 percent taps above and four 2.5 percent taps below normal full capacity.

F. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature.
G. Energy Efficiency for Transformers Rated 15 kVA and Larger:
   1. Complying with NEMA TP 1, Class 1 efficiency levels.
   2. Tested according to NEMA TP 2.

H. Electrostatic Shielding: Each winding shall have an independent, single, full-width copper
   electrostatic shield arranged to minimize interwinding capacitance.
   1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and
      output terminals.
   2. Include special terminal for grounding the shield.
   3. Shield Effectiveness:
      a. Capacitance between Primary and Secondary Windings: Not to exceed 33
         picofarads over a frequency range of 20 Hz to 1 MHz.
      b. Common-Mode Noise Attenuation: Minimum of minus 120 dBA at 0.5 to 1.5
         kHz; minimum of minus 65 dBA at 1.5 to 100 kHz.
      c. Normal-Mode Noise Attenuation: Minimum of minus 52 dBA at 1.5 to 10 kHz.

I. Wall Brackets: Manufacturer's standard brackets.

J. Low-Sound-Level Requirements: Maximum sound levels, when factory tested according to
   IEEE C57.12.91.

2.4 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution transformer,
   mounted with corrosion-resistant screws. Nameplates and label products are specified in
   Division 26 Section 260553 "Electrical Identification."

2.5 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.91.

B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for
   each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by
   NFPA 70 and manufacturer's written instructions.
C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in Division 26 Section 260526 "Grounding and Bonding" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. All transformers shall be installed per the manufacturer’s recommendations, Seismic requirements for project location and the contract documents.

B. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.

C. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions.

D. Floor mounted transformers below 100kVA shall be mounted on double deflection neoprene isolation mounts with 0.50 inch deflection, similar to Mason Industries type ND.

3.3 CONNECTIONS

A. Ground equipment according to Division 26 Section 260526 "Grounding and Bonding."

B. Connect wiring according to Division 26 Section 260519 "Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Tests and Inspections:
   1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification section 7.2.1.1. Certify compliance with test parameters.

C. Remove and replace units that do not pass tests or inspections and retest as specified above.

D. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.
3.5 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 262213
SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary
      Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY
   A. This Section includes the following equipment:
      1. Distribution panelboards.
      2. Lighting and appliance branch-circuit panelboards.
      3. Load centers.
      4. Transient voltage suppression panelboards.

1.3 DEFINITIONS
   A. EMI: Electromagnetic interference.
   B. GFCI: Ground-fault circuit interrupter.
   C. RFI: Radio-frequency interference.
   D. RMS: Root mean square.
   E. SPDT: Single pole, double throw.

1.4 SUBMITTALS
   A. Product Data: For each type of panelboard, overcurrent protective device, transient voltage
      suppression device, accessory, and component indicated. Include dimensions and
      manufacturers' technical data on features, performance, electrical characteristics, ratings, and
      finishes.
   B. Shop Drawings: For each panelboard and related equipment.
      1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed
         devices, equipment features, and ratings. Include the following:
         a. Enclosure types and details for types other than NEMA 250, Type 1.
b. Bus configuration, current, and voltage ratings.
c. Short-circuit current rating of panelboards and overcurrent protective devices.
d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

2. Wiring Diagrams: Power, signal, and control wiring.

C. Qualification Data: For testing agency.

D. Field quality-control test reports including the following:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

E. Panelboard Schedules: For installation in panelboards.

F. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals, include the following:
   1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
   2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.5 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. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories through one source from a single manufacturer.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of panelboards and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

D. 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.
E. Comply with NEMA PB 1.

F. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
   1. Ambient Temperature: Not exceeding 104 deg F (40 deg C).

B. Seismic Requirements: Seismic Zone for Project Location.

1.7 COORDINATION

A. 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, and encumbrances to workspace clearance requirements.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Keys: Six spares for each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:
      a. Eaton Corporation; Cutler-Hammer Products.
      b. Siemens Energy & Automation, Inc.
      c. Square D.
      d. GE Industrial Systems.
   2. Transient Voltage Suppression Panelboards:
b. Liebert Corporation.
c. APD
d. Eaton Corporation; Cutler-Hammer Products.
e. Square D

2.2 MANUFACTURED UNITS

A. Enclosures: Surface-mounted cabinets.
   1. Rated for environmental conditions at installed location.
      a. Indoor Dry and Clean Locations: NEMA Type 1.
      b. Outdoor Locations: NEMA Type 3R.
   2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
   3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
   4. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
   5. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.

B. Phase and Ground Buses:
   2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.

C. Conductor Connectors: Suitable for use with conductor material.
   1. Main and Neutral Lugs: Compression type.
   2. Ground Lugs and Bus Configured Terminators: Compression type.
   3. Feed-Through Lugs: Mechanical type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

D. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect switches.

E. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.
2.3 PANELBOARD SHORT-CIRCUIT RATING

A. Fully rated to interrupt symmetrical short-circuit current available at terminals unless otherwise noted on drawings the following ratings shall be used.


2.4 DISTRIBUTION PANELBOARDS

A. Doors: Secured with vault-type latch with tumbler lock; keyed alike. Omit for fused-switch panelboards.

B. Main Overcurrent Protective Devices: Circuit breaker.

C. Branch Overcurrent Protective Devices:

1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
2. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

D. For each distribution panelboard provide integral TVSS unit or unit mounted adjacent to panel in a NEMA I enclosure with an overall circuit length of a maximum of 10'-0".

2.5 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Branch Overcurrent Protective Devices Bolt-on circuit breakers, replaceable without disturbing adjacent units.

B. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.6 LOAD CENTERS


B. Conductor Connectors: Mechanical type for main, neutral, and ground lugs and buses.

2.7 PANELBOARD SUPPRESSORS

A. Surge Protection Device Description: Modular design with field-replaceable modules, sign-wave-tracking type with the following features and accessories:

1. Fabrication using bolted compression lugs for internal wiring.
2. Integral disconnect switch.
3. Redundant suppression circuits.
4. Redundant replaceable modules.
5. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
6. LED indicator lights for power and protection status.
7. Audible alarm, with silencing switch, to indicate when protection has failed.
8. One set of dry contacts rated at 5 A and 250-V, ac, for remote monitoring of protection status. Coordinate with building power monitoring and control system.
9. Surge-event operations counter.

B. Peak Single-Impulse Surge Current Rating 120 kA per phase.

C. Protection modes and UL 1449 SVR for grounded wye circuits with voltages of 480Y/277, 3-phase, 4-wire circuits shall be as follows:
1. Line to Neutral: 800 V for 480Y/277.
2. Line to Ground: 800 V for 480Y/277.

2.8 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker: UL 489, with interrupting capacity to meet available fault currents.
2. Electronic trip-unit circuit breakers shall have RMS sensing; field-replaceable rating plug; and with the following field-adjustable settings:
   a. Instantaneous trip.
   b. Long- and short-time pickup levels.
   c. Long- and short-time time adjustments.

B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
1. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1 and Seismic requirements for project location.

B. Mount top of trim 74 inches (1880 mm) above finished floor, unless otherwise indicated.

C. Mount plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.

D. Install overcurrent protective devices and controllers.
   1. Set field-adjustable switches and circuit-breaker trip ranges.

E. Install filler plates in unused spaces.

F. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section 260553 "Electrical Identification."

B. Create a directory to indicate installed circuit loads. Obtain approval before installing. Use a computer to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.3 CONNECTIONS

A. Ground equipment according to Division 26 Section 260526 "Grounding and Bonding."

B. Connect wiring according to Division 26 Section 260519 "Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:
   1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.
B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

C. Perform the following field tests and inspections and prepare test reports:
   1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. 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.

3.5 CLEANING

A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 262416
SECTION 26 24 19 - MOTOR-CONTROL CENTERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A Refer to Single Line Diagram; E-402.

1.2 SUMMARY

A This Section includes the provision of a motor-control center (MCC) for use on ac circuits rated 600 V and less and all required control devices shown on the contract documents and specified to be part of the MCC equipment. The MCC shall be 480V, 3-phase, 3-wire, 60 Hz.

1.3 SUBMITTALS

A Product Data: For each type of controller and each type of motor-control center. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.

B Shop Drawings: For each motor-control center.

   1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:

      a. Each installed unit's type and details.
      b. Nameplate legends.
      c. Short-circuit current ratings of buses and installed units.
      d. Vertical and horizontal bus capacities.
      e. UL listing for series rating of overcurrent protective devices in combination controllers.
      f. Features, characteristics, ratings, and factory settings of each motor-control center unit.

   2. Wiring Diagrams: Power, signal, and control wiring for class and type of motor-control center. Provide schematic wiring diagram for each type of controller.

C Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around motor-control centers where pipe and ducts are prohibited. Show motor-control center layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

D Qualification Data: For manufacturer.
E Field quality-control test reports.

F Operation and Maintenance Data: Provide for motor-control centers, all installed devices, and components to include in emergency, operation, and maintenance manuals.
   1. Routine maintenance requirements for motor-control centers and all installed components.
   2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

G Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

H Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that dip switch settings for motor running overload protection suit actual motor to be protected.

1.4 QUALITY ASSURANCE

A Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles (160 km) of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.

B 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.

C Source Limitations: Obtain motor-control centers and controllers of a single type through one source from a single manufacturer.

D 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.

E Comply with NFPA 70.

F MCC shall conform to:
   1. UL845, current revision, apply labeling to switchgear.
   2. CSA
   3. EEMAC
   4. NEMA ICS-2

G MCC shall be manufactured in an ISO 9001 certified facility.
H Product Selection for Restricted Space: Drawings indicate maximum dimensions for motor-control centers, including clearances between motor-control centers, and for adjacent surfaces and other items. Comply with indicated maximum dimensions and clearances.

1.5 DELIVERY, STORAGE, AND HANDLING

A Deliver motor-control centers in shipping splits of lengths that can be moved past obstructions in delivery path as indicated.

B Handle motor-control centers according to the following:
   1. NEMA ICS 2.3, "Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers Rated Not More Than 600 Volts."
   2. NECA 402, "Recommended Practice for Installing and Maintaining Motor Control Centers."

1.6 COORDINATION

A Coordinate layout and installation of motor-control centers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B Coordinate features of motor-control centers, installed units, and accessory devices with pilot devices and control circuits to which they connect.

C Coordinate features, accessories, and functions of each motor-control center, each controller, and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

1.7 EXTRA MATERIALS

A Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Spare Fuses: Furnish one spare for every five installed, but no fewer than one set of three of each type and rating.
   2. Indicating Lights: Two of each type installed.

1.8 WARRANTY

A MCC shall be warranted to be free from defects in materials and workmanship for a period of eighteen (18) months from date of final acceptance by owner.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Allen Bradley/Rockwell
2. G.E. Evolution
3. Square D.
5. Or Equivalent.

2.2 MOTOR-CONTROL CENTERS

A Wiring: NEMA ICS 3, Class I, Type A.

B Enclosures:

1. NEMA 1.

C Steel material shall comply with UL845 requirements

D Each MCC shall consist of one or more vertical sections of heavy gauge steel bolted together to form a rigid, free-standing assembly. A removable 7 gauge structural steel lifting angle shall be mounted full width of the MCC lineup at the top. Removable 7 gauge bottom channel sills shall be mounted underneath front and rear of the vertical sections extending the full width of the lineup. Vertical sections made of welded side-frame assembly formed from a minimum of 12 gauge steel. Internal reinforcement structural parts shall be of 12 and 14 gauge steel to provide a strong, rigid assembly. The entire assembly shall be constructed and packaged to withstand normal stresses included in transit and during installation.

E MCC Finish

1. All steel parts shall be provided with UL listed acrylic/alkyd baked enamel paint finish, except plated parts used for ground connections. All painted parts shall undergo a multi-stage treatment process, followed by the finishing paint coat.
2. Pre-treatment shall include:
   a. Hot alkaline cleaner to remove grease and oil.
   b. Iron phosphate treatment to improve adhesion and corrosion resistance.
3. The paint shall be applied using an electro-deposition process to ensure a uniform paint coat with high adhesion.
4. The standard paint finish shall be tested to UL 50 per ASTM B117 (5% ASTM Salt Spray) with no greater than 0.125 in loss of paint from a scribed line.
5. Paint color shall be #49 medium light gray per ANSI standard Z55.1-967 (60-70 gloss) on all surfaces unless specified otherwise. Control station plates and escutcheon plates shall be a contrasting gray.
F   Structures

1. Structures shall be totally enclosed, dead-front, free-standing assemblies. Structures shall be capable of being bolted together to form a single assembly.
2. The overall height of the MCC shall not exceed 90 in. Base channels, of 1.5 in. in height, and lifting angles, of 3 in. in height, shall be removable. The total width of one section shall be 24 inches or less.
3. Structures shall be NEMA/EEMAC type 1.
4. Each standard section shall have all the necessary hardware and bussing for modular plug-in units to be added and moved around. All unused space shall be covered by hinged blank doors and equipped to accept future units. Vertical bus openings shall be covered by automatic bus shutters.
5. Each section shall include a top plate.

G   Wireways

1. Structures shall contain a minimum 12 in high horizontal wireway at the top of each section and a minimum 6 in high horizontal wireway at the bottom of each section. These wireways shall run the full length of MCC to allow room for power and control cable to connect between units in different sections.
2. A full-depth vertical wireway shall be provided in each MCC section that accepts modular plug-in units. The vertical wireway shall connect with both the top and bottom horizontal wireway. The vertical wireway shall be 4 in wide minimum with a separate hinged door. There should be a minimum of 4,000 in³ of cabling space available. Access to the wireways shall not require opening control unit doors. Structures that house a single, full section control unit are not required to have vertical wireways. Those control units must open directly into the MCC horizontal wireways.

H   Barriers

1. All power bussing and splice connections shall be isolated from the unit compartments and the wireways. The horizontal bus shall be mounted onto a glass filled polyester support assembly that braces the bus against the forces generated during a short circuit. The horizontal bus shall be isolated from the top horizontal wireway by a two-piece rigid non-conductive barrier. The barrier design shall allow qualified personnel to slide the barriers both left and right, to allow access to the bus and connections for maintenance without having to remove the barrier. Barrier sliding shall occur via an upper and lower track system.
2. The vertical bus shall be housed in a molded glass-filled polyester support that provides bus insulation and braces the bus against the forces generated during a short circuit. These supports shall have openings every 6” for unit stab-on connections. Each opening shall be provided with a manual shutter to close off the stab opening. These shutters shall be attached to the structure so that when they are removed (to allow a stab connection) they are retained in the structure and are readily accessible for use should a plug-in unit be removed from the MCC.
3. Barriers shall be provided in the vertical structure and unit designs to prevent the contact of any energized bus or terminal by a fishtape inserted through the conduit or wireway areas.
I Bussing

1. All bussing and connectors shall be tin-plated copper; bussing shall be rated 65kAIC.
2. The main horizontal bus shall be rated at 1600A continuous and shall extend the full length of the MCC. Refer to drawings for bus ratings. Bus ratings shall be based on 65°C maximum temperature rise in a 40°C ambient. Provisions shall be provided for splicing additional sections onto either end of the MCC where drawings indicate.
3. The horizontal bus splice bars shall be pre-assembled into a captive bus stack. This bus stack is installed into the end of the MCC power bus to allow the installation of additional sections. The main bus splice shall utilize four bolts, two on each side of the bus split, for each phase. Additional bolts must not be required when splicing higher amperage bus. The splice bolts shall secure to self-clenching nuts installed in the bus assembly. It shall be possible to maintain any bus connection with a single tool. "Nut and bolt" bus connections to the power bus shall not be permitted.
4. Each section that accepts plug-in units shall be provided with a vertical bus for distributing power from the main bus to the individual plug-in starter units. This bus shall be of the same material and plating as the main bus, and shall be rated at 300A and 600A depending on section. The vertical bus shall be connected directly to the horizontal bus stack without the use of risers or other intervening connectors. It shall be possible to maintain the vertical to horizontal bus connection with a single tool. "Nut and bolt" bus connections to the power bus shall not be permitted. When a back-to-back unit arrangement is utilized, separate vertical bus shall be provided for both the front and rear units.
5. A tin-plated copper ground bus shall be provided that runs the entire length of the MCC. The ground bus shall be 0.25 in x 1.0 in and be rated for 300 amps. A compression lug shall be provided in the MCC for a 4/0-250 kcmil ground cable. The ground bus shall be provided with (6) 0.38 in holes for each vertical section to accept customer-supplied ground lugs for any loads requiring a ground conductor.
6. Each vertical section shall have a steel vertical ground bus that is connected to the horizontal ground bus. This vertical ground bus shall be installed so that the plug-in units engage the ground bus prior to engagement of the power stabs and shall disengage only after the power stabs are disconnected upon removal of the plug-in unit.
7. The system shall be rated for an available short circuit capacity as shown on the contract documents.

J Typical Unit Construction

1. Units with circuit breaker disconnects through 400 A frame, and fusible switch disconnects through 400 A, shall connect to the vertical bus through a spring reinforced stab-on connector. Units with larger disconnects shall be connected directly to the main horizontal bus with appropriately sized cable or riser bus. Stabs on all plug-on units shall be solidly bussed to the unit disconnect. Cabled stab assemblies are not permitted.
2. All conducting parts on the line side of the unit disconnect shall be shrouded by a suitable insulating material to prevent accidental contact with those parts.
3. Unit mounting shelves shall include hanger brackets to support the unit weight during installation and removal.
4. A handle operator must be provided on each disconnect. With the unit stabs engaged onto the vertical phase bus and the unit door closed, the handle mechanism shall allow complete ON/OFF control of the unit. All circuit breaker operators shall include a
separate TRIPPED position to clearly indicate a circuit breaker trip condition. It shall be possible to reset a tripped circuit breaker without opening the control unit door. Clear indication of disconnect status shall be provided.

5. A mechanical interlock shall prevent the operator from opening the unit door when the disconnect is in the ON position. Another mechanical interlock shall prevent the operator from placing the disconnect in the ON position while the unit door is open. It shall be possible for authorized personnel to defeat these interlocks.

6. A non-defeatable interlock shall be provided between the handle operator and the cam lever to prevent installing or removing a plug-on unit unless the disconnect is in the OFF position.

7. The plug-in unit shall have a grounded stab-on connector which engages the vertical ground bus prior to, and releases after, the power bus stab-on connectors.

8. Provisions shall be provided for locking all disconnects in the OFF position with up to three padlocks.

9. Handle mechanisms shall be located on the left side to encourage operators to stand to the left of the unit being switched.

10. Unit construction shall combine with the vertical wireway isolation barrier to provide a fully compartmentalized design.

11. Where units indicate a main circuit breaker, provide with fully rated trip functions Long time, Short time, Instantaneous and Ground fault (LSIG), with minimum of 15x inrush on the instantaneous function.

K Components for Typical Units

1. Combination Starters
   a. All combination starters shall utilize a unit disconnect as specified in the previous article. Magnetic starters shall be furnished in all combination starter units. All starters shall utilize NEMA/EEMAC rated contactors. Starters shall be provided with a three-pole, external manual reset, solid state overload relay without thermal overload units.
   b. Each starter unit shall have a control circuit transformer with two primary protection fuses and one secondary fuse (in the non-ground secondary conductor). The transformer shall be sized to accommodate the contactor and all connected control circuit loads.
   c. A minimum of 1 normally open and 1 normally closed auxiliary control circuit interlocks shall be provided. Auxiliary interlocks shall be field convertible to normally open or normally closed operation.
   d. NEMA/EEMAC Size 1-4 starters shall be mounted directly adjacent to the wireway so that power wiring (motor leads) shall connect directly to the starter terminals without the use of interposing terminals. Larger starters shall be arranged so that power wiring may exit through the bottom of the starter cubical without entering the vertical wireway.
   e. Each combination starter shall be provided with:
      1) Hand – off – automatic selector switch, with auxiliary contacts for remote monitoring of the position of the HOA selector switch
      2) Red LED pilot light indicating motor run
      3) Green LED pilot light indicating motor off
      4) Local push button start-stop
5) An RJ45 input for remote control. MCC manufacturer shall include patch panels/routers as required so that a single cable will be required for connection between the MCC and the owner’s existing Honeywell BMS system.

2. Terminal Blocks
   a. Wiring shall be Class I Type B. All starter units shall be provided with control wiring connected to unit control terminal blocks.
   b. Terminal blocks shall be the pull-apart type 600 volt and rated at 25 amps. All current carrying parts shall be tin plated. Terminals shall be accessible from inside the unit when the unit door is opened. Terminal blocks shall be DIN rail mounted with the stationary portion of the block secured to the unit bottom plate. The stationary portion shall be used for factory connections, and shall remain attached to the unit when removed. The terminals used for field connections shall face forward so they can be wired without removing the unit or any of its components.
   c. When Type C wiring is specified, all starter units shall be provided with unit control terminal blocks as described for Type B wiring. An additional set of identical terminal blocks shall be provided in a terminal compartment located in each section. These terminal blocks shall be pre-wired to the unit terminals so that all field control connections can be made at the terminal compartments.

3. Nameplates
   a. Unit nameplates shall be provided with a white background and black letters. Total outside dimensions will be a minimum of 1.5 in H x 6.25 in W total outside dimensions.

4. Unit Construction
   a. Units with circuit breaker disconnects through 100 A frame, and fusible switch disconnects through 100 A, shall connect to the vertical bus through a spring-reinforced stab-on connector. Stabs on all plug-on units shall be cable connected to the unit disconnect.
   b. All conducting parts on the line side of the unit disconnect shall be shrouded by a suitable insulating material.
   c. Unit mounting shelves shall include hanger brackets to support the unit weight during installation and removal.
   d. A handle operator must be provided on each disconnect. With the unit stabs engaged into the vertical phase bus and the unit door closed, the handle mechanism shall allow complete ON/OFF control of the unit disconnect with clear indication of the disconnects status. All circuit breaker operators shall include a separate TRIPPED position to clearly indicate a circuit breaker trip condition. It shall be possible to reset a tripped circuit breaker without opening the control unit door.

1) A mechanical interlock shall prevent an operator from opening the unit door when the disconnect is in the ON position. Another mechanical interlock shall prevent an operator from placing the disconnect in the ON position while the door is open. It shall be possible for authorized personnel to defeat these interlocks.
2) A non-defeatable interlock shall be provided between the handle operator
and the structure to prevent installing or removing a plug-on unit unless the
disconnect is in the OFF position. The plug-on unit shall have a grounded
stab-on connector which engages the vertical ground bus prior to, and
releases after, the power bus stab-on connectors.

e. Provisions shall be made for locking all disconnects in the OFF position with up to
three padlocks.

f. Handle mechanisms shall be located on the bottom left side of the unit and operate
horizontally to encourage operators to stand to the left of the unit being switched.

g. Unit construction shall combine with the vertical wireway isolation barrier to
provide a fully-compartmentalized design.

h. Up to a maximum of six size 1 starter units can be installed per vertical section
without placement restrictions in new or existing applications.

L MCC Mounted Adjustable Frequency Drives

1. Construction

a. The AC drive controller unit shall be a combination disconnect-drive motor control
center style unit. The input circuit breaker shall provide NEC required branch
circuit protection. The circuit breaker shall have an external operator. Wiring
between the AC inverter and the disconnect shall not be disturbed when removing
or installing the AC drive controller unit from the motor control center.

b. Units should be of modular construction so that it is possible to readily interchange
units of the same size without modifications to the MCC structure.

c. Current limiting power fuses shall be factory installed and wired ahead of the AC
inverter input.

d. All conducting parts on the line side of the unit disconnect shall be isolated to
prevent accidental contact with those parts.

e. AC drive controller units up to 50 hp variable torque shall be plug-on units, which
connect to the vertical bus through a spring-reinforced stab-on connector.

f. All AC drive controller units shall be enclosed in a structure, which contains a 12"
(305mm) high horizontal wireway at the top of each section, and a 6" (152mm)
high horizontal wireway at the bottom of each section. These wireways should be
unobstructed the full length of the motor control center to allow room for power
and control cable to connect between units in different sections.

g. A full-depth vertical wireway shall be provided within motor control center
sections containing AC drive controller units. The vertical wireway shall connect
both the top and bottom horizontal wireway, and shall be isolated from the AC
drive controller unit interiors by a full height barrier. Access to the wireways shall
not require opening control unit doors. AC drive controller units which require a
full section are not required to have vertical wireways.

h. All AC drive controller unit interior mounting panels shall be white for better
visibility inside.

i. The motor control center structure shall include unit mounting shelves with hanger
brackets to support AC drive controller units up to 50 hp variable torque during
installation and removal. A twin handle camming lever shall be located at the top
of AC drive controller units to rack in and out the unit.
WM Group Engineers

The College of New Jersey, Chilled Water Plant Expansion

March 16, 2015

j. A cast metal handle operator shall be provided on each AC drive controller unit disconnect. With the AC drive controller unit connected to the motor control center bus and the AC drive controller unit door closed, the handle mechanism shall allow complete on/off control of the unit disconnect with clear indication of the disconnects status. All circuit breaker operators shall include a separate tripped position to clearly indicate a circuit breaker trip condition. It shall be possible to reset a tripped circuit breaker without opening the control unit door.

1) A mechanical interlock shall prevent an operator from opening the AC drive controller unit door when the disconnect is in the on position. Another mechanical interlock shall prevent an operator from placing the disconnect in the on position while the AC drive controller unit door is open. It shall be possible for authorized personnel to defeat these interlocks.

2) A non-defeatable interlock shall be provided between the handle operator and the structure to prevent installing or removing a plug-on AC drive controller unit unless the disconnect is in the off position.

k. Provisions shall be provided for locking all disconnects in the off position with up to three padlocks.

l. All plug-on AC drive controller units shall have a grounded stab-on connector which engages the vertical ground bus prior to, and releases after, the power bus stab-on connectors.

m. Handle mechanisms shall be located on the left side to encourage operators to stand to the left of the unit being switched.

n. Unit construction shall combine with the vertical wireway isolation barrier to provide a fully compartmentalized design.

o. All AC drive controller units shall be provided with unit control terminal blocks for use in terminating field wiring. Terminal blocks shall be pull-apart type, 250 V, and rated for 10 amperes. All current-carrying parts shall be tin-plated. Terminals shall be accessible from inside the unit when the unit door is opened. The stationary portion of the terminal block shall be used for factory connections and will remain attached to the unit when the portion used for field connections is removed. The terminals used for field connections shall be accessible so they can be wired without removing the unit or any of its components.

2. Thermal Management

a. The AC drive controller unit shall incorporate a self contained air-based cooling system. Any air exhaust vents shall be louvered to help direct air flow away from personnel operating the AC drive controller unit. Any fans, ductwork or filters shall be easily accessible for maintenance.

b. The AC drive controller unit cooling system shall be sized to cool the drive regardless of mounting location within the motor control center. The AC drive controller unit shall not be restricted to a specific location in the motor control center.

c. An internal overtemperature trip shall be provided to detect cooling system failure or blockage. Upon occurrence of an overtemperature trip the cooling system fans shall continue running to provide a rapid cool down.
d. Power for the cooling system shall be provided internal to the AC drive controller unit by use of a control power transformer which includes two primary fuses and one secondary fuse (in the non-ground secondary conductor).

3. Electrical Ratings
   a. The AC drive controller unit shall be designed to operate from an input voltage of 480 VAC + or -10%.
   b. The AC drive controller unit shall operate from an input voltage frequency range from 57 to 63 Hz.
   c. The displacement power factor shall not be less than .98 lagging under any speed or load condition.
   d. The efficiency of the AC inverter at 100% speed and load shall not be less than 97%.
   e. The variable torque overtorque capacity shall be 110% for 1 minute.
   f. The output carrier frequency of the AC inverter shall be selectable between 0.5 kHz and 16 kHz depending on inverter rating for low noise operation.
   g. The AC inverter will be able to develop rated motor torque at .5 Hz (60 Hz base) in a V/Hz or advanced vector control mode using a standard induction motor without an encoder feedback signal.
   h. All AC drive controller unit feeder equipment including conductors, lugs, disconnects, contactors, etc. shall be sized per NEC 430-2 for the AC drive input current rating. An impedance range corresponding to a 22,000 to 100,000 Amp fault availability level shall be assumed. An AC drive input current rating label shall be attached inside each enclosure to enable feeder sizing.

4. Protection
   a. The AC drive controller unit shall be protected against fault currents up to and including 65,000 amps rms symmetrical at 480VAC and shall be UL 845 listed as verification.
   b. Upon power-up the AC inverter shall automatically test for valid operation of memory, option module, loss of analog reference input, loss of communication, dynamic brake failure, DC to DC power supply, control power, and the pre-charge circuit.
   c. The AC drive controller unit shall be protected against short circuits between output phases, between output phases and ground, on the internal power supplies, and on the logic and analog outputs.
   d. The AC drive controller unit shall have a minimum AC undervoltage power loss ride-through of 200 milliseconds (12 cycles).
   e. For a fault condition other than a ground fault, short circuit or internal fault, an auto restart function shall provide up to 6 restart attempts. The time delay before restart attempts shall be 30 seconds.
   f. The deceleration mode of the AC inverter shall be programmable. The stop modes shall include free-wheel stop, fast stop and DC injection braking.
   g. Upon loss of the analog process follower reference signal, the AC inverter shall be programmable to fault or operate at the user defined low speed setting.
   h. The AC inverter shall have solid-state I²t protection that is UL Listed and meets UL 508 C as a Class 20 overload protection and meets IEC 947. The minimum
adjustment range shall be from 0.45 to 1.05 percent of the nominal current rating of the AC drive controller unit.

i. The AC inverter shall have a programmable skip frequency with a bandwidth of 2.5Hz.

j. The AC inverter shall include Metal Oxide Varistors (MOVs) wired to the incoming AC Mains.

5. Line Reactor
   a. Each drive shall include a properly sized line reactor mounted and wired to the VFD to reduce power system harmonics and provide power quality protection for the drive. DC bus chokes do not meet specification and shall not be substituted.

6. Adjustments & Configurations
   a. The AC inverter motor and control parameters will be factory pre-set to operate most common applications. Necessary adjustments for factory supplied unit operator controls and sequencing shall be pre-programmed and tested by the manufacturer.
   b. A linear types of acceleration and deceleration ramps will be available in the AC inverter software.
   c. The acceleration and deceleration ramp times shall be adjustable from .05 to 999.9 seconds.
   d. The volts per frequency ratios shall be user selectable to meet variable torque loads, normal and high torque machine applications.
   e. The memory shall retain and record the last fault for operator review.
   f. The software shall have an Energy Economy (no load) function that will reduce the voltage to the motor when selected for variable torque loads. A constant volts/Hz ratio will be maintained during acceleration. The output voltage will then automatically adjust to meet the torque requirement of the load.
   g. The AC inverter shall have a software enabled fold-back function that will anticipate an inverter overload condition and fold back the frequency to avoid a fault condition.
   h. The AC inverter shall have an output signal with a user selectable threshold that can be used to signal motor overtemperature before a motor overload fault.
   i. The AC inverter shall offer programmable DC injection braking that will brake the AC motor by injecting DC current and creating a stationary magnetic pole in the stator.

7. Operator Interface
   a. The operator interface terminal will offer the modification of AC inverter adjustments via a touch keypad. All electrical values, configuration parameters, I/O assignments, application and activity function access, faults, local control, adjustment storage, will be in plain English. There will be a standard selection of 4 additional languages built-in to the operating software as standard.
   b. The display will be a high resolution, LCD backlit screen.
   c. As a minimum, the selectable display outputs shall consist of speed reference, output frequency, output current, line voltage, output power, motor thermal state, drive thermal state, and motor speed.
d. A programmable access code will limit access to programmable functions. A hardware selector switch shall allow the terminal keypad to be locked out from unauthorized personnel.

e. The keypad shall store in nonvolatile memory up to 4 user configuration programs. An operator shall have the ability to download a stored configuration to multiple AC inverters.

f. There will be arrow keys that will provide the ability to scroll through menus and screens, select or activate functions or change the value of a selected parameter.

g. A data entry key will allow the user to confirm a selected menu, numeric value or allow selection between multiple choices.

h. A RUN key and a STOP key will command a normal starting and stopping as programmed when the AC drive controller unit is in keypad control mode. The STOP key must be active in all control modes.

i. The AC drive controller unit shall have two LEDs mounted on the front panel to indicate functional status. A green LED will verify that the AC inverter power supply is on. A red LED indicator will indicate an AC inverter fault.

j. A user interface shall be available through a Windows based personal computer, serial communication link or detachable operator interface.

k. The operator interface shall be MCC door mounted on the AC drive controller unit for ease of access and increased visibility.

8. Control

a. External pilot devices shall be able to be mounted on a door mounted control station for starting/stopping the AC drive controller unit, speed control, and displaying operating status. All control inputs and outputs shall be software assignable. Software assignments for control inputs and outputs to operate factory-supplied controls shall be pre-configured from the factory.

b. Each drive shall be provided with:

   1) Hand – off – automatic selector switch, with auxiliary contacts for remote monitoring of the position of the HOA selector switch
   2) Red LED pilot light indicating motor run
   3) Green LED pilot light indicating motor off

9. Communication

a. Communications protocol shall be coordinated with owner. Minimally an AC drive controller shall be equipped with communication protocol compatible with the existing Honeywell BMS system and Modbus for monitoring and control.

   1) A minimum of (2) hardwired alarm contact output to indicate critical alarm conditions.
   2) A minimum of (2) hardwired start/stop input to operate the AC drive from a remote location.
   3) An RJ45 input for remote control. MCC manufacturer shall include patch panels/routers as required so that a single cable will be required for connection between the MCC and the owner’s existing Honeywell BMS system.
   4) Drive shall minimally include the following programmable points via the RJ45 input;
2.3 ACCESSORIES

A Devices shall be factory installed in controller enclosure, unless otherwise indicated.


C Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.

D Control Relays: Auxiliary and adjustable time-delay relays. 24VDC to 120VAC aux relays for starting for each motor controller.

E All HOA switches shall include one set of additional aux contacts for remote monitoring.

2.4 FACTORY FINISHES

A Finish: Manufacturer's standard paint applied to factory-assembled and -tested, motor-control centers before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A Examine areas and surfaces to receive motor-control centers for compliance with requirements, installation tolerances, and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A Select features of each controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, controller, and load; and configuration of pilot device and control circuit affecting controller functions.

B Select horsepower rating of controllers to suit motor controlled.
3.3 INSTALLATION

A Install motor-control centers inside PDC, and attach per MCC manufacturer’s recommendations.

B The PDC manufacturer shall be responsible for installing the motor control centers per manufacturer written instructions.

C The E.C. shall be responsible for all final power and communications terminations, conduit stub-up coordination, conduit and wire, bolting to pads, rigging, joining of shipping splits including control wiring, and standby assistance during commissioning for the following owner purchased equipment: Note: Actual commissioning (including final check of terminations, start-up and testing of equipment) will be performed by the manufacturer’s representative.

D Temporary Lifting Provisions: Remove temporary lifting eyes, channels, brackets, and temporary blocking of moving parts from switchgear units and components.

3.4 IDENTIFICATION

A Identify motor-control center, motor-control center components, and control wiring according to Division 26 Section 26 05 53 "Electrical Identification."

B Operating Instructions: Frame printed operating instructions for motor-control centers, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of motor-control centers.

3.5 CONTROL WIRING INSTALLATION

A Install wiring between motor-control devices according to Division 26 Section 26 05 19 "Conductors and Cables."

B Bundle, train, and support wiring in enclosures.

C Connect hand-off-automatic switch and other automatic-control devices where applicable.
   1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.
   2. Connect selector switches with motor-control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.6 CONNECTIONS

A Conduit installation requirements are specified in other Division 26 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.

B Ground equipment according to Division 26 Section 26 05 26 "Grounding and Bonding."
3.7 FACTORY QUALITY CONTROL

A The entire MCC shall go through a quality inspection before shipment. This inspection will include:

1. Physical Inspection of:
   a. Structure.
   b. Electrical conductors, including:
      1) bussing.
      2) general wiring.
      3) units.

2. Electrical Tests
   a. General electrical tests include:
      1) power circuit phasing.
      2) control circuit wiring.
      3) instrument transformers.
      4) meters.
      5) ground fault system.
      6) device electrical operation.
   b. AC dielectric tests shall be performed on the power circuit.

3. Markings/Labels, include:
   a. instructional type.
   b. Underwriters Laboratory (UL)/Canadian Standards Association (CSA).
   c. inspector's stamps.

4. The manufacturer shall use integral quality control checks throughout the manufacturing process to ensure that the MCC meets operating specifications.

5. Report results in writing to engineer.

3.8 FIELD QUALITY CONTROL

A Prepare for acceptance tests as follows:

1. Test insulation resistance for each motor-control center element, bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B Manufacturer's Field Service: Contractor shall engage a factory-authorized service representative to perform the following:

1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers to owner’s settings, components, and equipment to owner’s satisfaction. Variable frequency drive programming and settings shall be the responsibility of the manufacturer’s field service representative. Coordinate controller/drive settings with manufacturer of HVAC equipment that is controlled by the MCC and engineer.
2. In addition to services above-provide (1) day standby service for initial energization.
3. Report results in writing to engineer.

C Test Agency: Contractor will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports. Perform the following field tests and inspections and prepare test reports:

1. Perform each electrical test and visual and mechanical inspection, except for optional tests, stated in NETA ATS "Motor Control Centers." 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.

3.9 ADJUSTING

A Set field-adjustable switches and circuit-breaker trip ranges.

3.10 DEMONSTRATION

A Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain components of motor-control centers.

END OF SECTION 26 24 19
SECTION 262713 - ELECTRICITY METERING

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 equipment for electricity metering by Owner.

1.3 DEFINITIONS
   A. KY Pulse: Term used by the metering industry to describe a method of measuring consumption of electricity that is based on a relay opening and closing in response to the rotation of the disk in the meter.
   B. PC: Personal computer.

1.4 ACTION SUBMITTALS
   A. Product Data: For each type of product indicated.
   B. Shop Drawings: For electricity-metering equipment.
      1. Dimensioned plans and sections or elevation layouts.
      2. Wiring Diagrams: For power, signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features.

1.5 INFORMATIONAL SUBMITTALS
   A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS
   A. Operation and Maintenance Data. Include the following:
      1. Application and operating software documentation.
2. Software licenses.
3. Software service agreement.
4. Hard copies of manufacturer's operating specifications, design user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy Submittal.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.8 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Owner's written permission.

1.9 COORDINATION

A. Coordinate installation and connection of services, including provision for electricity-metering components.

PART 2 - PRODUCTS

2.1 EQUIPMENT FOR ELECTRICITY METERING BY OWNER

A. Basis-of-Design Product: Subject to compliance with requirements, provide meter as shown on drawings. Metering is proprietary to maintain system functionality.

B. General Requirements for Owner's Meters:

1. Comply with UL 1244.
2. Meters used for billing shall have an accuracy of 0.2 percent of reading, complying with requirements in ANSI C12.20.
3. Enclosure: NEMA Type as shown on the drawings, with hasp for padlocking or sealing.
4. Identification: Comply with requirements in Section 260553 "Identification for Electrical Systems."
5. Memory Backup: Self-contained to maintain memory throughout power outages of 72 hours, minimum.
6. Sensors: Current-sensing type, with current or voltage output, selected for optimum range and accuracy for meters indicated for this application.

7. Current-Transformer Cabinet (if required): Listed or recommended by metering equipment manufacturer for use with sensors indicated.

8. Building Automation System (BAS) Interface: One digital KY pulse to a user-definable increment of energy measurement. Match signal to BAS input and arrange to convey the instantaneous, integrated, demand level measured by meter to provide data for processing and possible programmed demand control action by destination system.

C. Kilowatt-hour/Demand Meter: Electronic three phase meters, measuring electricity use and demand. Demand shall be integrated over a 15-minute interval.

1. Voltage and Phase Configuration: Meter shall be designed for use on circuits with voltage rating and phase configuration indicated for its application.

2. Display: LCD with characters not less than 0.25 inch high, indicating accumulative kilowatt-hours, current time and date, current demand, and historic peak demand, and time and date of historic peak demand. Retain accumulated kilowatt-hour and historic peak demand in a nonvolatile memory, until reset.

D. Data Transmission Cable: Transmit KY pulse data over Class 1 control-circuit conductors in raceway. Comply with Section 260523 "Control-Voltage Electrical Power Cables."

E. Software: New meter shall interface with owner’s existing metering program.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with equipment installation requirements in NECA 1.

3.2 IDENTIFICATION

A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

1. Series Combination Warning Label: Self-adhesive type, with text as required by NFPA 70.

2. Equipment Identification Labels: Adhesive film labels with clear protective overlay.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.
1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Connect a load of known kilowatt rating, 1.5 kW minimum, to a circuit supplied by metered feeder.
2. Turn off circuits supplied by metered feeder and secure them in off condition.
3. Run test load continuously for eight hours minimum, or longer, to obtain a measurable meter indication. Use test-load placement and setting that ensures continuous, safe operation.
4. Check and record meter reading at end of test period and compare with actual electricity used, based on test-load rating, duration of test, and sample measurements of supply voltage at test-load connection. Record test results.

C. Electricity metering will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 262713
SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Receptacles, receptacles with integral GFCI, and associated device plates.
   2. Snap switches.
   3. Communication outlets.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.
B. GFCI: Ground-fault circuit interrupter.
C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
D. RFI: Radio-frequency interference.
E. TVSS: Transient voltage surge suppressor.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
C. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.
1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

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 latest applicable edition of “National Electrical Code” for devices and installation.

1.6 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
   1. Cord and Plug Sets: Match equipment requirements.
   2. Provide one (1) set of plug and receptacle per each special outlet.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
   1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
   2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
   4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Cooper; 5351 (single), 5352 (duplex).
      b. Hubbell; HBL5351 (single), CR5352 (duplex).
      c. Leviton; 5891 (single), 5352 (duplex).
      d. Pass & Seymour; 5381 (single), 5352 (duplex).
2.3 GFCI RECEPTACLES

A. General Description: Straight blade, non-feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Cooper; GF20.
      b. Pass & Seymour; 2084.

2.4 CORD AND PLUG SETS

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
   1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.

2.5 SNAP SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Switches, 120/277 V, 20 A:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
      b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
      c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
      d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

C. Pilot Light Switches, 20 A:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Cooper; 2221PL for 120 V and 277 V.
      b. Hubbell; HPL1221PL for 120 V and 277 V.
      c. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.
d. Pass & Seymour; PS20AC1-PLR for 120 V.

2. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."

D. Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

2. Products: Subject to compliance with requirements, provide one of the following:
   b. Hubbell; HBL1557.
   c. Leviton; 1257.
   d. Pass & Seymour; 1251.

2.6 COMMUNICATIONS OUTLETS

A. Telephone Outlet:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

2. Products: Subject to compliance with requirements from Fortistar Controls engineer, provide one of the following:
   a. Cooper; 3560-6.
   b. Leviton; 40649.

3. Description: Single RJ-45 jack for terminating 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 5e. Comply with UL 1863.

B. Combination TV and Telephone Outlet:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

2. Products: Subject to compliance with requirements, provide one of the following:
   a. Cooper; 3562.
   b. Leviton; 40595.

3. Description: Single RJ-45 jack for 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 5e; and one Type F coaxial cable connector.

2.7 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces 0.035-inch-thick, satin-finished stainless steel.
4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.

2.8 OUTLET BOXES AND CADDY SUPPORTS

A. Manufacturer: Steel City, Raco or Appleton

   b. Minimum size: 4-inch square or octagon, gangable 2”x3” where used with cable, depth as required for project.
   c. Extension rings: To suit various conditions.
   d. Hardware: Grounding screw and cable wiring connectors as required by wiring method.
   e. Caddy box supports must be provided and installed on project Series type H, HS3 and series type 766.
   f. Other types: As required by job conditions.
   g. Exposed installations: round edges, industrial type.

2.9 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color.

1. Wiring Devices Connected to Normal Power System: Black or as selected by owner, unless otherwise indicated or required by NFPA 70 or device listing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:

1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.

3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.

4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:
   1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
   2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
   3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.

D. Device Installation:
   1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
   2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
   3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
   4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
   5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
   6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
   7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
   8. Tighten unused terminal screws on the device.
   9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:
   1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

3.2 IDENTIFICATION

A. Comply with Division 26 Section 260553 "Electrical Identification."
   1. Receptacles: Identify panelboard and circuit number from which served. Use P-touch clear tape machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.
   1. Test Instruments: Use instruments that comply with UL 1436.
   2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:
   1. Line Voltage: Acceptable range is 105 to 132 V.
   2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
   3. Ground Impedance: Values of up to 2 ohms are acceptable.
   4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
   5. Using the test plug, verify that the device and its outlet box are securely mounted.
   6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION 262726
SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following individually mounted, enclosed switches and circuit breakers:
   1. Fusible switches.
   2. Nonfusible switches.
   5. Enclosures.

1.3 DEFINITIONS

A. GD: General duty.
B. GFCI: Ground-fault circuit interrupter.
C. HD: Heavy duty.
D. RMS: Root mean square.
E. SPDT: Single pole, double throw.

1.4 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
   1. Enclosure types and details for types other than NEMA 250, Type 1.
   2. Current and voltage ratings.
4. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Manufacturer's field service report.

D. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. Operation and Maintenance Data shall include the following:
   1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
   2. Time-current curves, including selectable ranges for each type of circuit breaker.

1.5 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 (NETA) 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.

D. Listing and labeling: Provide products specified in this section that are listed and labeled. The term "listed and labeled" as defined in the latest edition of the National Electrical Code, article 100.

E. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.6 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Spares for the following:
      a. Potential Transformer Fuses: Five of each type installed.
      b. Control-Power Fuses: Five of each type installed.
      c. Fuses for Fusible Switches: Three of each type installed.
   2. Spare Indicating Lights: Six of each type installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 FUSIBLE AND NONFUSIBLE SWITCHES

A. Manufacturers:
   1. Eaton Corporation; Cutler-Hammer Products.
   2. General Electric Co.; Electrical Distribution & Control Division.
   4. Square D/Group Schneider.

B. Fusible Switch, 800A and Smaller: NEMA KS 1, Type HD, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in CLOSED position.

C. Nonfusible Switch: NEMA KS 1, Type HD, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

D. Accessories:
   1. Equipment Ground Kit: Internally mounted and labeled for copper ground conductors.
   2. Auxiliary Contact Kit: Auxiliary set of contacts arranged to open before switch blades open.

E. Non-Fusible switches for use in a Class I, Division 2 location, provide the following:
1. Up to 100 Amps  
   a. Cooper Crouse-Hinds Series GHG or approved equal.
2. Over 100 Amps  
   a. Cooper Crouse-Hinds Series EBM or approved equal.

2.3 MOLDED-CASE CIRCUIT BREAKERS AND SWITCHES

A. Manufacturers:
   1. Eaton Corporation; Cutler-Hammer Products.
   2. General Electric Co.; Electrical Distribution & Control Division.
   4. Square D/Group Schneider.

B. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents, 22kAIC minimum.
   3. Electronic Trip-Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:
      a. Instantaneous trip.
      b. Long- and short-time pickup levels.
      c. Long- and short-time time adjustments.
      d. Ground-fault pickup level, time delay, and I\textsuperscript{2}t response.

C. Molded-Case Circuit-Breaker Features and Accessories:
   1. Standard frame sizes, trip ratings, and number of poles.
   2. Lugs: Mechanical style with compression lug kits suitable for number, size, trip ratings, and conductor material.
   3. Application Listing: Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
D. Molded-Case Switches: Molded-case circuit breaker with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

E. Molded-Case Switch Accessories:
   1. Lugs: Mechanical style with compression lug kits suitable for number, size, trip ratings, and material of conductors.
   2. Application Listing: Type HACR for heating, air-conditioning, and refrigerating equipment.

2.4 ENCLOSURES

A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
   1. Outdoor Locations: NEMA 250, Type 3R.
   2. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
   3. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install per Manufacturers recommendations and Seismic requirements for project location.

B. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.

C. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated.

D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section 260553 "Electrical Identification."

B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Division 26 Section 260553 "Electrical Identification."

3.4 FIELD QUALITY CONTROL

A. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.5 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.6 CLEANING

A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.

B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION 262816
SECTION 262923 – EXISTING VARIABLE-FREQUENCY MOTOR CONTROLLER PROGRAMMING

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 separately enclosed, preassembled, combination VFCs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.

B. Related Requirements:

1. Section 262419 "Motor-Control Centers" for VFCs installed in motor-control centers.

1.3 DEFINITIONS

A. CE: Conformite Europeene (European Compliance).

B. CPT: Control power transformer.

C. DDC: Direct digital control.

D. EMI: Electromagnetic interference.

E. LED: Light-emitting diode.

F. NC: Normally closed.

G. NO: Normally open.

H. OCPD: Overcurrent protective device.

I. PID: Control action, proportional plus integral plus derivative.

J. RFI: Radio-frequency interference.

K. VFC: Variable-frequency motor controller.
1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 EXISTING MANUFACTURER OF DRIVES

A. Safetronics with JVOP-131U digital operator interface.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for conduit systems to verify actual locations of conduit connections before installation of new monitoring circuits.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

3.3 CONTROL WIRING INSTALLATION

A. Install wiring between VFCs and remote devices and facility's central-control system. Comply with requirements in Section 260523 "Control-Voltage Electrical Power Cables."

B. Bundle, train, and support wiring in enclosures.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections, as well as program drives for new monitoring points.

B. Tests and Inspections:
1. Test and adjust new control points that interface with owner’s existing Honeywell BMS system. Honeywell and/or engineer to provide points to be programmed in existing drives that will send information to existing Honeywell BMS system.

C. Prepare test and inspection reports, including a certified report that identifies the VFC and describes programming results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.5 ADJUSTING

A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, reprogram, and maintain VFC’s with new programmed settings.

END OF SECTION 262923
SECTION 263111 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. System smoke detectors.

1.2 SYSTEM DESCRIPTION

A. Existing Fire Alarm system with new fire alarm devices, dedicated to fire-alarm service only.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.
   B. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.
      2. Include voltage drop calculations for notification appliance circuits.
      3. Include battery-size calculations.
      4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
      5. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.

C. General Submittal Requirements:
   1. Submittals shall be approved by authorities having jurisdiction (if required) prior to submitting them to Engineer.
   2. Shop Drawings shall be prepared by persons with the following qualifications:
      a. Trained and certified by manufacturer in fire-alarm system design.
1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.
B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data, deliver copies to authorities having jurisdiction (if required) and include the following:

1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
3. Record copy of site-specific software.
4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
   a. Frequency of testing of installed components.
   b. Frequency of inspection of installed components.
   c. Requirements and recommendations related to results of maintenance.
   d. Manufacturer's user training manuals.

5. Manufacturer's required maintenance related to system warranty requirements.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing system.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]
   1. Honeywell.
   2. Or Equivalent that is compatible with existing building fire alarm system.

2.2 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:
   1. Equivalent to the existing smoke detectors used on the existing fire alarm system.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Comply with NFPA 72 for installation of fire-alarm equipment.

B. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.
   1. Connect new equipment to existing control panel in existing part of the building.
   2. Expand, modify, and supplement existing control equipment as necessary to extend existing control functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.

C. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.

3.2 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.3 GROUNDING

A. Ground associated circuits; comply with IEEE 1100.
3.4 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by Owner and/or Engineer.

B. Tests and Inspections:

1. Visual Inspection: Conduct visual inspection prior to testing.
   a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
   b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.


C. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

D. Fire-alarm system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 283111
SECTION 264113 - LIGHTNING PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes lightning protection for building, equipment, and housing enclosures.

B. The lightning protection system shall include, but not limited to, air terminals, above ground aluminum conductors, underground copper grounding conductors, ground rods, accessories and fittings designed for that purpose.

C. Related Sections include the following:

1. Division 26 Section 260526 "Grounding and Bonding".

D. Lightning Protection System indicated in the project drawings

1. The information included on the project drawings for the Lightning Protection System shall be used for pricing guidelines only.

2. The lightning protection system shown on this drawing is diagrammatic. All devices, equipment, specialties and accessories shall be provided as required.

3. The E.C. shall submit to the owner lightning protection drawings identified as "working drawing" for approval. The "working drawings" shall be prepared by a certified lightning protection specialist, in conformance with all applicable codes and NFPA standards. Approved drawings are required for construction.

4. At the end of the project, the E.C. shall provide the owner with a certified set of drawings, certified final inspection approval and master label certificate.

1.3 DEFINITIONS

A. LPI: Lightning Protection Institute.

B. NRTL: National recognized testing laboratory.

1.4 SUBMITTALS

A. Product Data: For air terminals and mounting accessories.
B. Shop Drawings: Detail lightning protection system, including air-terminal locations, conductor routing and connections, and bonding and grounding provisions. Include indications for use of raceway, data on how concealment requirements will be met, and calculations required by NFPA 780 for bonding of grounded and isolated metal bodies.

C. Qualification data for firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include data on listing or certification by an NRTL or LPI.

D. Field inspection reports indicating compliance with specified requirements.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who is an NRTL or who is certified by LPI as a Master Installer/Designer.

B. Listing and Labeling: As defined in NFPA 780, "Definitions" Article.

1.6 COORDINATION

A. Coordinate installation of lightning protection with installation of other building systems and components, including electrical wiring, supporting structures and building materials, metal bodies requiring bonding to lightning protection components, and building finishes.

B. Coordinate installation of air terminals attached to equipment and housing enclosures with the equipment vendors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with Specifications; provide products by one of the following Manufacturers:

1. Harger Lightning and Grounding
2. Erico
3. Burndy
4. Ilsco
5. Thomas and Betts
6. Heary Brothers
7. ALLTEC

B. If the contractor chooses to submit an alternate product design he shall bear the responsibility of performing new calculations. These calculations shall be plotted on a map of the site. The drawings shall indicate all components of the system and be approved by the engineer.
2.2 LIGHTNING PROTECTION SYSTEM COMPONENTS

A. Comply with UL 96.

B. Roof-Mounting Air Terminals: NFPA Class I, aluminum, solid, blunt tipped unless otherwise indicated.

C. Ground Rods, Ground Loop Conductors, and Concrete-Encased Electrodes: Comply with Division 26 Section 260526 "Grounding and Bonding" and with standards referenced in this Section.

D. Grounding shall be suitable for the soil conditions per NFPA 780 code.

E. Bonding devices, cable splicers and miscellaneous connectors shall be of cast bronze with bolt pressure connections to cable. Cast or stamped crimp fittings are not acceptable.

2.3 LIGHTNING PROTECTION SYSTEM

A. All devices, equipment, specialties and accessories for the Lightning Protection System shall be provided as required.

B. E.C. shall submit to the owner lightning protection drawings identified as "working drawing" for approval. The "working drawings" shall be prepared by a certified lightning protection specialist, in conformance with all applicable codes and NFPA standards. Approved drawings are required for construction.

C. At the end of the project, E.C. shall provide the owner with a certified set of drawings, a certified final inspection approval and a master label certificate.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install lightning protection components and systems according to UL 96A and NFPA 780.

B. Install system materials according to manufacturer’s written instructions.

C. Materials for the lightning protection system shall be coordinated with the building construction materials to assure compatibility. Aluminum materials shall not be embedded in concrete or masonry, installed on or below copper surfaces, or used below ground.

D. Install conductors with direct paths from air terminals to ground connections. Avoid sharp bends and narrow loops.

E. Cable Connections: Use approved exothermic-welded connections for all conductor splices and connections between conductors and other components.
F. Air Terminals on Single-Ply Membrane Roofing: Comply with adhesive manufacturer's written instructions.

G. Air Terminals shall be blunt tipped:
   1. Shall be located as shown on contract documents.
   2. Maximum 24” from roof edges.
   3. Minimum 10” above protected object.
   4. Maximum spacing of air terminals shall not exceed 20’.
   5. Air terminals that extend 24” above the protected object shall not exceed a spacing of 25’.

3.2 CORROSION PROTECTION

A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.

B. Use conductors with protective coatings where conditions would cause deterioration or corrosion of conductors.

3.3 FIELD QUALITY CONTROL

A. UL Inspection: Provide inspections as required and obtain a UL Master Label for system and building. Provide letter of findings if UL Master Label can not be furnished.

B. Install UL Master Label C plate on switchgear enclosure.

C. Any component or method found not to be in accordance with this specification shall be replaced or repaired without additional cost to the owner.

END OF SECTION 264113
SECTION 264950 – SUBSTATION CONTROL HOUSE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions by Owner shall apply to this Section.

B. Drawings E4.02 and E5.03.

C. Section 260526, Grounding and Bonding

D. Section 260533, Raceways, Boxes and Cabinets

E. Section 262726, Wiring Devices

F. Section 262416, Panelboards

G. Section 262419, Motor Control Centers

H. Section 262213, Dry-type Transformers

I. Section 265113, Interior Lighting

J. Section 265623, Exterior Lighting

1.2 SUMMARY

A. The Manufacturer shall furnish the substation control house complete with components, wiring equipment and accessory equipment as described herein and as shown on the contract drawings including all appurtenances such as terminal blocks, shorting blocks, jumpers, etc for a complete working system.

B. The manufacturer shall provide full engineering services and control wire integration drawings as follows:

1. Three line diagrams which shall show all external substation equipment.
2. Terminal block points for landing external wiring including CT & PT polarities, etc.
3. Coordination with other pre-manufactured equipments shop drawings such as 15kV circuit breakers, transformers, etc and show where control and protection wiring lands on their equipment as well as relays, lockouts, etc.

C. The control house shall consist of relay racks, 3 sets of station battery chargers and station batteries, 75kVA, 480V-208V/120V transformer, 208V/120V, 3-phase, house panelboard, etc. in an outdoor environmentally controlled, weatherproof, pre-wired, pre-fabricated enclosure.
D. All 208V/120V equipment such as panels, fans, lights, etc. shall be pre-wired by Control House manufacturer.

1.3 DEFINITIONS

B. GFCI: Ground-fault circuit interrupter.
C. HMI: Human machine interface.

1.4 SUBMITTALS

A. Product Data: For each type of equipment, include the following:

1. Technical data on features, performance, electrical characteristics, ratings, and finishes.
2. Cut sheets and model #’s on all peripheral equipment such as: batteries, chargers, panelboards, etc.

B. Provide (6) sets of Shop Drawings minimum, (1) electronic copy also acceptable: Include the following:

1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Include the following:
   a. Tabulation of installed devices with features and ratings.
   b. Enclosure types and details.
   c. Outline and general arrangement drawing showing dimensions, shipping sections, and weights of each assembled section.
   d. Floor plan drawing showing locations for all equipment, anchor bolts and leveling channels.
   e. Nameplate legends.
   f. Battery run time A-HR calculations.

2. Wiring Diagrams: Include the following: (Note: preliminary three-line diagrams and control diagrams shall be provided by engineer.)

   a. Power, signal, and control wiring.
   b. Schematic control diagrams.
   c. Diagrams showing connections of component devices and equipment.
   d. Three-line diagrams of current and future circuits showing device terminal numbers and internal diagrams.
   e. Schematic diagrams showing connections to remote devices including transformers, 15kV breakers, all SCADA remote terminal units, etc.

C. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around control house where pipe and ducts are prohibited. Show
layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

D. Manufacturer Seismic Qualification Certification: Submit certification that control house, overcurrent protective devices, accessories, and components will withstand seismic forces for project location; Ewing, NJ. Include the following:

1. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
2. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
3. Structural engineering calculations, signed by a PE shall be provided.

E. Qualification Data: For testing agency.

F. Source quality-control test reports.

G. Field quality-control test reports.

H. Operation and Maintenance Data: For control house and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's sample system checklists and log sheets.
2. Provide (6) sets minimum.

I. Shop drawings schedule:

1. Preliminary shop drawings with seismic certification, weights and dimensions are due 3 weeks after receipt of a purchase order.
2. Three lines and protection shop drawings are due 6 weeks after receipt of PO.
3. Final shop drawing and/or field submittals including wiring diagrams are due within 12 weeks of receipt of PO.
4. As built shop drawings are due after any field modifications have been made.

1.5 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

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.
D. Comply with ANSI Standards.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver control house in one (1) assembly that can be moved past obstructions in delivery path. This project requires the full assembly to be delivered to the site without shipper splits if possible.

B. If stored in areas subjected to weather, cover control house to provide protection from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside control house; install electric heating (250 W per section) to prevent condensation.

C. All equipment within the walk in enclosure shall be permanently installed where possible. All equipment and appurtenances not installed at factory shall be installed by the manufacturer in the field using field services. These costs shall be included in the manufacturers bid.

1.7 PROJECT CONDITIONS

A. Product Selection for Restricted Space: Drawings indicate maximum dimensions for control house, including clearances between relays and adjacent surfaces and other items. Comply with indicated maximum dimensions.

B. Environmental Limitations: Rate equipment for continuous operation at indicated ampere ratings for the following conditions:

   1. Ambient high temperature for project location
   2. Ambient Low temperature not exceeding the extreme minimum for project location.
   3. Altitude above sea level specific to project location
   4. Roof designed for heavy snow loading.
   5. Maximum wind speed of 125mph.

1.8 DELIVERY

A. Substation Control House shall be delivered to the site by the date specified by the owner.

1.9 COORDINATION

A. Coordinate size and location for concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

1.10 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Fuses: Six of each type and rating used.
2. Indicating LED Lights: Six of each type installed.
3. Touchup Paint: 3 containers of paint matching enclosure finish, each 0.5 pint (250 mL).

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide Walk-In Protected Isle by the following manufacturers or approved equal.

1. Protect Controls, Inc.
2. Schweitzer Engineering Laboratories.
3. Atkinson – EPSI.
4. Power Electronics, Inc.
5. Asea Brown Boveri-ABB

2.2 OUTDOOR ENCLOSURE CONSTRUCTION

A. The control house and all mounted components shall be designed for and anchored sufficiently for transportation to jobsite. See drawing E5.03 for control house general layout.

B. Construction:

1. Base skid construction shall be suitable for 125mph winds and heavy roof snow loads.
   a. The skid shall be of all welded, seamless construction utilizing ASTM-A36 structural steel members, sized and arranged for proper strength, and able to withstand the stress and loads which will result when lifting the complete factory fabricated and equipment assemblies. Cross members shall be located so as not to obstruct conduit entry into bottom of equipment.
   b. Deflection shall be L/240. Shall be suitable for installation on a concrete pad, piers, vault, or structural framework. Mounting method shall be indicated on the data sheet.
   c. The skid shall be equipped with two (2) stainless steel ground pads located at opposite corners of the skid.
   d. The floor shall be a minimum of 1/4” H.R. ASTM-A36 smooth steel plate welded to the perimeter and longitudinal and/or transverse structural members of the skid.

2. Walls, roof and ceiling shall be fabricated from G90 galvanized steel utilizing self-framing, interlocking panels. Panel width shall not exceed 16”. Framed construction is not acceptable. Interior walls to be fabricated as liners.
3. Wall thickness shall be 3”.
4. Panel thickness shall be minimum 18-guage. Bidder is responsible to determine if thicker gauge material is required to meet loading criteria.
5. The roof shall be sloped at 1/4” per linear foot, and shall be sloped away from the personnel doors. Roof shall be designed for single pitch slope, fabricated in multiple sections.

C. Ship in single section.

D. Penetrations
1. The floor and walls shall be provided with penetrations where required for power and control cable entry/exit from this equipment. Coordinate with equipment.
2. Provide rodent and insect screens on all open penetrations through the floor, wall and roof.
3. Cable tray penetration shall include weather proofing.

E. All fastening hardware shall be zinc plated. Welding of panels and rivets shall not be acceptable method of exterior fastening.

F. Provided with a minimum of two (2) entrance doors. The doors shall be double wall construction, insulated, with brushed aluminum panic, cylinder lock and thumb latch, brushed aluminum automatic closure with built-in hold open device, prime coat hinges, stainless steel threshold integral to door frame, neoprene gasket, drip shield/water flashing, “DANGER, HIGH VOLTAGE, KEEP OUT” sign, and removal transom above the equipment door only. Door sizes shall be minimum 36 inches; suitable for equipment replacement. If required, doors shall include louvers to allow proper air flow. Include on door louvers, rodent and insect screens.

G. The walls, roof and floor shall be fully insulated, with minimum of R-11 insulation. All insulation shall carry a flame spread rating of 25 or less.
1. The walls and roof shall be provided with fiberglass batt type insulation or poly foam board.
2. The floor shall be provided with polyurethane spray foam insulation.

H. Provide with the manufacture’s standard paint system, including:
1. The skid shall be provided with a 2-3 mil application of epoxy primer.
2. The underside of the skid shall have a 20-25 mil application of bituminous mastic.
3. The floor shall be provided with a 2-3 mil application of epoxy primer, followed by a 2-3 mil application of ANSI-61 gray epoxy, with non-skid finish.
4. The exterior and interior shall be provided with a 0.3-0.6 mil application of a vinyl wash primer, followed by a 2-3 mil application of polyurethane paint. Exterior and interior finish color shall be white unless otherwise indicated on the data sheet.

I. HVAC System
1. The HVAC system shall be provided by the control house supplier.
2. Provide two (2) air cool, self-contained, wall mounted direct expansion air conditioners with supplemental electric heat as manufactured by Bard Manufacturing Company, Inc or Equivalent. Each unit shall be provided as follows:
   a. Model W70A2-C09WPXXXJ, nominal 6 Ton cooling capacity
b. Electrical: 208 volt – 3 phase – 60 Hz
c. Standard features:
   1) 2-speed fan motor with motor overload protection
   2) 2-speed blower motor with motor overload protection
   3) Scroll compressor
   4) Refrigerant R-410A
   5) Phase rotation monitor
   6) 20 gauge zinc coated cabinet
   7) Foil faced insulation
   8) Lockable hinged access cover to the built in circuit breaker.
   9) Air filter service door
   10) Barometric fresh air damper
   11) Slope top for water run off
   12) Top rain flashing
   13) Liquid line filter dryer
   14) Compressor control module
      a) Off-delay, 30 seconds – 5 minutes
      b) 2 minute delay on if power is interrupted
      c) 120 second bypass for low pressure control
      d) Soft and manual lockout for high and low pressure controls
      e) Alarm output for alarm relay: set of Normally Open and Normally Closed dry contacts
      f) Auto reset High & Low pressure switches with built in lockout circuit resets from the room thermostat and compressor anti-cycle relays
   15) Provide Manufacturers standard color - Beige
d. Provide the following optional features:
   1) Supplemental electric heat 9kw for 208/3/60
   2) 2” pleated air filter
   3) Low Ambient Control
   4) Remote Sensor w/35’ Lead, 8612-023A
   5) Alarm Relay
   6) Economizer
   7) Lead/Lag Control module: MC4001
   8) Supply Air Grille; Bard model SG-5W
   9) Return Air Grille; Bard model RG-5W

3. Each system shall be provided with a 24volt, wall mounted, electronic thermostat; 2-stage cooling, 1-stage heating; Bard 8403-060 Programmable Thermostat.

J. Electrical Devices

1. The supplier shall furnish all electrical distribution equipment necessary for the proper operation of building services. Refer to drawing E2.08 for details.
2. Provide 75kVA, 480V-208/120V. 3-phase, delta-wye ground transformer. Refer to section, “Dry-type Transformers” for details.
3. Provide 208/120V, 3-phase, 4 wire, and 400A, panel. Refer to section, “Panelboards” for more information.
4. Provide lighting contactor with
5. Provide with combination emergency/exit lighting fixtures above each door and emergency lighting fixtures as necessary throughout the building to create an illuminated egress path. Provide weatherproof emergency light over each exit door exterior.

6. Providing fluorescent ceiling light fixtures throughout to a 50 minimum average foot candles. Provide weatherproof metal halide wall packs over each exit door exterior.

7. Control house shall be provided with 125V, 20A, interior surface mount duplex receptacles at each entry door. Refer to Section ;“Wiring Devices” for more information.

8. Control house shall be provided with 125V, 20A, exterior surface mount GFCI duplex receptacles at each entry door, with in-use covers. Refer to Section, “Wiring Devices” for more information.

9. Each Panelboard shall be equipped with a built in Surge Protection Device, Class 1 on each panel; or remote within 10’-0” of panel. TVSS ratings shall be minimum:
   a. 160kVA per mode/320kVA per phase.
   b. UL 1449 listed.
   c. LED indicators.
   d. Alarm contacts for failure of unit or protection wired to site monitor.
   e. 208V/120V 3Φ grounded system.
   f. 400V peak for all modes.
   g. Field replaceable modules.

10. Temperature sensor to monitor ambient room temperature. Provide and wire contact from sensor to site monitoring by manufacturer.

K. Wire, Cable Transiting, and Grounding

1. All wiring shall be type THWN, #12 AWG minimum for power circuits, minimum #14 AWG stranded for control circuits, minimum #16 AWG for instrumentation circuits, and #10 DWG for current transformers. Refer to Section ;“Control-Voltage Cables” for more information.

L. Identification: Electrical identification devices and installation requirements are specified in Section "Electrical Identification."

1. Identify units, devices, controls, and wiring.

M. 1/4” thick x 3” wide x 24” long copper ground bar mounted approximately 6” above floor. A #4/0 green insulated copper ground cable shall be provided from the ground bar to the exterior ground pads. A (minimum #6 DWG)green insulated copper ground wire/cable will be provided from the ground bar to all auxiliary electrical equipment per NEC Table 250-95. All ground connectors inside the control house by control house manufacturer.

N. Provide (2) fire extinguishers, one at each exit, as required by ANSI/NFPA code.

2.3 SOURCE QUALITY CONTROL

A. Factory Tests: Perform the following factory-certified tests:
1. Verify that electrical control wiring installation complies with manufacturer's as-built drawings by means of point-to-point continuity testing. Verify that wiring installation complies with requirements in Division 16 Sections.
2. Inspect assembly, including wiring, components, connections, and equipment.
3. Relay, metering, and monitoring equipment program review.
4. Owner and/or engineer will witness all required factory tests. Notify engineer at least 14 days before date of tests and indicate their approximate duration.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces where control house will be installed for compliance with installation tolerances, required clearances, and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Anchor control house assembly to 4-inch (100-mm) channel-iron embedded in concrete base and attach by bolting.

1. Sills: Select to suit control house; level and grout flush into concrete base.
2. Concrete Bases: Provided and designed by others.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, brackets, and temporary blocking of moving parts from control house units and components.

C. The Electrical Contractor shall be responsible for installing the control house per manufacturer written instructions. The E.C. shall be responsible for temporary, physical and weather element protection at site, all final power and communications terminations, conduit stub-up coordination, conduit and wire, bolting to pads, rigging, joining of shipping splits including control wiring, and standby assistance during commissioning for this equipment: **Note:** Actual commissioning (including final check of terminations, start-up and testing of equipment) will be performed by the manufacturer’s representative.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Section "Electrical Identification."

B. Diagrams and Instructions:

1. Frame and mount under clear acrylic plastic on front of control house.
a. Operating Instructions: Printed basic instructions for control house, including control and key-interlock sequences and emergency procedures.
b. System Power Riser Diagrams: Depict power sources, feeders, distribution components, and major loads.

2. Storage for Maintenance: Include a rack or holder, near the operating instructions, for a copy of maintenance manual.

3.4 CONNECTIONS

A. Ground equipment according to Section "Grounding and Bonding."

B. Connect wiring according to Section "Conductors and Cables" and Section “Control-Voltage Cables”.

3.5 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:
   1. Test insulation resistance for each component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:
   1. It shall be the manufacturer’s responsibility to provide on site product checkout and startup for as long as necessary to complete substation startup. This service shall be supplied when requested within one (1) week notice by the owner. The manufacturers start up technician shall remain on site until work is complete.
   2. The manufacturer shall provide the same tech with site knowledge for standby assistance during utility company testing. Technician shall assist Owner in any way required to help pass the testing.
   3. Inspect installation, including wiring, components, connections, and equipment. Test and adjust components and equipment.
   4. Verify that electrical control wiring installation complies with manufacturer's submittal by means of point-to-point continuity testing. Verify that wiring installation complies with requirements in Division 26 Sections.
   5. Complete installation and startup checks according to manufacturer's written instructions.
   6. Assist in field testing of equipment including pretesting and adjusting of equipment and components.
   7. Report results in writing

C. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters. Perform all NETA tests and inspections for each of the following NETA categories:
   a. Protective relays.
   b. Instrument transformers.
   c. Metering and instrumentation.
   d. Battery systems.
   e. Surge arresters.
   f. Capacitors.

2. Remove and replace malfunctioning units and retest as specified above.

3.6 ADJUSTING
   A. Set field-adjustable, protective-relay trip characteristics.

3.7 CLEANING
   A. Upon completion of installation, inspect interior and exterior of control house. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair damaged finishes.

3.8 PROTECTION
   A. Temporary Heating: Apply temporary heat to control house, according to manufacturer's written instructions, throughout periods when control house environment is not controlled for temperature and humidity within manufacturers stipulated service conditions.

3.9 DEMONSTRATION
   A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain control house.

END OF SECTION 264950
SECTION 265113 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Interior lighting fixtures, lamps, and ballasts.
   2. Emergency lighting units.
   3. Exit signs.
   4. Lighting fixture supports.

B. Lighting fixture designations are indicated on the contract documents by an alpha-numeric designation adjacent to each lighting fixture symbol or by a note for areas where fixtures are alike. Refer to drawings for type, count, and specific manufacturer and model number.

1.3 DEFINITIONS

A. BF: Ballast factor.

B. CRI: Color-rendering index.

C. CU: Coefficient of utilization.

D. HID: High-intensity discharge.

E. LER: Luminaire efficacy rating.

F. Luminaire: Complete lighting fixture, including ballast housing if provided.

G. RCR: Room cavity ratio.

H. PIR: Passive Infrared
1.4 SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
   1. Physical description of lighting fixture including dimensions.
   2. Emergency lighting units including battery and charger.

B. Field quality-control test reports.

C. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

D. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. 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.

B. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.7 WARRANTY

A. Special Warranty for Emergency Lighting Batteries: Manufacturer’s standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
   1. Warranty Period for Emergency Lighting Unit Batteries: 5 years from date of Substantial Completion.
   2. Warranty Period for Self-Powered Exit Sign Batteries: 5 years from date of Substantial Completion.
B. Special Warranty for Ballasts: Manufacturer's standard form in which ballast manufacturer agrees to repair or replace ballasts that fail in materials or workmanship within specified warranty period.
   1. Warranty Period for Electronic Ballasts: Five years from date of Substantial Completion.
   2. Warranty Period for Electromagnetic Ballasts: Three years from date of Substantial Completion.

C. Special Warranty for T8 Fluorescent Lamps: Manufacturer's standard form, made out to Owner and signed by lamp manufacturer agreeing to replace lamps that fail in materials or workmanship, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
   1. Warranty Period: One year from date of Substantial Completion.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Lamps: Furnish at least one of each type.
   2. Plastic Diffusers and Lenses: Furnish at least one of each type.
   3. Battery and Charger Data: One for each emergency lighting unit.
   4. Ballasts: Furnish at least one of each type.
   5. Globes and Guards: Furnish at least one of each type.

PART 2 - PRODUCTS

2.1 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Incandescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A.

C. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.

D. HID Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5B.

E. Metal Parts: Free of burrs and sharp corners and edges.

F. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
G. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

H. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
   1. White Surfaces: 85 percent.
   2. Specular Surfaces: 83 percent.
   3. Diffusing Specular Surfaces: 75 percent.
   4. Laminated Silver Metallized Film: 90 percent.

I. Plastic Diffusers, Covers, and Globes:
   1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
      a. Lens Thickness: At least 0.125 inch minimum unless different thickness is indicated.
      b. UV stabilized.
   2. Glass: Annealed crystal glass, unless otherwise indicated.

2.2 BALLASTS FOR LINEAR FLUORESCENT LAMPS

A. Electronic Ballasts: Comply with ANSI C82.11; instant-start type, unless otherwise indicated, and designed for type and quantity of lamps served. Ballasts shall be designed for full light output unless dimmer or bi-level control is indicated.
   1. Sound Rating: A.
   2. Total Harmonic Distortion Rating: Less than 10 percent.
   3. Transient Voltage Protection: IEEE C62.41, Category A or better.
   4. Operating Frequency: 20 kHz or higher.
   5. Lamp Current Crest Factor: 1.7 or less.
   6. BF: 0.85 or higher.
   7. Power Factor: 0.95 or higher.

B. Electromagnetic Ballasts: Comply with ANSI C82.1; energy saving, high-power factor, Class P, and having automatic-reset thermal protection.

2.3 BALLASTS FOR COMPACT FLUORESCENT LAMPS

A. Description: Electronic programmed rapid-start type, complying with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:
1. Lamp end-of-life detection and shutdown circuit.
2. Automatic lamp starting after lamp replacement.
3. Sound Rating: A.
4. Total Harmonic Distortion Rating: Less than 20 percent.
5. Transient Voltage Protection: IEEE C62.41, Category A or better.
6. Operating Frequency: 20 kHz or higher.
7. Lamp Current Crest Factor: 1.7 or less.
8. BF: 0.95 or higher, unless otherwise indicated.
9. Power Factor: 0.95 or higher.

2.4 EMERGENCY FLUORESCENT POWER UNIT

A. Internal Type: Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture body and compatible with ballast capable of powering one or more remote fluorescent lamps. Comply with UL 924.
   1. Emergency Connection: Operate all fluorescent lamps continuously at a maximum Lumen output of each fixture connected to one emergency unit. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
   2. Test Push Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.
      a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
      b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
   3. Battery: Sealed, maintenance-free, lead calcium type.
   5. Housing: NEMA 250, type I enclosure.

2.5 BALLASTS FOR HID LAMPS

A. Electromagnetic Ballast for Metal-Halide Lamps: Comply with ANSI C82.4 and UL 1029. Include the following features, unless otherwise indicated:
   1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.
   2. Minimum Starting Temperature: Minus 22 deg F (Minus 30 deg C) for single-lamp ballasts.
4. Open-circuit operation that will not reduce average life.

B. Electronic Ballast for Metal-Halide Lamps: For all HID fixtures where applicable, include the following features unless otherwise indicated:
   1. Lamp end-of-life detection and shutdown circuit.
   2. Sound Rating: A.
   3. Total Harmonic Distortion Rating: Less than 15 percent.
   4. Transient Voltage Protection: IEEE C62.41, Category A or better.
   5. Lamp Current Crest Factor: 1.5 or less.
   6. Power Factor: .90 or higher.
   7. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
   8. Protection: Class P thermal cutout.

C. Electronic Ballast for Pulse Start Metal-Halide Lamps in a Class I, Division location:
   1. Cooper Crouse-Hinds Super CWA 120/277/347 or approved equal.

2.6 EXIT SIGNS

A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:
   1. Retain one of two subparagraphs below. See Evaluations for discussion of energy considerations.
   2. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.
   3. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
      a. Battery: Sealed, maintenance-free, lead calcium type.
      b. Charger: Fully automatic, solid-state type with sealed transfer relay.
      c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
      d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
      e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
   4. Master/Remote Sign Configurations:
a. Master Unit: Comply with requirements above for self-powered exit signs, and provide additional capacity for power connection to remote unit.

b. Remote Unit: Comply with requirements above for self-powered exit signs, except omit power supply, battery and test features. Arrange to receive full power requirements from master unit. Connect for testing concurrently with master unit as a unified system.

5. Exit Signs for use in a Class I, Division 2 location
   a. Cooper Sure-Lites series UX with HAZ option or approved equal.

2.7 EMERGENCY LIGHTING UNITS

A. Description: Self-contained units complying with UL 924.

1. Battery: Sealed, maintenance-free, lead-calcium type.

2. Charger: Fully automatic, solid-state type with sealed transfer relay.

3. Operation: Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.

4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.

5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

6. Emergency Lighting units for use in a Class I, Division 2 location
   a. Cooper Crouse-Hinds N2LPS series or approved equal

2.8 FLUORESCENT LAMPS

A. Low-Mercury Lamps: Comply with EPA's toxicity characteristic leaching procedure test; shall yield less than 0.2 mg of mercury per liter when tested according to NEMA LL 1.

B. T8 rapid-start low-mercury lamps, rated 32 W maximum, nominal length of 48 inches (1220 mm), 2800 initial lumens (minimum), CRI 75 (minimum), color temperature 3500 K, and average rated life 20,000 hours, unless otherwise indicated.

2.9 COMPACT FLUORESCENT LAMPS

A. 4-Pin, low mercury, CRI 80 (minimum), color temperature 3500, average rated life of 10,000 hours at 3 hours operation per start, unless otherwise indicated.

   1. 13W: T4, double or triple tube, rated 900 initial lumens (minimum).
2. 18W: T4, double or triple tube, rated 1200 initial lumens (minimum).
3. 26W: T4, double or triple tube, rated 1800 initial lumens (minimum).

B. Low mercury products may not be available in higher-wattage products in the three subparagraphs below. Consult manufacturers.
1. 32W: T4, double or triple tube, rated 2400 initial lumens (minimum).
2. 42W: T4, double or triple tube, rated 3200 initial lumens (minimum).
3. 55W: T4, double or triple tube, rated 4300 initial lumens (minimum).

2.10 HID LAMPS
A. Metal-Halide Lamps: M58PG-175W, with a minimum CRI 65, and color temperature 4000 K.
B. Pulse Start Metal-Halide Lamps: GE MXR400/VBU/PA or approved equal.

2.11 LIGHTING FIXTURE SUPPORT COMPONENTS
A. Comply with Section 260529 "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.
B. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
E. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

2.12 REQUIREMENTS FOR INDIVIDUAL LIGHTING FIXTURES
A. Refer to drawings for lighting fixture specifications.
   1. Basis-of-Design Product: Cooper Lighting or equal.

PART 3 - EXECUTION

3.1 INSTALLATION
A. Install light fixtures per the manufacturer’s written installation instructions.
B. Support for lighting fixtures in or on grid-type suspended ceilings:
1. Install a minimum of four ceiling support system rods or wires for each fixture to the structure above the ceiling. Locate not more than 6 inches from lighting fixture corners.

C. Suspended Lighting Fixture Support:
   1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
   3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
   4. Mount fixtures at heights as indicated on contract documents.

D. Adjust aimable lighting fixtures to provide required light intensities.

E. Connect wiring according to Section 260519 "Conductors and Cables."

3.2 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 265113
SECTION 265623 - EXTERIOR LIGHTING

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. This Section includes the following:
      1. Exterior luminaires with lamps and ballasts.
      2. Luminaire-mounted photoelectric relays.
      3. Poles and accessories.

1.3 DEFINITIONS
   A. CRI: Color-rendering index.
   B. HID: High-intensity discharge.
   C. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.4 SUBMITTALS
   A. Product Data: For each luminaire and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:
      1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
      2. Details of attaching luminaires and accessories.
      3. Details of installation and construction.
      4. Luminaire materials.
      5. Photoelectric relays.
      6. Ballasts, including energy-efficiency data.
      7. Lamps, including life, output, and energy-efficiency data.
      8. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
B. Field quality-control test reports.

C. Operation and Maintenance Data: For luminaires to include in emergency, operation, and maintenance manuals.

D. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. 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.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.

1. Warranty Period for Luminaires: Five years from date of Substantial Completion.

2. Warranty Period for Metal Corrosion: Five years from date of Substantial Completion.

3. Warranty Period for Color Retention: Five years from date of Substantial Completion.

4. Warranty Period for Lamps: Replace lamps and fuses that fail within 12 months from date of Substantial Completion.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: 1 of each type and rating installed. Furnish at least one of each type.

2. Glass and Plastic Lenses, Covers, and Other Optical Parts: 1 of each type and rating installed.

3. Ballasts: 1 of each type and rating installed. Furnish at least one of each type.

4. Globes and Guards: 1 of each type and rating installed. Furnish at least one of each type.
PART 2 - PRODUCTS

2.1 LUMINAIRES, GENERAL REQUIREMENTS

A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

B. Metal Parts: Free of burrs and sharp corners and edges.

C. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.

D. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.

E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

F. Exposed Hardware Material: Stainless steel.

G. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

H. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
   1. White Surfaces: 85 percent.
   2. Specular Surfaces: 83 percent.
   3. Diffusing Specular Surfaces: 75 percent.

I. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

J. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping.

K. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
   1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of polyester powder coat finish.

2.2 BALLASTS FOR HID LAMPS

A. Comply with ANSI C82.4 and UL 1029 and capable of open-circuit operation without reduction of average lamp life. Include the following features, unless otherwise indicated:
   1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.
   2. Minimum Starting Temperature: Minus 22 deg F (Minus 30 deg C).
   4. Ballast Fuses: One in each ungrounded power supply conductor. Voltage and current ratings as recommended by ballast manufacturer.

2.3 HID LAMPS

A. Metal-Halide Lamps: ANSI C78.1372, with a minimum CRI 65, and color temperature 3500 K.

2.4 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

A. Comply with UL 773 or UL 773A.

B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay.
   1. Relay with locking-type receptacle shall comply with NEMA C136.10.
   2. Adjustable window slide for adjusting on-off set points.

2.5 SUPPORT COMPONENTS, GENERAL REQUIREMENTS

A. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts, unless otherwise indicated.

B. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
   1. Materials: Shall not cause galvanic action at contact points.
   2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication, unless stainless-steel items are indicated.
   3. Anchor-Bolt Template: Plywood or steel.
PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION
A. Install light fixtures per the manufacturer’s written installation instructions.
B. Install lamps in each luminaire.
C. Fasten luminaire to structural supports.
   1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
D. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources.

3.2 SENSOR INSTALLATION
A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer’s written instructions.

3.3 CORROSION PREVENTION
A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
B. Steel Conduits: Comply with Division 26 Section 260533 "Raceways, Boxes and Cabinets." In concrete foundations, wrap conduit with 0.010-inch thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.4 FIELD QUALITY CONTROL
A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.
   1. Verify operation of photoelectric controls.
C. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.
D. Perform the following field tests and inspections and prepare test reports:
   1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
2. Operational Test: Verify operation of each lighting control device and adjust time delays.

E. Lighting control devices that fail tests and inspections are defective work.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 265623
SECTION 271500 - COMMUNICATIONS HORIZONTAL CABLING

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. Pathways.
   2. Multiuser telecommunications outlet assemblies.
   3. Cable connecting hardware, patch panels, and cross-connects.
   4. Telecommunications outlet/connectors.
   5. Cabling system identification products.
   6. Cable management system.

1.3 DEFINITIONS


B. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel.

C. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.

D. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

E. EMI: Electromagnetic interference.

F. IDC: Insulation displacement connector.

G. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).

H. LAN: Local area network.
I. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications outlet/connectors.

J. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.

K. RCDD: Registered Communications Distribution Designer.

L. Solid-Bottom or Nonventilated Cable Tray: A fabricated structure consisting of longitudinal side rails and a bottom without ventilation openings.

M. Trough or Ventilated Cable Tray: A fabricated structure consisting of longitudinal side rails and a bottom having openings for the passage of air.

N. UTP: Unshielded twisted pair.

1.4 HORIZONTAL CABELING DESCRIPTION

A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.

1. TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.

2. Horizontal cabling shall contain no more that one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.

3. Bridged taps and splices shall not be installed in the horizontal cabling.

4. Splitters shall not be installed as part of the optical fiber cabling.

B. The maximum allowable horizontal cable length is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment. The maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) in the horizontal cross-connect.

1.5 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

1.6 SUBMITTALS

A. Qualification Data: For installer, qualified layout technician, installation supervisor, and field inspector.
B. Source quality-control reports.

C. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

B. Testing Agency Qualifications: An NRTL.
   1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Flame-Spread Index: 25 or less.
   2. Smoke-Developed Index: 450 or less.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.


1.8 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.
   1. Test each pair of UTP cable for open and short circuits.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.10 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.
1.11  EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Device Plates: One of each type.
   2. Multiuser Telecommunications Outlet Assemblies: One of each type.

PART 2 - PRODUCTS

2.1  PATHWAYS

A. General Requirements: Comply with TIA/EIA-569-A.

B. Conduit and Boxes: Comply with requirements in Division 16 Section 1600 "Raceways, Boxes and Cabinets." Flexible metal conduit shall not be used.
   1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

2.2  BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm).

2.3  UTP CABLE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Belden CDT Inc.; Electronics Division.
   2. Berk-Tek; a Nexans company.
   3. CommScope, Inc.
   4. Draka USA.
   5. Genesis Cable Products; Honeywell International, Inc.
   6. KRONE Incorporated.
   7. Mohawk; a division of Belden CDT.
   8. Nordex/CDT; a subsidiary of Cable Design Technologies.
   9. Superior Essex Inc.
  10. SYSTIMAX Solutions; a CommScope, Inc. brand.
  11. 3M.
  12. Tyco Electronics/AMP Netconnect; Tyco International Ltd.
B. Description: 100-ohm, 4-pair UTP, formed into 25-pair, binder groups covered with a blue thermoplastic jacket.
   1. Comply with ICEA S-90-661 for mechanical properties.
   2. Comply with TIA/EIA-568-B.1 for performance specifications.
   4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
      a. Communications, General Purpose: Type CM or CMG.
      b. Communications, Plenum Rated: Type CMP, complying with NFPA 262.

2.4 UTP CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Dynacom Corporation.
   3. Hubbell Premise Wiring.
   4. KRONE Incorporated.
   5. Leviton Voice & Data Division.
   6. Molex Premise Networks; a division of Molex, Inc.
   7. Nordex/CDT; a subsidiary of Cable Design Technologies.
   8. Panduit Corp.
   10. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

C. Connecting Blocks: 66-style IDC for Category 6. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
   1. Number of Terminals per Field: One for each conductor in assigned cables.

E. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
1. Number of Jacks per Field: One for each four-pair conductor group of indicated cables, plus spares and blank positions adequate to suit specified expansion criteria.

F. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

G. Patch Cords: Factory-made, four-pair cables in 36-inch (900 mm) or 48-inch (1200-mm) lengths; terminated with eight-position modular plug at each end.
   1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.
   2. Patch cords shall have color-coded boots for circuit identification.

2.5 TELECOMMUNICATIONS OUTLET/CONNECTORS


B. Workstation Outlets: Four-port-connector assemblies mounted in multigang faceplate.
   1. Plastic Faceplate: High-impact plastic. Coordinate color with Division 26 Section 262726 "Wiring Devices."
   2. Metal Faceplate: Brass, complying with requirements in Division 26 Section 262726 "Wiring Devices."
   3. For use with snap-in jacks accommodating any combination of UTP, optical fiber, and coaxial work area cords.
      a. Flush mounting jacks, positioning the cord at a 45-degree angle.
   4. Legend: Machine printed, in the field, using adhesive-tape label.

2.6 GROUNDING

A. Comply with requirements in Division 26 Section 260526 "Grounding and Bonding" for grounding conductors and connectors.

B. Comply with ANSI-J-STD-607-A.

2.7 IDENTIFICATION PRODUCTS

A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

B. Comply with requirements in Division 26 Section 260553 "Electrical Identification."
2.8  SOURCE QUALITY CONTROL

A.  Testing Agency: Engage a qualified testing agency to evaluate cables.
B.  Factory test UTP cables according to TIA/EIA-568-B.2.
C.  Cable will be considered defective if it does not pass tests and inspections.
D.  Prepare test and inspection reports.

PART 3 - EXECUTION

3.1  ENTRANCE FACILITIES

A.  Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2  WIRING METHODS

A.  Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
   1.  Comply with requirements for raceways and boxes specified in Division 26 Section 260533 "Raceways, Boxes and Cabinets."

3.3  INSTALLATION OF PATHWAYS

A.  Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
B.  Comply with requirements in Division 26 Section 260533 "Raceways, Boxes and Cabinets" for installation of conduits and wireways.
C.  Install manufactured conduit sweeps and long-radius elbows whenever possible.
D.  Pathway Installation in Communications Equipment Rooms:
   1.  Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
   2.  Install cable trays to route cables if conduits cannot be located in these positions.
   3.  Secure conduits to backboard when entering room from overhead.
   4.  Extend conduits 3 inches (76 mm) above finished floor.
   5.  Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
E. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.4 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:
   2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
   3. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
   4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
   5. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
   6. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
   7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
   8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
   9. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
   10. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:
   2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. Separation from EMI Sources:
   1. Comply with BICSI TDMM and TIA/EIA-569-A for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
   2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).

6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.5 FIRESTOPPING

A. Comply with TIA/EIA-569-A, Annex A, "Firestopping."

B. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.6 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with ANSI-J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding
bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.7 IDENTIFICATION

A. Cable and Wire Identification:

1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.

2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.

3. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
   a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
   b. Label each unit and field within distribution racks and frames.

4. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

5. Uniquely identify and label work area cables extending from the MUTOA to the work area. These cables may not exceed the length stated on the MUTOA label.

B. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.

1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Visually confirm Category 6, marking of outlets, cover plates, outlet/connectors, and patch panels.

2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test cables after termination but not cross-connection.
   a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

4. UTP Performance Tests:
   a. Test for each outlet and MUTOA. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.2:
      1) Wire map.
      2) Length (physical vs. electrical, and length requirements).
      3) Insertion loss.
      4) Near-end crosstalk (NEXT) loss.
      5) Power sum near-end crosstalk (PSNEXT) loss.
      6) Equal-level far-end crosstalk (ELFEXT).
      7) Power sum equal-level far-end crosstalk (PSELFEXT).
      8) Return loss.
      9) Propagation delay.
     10) Delay skew.

5. Final Verification Tests: Perform verification tests for UTP systems after the complete communications cabling and workstation outlet/connectors are installed.
   a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.
   b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.

D. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

E. End-to-end cabling will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION 271500