Issued: November 14, 2022

PROJECT MANUAL

VOLUME 01 OF 01: DIVISIONS 00 – 26

Cornwall Central School District
Middle School Air Conditioning Project

- Cornwall Central Middle School SED# 44-03-01-06-0-0001-029

The design of this project conforms to applicable provisions of the New York State Uniform Fire Prevention and Building Code the New York State Energy Conservation Construction Code and the Manual of Planning Standards of the New York State Education Department

BLAKE ENGINEERING PLLC

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SECTION 001113 – ADVERTISEMENT TO BIDDERS

Engineer
Blake Engineering PLLC
1898 County Route 1
Westtown, NY 10998
PH: 845-820-3431

Project Information
Cornwall Central School District
24 Idlewild Ave.
Cornwall on Hudson, NY 12520
PH: 845-534-8009

Cornwall Central Middle School Air Conditioning Project

Cornwall Central Middle School SED# 44-03-01-06-0-001-029

The Owner, the School Board of Cornwall Central School District, will receive sealed bids to furnish materials and labor to complete the Air Conditioning Project within the District, as noted above. Each bid shall be on a stipulated sum basis for the following contract(s):

Contract No. 01 – Mechanical Construction (MC)
Contract No. 02 – Electrical Construction (EC)

Two copies of sealed bids in an envelope on which is clearly stated the contract number and title will be received until **3:00 pm** on **December 8, 2022,** at Cornwall Central School District Business Office, 24 Idlewild Avenue, Cornwall on Hudson, NY 12520. Bids received after this time will not be accepted and returned to Bidder unopened. Bids will be opened publicly and read aloud after specified receipt time. All interested parties are invited to attend.

It is the intention of this Project to be both environmentally and fiscally conscious of paper use and consumption. Therefore, documents will be distributed as digital sets. Bidding Documents, Drawings, and Specifications may be viewed online free of charge beginning **November 14, 2022,** at www.revplans.com under 'Public Projects', or electronically downloaded for a non-refundable charge of one hundred dollars ($100.00).

Complete sets of Bidding Documents, Drawings, and Specifications, on compact disc (CD) in PDF format may be obtained from REVplans, 28 Church Street, Unit 7, Warwick, NY 10990 Tel: 1-877-272-0216, upon depositing the sum of one hundred dollars ($100.00) for each combined set of documents. Checks or money orders shall be made payable to Cornwall Central School District.

All bid addenda will be transmitted to registered plan holders via e-mail and will be available on www.revplans.com.

Each Bidder must deposit a Bid Security in the amount and form per the conditions provided in Instructions to Bidders. All Bids will remain subject to acceptance for forty-five (45) days after the Bid Opening. Owner may, in its sole discretion, release any Bid and return Bid Security prior to that date.

A full performance bond, together with labor and material payment bonds in form acceptable to Owner, shall be required of the successful Bidder for the full contract amount.

The award of bid pursuant to this notice is subject to appropriation of funds for this purpose in accordance with the applicable provisions of the General Municipal Law. All bids must meet the requirements of the General Municipal law of the State of New York and all other applicable statues and have attached

a statement of non-collusion. All documents submitted in connection with this bid will become the property of the Cornwall Central School District, and the district will not return bids or bid documents.

A Pre-Bid Conference will be held on **Tuesday November 22, 2022,** at **10:00 am**, at **Cornwall Central Middle School, 122 Main Street, Cornwall, NY.** Use this page to verify identification as a Bidder. Attendance at this meeting is requested as the Owner and Engineer will be present to discuss the Project. Attendees should anticipate a Q & A session, followed by a walk-thru of the respective spaces/buildings. The Engineer will transmit to all listed Bidders record of Addenda in response to clarifications arising from the Conference.

Bids shall not include New York State sales and compensating use taxes on materials and supplies incorporated into the Work, the Owner being exempt therefrom. The Bidders must comply with New York State Department of Labor Prevailing Wage Rate Schedule and conditions of employment.

The Board of Education of the Cornwall Central School District reserves the right to waive any informality in submitted bids, reject any or all bids, and to award contracts on its determination of the lowest responsible bidder.

By Order of: Cornwall Central School District

END OF SECTION 001113

SECTION 002113 – INSTRUCTIONS TO BIDDERS

PART 1 - DEFINITIONS

A. Bidding Documents include the Bidding Requirements and the proposed Contract Documents. The Bidding Requirements consist of the Invitation to Bid, Instruction to Bidders, the Bid Form, Supplementary Bid Forms and other sample bidding and contract forms.

B. Contract Documents include the Contract Forms between the Owner and Contractor, Contractor's executed Bid Form and executed Supplementary Bid Forms, Conditions of the Contract (General, supplemental and other Conditions), Drawings, Specifications and all Addenda issued prior to execution of the Contract.

C. Definitions set forth in the General Conditions of the Contract of Construction, or in other Contract Documents are applicable to the Bidding Documents.

D. Addenda are written or graphic instruments issued by the Engineer prior to the execution of the Contract which modify or interpret the Bidding Documents by additions, deletions, clarifications or corrections.

E. A Bid is a complete and properly executed proposal to do the Work for the sums stipulated therein, submitted in accordance with the Bidding Documents.

1. Wherever the word "Bid" occurs in the documents, it refers to Bidders Proposal.

F. The Base Bid is an amount stated in the Bid for which the Bidder offers to perform the Work described in the Bidding Documents.

G. An Alternate is an amount stated on the Bid Form to be added to or deducted from the amount of the Base Bid if the corresponding change in the Work, as described in the Bidding Documents, is accepted.

H. A Unit Price is an amount stated on the Bid Form as a price per unit of measurement for materials, equipment for services or a portion of the Work as described in the Bidding Documents.

I. A Bidder is a person or entity who submits a Bid and who meets the requirements set forth in the Bidding Documents.

1. A Sub-bidder is a person or entity who submits a Bid to a Bidder for materials, equipment or labor for a portion of the Work.

PART 2 - BIDDER'S REPRESENTATIONS

A. The Bidder by making a Bid represents that:

1. The Bidder has read and understands the Bidding Documents, to the extent that such documentation relates to the Work for which the Bid is submitted, and for other portions of the Project, if any, being Bid concurrently or presently under construction.
2. The Bid is made in compliance with the Bidding Documents.

3. The Bidder has visited the site, become familiar with local conditions under which the Work is to be performed and has correlated the Bidder's personal observations with the requirements of the proposed Contract Documents.
4. The Bid is based upon the materials, equipment and systems required by the Bidding Documents without exception.

B. Each Bidder is required to form an individual opinion of the quantities and character of construction work by personal examination of the site and all existing facilities where the project work is to be done, and of the plans and specifications relating to it by such means as is preferred. Each Bidder shall inspect accessible concealed areas of existing construction, provided no significant permanent damage is inflicted upon the property. Lack of knowledge about conditions in accessible concealed areas shall not be the basis for additional cost claims at a later time.

C. By submission of this bid, each bidder and each person signing on behalf of any bidder certifies, and in the case of a joint bid, each party thereto certifies as to its own organization, under penalty of perjury, that the budder has and has implemented a written policy addressing sexual harassment prevention in the workplace and provides annual sexual harassment prevention training to all its employees. Such policy shall, at minimum, meet the requirements of Section 201-G of the New York State Labor Law.

PART 3 - BIDDING DOCUMENTS

3.1 COPIES

A. It is the intention of this Project to be both environmentally and fiscally conscious of paper use and consumption. Therefore, documents will be distributed as digital sets. Bidding Documents, Drawings, and Specifications may be viewed online free of charge at www.revplans.com under 'Public Projects', or electronically downloaded for a non-refundable charge of one hundred dollars ($100.00).

1. Please note, in order to access online documents and information, a log in is required. New users can create a free online account upon visiting site by clicking 'Register for an Account'.

B. Complete sets of Bidding Documents, Drawings, and Specifications, on compact disc (CD) may be obtained from REVplans, 28 Church Street, Unit 7, Warwick, NY 10990 Tel: 1-877-272-0216, upon depositing the sum of one hundred dollars ($100.00) for each combined set of documents. Checks or money orders shall be made payable to Cornwall Central School District.

1. Deposit is refundable in accordance with the terms in the Instructions to Bidders to all submitting bids. Any bidder requiring CD(s) to be shipped shall make arrangements with the printer and pay for all related packaging and shipping costs.
2. Any bidder requiring paper copies of the Bidding Documents, Drawings, and Specifications, shall make arrangements with the printer, and pay for all related printing, packaging, and shipping costs. Such costs are non-refundable.

C. All bid addenda will be transmitted to registered plan holders via email and will be available at www.revplans.com. Plan holders who have paid for CD's or hard copies of the bid documents

will need to make the determination if hard copies of the addenda are required for their use and coordinate directly with the printer for hard copies of addenda to be issued.

1. There will be no charge for registered plan holders to obtain hard copies of the bid addenda.

D. Bidders shall use complete sets of Bidding Documents in preparing Bids; neither the Owner nor Engineer assumes responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

E. The Owner and Engineer may make copies of the Bidding Documents available on the above terms for the purpose of obtaining Bids on the Work. No license or grant of use is conferred by issuance of copies of the Bidding Documents.

3.2 INTERPRETATION OR CORRECTION OF BIDDING DOCUMENTS

A. The Bidder shall carefully study and compare the Bidding Documents with each other, and with other work being Bid concurrently or presently under construction to the extent that it relates to the Work for which the Bid is submitted, shall examine the site and local conditions, and shall at once report to the Engineer errors, inconsistencies or ambiguities discovered. All reports to the Engineer shall be in writing.

B. No interpretation of the meaning of the Contract Documents, the existing conditions, or of the scope of Work will be made verbally. Provide every request for such interpretation in writing, addressed to Blake Engineering, Attention: Broderick Knoell, 1898 County Route 1, Westtown, New York 10998 by e-mail: bknoell@blakeengineeringpllc.com and to be given consideration must be received at least seven (7) business days prior to the date of the Bids opening.

C. Interpretations, corrections and changes of the Bidding Documents will be made by Addendum. Interpretations, corrections and changes of the Bidding Documents made in any other manner will not be binding, and Bidders are not required to rely upon them.

D. The Bidding Documents for this project have been prepared using certain existing construction documents furnished by the Owner, which pertain to the construction of the existing conditions, and limited observations obtained by the Engineer at the project site.

1. More extensive investigations of existing conditions, including disassembly or testing of existing building components, was not undertaken by the Engineer.
2. Portrayal of such existing conditions obscured or concealed from the Owner or Engineer's view prior to the start of this Project's construction activities, is based on reasonable implications and assumptions. The Owner and Engineer do not imply or guarantee to the Bidders, in any way, that such portrayals are accurate or true existing conditions.

3.3 EQUIVALENTS

A. Each Bidder shall base his Bid upon the materials and equipment described in the Bidding Documents to the fullest extent possible.

B. In the specifications, two or more kinds, types, brands, or manufacturers or materials may be named. They shall be regarded as the required standard of quality, and overall, are judged to be

equalivent by the Engineer. The Bidder may select one of these named items as the basis for his Bid or, if the Bidder desires to use any other kind, type, brand, or manufacturer or material other than those named in the specification, it shall indicate in writing, when requested, and prior to the award of the Contract, what kind, type, brand, or manufacturer is proposed in lieu of the named specified item(s).

3.4 ADDENDA

A. Addenda will be transmitted to all that are known to have received a complete set of Bidding Documents.

1. Provide Bidding Document distributor with full company name, address, telephone and facsimile numbers and contact person’s name.

B. Copies of Addenda will be made available for inspection wherever Bidding Documents are on file for that purpose.

C. Addenda will not be issued later than five (5) business days prior to the time specified for receipt of Bids, except any Addendum withdrawing the request for Bids or one which includes postponement of the time for receipt of Bids.

D. Each Bidder shall ascertain upon submitting a Bid that the Bidder has received all Addenda issued, and the Bidder shall acknowledge their receipt on the Bid Form.

3.5 TAX LIABILITY

A. Bidders are exempt from payment of manufacturer's excise taxes for materials purchased for the exclusive use of the Owner, provided that manufacturer has complied with rules and regulation of the Commissioner of Internal Revenue Service.

B. New York State Sales Tax does not apply to this project. Contractors are exempt from payment on purchase of materials for the execution of this Contract and such taxes shall not be included in Bids. Exemption Certificates will be provided upon request.

C. All other taxes shall be included in the Bid.

3.6 PRE-BID CONFERENCE

A. There will be a Pre-Bid Conference as detailed in the Advertisement for Bids. A lack of representation at the Pre-Bid Conference will not be justification for additional costs due to unforeseen conditions during the construction phases of the Contracts.

PART 4 - BIDDING PROCEDURES

4.1 PREPARATION OF BIDS

A. Bids shall be submitted on forms identical to the Bid Forms contained in this Project Manual or submitted using unaltered and legible copies thereof.

B. All blanks on the Bid Form shall be legible executed in a non-erasable medium.

C. Sums shall be expressed in both words and figures. In case of discrepancy, the amount written in word shall govern.

D. Interlineations, alterations and erasures must be initialed by the signer of the Bid.

E. Bid all requested alternates. If no change in the Bid is required, enter "No Change."

F. Each copy of the Bid shall state the legal name of the Bidder and the nature of legal form of the Bidder. The Bidder shall provide evidence of legal authority to perform within the jurisdiction of the Work. Each Bid copy shall be signed by the person or persons legally authorized to bind the Bidder to a Contract. A Bid by a corporation shall further give the state of incorporation and have the corporate seal affixed. A Bid submitted by an agent shall have a current power of attorney attached certifying the agent's authority to bind the Bidder.

4.2 BID SECURITY

A. Each Bid must be accompanied by a certified bank check of the Bidder, or a Bid Bond prepared by a surety company licensed in New York State.

1. Bid Security shall be provided in the amount of five (5) percent of the dollar amount of the Base Bid.
2. Bid Security shall be payable to Cornwall Central School District.
3. If certified check is utilized, the Bidder shall provide written confirmation from a licensed New York State Surety company that Performance and Payment Bonds will be available to said Bidder for this project.
4. The apparent successful Bidders, upon failure or refusal to furnish the required Performance and Payment Bonds and execute a Contract within ten (10) calendar days after receipt of notice of the acceptance of Bid, shall forfeit the Bid Security as liquidated damages for such failure to refusal, and not as a penalty.
5. The successful Bidders shall have the Bid Security returned upon execution of an Owner/Contractor Agreement.
6. Unsuccessful Bidders shall have their Bid Security returned following the execution of the Owner/Contractor Agreements or the forty-five (45) day period following the Bid Opening, whichever occurs first.
7. The Bid Security shall not be forfeited to the Owner in the event the Owner fails to comply with subparagraph 6.2.

B. Surety Bond shall be written on AIA Document A310, Bid Bond, and the attorney-in-fact that executes the bond on behalf of the surety shall affix to the bond a certified and current copy of the power of attorney.

C. The Owner will have the right to retain the Bid Security of Bidders to whom an award is being considered until either:

1. The Contract has been executed and bonds, when required, have been furnished, or;
2. The specified time has elapsed so that Bids may be withdrawn or;
3. All Bids have been rejected.

4.3 SUBMISSION OF BIDS

A. All copies of the Bid, the Bid Security, and any other documents required to be submitted with the Bid shall be enclosed in a sealed opaque envelope. The envelope shall be addressed to the party receiving the Bids and shall be identified with the Project name, the Bidder's name and address and, if applicable, the designated Contract for which the Bid is submitted. If the Bid is sent by mail, the sealed envelope shall be enclosed in a separate mailing envelope with the notation "SEALED BID ENCLOSED" on the face thereof.

1. If Bidder submits for different Contracts, each shall be submitted individually and so labeled for that Contract.

B. Bids shall be deposited at the designated location prior to the time and date indicated in the Advertisement for Bids for the receipt of Bids. Bids received after the time and date for receipt of Bids will be returned unopened.

1. The Bidder shall assume full responsibility for timely delivery at the location designated for receipt of Bids.
2. Oral, telephonic, telegraphic, facsimile or other electronically transmitted Bids will not be considered.

C. Bids not exhibiting original signatures or seals will not be accepted as a responsive Bid.

D. Bids shall be submitted in duplicate. Executed forms required for each submitted Bid are as follows:

1. Bid Form.
2. Resolution.
3. Non-Collusive Bid Certification.
4. Iran Divestment Act Certification.
5. Bid Security.

4.4 MODIFICATION OR WITHDRAWAL OF BID

A. A Bid may not be modified, withdrawn or canceled by the Bidder during the stipulated period following the time and date designated for the receipt of Bids, and each Bidder so agrees in submitting a Bid. No Bidder may withdraw a Bid within the forty-five (45) day period following the time of the Bid Opening.

B. Prior to the time and date designated for receipt of Bids, a Bid submitted may be modified or withdrawn by notice to the party receiving Bids at the place designated for receipt of Bids. Such notice shall be in writing over the signature of the Bidder. Written confirmation over the signature of the Bidder shall be received, and date and time- stamped by the receiving party on or before the date and time set for receipt of Bids. A change shall be so worded as not to reveal the amount of the original Bid.

C. Withdrawn Bids may be resubmitted up to the date and time designated for the receipt of Bids, provided that they are then fully in conformance with these Instructions to Bidders.

PART 5 - CONSIDERATION OF BIDS

5.1 OPENING OF BIDS

A. The properly identified Bids received on time will be publicly opened and will be read aloud. An abstract of the Bids will be made available to Bidders.

5.2 REJECTION OF BIDS

A. The Owner shall maintain the right to reject any or all Bids. A Bid not accompanied by the required Bid Security or by other data required by the Bidding Documents, or which is in any way incomplete or irregular is subject to rejection.

5.3 AWARD OF BID

A. The Board of Education of the **Cornwall Central School District** reserves the right to waive any informality in submitted bids, reject any or all bids, and to award contracts on its determination of the lowest responsible bidder. The Owner shall have the right to accept Alternates in any order or combination, unless otherwise specifically provided in the Bidding Documents, and to determine the low Bidder on the basis of the sum of the Base Bid and Alternates accepted.

PART 6 - SUPPLEMENTARY BID FORMS

6.1 CONTRACTOR'S QUALIFICATION STATEMENT

A. Bidders to whom award of a Contract is under consideration shall submit to the Engineer & Construction Manager, within three (3) calendar days, a properly executed AIA Document A305, Contractor's Qualification Statement, unless such statement has been previously required and submitted as a prerequisite to the issuance of Bidding Documents.

6.2 OWNERS FINANCIAL CAPABILITY

A. The Owner shall, at the request of the Bidder to whom award of a Contract is under consideration and no later than seven (7) days prior to the expiration of the time for withdrawal of Bids, furnish to the Bidder reasonable evidence that financial arrangements have been made to fulfill the Owner's obligations under the Contract. Unless such reasonable evidence is furnished, the Bidder will not be required to execute the Agreement between the Owner and Contractor.

6.3 SUBMITTALS

A. Within three (3) calendar days following the Bid Opening time, the apparent lowest Bidder, shall furnish to the Owner through the Engineer the following information:

1. DRAFT Schedule of Values (cost breakdown)
2. Proposed Project Manager and Superintendent resumes.
3. Contractor’s Qualification Statement – AIA Document 305, 1986 edition.
4. Proposed Substitution List.
5. Proposed Subcontractor List.
6. Itemized list of Work to be self-performed.

B. The Bidder will be required to establish to the satisfaction of the Owner, Engineer and Construction Manager the reliability and responsibility of the persons or entities proposed to furnish and perform the Work described in the Bidding Documents.

C. Upon request only, the apparent second and third low Bidders shall be prepared to submit the information of paragraphs 6.1 and 6.3.A.

D. Prior to the execution of the Contract, the Construction Manager will notify the Bidder in writing if either the Owner, Engineer/Engineer or Construction Manager, after due investigation, has reasonable objection to a person or entity proposed by the Bidder. If the Owner, Engineer or Construction Manager has reasonable objection to a proposed person or entity, the Bidder may, at the Bidder's option, (1) withdraw the Bid or (2) submit an acceptable substitute person or entity. In the event of withdrawal or disqualification, Bid Security will not be forfeited.

E. Persons and entities proposed by the Bidder and to whom the Owner, Engineer and Construction Manager have made no reasonable objection must be used on the Work for whom they were proposed and shall not be changed except with the written consent of the Owner and Construction Manager.

F. Any Bidder, upon failure to submit the information required in subparagraphs 6.1.A, 6.3.A, and 6.3.B in the allowed time, may have the Bid rejected. In that event, the Bidder shall forfeit the Bid Security to the Owner as liquidated damages for such failure or refusal, and not as penalty.

6.4 BOND REQUIREMENTS

A. The Owner requires the apparent successful Bidder to furnish and deliver bonds, covering the faithful performance of the Contract Work and payment of all obligations arising thereunder duly executed by the Bidder and a surety company licensed to do business in New York State rating.

B. The premiums shall be included in the Bid and paid by the Contractor. The Bidder shall proportionally distribute the costs of such bonds between the Base Bid and any Alternates.

6.5 TIME OF DELIVERY AND FORM OF BONDS

A. The Bidder shall deliver the required bonds to the Owner through the Construction Manager on or before the time of execution of the Owner/Contractor Agreement. Bonds shall be payable to Cornwall Central School District.

B. Unless otherwise provided, the bonds shall be written on AIA Document A312, Performance Bond and Payment Bond, Version 2010. Both bonds shall be written in the amount of the Contract Sum.

C. The bonds shall be dated the same as the Owner/Contractor Agreement.

D. The Bidder shall require the attorney-in-fact who executes the required bonds on behalf of the surety to affix thereto a certified and current copy of the power of attorney.

PART 7 - AGREEMENT FORM BETWEEN OWNER AND CONTRACTOR

A. The Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum – Owner/Contractor Agreement – AIA Document A101, 2007 Edition.

END OF SECTION 002113

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SECTION 004116.1 – BID FORM CONTRACT NO. 01 – MECHANICAL CONSTRUCTION (MC)

BIDDER INFORMATION

COMPANY:_____

ADDRESS: _____

CONTACT:_____

TELEPHONE: (_____)_____

FACSIMILE: (_____)_____

E-MAIL:_____

BID TO (Owner):

Attention: Harvey Sotland
Cornwall Central School District Offices 24 Idlewild Avenue
Cornwall on Hudson, New York 12520

PROJECT TITLE:

Cornwall Central School District
Cornwall Middle School Air Conditioning Project

Cornwall Middle School SED# 44-03-01-06-0-001-029

1. Addenda: The Bidder acknowledges receipt of the following Bid Addenda:

No. _____ Dated _____

No. _____ Dated _____

No. _____ Dated _____

No. _____ Dated _____

2. Bid Security: Attached hereto is Bid Security in the form of (circle correct form) Bid Bond, Certified Check, Cash in the amount of five (5%) percent of the written Base Bid amount.

3. Representations: By making this Bid, the Bidder represents that they have examined and fully understands the requirements and intent of the Bidding and Contract Documents, including Drawings, Project Manual, and Addenda; and proposes to provide all labor, material, and equipment necessary to complete the Work on, or before, the dates specified in the Agreement.

4. Base Bid: _____ $ _____
(Words)* *(Figures)*
**In case of discrepancy, written word governs.*

5. Alternates:

   ADD Alternate MC-01: Perform all contract work on 2nd shift between the hours of 3:00 PM – 11:00 PM during the school year. Work to be completed in Spring 2023, as soon as equipment can be delivered, prior to the summer break.

   ADD to the base bid, the sum of:

   _____ ($ _____)

6. Allowances: The Bidder affirms that all allowances listed in the Bidding Documents have been included in the Base Bid and include related the overhead and profit for said Allowance.

7. Time of Commencement and Completion: The Bidder agrees to commence Work on the stipulated starting date(s) and will substantially complete the Work in accordance with the project schedule stipulated in specification Section 003113 Preliminary Schedules, and supplemental inclusions.

8. Rejection of Bids: The Bidder acknowledges that the Owner reserves the right to waive any informality in submitted bids, reject any or all bids, and to award contracts on its determination of the lowest responsible bidder.

9. Execution of Contract: If notice of the acceptance of this Bid is mailed, telegraphed, or otherwise delivered to the undersigned within forty-five (45) days after the date of the Bid Opening, or any time thereafter, the undersigned will, within ten (10) working days after the receipt of the form of Agreement, execute and deliver the Contract.

10. Site Visit: By initialing at the end of this paragraph the Bidder acknowledges visiting the project Site as requested by the Bidding Documents.

    _____

    (Name-Printed) *(Initials)*

11. Signature:

    _____

    (Signature) *(Date)*

12. Attachments: As itemized in the "Instructions to Bidders" for a complete Bid include the following:

    a. Bid Form
    b. Non-Collusive Bid Certification
    c. Iran Divestment Act Certification
    d. Resolution
    e. Bid Security

13. Supplementary Bid Information: If apparent lowest Bidder upon Bid Opening, submit in accordance with the "Instruction to Bidders" within 3 business days the following:

a. Draft Schedule of Values (cost breakdown)
b. Proposed Subcontractor List
c. Proposed Substitution List
d. Proposed Project Manager & Superintendent Resumes
e. Itemized list of Work to be self-performed
f. Contractor's Qualification Statement – AIA Document A305, 1986 edition

END OF SECTION 004116.1

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SECTION 004116.2 – BID FORM CONTRACT NO. 02 – ELECTRICAL CONSTRUCTION (EC)

BIDDER INFORMATION

COMPANY:_____

ADDRESS: _____

CONTACT:_____

TELEPHONE: (_____)_____

FACSIMILE: (_____)_____

E-MAIL:_____

BID TO (Owner):

Attention: Harvey Sotland
Cornwall Central School District Offices 24 Idlewild Avenue
Cornwall on Hudson, New York 12520

PROJECT TITLE:

Cornwall Central School District
Cornwall Middle School Air Conditioning Project

Cornwall Middle School SED# 44-03-01-06-0-001-029

1. Addenda: The Bidder acknowledges receipt of the following Bid Addenda:

No. _____ Dated _____

No. _____ Dated _____

No. _____ Dated _____

No. _____ Dated _____

2. Bid Security: Attached hereto is Bid Security in the form of (circle correct form) Bid Bond, Certified Check, Cash in the amount of five (5%) percent of the written Base Bid amount.

3. Representations: By making this Bid, the Bidder represents that they have examined and fully understands the requirements and intent of the Bidding and Contract Documents, including Drawings, Project Manual, and Addenda; and proposes to provide all labor, material, and equipment necessary to complete the Work on, or before, the dates specified in the Agreement.

4. Base Bid: _____ $ _____
(Words)* *(Figures)*
**In case of discrepancy, written word governs.*

5. Alternates:

   ADD Alternate EC-01: Perform all contract work on 2nd shift between the hours of 3:00 PM – 11:00 PM during the school year. Work to be completed in Spring 2023, as soon as equipment can be delivered, prior to the summer break.

   ADD to the base bid, the sum of:

   _____ ($ _____)

6. Allowances: The Bidder affirms that all allowances listed in the Bidding Documents have been included in the Base Bid and include related the overhead and profit for said Allowance.

7. Time of Commencement and Completion: The Bidder agrees to commence Work on the stipulated starting date(s) and will substantially complete the Work in accordance with the project schedule stipulated in specification Section 003113 Preliminary Schedules, and supplemental inclusions.

8. Rejection of Bids: The Bidder acknowledges that the Owner reserves the right to waive any informality in submitted bids, reject any or all bids, and to award contracts on its determination of the lowest responsible bidder.

9. Execution of Contract: If notice of the acceptance of this Bid is mailed, telegraphed, or otherwise delivered to the undersigned within forty-five (45) days after the date of the Bid Opening, or any time thereafter, the undersigned will, within ten (10) working days after the receipt of the form of Agreement, execute and deliver the Contract.

10. Site Visit: By initialing at the end of this paragraph the Bidder acknowledges visiting the project Site as requested by the Bidding Documents.

    _____

    (Name-Printed) *(Initials)*

11. Signature:

    _____

    (Signature) *(Date)*

12. Attachments: As itemized in the "Instructions to Bidders" for a complete Bid include the following:

    a. Bid Form
    b. Non-Collusive Bid Certification
    c. Iran Divestment Act Certification
    d. Resolution
    e. Bid Security

13. Supplementary Bid Information: If apparent lowest Bidder upon Bid Opening, submit in accordance with the "Instruction to Bidders" within 3 business days the following:

a. Draft Schedule of Values (cost breakdown)
b. Proposed Subcontractor List
c. Proposed Substitution List
d. Proposed Project Manager & Superintendent Resumes
e. Itemized list of Work to be self-performed
f. Contractor's Qualification Statement – AIA Document A305, 1986 edition

END OF SECTION 004116.2

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SECTION 004519 – NON-COLLUSION AFFIDAVIT

The following provisions of the New York State General Municipal Law form a part of the Bidding Requirements:

NON-COLLUSIVE BIDDING CERTIFICATION

A. By submission of this Bid, each Bidder and each person signing on behalf of any Bidder certifies, and in the case of a joint Bid, each party thereto certifies as to its own organization, under penalty of perjury, that, to the best of his or her knowledge and belief:

1. The prices in this Bid have been arrived at independently without collusion, consultation, communication, or agreement, for the purpose of restricting competition, as to any matter relating to such prices with any other bidder or with any competitor.
2. Unless otherwise required by law, the prices which have been quoted in this Bid have not been knowingly disclosed by the Bidder and will not knowingly be disclosed by the Bidder prior to opening, directly or indirectly, to any other bidder or to any competitor; and
3. No attempt has been made or will be made by the Bidder to induce any other person, partnership or corporation to submit or not to submit a bid for the purpose of restricting competition.

B. A Bid shall not be considered for award nor shall any award be made where (A) (1), (2) and (3) above have not been complied with; provided, however, that if in any case the Bidder cannot make the foregoing certification, the Bidder shall so state and shall so furnish with the Bid, a signed statement which sets forth in detail the reasons therefore. Where (A) (1), (2) and (3) above have not been complied with, the Bid shall not be considered for award nor shall any award be made unless the head of the purchasing unit of the political subdivision, public department, agency or official thereof to which the Bid is made, or his designee, determines that such disclosure was not made for the purpose of restricting competition.

The fact that a bidder (a) has published price lists, rates, or tariffs covering items being procured, has informed prospective customers of proposed or pending publication of new or revised price lists for such items, or (c) has sold the same items to other customers at the same prices being bid, does not constitute, without more, a disclosure within the meaning of subparagraph (A).

C. Any bid hereafter made to any political subdivision of the State or any public department, agency or official thereof by a corporate bidder for work or services performed or to be performed or goods sold or to be sold, where competitive bidding is required by statute, rule, regulation, or local law, and where such bid contains the certification referred to in subdivision one of this section, shall be deemed to have been authorized by the board of directors of the bidder, and such authorization shall be deemed to include the signing and submission of the bid and the inclusion therein of the certificate as to non-collusion as the act and deed of the corporation.

D. The person signing this Bid or Proposal certifies that he has fully informed himself regarding the accuracy of the statements contained in this certification, and under the penalties of perjury, affirms the truth thereof, such penalties being applicable to the Bidder as well to the person signing in his behalf.

Signature _____

Date _____

Title _____ Federal ID No.: _____

Business Address: _____

Telephone: _____ Email: _____

END OF SECTION 004519

SECTION 004520 – IRAN DIVESTMENT ACT AFFIDAVIT

The following provisions of the New York State General Municipal Law form a part of the Bidding Requirements:

IRAN DIVESTMENT ACT CERTIFICATION

A. By submission of this Bid, each Bidder and each person signing on behalf of any Bidder certifies, and in the case of a joint Bid, each party thereto certifies as to its own organization, under penalty of perjury, that, to the best of his or her knowledge and belief:

1. That the Bidder is not on the list created pursuant to Paragraph (b) of Subdivision 3 of Section 165-a of the New York State finance law.
2. By submitting a bid in response to this solicitation or by assuming the responsibility of a Contract awarded hereunder, Bidder / Contractor (or any assignee) certifies that once the prohibited entities list is posted on the Office of General Services (OGS) website, it will not utilize on such Contract any subcontractor that is identified on the prohibited entities list; and
3. Additionally, Bidder / Contractor is advised that once the list is posted on the OGS website, any Contractor seeking to renew or extend a Contract or assume the responsibility of a contract awarded in response to the solicitation, must certify at the time the Contract is renewed, extended or assigned that it is not included on the prohibited entities list.

B. A bid shall not be considered for award nor shall any award be made where the condition set forth in paragraph a of this subdivision has not been complied with; provided, however, that if in any case the bidder cannot make the foregoing certification, the bidder shall so state and shall furnish with the bid a signed statement which sets forth in detail the reasons therefor. A political subdivision may award a bid to a bidder who cannot make the certification pursuant to paragraph

1. The investment activities in Iran were made before the effective date of this section, the investment activities in Iran have not been expanded or renewed after the effective date of this section, and the person has adopted, publicized, and is implementing a formal plan to cease the investment activities in Iran and to refrain from engaging in any new investments in Iran; or
2. The political subdivision makes a determination that the goods or services are necessary for the political subdivision to perform its functions and that, absent such an exemption, the political subdivision would be unable to obtain the goods or services for which the contract is offered. Such determination shall be made in writing and shall be a public document.

C. Any bid hereafter made to any political subdivision of the State or any public department, agency or official thereof by a corporate bidder for work or services performed or to be performed or goods sold or to be sold, where competitive bidding is required by statute, rule, regulation, or local law, and where such bid contains the certification referred to in subdivision one of this section, shall be deemed to have been authorized by the board of directors of the bidder, and such authorization shall be deemed to include the signing and submission of the bid and the inclusion therein of the certificate as to non-engagement in investment activities in Iran as the act and deed of the corporation.

D. The person signing this Bid or Proposal certifies that he has fully informed himself regarding the accuracy of the statements contained in this certification, and under the penalties of perjury, affirms the truth thereof, such penalties being applicable to the Bidder as well to the person signing in his behalf.

Signature _____

Date _____

Title _____ Federal ID No.: _____

Business Address: _____

Telephone: _____ Email: _____

END OF SECTION 004520

AGREEMENT

THIS AGREEMENT, made as of the __ day of _____ 20__ by and between the Cornwall Central School District hereinafter called the OWNER, and _____ hereinafter called the CONTRACTOR, WITNESSETH that whereas the OWNER intends to provide:

Cornwall Central School District – Middle School Air Conditioning Project
Contract 1 - Mechanical Construction (MC)

hereinafter called the PROJECT, in accordance with the Drawings, Specifications and other Contract Documents prepared by Blake Engineering PLLC, NOW THEREFORE, OWNER and CONTRACTOR for the consideration hereinafter set forth, agree as follows:

A. THE CONTRACTOR AGREES to furnish all the necessary plant, labor, supervision, materials, equipment, tools and services and to complete all work required for the construction of the Project, in strict compliance with the Contract Documents herein mentioned, which are hereby made a part of the Contract, including the following Addenda, if any:

Addendum No.	Date
_____	_____
_____	_____
_____	_____

B. THE CONTRACTOR AGREES to commence work on or within five (5) days after the date referenced in the Notice to Proceed (but not before) and shall be completed by said referenced date, unless such period is extended by the Owner.

C. THE CONTRACTOR AGREES to bind every subcontractor by the terms of the Contract Documents. The Contract Documents shall not be construed as creating any contractual relation between any Subcontractor and the Owner.

D. THE CONTRACTOR AGREES that the only person or persons interested as principal or principals in the proposal submitted by the Contractor for this Contract are named therein, and that no person other than those mentioned therein, except regular agents of Contractor, has any interest in the said proposal or in the securing of the award, and that this contract has been secured without any connection with any person or persons other than those named, and that the proposal is in all respects fair, and was prepared, and that the contract was secured, without collusion or fraud, and that no officer or employee of the Owner has or shall have a financial interest in the performance of the contract or in the supplies, work, or business to which it is related, or in any portion of the proceeds thereof.

E. CONTRACT DOCUMENTS. The Bidding Requirements, Contract Forms, Conditions of the Contract, Specifications, Plans and Addenda shall form part of this Agreement and the provisions thereof shall be as binding upon the parties hereto as if they were herein fully set forth. The table of contents, titles, headings, running headlines and marginal notes contained herein and in said

documents are solely to facilitate reference to various provisions of the Contract Documents and in no way affect, limit or cast light upon interpretations of the provisions of which they refer.

F. AUTHORITY AND RESPONSIBILITY OF THE ENGINEER. All work shall be done under the general review of the Engineer. The Engineer shall decide any and all questions which may arise as to the quality and acceptability of materials furnished, work performed, rate of progress of work, interpretation of Drawings and Specifications and all questions as to the acceptable fulfillment of the Contract.

1. The Engineer will not be responsible for the Contractor's compliance with Health and Safety standards set forth in the Occupational Safety and Health Act of 1970 (PL 91-596), or the Contract Work Hours and Safety Standards Act (PL 91-54), or any amendments thereto.
2. The Engineer will not be responsible for the construction means, methods, techniques, sequences or procedure or the safety precautions and programs incident thereto.
3. The Engineer will not be responsible for the acts or omissions of any Contractor, any subcontractor or any of the Contractor(s)' or subcontractor(s)' agents or employees or any other person performing any of the work under their agreement; and in no way does the Engineer guarantee, insure, nor assume responsibility for methods or appliances used by the Contractor(s) or subcontractor(s), nor safety of the job or project or compliance with the laws and regulations.
4. The Engineer shall not be in any way responsible for any liability for claims, lawsuits, expenses or damages arising from, or in any manner related to the exposure to, or the handling or disposal of any asbestos or asbestos products or waste.

G. SUCCESSORS AND ASSIGNS. This Agreement and all of the covenants hereof shall inure to the benefit of and be binding upon the Owner and the Contractor respectively and his partners, successors, assigns and legal representatives. Neither the Owner nor the Contractor shall have the right to assign, transfer or sublet his interests or obligations hereunder without consent of the other party.

H. THE OWNER AGREES to pay, and the Contractor will accept in full consideration for the performance of the Contract (Subject to additions or deductions noted therein) the summation of the products of the quantities, as determined by the Engineer, by the unit price bid in the Proposal (Form of Bid), no allowance being made for anticipated profit.

1. The unit and/or lump sum prices bid in the Proposal shall be deemed to include all work to be performed on the project, other than "Changes in Contract Price" hereinafter defined.

I. FINAL PAYMENT. After the issuance of a Certificate of Substantial Completion, and submittal of an acceptable Maintenance Guarantee, the Owner shall pay to the Contractor the entire balance found to be due the Contractor, including retained percentage, less twice the value of uncompleted work and amounts withheld due to claims. All prior estimates and payments, including those relating to extra work shall be subject to correction by this payment, which throughout this Contract is called "FINAL PAYMENT". At the time of Final Payment and/or release of retainage, the Contractor agrees to complete a "Contractor's Affidavit for Release of Retainage and/or Final Payment" as furnished by the Engineer. Please refer to the Section 19 of the General Conditions for the payment provisions.

J. RELEASE OF RETAINER. If the Contractor has complied with all the requirements of this contract and has remedied any and all defects that may have developed in the work within the

Contract period, then at the end of the contract period, upon order of the Owner through his authorized representative, and upon verification there is no incomplete work and no claims made to Owner, the Contractor shall receive the retainer. If the Owner has had to make any necessary repairs and to remedy any defects at any time during the warranty period, then the Owner shall have the power to expend all or such part of the retainer as he may see fit and apply the same to making the necessary repairs and to remedy any defects. Should the amount of the retainer not be sufficient to make the required repairs, the Contractor or his surety shall at once make good the deficiency.

K. ACCEPTANCE OF SECURITIES: The Owner may accept Municipal, State or Federal bonds, securities negotiable without recourse, condition or restrictions, in a form and amount subject to the approval of the Owner, or an irrevocable letter of credit in lieu of all or part of the cash retainage in accordance with applicable law.

L. The Contractor shall invoice the Owner on the 1st day of each month for work rendered through the date of that invoice with sufficient details showing such progress supporting the sum invoiced. The invoice shall be submitted to the Engineer who shall examine the invoice and then certify the amount due to the Contractor. The School District shall pay the Consultant within thirty (30) business days following it receipt of the detailed invoice and Engineer's certification.

M. This Agreement may be terminated by either party upon not less than thirty (30) days' written notice should the other party fail substantially to perform in accordance with the terms of this Agreement through no fault of the party initiating the termination. In addition, the Owner has the right to terminate this Agreement for convenience at any time, with or without reason, upon seven days' written notice to the Contractor. In the event that the Owner terminates this Agreement pursuant to this provision, it shall provide payment for all work properly performed prior to termination.

N. If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a seven-day period after receipt of written notice from the Owner or Engineer to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, after such seven-day period, without prejudice to other remedies the Owner may have, immediately correct such deficiencies. In such case, an appropriate change order, or construction change directive as appropriate, shall be issued deducting from payments then or thereafter due the Contractor the cost of correcting such deficiencies, including compensation for the Engineer's additional services and expenses made necessary by such default, neglect or failure, including, without limitation, the Owner's reasonable attorneys' fees. Such action by the Owner and amounts charged to the Contractor are both subject to prior consultation with the Engineer. Such change order shall be deemed to have been executed by the Contractor, whether or not actually signed by the Contractor. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner."

O. Execution of the Agreement by the Contractor is a representation that the Contractor has carefully examined the Contract Documents and the site and represents that the Contractor is thoroughly familiar with the nature and location of the Work, the site, the specific conditions under which the Work is to be performed, and all matters which may in any way affect the Work or its performance. The Contractor further represents that as a result of such examinations and investigations, the Contractor thoroughly understands the Contract Documents and their intent and purpose, and is familiar with all applicable codes, ordinances, laws, regulations, and rules as they apply to the Work, and that the Contractor will abide by same. Claims for additional time

or additional compensation as a result of the Contractor's failure to follow the foregoing procedure and to familiarize itself with all local conditions and the Contract Documents will not be permitted. It is intended that all mechanical and electrical systems will be complete and in proper operation and that all construction components will be complete and in compliance with accepted construction practice upon completion of the Work. Even if items are missing from the Plans and/or Specifications but are normally required for proper operation of mechanical and electrical systems, or to complete otherwise incomplete construction or to meet governing code requirements, they shall be included by the Contractor, unless he sought and received contradictory interpretation or clarification from the Architect.

P. Unless otherwise provided, this Agreement shall be governed by the laws of the State of New York. The parties agree that any action commenced by either party concerning this Agreement shall be commenced in Supreme Court for the County of Orange in New York State.

Q. To the fullest extent permitted by law, the Contractor shall defend, indemnify and hold harmless the Owner and Engineer, each of their consultant's, officers, board members, agents, and employees from and against any suits, claims, damages, losses, or expenses, including but not limited to attorneys' fees and litigation costs, arising out of or resulting from performance of the Work, provided that such suit, claim, damage, loss or expense is attributable to any bodily injury, sickness, disease, or death, or injury to or destruction of any tangible property, including loss of use resulting therefrom, but only to the extent caused in whole or in part by the act, omission, fault, or statutory violation of the Contractor, a subcontractor, or any person or entity directly or indirectly employed by them, or any person or entity for whose acts they may be liable or arises out of operation of law as a consequence of any act or omission of the Contractor, any Subcontractor, anyone directly or indirectly employed by any of them, or anyone for whose acts any of the above may be liable, regardless of whether any of them has been negligent. This provision shall not be construed to require the Contractor to indemnify the Owner or Engineer for the negligence of the Owner or Engineer to the extent such negligence, in whole or in part, proximately caused the damages resulting in the suit, claim, damage, loss or expense.

R. This Agreement represents the entire and integrated agreement between the Owner and Contractor, including the referenced work and documents in Paragraph "A" above which are made a part hereof, and supersedes all prior negotiations, representations or agreements, either written or oral. This Agreement may be amended only by written instrument signed by both the Owner and Contractor specifically referencing this Agreement.

IN WITNESS WHEREOF, the parties have made and executed this Agreement the day and year above written.

Cornwall Central School District	
OWNER	CONTRACTOR
BY	BY
SIGNATURE	SIGNATURE
TITLE	TITLE
24 Idlewild Ave.	
BUSINESS ADDRESS	BUSINESS ADDRESS
Cornwall NY / 12520	
CITY STATE/ZIP	CITY STATE/ZIP
(845) 534-8009	
BUSINESS TELEPHONE	BUSINESS TELEPHONE
	CONTRACTOR'S F.E.I.N.

SEAL

(Acknowledgement of officer or Owner Executing Agreement)

State of _____)
) SS.:
County of_____)

On this_____day of _____20__, before me personally came and appeared_____to me known and known to me, being duly sworn, did depose and say that he/she is the_____of _____ the foregoing instrument; that by virtue of the authority conferred on him by law he subscribed his name to the foregoing instrument and that he executed the same for the purpose therein mentioned.

_____
(Notary Public)

_____
(SEAL)

(Acknowledgement of Contractor)

State of _____)
) SS.:
County of _____)

On this ___ day of _____in the year ____ before me, the undersigned, personally appeared_____, personally known to me or provided to me on the basis of satisfactory evidence to be the individual(s) whose name(s) is (are) subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their capacity(ies), and that by his/her/their signature(s) on the instrument, the individual(s), or the person upon behalf of which the individual(s) acted, executed the instrument.

_____
Notary Public

_____
(SEAL)

AGREEMENT

THIS AGREEMENT, made as of the __ day of _____ 20__ by and between the Cornwall Central School District hereinafter called the OWNER, and _____ hereinafter called the CONTRACTOR, WITNESSETH that whereas the OWNER intends to provide:

Cornwall Central School District – Middle School Air Conditioning Project
Contract 2- Electrical Construction (EC)

hereinafter called the PROJECT, in accordance with the Drawings, Specifications and other Contract Documents prepared by Blake Engineering PLLC, NOW THEREFORE, OWNER and CONTRACTOR for the consideration hereinafter set forth, agree as follows:

A. THE CONTRACTOR AGREES to furnish all the necessary plant, labor, supervision, materials, equipment, tools and services and to complete all work required for the construction of the Project, in strict compliance with the Contract Documents herein mentioned, which are hereby made a part of the Contract, including the following Addenda, if any:

Addendum No.	Date
_____	_____
_____	_____
_____	_____

B. THE CONTRACTOR AGREES to commence work on or within five (5) days after the date referenced in the Notice to Proceed (but not before) and shall be completed by said referenced date, unless such period is extended by the Owner.

C. THE CONTRACTOR AGREES to bind every subcontractor by the terms of the Contract Documents. The Contract Documents shall not be construed as creating any contractual relation between any Subcontractor and the Owner.

D. THE CONTRACTOR AGREES that the only person or persons interested as principal or principals in the proposal submitted by the Contractor for this Contract are named therein, and that no person other than those mentioned therein, except regular agents of Contractor, has any interest in the said proposal or in the securing of the award, and that this contract has been secured without any connection with any person or persons other than those named, and that the proposal is in all respects fair, and was prepared, and that the contract was secured, without collusion or fraud, and that no officer or employee of the Owner has or shall have a financial interest in the performance of the contract or in the supplies, work, or business to which it is related, or in any portion of the proceeds thereof.

E. CONTRACT DOCUMENTS. The Bidding Requirements, Contract Forms, Conditions of the Contract, Specifications, Plans and Addenda shall form part of this Agreement and the provisions thereof shall be as binding upon the parties hereto as if they were herein fully set forth. The table of contents, titles, headings, running headlines and marginal notes contained herein and in said

documents are solely to facilitate reference to various provisions of the Contract Documents and in no way affect, limit or cast light upon interpretations of the provisions of which they refer.

F. AUTHORITY AND RESPONSIBILITY OF THE ENGINEER. All work shall be done under the general review of the Engineer. The Engineer shall decide any and all questions which may arise as to the quality and acceptability of materials furnished, work performed, rate of progress of work, interpretation of Drawings and Specifications and all questions as to the acceptable fulfillment of the Contract.

1. The Engineer will not be responsible for the Contractor's compliance with Health and Safety standards set forth in the Occupational Safety and Health Act of 1970 (PL 91-596), or the Contract Work Hours and Safety Standards Act (PL 91-54), or any amendments thereto.
2. The Engineer will not be responsible for the construction means, methods, techniques, sequences or procedure or the safety precautions and programs incident thereto.
3. The Engineer will not be responsible for the acts or omissions of any Contractor, any subcontractor or any of the Contractor(s)' or subcontractor(s)' agents or employees or any other person performing any of the work under their agreement; and in no way does the Engineer guarantee, insure, nor assume responsibility for methods or appliances used by the Contractor(s) or subcontractor(s), nor safety of the job or project or compliance with the laws and regulations.
4. The Engineer shall not be in any way responsible for any liability for claims, lawsuits, expenses or damages arising from, or in any manner related to the exposure to, or the handling or disposal of any asbestos or asbestos products or waste.

G. SUCCESSORS AND ASSIGNS. This Agreement and all of the covenants hereof shall inure to the benefit of and be binding upon the Owner and the Contractor respectively and his partners, successors, assigns and legal representatives. Neither the Owner nor the Contractor shall have the right to assign, transfer or sublet his interests or obligations hereunder without consent of the other party.

H. THE OWNER AGREES to pay, and the Contractor will accept in full consideration for the performance of the Contract (Subject to additions or deductions noted therein) the summation of the products of the quantities, as determined by the Engineer, by the unit price bid in the Proposal (Form of Bid), no allowance being made for anticipated profit.

1. The unit and/or lump sum prices bid in the Proposal shall be deemed to include all work to be performed on the project, other than "Changes in Contract Price" hereinafter defined.

I. FINAL PAYMENT. After the issuance of a Certificate of Substantial Completion, and submittal of an acceptable Maintenance Guarantee, the Owner shall pay to the Contractor the entire balance found to be due the Contractor, including retained percentage, less twice the value of uncompleted work and amounts withheld due to claims. All prior estimates and payments, including those relating to extra work shall be subject to correction by this payment, which throughout this Contract is called "FINAL PAYMENT". At the time of Final Payment and/or release of retainage, the Contractor agrees to complete a "Contractor's Affidavit for Release of Retainage and/or Final Payment" as furnished by the Engineer. Please refer to the Section 19 of the General Conditions for the payment provisions.

J. RELEASE OF RETAINER. If the Contractor has complied with all the requirements of this contract and has remedied any and all defects that may have developed in the work within the

Contract period, then at the end of the contract period, upon order of the Owner through his authorized representative, and upon verification there is no incomplete work and no claims made to Owner, the Contractor shall receive the retainer. If the Owner has had to make any necessary repairs and to remedy any defects at any time during the warranty period, then the Owner shall have the power to expend all or such part of the retainer as he may see fit and apply the same to making the necessary repairs and to remedy any defects. Should the amount of the retainer not be sufficient to make the required repairs, the Contractor or his surety shall at once make good the deficiency.

K. ACCEPTANCE OF SECURITIES: The Owner may accept Municipal, State or Federal bonds, securities negotiable without recourse, condition or restrictions, in a form and amount subject to the approval of the Owner, or an irrevocable letter of credit in lieu of all or part of the cash retainage in accordance with applicable law.

L. The Contractor shall invoice the Owner on the 1st day of each month for work rendered through the date of that invoice with sufficient details showing such progress supporting the sum invoiced. The invoice shall be submitted to the Engineer who shall examine the invoice and then certify the amount due to the Contractor. The School District shall pay the Consultant within thirty (30) business days following it receipt of the detailed invoice and Engineer's certification.

M. This Agreement may be terminated by either party upon not less than thirty (30) days' written notice should the other party fail substantially to perform in accordance with the terms of this Agreement through no fault of the party initiating the termination. In addition, the Owner has the right to terminate this Agreement for convenience at any time, with or without reason, upon seven days' written notice to the Contractor. In the event that the Owner terminates this Agreement pursuant to this provision, it shall provide payment for all work properly performed prior to termination.

N. If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a seven-day period after receipt of written notice from the Owner or Engineer to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, after such seven-day period, without prejudice to other remedies the Owner may have, immediately correct such deficiencies. In such case, an appropriate change order, or construction change directive as appropriate, shall be issued deducting from payments then or thereafter due the Contractor the cost of correcting such deficiencies, including compensation for the Engineer's additional services and expenses made necessary by such default, neglect or failure, including, without limitation, the Owner's reasonable attorneys' fees. Such action by the Owner and amounts charged to the Contractor are both subject to prior consultation with the Engineer. Such change order shall be deemed to have been executed by the Contractor, whether or not actually signed by the Contractor. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner."

O. Execution of the Agreement by the Contractor is a representation that the Contractor has carefully examined the Contract Documents and the site and represents that the Contractor is thoroughly familiar with the nature and location of the Work, the site, the specific conditions under which the Work is to be performed, and all matters which may in any way affect the Work or its performance. The Contractor further represents that as a result of such examinations and investigations, the Contractor thoroughly understands the Contract Documents and their intent and purpose, and is familiar with all applicable codes, ordinances, laws, regulations, and rules as they apply to the Work, and that the Contractor will abide by same. Claims for additional time

or additional compensation as a result of the Contractor's failure to follow the foregoing procedure and to familiarize itself with all local conditions and the Contract Documents will not be permitted. It is intended that all mechanical and electrical systems will be complete and in proper operation and that all construction components will be complete and in compliance with accepted construction practice upon completion of the Work. Even if items are missing from the Plans and/or Specifications but are normally required for proper operation of mechanical and electrical systems, or to complete otherwise incomplete construction or to meet governing code requirements, they shall be included by the Contractor, unless he sought and received contradictory interpretation or clarification from the Architect.

P. Unless otherwise provided, this Agreement shall be governed by the laws of the State of New York. The parties agree that any action commenced by either party concerning this Agreement shall be commenced in Supreme Court for the County of Orange in New York State.

Q. To the fullest extent permitted by law, the Contractor shall defend, indemnify and hold harmless the Owner and Engineer, each of their consultant's, officers, board members, agents, and employees from and against any suits, claims, damages, losses, or expenses, including but not limited to attorneys' fees and litigation costs, arising out of or resulting from performance of the Work, provided that such suit, claim, damage, loss or expense is attributable to any bodily injury, sickness, disease, or death, or injury to or destruction of any tangible property, including loss of use resulting therefrom, but only to the extent caused in whole or in part by the act, omission, fault, or statutory violation of the Contractor, a subcontractor, or any person or entity directly or indirectly employed by them, or any person or entity for whose acts they may be liable or arises out of operation of law as a consequence of any act or omission of the Contractor, any Subcontractor, anyone directly or indirectly employed by any of them, or anyone for whose acts any of the above may be liable, regardless of whether any of them has been negligent. This provision shall not be construed to require the Contractor to indemnify the Owner or Engineer for the negligence of the Owner or Engineer to the extent such negligence, in whole or in part, proximately caused the damages resulting in the suit, claim, damage, loss or expense.

R. This Agreement represents the entire and integrated agreement between the Owner and Contractor, including the referenced work and documents in Paragraph "A" above which are made a part hereof, and supersedes all prior negotiations, representations or agreements, either written or oral. This Agreement may be amended only by written instrument signed by both the Owner and Contractor specifically referencing this Agreement.

IN WITNESS WHEREOF, the parties have made and executed this Agreement the day and year above written.

Cornwall Central School District	
OWNER	CONTRACTOR
BY	BY
SIGNATURE	SIGNATURE
TITLE	TITLE
24 Idlewild Ave.	
BUSINESS ADDRESS	BUSINESS ADDRESS
Cornwall NY / 12520	
CITY STATE/ZIP	CITY STATE/ZIP
(845) 534-8009	
BUSINESS TELEPHONE	BUSINESS TELEPHONE
	CONTRACTOR'S F.E.I.N.

SEAL

(Acknowledgement of officer or Owner Executing Agreement)

State of _____)
) SS.:
County of_____)

On this_____day of _____20__, before me personally came and appeared_____to me known and known to me, being duly sworn, did depose and say that he/she is the_____of _____ the foregoing instrument; that by virtue of the authority conferred on him by law he subscribed his name to the foregoing instrument and that he executed the same for the purpose therein mentioned.

_____
(Notary Public)

_____
(SEAL)

(Acknowledgement of Contractor)

State of _____)
) SS.:
County of _____)

On this ___ day of _____in the year ____ before me, the undersigned, personally appeared_____, personally known to me or provided to me on the basis of satisfactory evidence to be the individual(s) whose name(s) is (are) subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their capacity(ies), and that by his/her/their signature(s) on the instrument, the individual(s), or the person upon behalf of which the individual(s) acted, executed the instrument.

_____
Notary Public

_____
(SEAL)

LABOR AND MATERIAL PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS, that _____

_____

(Here insert the name and address of the Contractor)

as Principal, hereinafter called the Principal, and _____

_____

(Here insert the name and address of the Surety)

as Surety, hereinafter called the Surety, are held and firmly bound unto the Town of Crawford as Obligee, hereinafter called the Owner, for the use and benefit of the claimants as hereinbelow defined, in the amount of_____ _____Dollars ($_____), for payment whereof Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, Principal has by written agreement, dated _____ day of _____20__, entered into a contract with the Owner for the construction of the **Cornwall Central School District Middle School Air Conditioning Project,** which contract is by reference made a part hereof, and is hereinafter referred to as the Contract.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION is such that if the Principal shall promptly make payment to all claimants as hereinafter defined, for all labor and material used or reasonably required for use in the performance of the Contract, then this obligation shall be void; otherwise it shall remain in full force and effect, subject, however, to the following conditions:

1. A claimant is defined as one having a direct contract with the Principal or with a subcontractor of the Principal for labor, material, or both, used or reasonably required for use in the performance of the contract, labor and material being construed to include that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental of equipment directly applicable to the Contract.

2. The above named Principal and Surety hereby jointly and severally agree with the Owner that every claimant as herein defined, who has not been paid in full before the expiration of a period of ninety (90) days after the date on which the last of such claimant's work or labor was done or performed, or materials were furnished by such claimant, may sue on this bond for the use of such claimant, prosecute the suit to final judgement for such sum or sums as may be justly due the claimant, and have execution thereon. The Owner shall not be liable for the payment of any costs or expenses of any such suit.

3. No suit or action shall be commenced hereunder by any claimant.

    (a) Unless claimant, other than one having a direct contract with the Principal, shall have given written notice to any two of the following: The Principal, the Owner, or the Surety above named, within ninety (90) days after such claimant did or performed the last of the work or labor, or furnished the last of the materials for which said claim is made, stating with substantial accuracy the amount claimed and the name of the party to whom the work or labor was done or performed. Such notice shall be served by mailing the same by registered mail or certified mail, postage prepaid, in an envelope addressed to the Principal, Owner or Surety, at any place where an office is regularly

maintained for the transaction of business, or served in any manner in which legal process may be served in the state in which the aforesaid project is located, save that such service need not be made by a public officer.

(b) After the expiration of one (1) year following the date on which the Principal ceased work on said Contract, it being understood, however, that if any limitation embodied in this bond is prohibited by law controlling the construction hereof such limitation shall be deemed to be amended so as to be equal to the minimum period of limitation permitted by such law.

(c) Other than in a state court of competent jurisdiction in and for the county or other political subdivision of the state in which the project, or any part thereof, is situated, or in the United States District Court for the district in which the project, or any part thereof, is situated, and not elsewhere.

4. The amount of this bond shall be reduced by and to the extent of any payment or payments made in good faith hereunder, inclusive of payment by Surety of mechanics' liens which may be filed of record against said improvement, whether or not claim for the amount of such lien be presented under and against this bond.

5. Notwithstanding any of the foregoing limitations herein, this bond shall secure the prompt payment or discharge otherwise of any claim filed within the provisions of the Labor or Lien Law of the State of New York governing liens on account of public improvements, notice of which is given by the Obligee to the Surety within 30 days after the filing thereof with the Obligee, addressed to the Surety at the following address:

Unless a proper address is inserted above, this bond shall be unacceptable to the Obligee.)

No right of action shall accrue on this bond to or for the use of any person or corporation other than the Owner named herein or the heirs, executors, administrators or successors of the Owner.

IN WITNESS WHEREOF, the above-bounded parties have executed this instrument under their several seals on the date indicated below.

Signed and sealed this _____day of_____20__.

IN THE PRESENCE OF

_____(SEAL)
((Principal)
(
(
(_____
(Title)

_____

_____(SEAL)
((Surety)
(
(
(_____
(Title)

_____

(Acknowledgement of Principal)

State of _____)
) SS.:
County of _____)

On this ___ day of _____in the year _____ before me, the undersigned, personally appeared_____, personally known to me or provided to me on the basis of satisfactory evidence to be the individual(s) whose name(s) is (are) subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their capacity(ies), and that by his/her/their signature(s) on the instrument, the individual(s), or the person upon behalf of which the individual(s) acted, executed the instrument.

_____
Notary Public

_____ (SEAL)

(Acknowledgement of Surety)

State of _____)
) SS.:
County of _____)

On this ___ day of _____in the year _____ before me, the undersigned, personally appeared_____, personally known to me or provided to me on the basis of satisfactory evidence to be the individual(s) whose name(s) is (are) subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their capacity(ies), and that by his/her/their signature(s) on the instrument, the individual(s), or the person upon behalf of which the individual(s) acted, executed the instrument.

_____
Notary Public

_____ (SEAL)

If the Contractor (Principal) is a partnership, the bond should be signed by each of the individuals who are partners.

If the Contractor (Principal) is a corporation, the bond should be signed in its correct corporate name by a duly authorized officer, agent, or attorney-in-fact.

There should be executed an appropriate number of counterparts of bond corresponding to the number of counterparts of the Contractor.

Each executed bond should be accompanied by

(a) appropriate acknowledgements of the respective parties;
(b) appropriate duly certified copy of Power of Attorney or other certificate of authority where bond is executed by agent, officer, or other representative of Principal or Surety;
(c) a duly certified extract from By-Laws, or resolutions of Surety under which Power of Attorney or other certificate of authority of its agent, officer, or representative was issued, and
(d) duly certified copy of latest published financial statement of assets and liabilities of Surety.

PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS, that _____

_____

(Here insert the name and address of the Contractor)

as Principal, hereinafter called the Principal, and _____

_____

(Here insert the name and address of the Surety)

as Surety, hereinafter called the Surety, are held and firmly bound unto the Cornwall Central School District, as Obligee, hereinafter called the Owner, in the amount of _____ Dollars ($_____), for payment whereof Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, Principal has by written agreement dated _____ day of _____ 20__, entered into a contract with the Owner for the construction of the **Cornwall Central School District Middle School Air Conditioning Project,** in accordance with the drawings and specifications prepared by Blake Engineering PLLC, which contract is by reference made a part hereof, and is hereinafter referred to as the Contract.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION is such that is the Principal shall well and truly perform and fulfill all the undertakings, covenants, terms, conditions, and agreements of said Contract during the original term of said Contract and any extensions thereof that may be granted by the Owner, with or without notice to the Surety, and during the life of any guaranty required under the Contract, and shall also well and truly perform and fulfill all the undertakings, covenants, term conditions, and agreements of any and all duly authorized modifications of said contract that may hereafter be made, notice of which modifications to the Surety being hereby waived, and fully indemnify and save harmless the Owner all outlay and expense which it may incur in making good any such default, then this obligation is to be null and void, otherwise to remain in full force and effect.

No right of action shall accrue on this bond to or for the use of any person or corporation other than the Owner named herein or the heirs, executors, administrators or successors of the Owner.

IN WITNESS WHEREOF, the above-bounded parties have executed this instrument under their several seals on the date indicated below.

Signed and sealed this_____day of_____20__.

IN THE PRESENCE OF

_____

_____(SEAL)
((Principal)
(
(
(_____
(Title)

_____(SEAL)
((Surety)
(
(
(_____
(Title)

_____

(Acknowledgement of Principal)

State of _____)
) SS.:
County of _____)

On this ___ day of _____in the year _____ before me, the undersigned, personally appeared_____, personally known to me or provided to me on the basis of satisfactory evidence to be the individual(s) whose name(s) is (are) subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their capacity(ies), and that by his/her/their signature(s) on the instrument, the individual(s), or the person upon behalf of which the individual(s) acted, executed the instrument.

_____
Notary Public

_____
(SEAL)

(Acknowledgement of Surety)

State of _____)
) SS.:
County of _____)

On this ___ day of _____in the year _____ before me, the undersigned, personally appeared_____, personally known to me or provided to me on the basis of satisfactory evidence to be the individual(s) whose name(s) is (are) subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their capacity(ies), and that by his/her/their signature(s) on the instrument, the individual(s), or the person upon behalf of which the individual(s) acted, executed the instrument.

_____
Notary Public

_____
(SEAL)

If the Contractor (Principal) is a partnership, the bond should be signed by each of the individuals who are partners.

If the Contractor (Principal) is a corporation, the bond should be signed in its correct corporate name by a duly authorized officer, agent, or attorney-in-fact.

There should be executed an appropriate number of counterparts of the bond corresponding to the number of counterparts of the Contractor.

Each executed bond should be accompanied by

(a) appropriate acknowledgements of the respective parties;
(b) appropriate duly certified copy of Power of Attorney or other certificate of authority where bond is executed by agent, officer, or other representative of Principal or Surety;
(c) a duly certified extract from By-Laws, or resolutions of Surety under which Power of Attorney or other certificate of authority of its agent, officer or representative was issued, and
(d) duly certified copy of latest published financial statement of assets and liabilities of Surety.

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SECTION 007216 – GENERAL CONDITIONS

PART 1 - GENERAL

1.1 DEFINITIONS

A. Wherever used in the CONTRACT DOCUMENTS, the following terms shall have the meanings indicated which shall be applicable to both the singular and plural thereof.

B. ADDENDA - Written or graphic instruments issued prior to the execution of the Agreement which modify or interpret the CONTRACT DOCUMENTS, DRAWINGS and SPECIFICATIONS, by additions, deletions, clarifications or corrections.

C. BID - The offer or proposal of the BIDDER submitted on the prescribed form setting forth the prices for the WORK to be performed.

D. BIDDER - Any person, firm or corporation submitting a BID for the WORK.

E. BONDS - Bid, Performance and Labor and Material Payment Bonds and other instruments of security, furnished by the CONTRACTOR and his surety in accordance with the CONTRACT DOCUMENTS.

F. CHANGE ORDER - A written order to the CONTRACTOR authorizing an addition, deletion or revision in the WORK within the general scope of the CONTRACT DOCUMENTS or authorizing an adjustment in the CONTRACT PRICE or CONTRACT TIME.

G. CONTRACT DOCUMENTS - The contract, including Advertisement for Bids, Instructions to Bidders, Proposal, Bid Bond, Agreement, Performance Bond, Labor and Material Payment Bond, General Conditions, Supplementary Conditions, Special Provisions, Supplemental Conditions, NOTICE OF AWARD, NOTICE TO PROCEED, CHANGE ORDER, DRAWINGS, TECHNICAL SPECIFICATIONS, and ADDENDA.

H. CONTRACT PERIOD - That period of time commencing at the time of the execution of the Agreement and terminating at the end of the Guaranty period.

I. CONTRACT PRICE - The total monies payable to the CONTRACTOR under the terms and conditions of the CONTRACT DOCUMENTS.

J. CONTRACT TIME - The number of consecutive calendar days stated in the CONTRACT DOCUMENTS for the completion of WORK. Wherein these documents reference is made to the Time for Completion, same shall be understood to be defined as the same as the Contract Time.

K. CONTRACTOR - The person, firm or corporation with whom the OWNER has executed the Agreement.

L. DRAWINGS - The part of the CONTRACT DOCUMENTS which show the characteristics and scope of WORK to be performed and which have been prepared or approved by the ENGINEER.

M. ENGINEER - The person, firm or corporation named as such in the CONTRACT DOCUMENTS.

N. FIELD NOTIFICATION - A written notice from the ENGINEER to the CONTRACTOR, delivered to the project site or mailed to the Contractor's business address, which advises the CONTRACTOR of observations made by the ENGINEER which, in his or the OWNER'S opinion, require the action and/or a response by the CONTRACTOR.

O. FIELD ORDER - A written order effecting a change in the WORK not involving an adjustment in the CONTRACT PRICE or an extension of the CONTRACT TIME, issued by the OWNER and/or ENGINEER to the CONTRACTOR during construction.

P. NOTICE OF AWARD - The written notice of the acceptance of the BID from the OWNER to the successful BIDDER.

Q. NOTICE TO PROCEED - Written communication issued by the OWNER, or his authorized representative, to the CONTRACTOR authorizing him to proceed with the WORK and establishing the date of commencement of the WORK.

R. OWNER - A public or quasi-public body or authority, corporation, association, partnership, or individual for whom the WORK is to be performed.

S. PROJECT - The undertaking to be performed as provided in the CONTRACT DOCUMENTS.

T. RESIDENT PROJECT REPRESENTATIVE - The authorized representative of the OWNER who is assigned to the PROJECT site or any part thereof.

U. SHOP DRAWINGS - All drawings, diagrams, illustrations, brochures, schedules and other data which are prepared by the CONTRACTOR, a SUBCONTRACTOR, manufacturer, SUPPLIER or distributor, which illustrate how specific portions of the WORK shall be fabricated or installed.

V. SPECIFICATIONS - A part of the CONTRACT DOCUMENTS consisting of written descriptions of a technical nature of materials, equipment, construction systems, standards and workmanship.

W. SUBCONTRACTOR - An individual, firm or corporation having a direct contract with the CONTRACTOR or with any other SUBCONTRACTOR for the performance of a part of the WORK at the site.

X. SUBSTANTIAL COMPLETION - That date as certified by the ENGINEER and so agreed to by the OWNER when the construction of the PROJECT or a specified major part thereof is sufficiently completed, in accordance with CONTRACT DOCUMENTS, so that the PROJECT or specified part can be utilized for the purposes for which it is intended.

Y. SUPPLEMENTAL GENERAL CONDITIONS - Modifications to General Conditions required by a Federal agency for participation in the PROJECT and approved by the agency in writing prior to inclusion in the CONTRACT DOCUMENTS, or such requirements that may be imposed by applicable state laws.

Z. SUPPLIER - Any person or organization who supplies the materials or equipment for the WORK, including that fabricated to a special design, but who does not perform labor at the site.

AA. WORK - All plant, labor, supplies and materials necessary to produce the construction required by the CONTRACT DOCUMENTS, and all materials and equipment incorporated or to be incorporated in the PROJECT.

BB. WRITTEN NOTICE - Any notice to any party of the Agreement relative to any part of this Agreement in writing and considered delivered and the service thereof completed, when posted by certified or registered mail to the said party at his last given address, or delivered in person to said party or his authorized representative on the WORK

1.2 ADDITIONAL INSTRUCTIONS AND DETAIL DRAWINGS

A. The CONTRACTOR may be furnished additional instructions and detail drawings, by the ENGINEER, as necessary to carry out the WORK required by the CONTRACT DOCUMENTS.

B. The additional drawings and instruction thus supplied will become a part of the CONTRACT DOCUMENTS and shall have the same force and effect as any other Contract Documents. The CONTRACTOR shall carry out the WORK in accordance with the additional detail drawings and instructions.

C. In case the Contractor finds the Specifications or Contract Drawings are not sufficiently clear or complete, he shall request the Engineer to provide such Supplementary Drawings and Specifications and the Engineer will provide such additional information as may be necessary. Such request shall be made in writing at least two (2) weeks prior to the time such Drawings or Specifications are to be needed or the work to be performed, and no delay caused by the tardiness of the Engineer in supplying such information shall be considered as neglect or default on his part unless written request as noted shall have been so made.

1.3 PROGRESS AND SUBMISSION SCHEDULES; PRECONSTRUCTION CONFERENCE; NOTIVE TO PROCEED

A. Within ten (10) days after execution of the Agreement and before commencement of work, the CONTRACTOR will submit to the ENGINEER for acceptance, a detailed work progress schedule indicating the starting and completion dates of the various stages of the WORK, and the schedule of Shop Drawing submissions.

B. Before starting the WORK, a conference will be held to review the above schedules, to establish procedures for handling Shop Drawings and other submissions and for processing Applications for Payment, and to establish a working understanding between the parties as to the PROJECT. Present at the conference will be the ENGINEER, the PROJECT REPRESENTATIVE, the CONTRACTOR and his Superintendent and any other parties designated by the OWNER. The CONTRACTOR shall also submit a Schedule of Payments that he anticipates he will earn during the course of WORK.

C. By issuance of the NOTICE TO PROCEED, the OWNER or his authorized representative will give the CONTRACTOR written notice of the date on which it is expected that the CONTRACTOR will start the WORK.

D. Such date shall not be more than thirty (30) days after the award of the CONTRACT. A copy of such notice shall be given to the ENGINEER. The Contract Time shall start to run on that date. No WORK shall be done by the CONTRACTOR prior to that date.

E. The ENGINEER may periodically schedule additional conferences with any/or all involved CONTRACTORS during the construction of the PROJECT to review work progress and schedules of construction. For multiple prime contracts, the individual CONTRACTORS shall be responsible for monitoring the work and progress of other CONTRACTORS.

F. In the event the CONTRACT DOCUMENTS require the completion of any particular part thereof within a shorter period than the time specified to complete the entire CONTRACT, provision for liquidated damages shall also be applicable to any failure to complete such particular part of such CONTRACT within such shorter period specified.

G. Each CONTRACTOR (in the case of multiple prime contracts) shall circulate their individual work progress schedules with all other contractors, and provide documentation of the same to the ENGINEER or OWNER; in addition, the individual CONTRACTORS shall be fully responsible for reviewing and coordinating their work and the work of others, as referenced on said schedules or otherwise required under the individual CONTRACTS.

1.4 DRAWINGS AND SPECIFICATIONS

A. The intent of the DRAWINGS and SPECIFICATIONS is that the CONTRACTOR shall furnish all labor, materials, tools, equipment, and transportation necessary for the proper execution of and completion of the WORK in accordance with the CONTRACT DOCUMENTS and all incidental work necessary to complete the PROJECT in an acceptable manner, ready for use, occupancy or operation by the OWNER.

B. The CONTRACT DOCUMENTS are complimentary and what is called for by any one or more of them though not mentioned in the others, shall be as binding as if called for by all of them. Anything shown on the DRAWINGS and not mentioned in the SPECIFICATIONS or mentioned in the SPECIFICATIONS and not shown on the DRAWINGS, shall have the same effect as if shown or mentioned respectively in both.

C. In case of conflict or inconsistency between the DRAWINGS and SPECIFICATIONS, the SPECIFICATIONS shall govern. Figure dimensions on DRAWINGS shall govern over scale dimensions, and detailed DRAWINGS shall govern over general DRAWINGS.

D. Any discrepancies found between the DRAWINGS and SPECIFICATIONS and site conditions or inconsistencies or ambiguities in the DRAWINGS or SPECIFICATIONS shall be immediately reported to the ENGINEER, in writing, who shall promptly correct such inconsistencies or ambiguities in writing. WORK done by the CONTRACTOR after his discovery of such discrepancies, inconsistencies or ambiguities shall be done at the CONTRACTOR'S risk. Notwithstanding the foregoing, to the extent the contractor failed to bring to the engineer’s attention in writing such ambiguities or inconsistencies at least seven days prior to the opening of the bid as set forth in the bid invitation, all claims for damages relating to such inconsistencies or ambiguities shall be deemed irrevocably waived.

E. PLANS AND SPECIFICATIONS - The CONTRACTOR shall keep at the site of the WORK one copy of the PLANS and SPECIFICATIONS signed and identified by the ENGINEER and shall at all times give the ENGINEER and other representatives of the OWNER access thereto.

1.5 SHOP DRAWINGS

A. The CONTRACTOR shall promptly submit six (6) copies of each Shop or Setting Drawings, which are prepared in accordance with the accepted schedule provided for in the GENERAL CONDITIONS. All submissions shall be bound, dated and properly labeled to indicate CONTRACT number, SPECIFICATION reference, manufacturer and supplier's name, the name of type of item the SPECIFICATION covers, and certification of the origin of materials and equipment. Each element of the submission shall be marked and tabulated.

B. This review 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. Corrections or comments made on the working or SHOP DRAWINGS during this review do not relieve the CONTRACTOR from compliance with the requirements of the CONTRACT DOCUMENTS.

C. ENGINEER'S acceptance of a shop drawing shall not authorize any deviation from the Contract Documents, which can only be made by a signed Change Order. Any change or deviation from the Contract Documents should be clearly identified and be the subject of a specific separate request.

D. SHOP DRAWINGS shall, in general, cover such items as all materials of construction, reinforcement, structural steel, miscellaneous metal, equipment, layout and support of pipe, plumbing, heating, ventilating, wiring, electrical components, fabrication details, details of supporting and relocating utilities or other adjacent structures, and similar work, and shall give all sizes, working and erection dimensions, arrangements, details of connections and supports, kinds of materials, machine work and finishes, and like information. The DRAWINGS shall, where needed for clarity, include outline and sectional views, and detailed working dimensions and designations of the kind of materials and the kinds of machine work and finishes required. DRAWINGS for submission shall be coordinated by the CONTRACTOR with the DRAWINGS heretofore accepted, and with the design and function of any equipment or structure.

E. After examination of such drawings by the ENGINEER and the return thereof, the CONTRACTOR shall make such corrections to the drawings as have been indicated and shall furnish the ENGINEER with six (6) corrected copies. After a SHOP DRAWING has been reviewed by the ENGINEER and returned to the CONTRACTOR for correction, the CONTRACTOR shall make only the corrections indicated by the ENGINEER. He shall not change or alter, in any way, the information or data acceptable to the ENGINEER on any DRAWING. If requested by the ENGINEER, the CONTRACTOR must furnish additional copies. Regardless of corrections made in or reviews given to such drawings by the ENGINEER, the CONTRACTOR will nevertheless be responsible for the accuracy of such drawings and for the conformity to the PLANS and SPECIFICATIONS unless he notified the ENGINEER, in writing, of any deviations, at the time he furnished such drawings and same was subsequently accepted in writing. The acceptance of any Shop Drawing which substantially deviates from the requirement of the CONTRACT DOCUMENTS shall be evidenced by a CHANGE ORDER.

F. When submitted for the ENGINEER'S review, Shop Drawings shall bear the CONTRACTOR'S stamped and signed certification that he has reviewed, checked and approved the Shop Drawings and that they are in conformance with the requirements of the CONTRACT DOCUMENTS. The stamp shall completely reflect these requirements.

G. All Shop Drawings shall clearly define the specific item proposed, as well as all options and auxiliary parts which are to be provided as part of the unit. The failure of the CONTRACTOR to identify all such appurtenances does not relieve him of the responsibility to provide complete and satisfactorily operating work.

H. The CONTRACTOR is responsible for confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating his work with that of all other trades and SUBCONTRACTORS; and performing his work in a safe and satisfactory manner.

I. Portions of the WORK requiring a Shop Drawing or sample submission shall not begin until the Shop Drawing or submission has been accepted by the ENGINEER. A copy of each Shop Drawing and each accepted sample shall be kept in good order by the CONTRACTOR at the site and shall be available to the ENGINEER.

1.6 MATERIALS, SERVICES AND FACILITIES

A. It is understood that, except as otherwise specifically stated in the CONTRACT DOCUMENTS, the CONTRACTOR shall provide and pay for all materials, labor, tools, equipment, water, light, power, transportation, supervision, temporary construction of any nature and all other services and facilities of any nature whatsoever necessary to execute, complete, and deliver the WORK within the specified time.

B. Materials and equipment shall be so stored as to insure the preservation of their quality and fitness for the WORK. Stored materials and equipment to be incorporated in the WORK shall be located so as to facilitate prompt inspection.

C. All manufactured articles, materials, and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned in conformance with the recommendations of the manufacturer.

D. All materials, supplies and equipment which are to be incorporated into the WORK shall not be purchased by the CONTRACTOR or SUBCONTRACTOR subject to a chattel mortgage or under a conditional sale contract or other agreement by which an interest is retained by the seller.

E. Materials, supplies and equipment shall be in accordance with samples submitted by the CONTRACTOR and accepted by the ENGINEER.

F. All materials to be incorporated in this project shall be new and unused unless specifically noted otherwise on the Contract Plans or Specifications.

G. The OWNER is exempt from payment of sales and compensating use taxes of the State of New York and of cities and counties on all materials supplied to the OWNER pursuant to this CONTRACT. This exemption does not, however, apply to tools, machinery, equipment or other property purchased by, leased by or to the CONTRACTOR or a SUBCONTRACTOR or the

purchase by SUBCONTRACTORS of materials to be sold hereunder which will also be a purchase or procurement for resale to the CONTRACTOR (either directly or through other subcontractors) and therefore not subject to the aforesaid sales or compensating use taxes, provided that the subcontract agreements provided for the resale of such materials prior to and separate and apart from the incorporation of such materials into the permanent construction and that such subcontract agreements are in a form similar to this contract with respect to the separation of the sale of materials from the work and labor to be provided.

1.7 INSPECTION AND TESTING

A. All materials and equipment used in the construction of the PROJECT shall be subject to adequate inspection and testing in accordance with the generally accepted standards, as required and defined in the CONTRACT DOCUMENTS.

B. The OWNER shall provide all the inspection and test services not required by the CONTRACT DOCUMENTS.

C. The CONTRACTOR shall provide, at his expense, the testing and inspection services required by CONTRACT DOCUMENTS.

D. If the CONTRACT DOCUMENTS, laws, ordinances, rules, regulations or orders of any public authority having jurisdiction require any WORK to specifically be inspected, tested, or approved by someone other than the CONTRACTOR, the CONTRACTOR will give the ENGINEER timely notice of readiness, the CONTRACTOR will then furnish the ENGINEER the required certificates of inspection, testing or approval.

E. Observations, reviews, tests or acceptance by the ENGINEER or others shall not relieve the CONTRACTOR from his obligations to perform the WORK in accordance with the requirements of the CONTRACT DOCUMENTS.

F. The ENGINEER and his representatives will at all times have access to the WORK. In addition, authorized representatives and agents of any participating Federal or state agency shall be permitted to inspect all work, materials, and other relevant data and records. The CONTRACTOR will provide proper facilities for such access and observation of the WORK and also for any inspection or testing thereof.

G. If any WORK is covered contrary to the written instructions of the ENGINEER or Contract Requirements it must, if requested by the ENGINEER, be uncovered for his observation and replacement (if necessary), fully at the CONTRACTOR'S expense.

H. If the ENGINEER considers it necessary or advisable that covered WORK (other than noted in 7.7 above) be inspected or tested by others, the CONTRACTOR, at the ENGINEER'S request, will uncover, expose or otherwise make available for observation, inspection or testing as the ENGINEER may require, that portion of the WORK in question, furnishing all necessary labor, materials, tools, and equipment. If it is found that such WORK is defective, the CONTRACTOR will bear all the expenses of such uncovering, exposure, observation, inspection and testing and of satisfactory reconstruction. If, however, such WORK is not found to be defective, the CONTRACTOR will be allowed an increase in the CONTRACT PRICE or an extension of the CONTRACT TIME, or both, directly attributable to such uncovering, exposure, observation, inspection, testing and reconstruction and an appropriate CHANGE ORDER shall be issued.

1.8 SUBSTITUTIONS

A. Whenever a material, article or piece of equipment is identified on the DRAWINGS or SPECIFICATIONS by reference to brand name or catalogue number, it shall be understood that this is referenced for the purpose of defining the performance or other salient requirements and that other products of equal capacities, quality and function shall be considered. The CONTRACTOR may recommend the substitution of a material, article or piece of equipment of equal substance and function for those referred to in the CONTRACT DOCUMENTS by reference to brand name or catalogue number, and if, in the opinion of the ENGINEER, such material, article or piece of equipment is of equal substance, quality, performance and function to that specified, the ENGINEER may accept its substitution and use by the CONTRACTOR.

B. If the CONTRACTOR proposes a substitution which is documented/determined by the OWNER and/or ENGINEER as substandard, or that such material, article or piece of equipment is of lesser substance and/or function, the OWNER shall have the option to consider such alternate item. In this case, any cost differential shall be deductible from the CONTRACT PRICE and the CONTRACT DOCUMENTS shall be appropriately modified by CHANGE ORDER.

C. The CONTRACTOR warrants that if substitutes are accepted, no major changes in the function or general design of the PROJECT will result. Incidental changes or addition of extra component parts required to accommodate the substitute will be made by the CONTRACTOR without a change in the CONTRACT PRICE or CONTRACT TIME. For substitutions, the OWNER may require that the CONTRACTOR reimburse the OWNER for engineering review costs associated with the review of the proposed substitution.

1.9 PATENTS

A. The CONTRACTOR shall pay all applicable royalties and license fees. He shall defend all suits or claims for infringement of any patent rights and save the OWNER harmless from loss on account thereof, except that the OWNER shall be responsible for any such loss when a particular process, design, or the product of a particular manufacturer or manufacturers is specified, however, if the CONTRACTOR has reason to believe that the design process or product specified is an infringement of a patent, he shall be responsible for such loss unless he promptly gives such information to the ENGINEER.

1.10 PERMITS AND REGULATIONS

A. The CONTRACTOR shall carefully preserve bench marks, reference points and stakes and, in the case of willful or careless destruction, he shall be charged with the resulting expense and shall be responsible for any mistakes that may be caused by their unnecessary loss or disturbance.

B. Permits and licenses of a temporary nature necessary for the prosecution of the WORK shall be secured and paid for by the CONTRACTOR unless otherwise stated in the SUPPLEMENTAL GENERAL CONDITIONS. Permits, licenses and easements for permanent structures or permanent changes in the existing facilities shall be secured and paid for by the OWNER, unless otherwise specified. The CONTRACTOR shall give all notices and comply with all laws, ordinances, rules and regulations bearing on the conduct of the WORK as drawn and specified. If the CONTRACTOR observes that the CONTRACT DOCUMENTS are at variance therewith,

he shall promptly notify the ENGINEER in writing, and any necessary changes shall be adjusted as provided in Section 1.13, CHANGES IN THE WORK.

1.11 PROTECTION OF WORK, PROPERTY AND PERSONS

A. The CONTRACTOR will be responsible for initiating, maintaining and supervising all the safety precautions and programs in connection with the WORK. He will take all necessary precautions for the safety of, and will provide the necessary protection to prevent damage, injury or loss to all employees on the WORK and other persons who may be affected thereby, all the WORK and all materials or equipment to be incorporated therein, whether in storage on or off the site, and other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction.

B. The Engineer or Owner is not responsible for the Contractor's means, methods, techniques, sequences, procedures of construction, or the safety precautions and programs incident thereto.

C. The CONTRACTOR will comply with all the applicable laws, ordinances, rules, regulations and orders of any public body having jurisdiction. He will erect and maintain, as required by conditions and progress of the WORK, all the necessary safeguards for safety and protection, including barricades, warning signs and lights. He will notify the owners of adjacent utilities when prosecution of the WORK may affect them. The CONTRACTOR will remedy all damage, injury or loss to any property caused, directly or indirectly, in whole or in part, by the CONTRACTOR, any SUBCONTRACTOR or anyone directly or indirectly employed by any of them or anyone for whose acts any of them be liable, except damage or loss attributable to the fault of the CONTRACT DOCUMENTS or to the acts or omissions of the OWNER or the ENGINEER or anyone employed by either of them or anyone for whose acts either of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of the CONTRACTOR.

D. In emergencies affecting the safety of persons or the WORK or property at the site or adjacent thereto, the CONTRACTOR, without special instruction or authorization from the ENGINEER or the OWNER, shall act to prevent threatened damage, injury or loss. He will give the ENGINEER prompt WRITTEN NOTICE of any significant changes in WORK or deviations from the CONTRACT DOCUMENTS caused thereby, and a CHANGE ORDER shall thereupon be issued covering the changes and deviations involved.

E. The Contractor will insure use by his employees and subcontractors of all appropriate and required safety equipment, protective clothing as applicable to this project.

1.12 SUPERVISION BY THE CONTRACTOR

A. The CONTRACTOR will supervise and direct the WORK. He will be solely responsible for means, methods, techniques, sequences and procedures of construction. The CONTRACTOR will employ and maintain on the WORK a qualified supervisor or superintendent who shall have been designated by the CONTRACTOR as the CONTRACTOR'S representative at the site. Designation shall be by letter to the Owner and Engineer, provided at the time of the execution of the Agreement. The supervisor shall have full authority to act on behalf of the CONTRACTOR and all communications given to the supervisor shall be as binding as if given to the

CONTRACTOR. The supervisor shall be present on the site at all times as required to perform adequate supervision and coordination of the WORK. The Supervisor shall be fluent in the English language both verbally and in writing.

B. Any change in the designated supervisor shall be made by letter to the Owner and the Engineer, with receipt by each at least two (2) days prior to said change.

1.13 CHANGES IN THE WORK

A. Without invalidating this CONTRACT, the OWNER may at any time, as the need arises, order changes within the scope of the WORK, consisting of additions, deletions or other modifications. If such changes increase or decrease the amount due under the CONTRACT DOCUMENTS or result in a change in the time required for performance of the WORK, an equitable adjustment (cost or credit) shall be authorized by CHANGE ORDER. Such changes shall not invalidate the CONTRACT nor release the surety, and the CONTRACTOR agrees to perform the work as altered.

B. The ENGINEER, also, may at any time, by issuing a FIELD ORDER, make changes in the details of the WORK. The CONTRACTOR shall proceed with the performance of any changes in the WORK so ordered by the ENGINEER unless the CONTRACTOR believes that such FIELD ORDER entitles him to a change in CONTRACT PRICE or TIME, or both, in which event he shall give the OWNER and the ENGINEER WRITTEN NOTICE immediately thereof, and in any case prior to performing the modified or altered work. Thereafter, the CONTRACTOR shall document the basis for the change in CONTRACT PRICE or TIME within seven (7) days (or such additional time as may be agreed to in writing by the OWNER or ENGINEER). The CONTRACTOR shall not execute such changes pending the receipt of an executed CHANGE ORDER or further instruction from the OWNER. No claim for a change in Contract Price and/or time will be considered unless written notice shall be so immediately made and documents submitted within the aforementioned time period.

C. Claims for additional compensation for extra, due to alleged errors in ground elevations, contour lines, or bench marks, will not be recognized unless accompanied by survey data, certified by a Licensed Surveyor in the State of New York, made prior to the time the original ground was disturbed, clearly showing that errors exist which resulted, or would result, in the handling of more material, or performing more work, than would be reasonably estimated from the Drawings and maps issued.

D. The CONTRACTOR agrees that all extra work shall only be performed pursuant to a valid written CHANGE ORDER and that no oral changes in the CONTRACTOR'S scope of work shall be valid or binding upon the OWNER; and that no oral waiver of the conditions and requirements set forth in paragraphs 1.13.A, 1.13.B or 1.13.C shall be deemed made by the OWNER or claimed by the CONTRACTOR.

1.14 CHANGES IN CONTRACT PRICE

A. The CONTRACT PRICE may be changed only by a CHANGE ORDER. The value of any WORK covered by a CHANGE ORDER or of any claim for increase or decrease in the CONTRACT PRICE shall be determined by mutual agreement by one or more of the following methods in the order of precedence listed below:

1. Unit prices previously approved.
2. An agreed lump sum.
3. The actual cost for labor, direct overhead, materials, supplies, equipment, and other services necessary to complete the work. In addition, there shall be added an amount to be agreed upon but not to exceed fifteen (15) percent of the actual cost of the WORK to cover the cost of general overhead and profit, all as further delineated under paragraph 1.14.C below.

B. Should the parties fail to agree on the cost or credit of additions, deletions or other modifications, then the OWNER shall issue a CONSTRUCTION CHANGE ORDER DIRECTIVE directing the CONTRACTOR to perform the work on a time and materials basis. Upon receipt of a CONSTRUCTION CHANGE ORDER DIRECTIVE, the CONTRACTOR shall promptly perform such work and furnish to the OWNER on a weekly basis an itemized statement setting forth in detail the hours, rates, names of employees, amounts, etc., of the labor, material, equipment and other costs incurred during the preceding week in the performance of such changed or extra work.

C. Such detailed statements are necessary to enable the OWNER to monitor the cost of such WORK and if such statements are not provided for any such WORK within seven (7) calendar days or with the following Application for Payment (whichever comes first), the CONTRACTOR's claim for extra compensation therefor shall be forfeited.

D. The detailed statements shall include all information and shall comply with the provisions noted under paragraph 1.14.C.

E. For work performed on an actual cost (time and materials) basis or pursuant to a CONSTRUCTION CHANGE ORDER DIRECTIVE, the cost or credit for such work shall be the actual net cost of labor, materials (including cost of delivery by supplier), field supervision (for personnel not otherwise at the site during performance of the changed work), payroll taxes, union fringe benefits, sales and use taxes and equipment rental (for equipment not otherwise at the site and exclusive of hand tools), plus 15% for overhead and profit.

F. The CHANGE ORDER amount shall be established and limited based on the following definitions for components of the CHANGE ORDER cost. The CONTRACTOR shall furnish supporting information in accordance with the timeframes otherwise noted herein, with copies to both the OWNER and ENGINEER, as follows:

1. Materials: Necessary materials (including transportation to site). Materials used, if acquired by direct purchase, must be covered by acceptable invoices. All prices on used materials incorporated in either temporary or permanent work shall be billed at a fair market value, and in an amount less than the original cost when new. A reasonable salvage credit shall be given to the OWNER by the CONTRACTOR for all salvageable material recovered by it. Salvage value of substantial material recovered must be jointly determined by and be acceptable to the CONTRACTOR and the ENGINEER;
2. Labor Costs: Necessary total labor directly engaged on the CHANGE ORDER work, and for foremen in direct charge of the specific operations. Each class of labor shall be billed separately at actual payroll rates. Average payroll rates based on different classes of labor shall not be accepted. Total labor costs shall include workers' compensation insurance, public liability and property damage insurance, unemployment insurance, Federal old age benefits, other payroll taxes and payments required to be made to labor organizations under

existing labor agreements, and the rates for such costs shall be substantiated by satisfactory evidence furnished by the CONTRACTOR;

3. Sales Tax: Sales tax, if any, required to be paid on the changed or disputed work;
4. Equipment, Truck and Plant Rentals, Other Than Small Tools: The CONTRACTOR shall be reimbursed for the number of hours that the equipment, truck or plant is actually used on a specified CHANGE ORDER. Equipment used by the CONTRACTOR shall be specifically described by the manufacturer, model number and date of manufacture and be of suitable size and suitable capacity required for the work to be performed. In the event the CONTRACTOR elects to use equipment of a higher rental rate than the equipment suitable for the work, payment will be made at the rate applicable to the suitable equipment. The equipment actually used and the suitable equipment upon which he rental rate is based will be recorded as a part of the record for CHANGE ORDER work. The OWNER shall determine the suitability of the equipment. If there is a differential in the rate of pay of the operator of oversize or higher rate equipment, the rate paid for the operator will likewise be related to the suitable equipment.

    a. CONTRACTOR Owned Equipment, Trucks and Plant: CONTRACTOR shall be reimbursed for its ownership costs and for its operating costs for self-owned equipment at the rates listed in the Rental Rate Blue Book published by the Dataquest, Inc. applied in the following manner as modified by the "Rate Adjustment Table".

        1) Ownership Costs: It is mutually understood that the rates for ownership costs reimburse the CONTRACTOR for all nonoperating costs of owning the equipment, truck or plant including depreciation on the original purchase, insurance, applicable taxes, interest on investment, storage, overhead, repairs, moving the equipment onto and away from the project or work site, and profit. Reimbursement will be made for the hours of actual use as described below:

            a) Less than 8 hours of actual use, the product of the actual number of hours used or fraction thereof multiplied by the hourly rate, or the daily rate, whichever is less.
            b) Between 8 hours and 40 hours of actual use, the product of the actual number of hours used divided by 8 multiplied by the daily rate, or the weekly rate, whichever is less.
            c) Between 40 and 176 hours of actual use, the product of the actual number of hours used divided by 40 multiplied by the weekly rate, or the monthly rate, whichever is less.
            d) Over 176 hours of actual use, the product of the actual number of hours used divided by 176 multiplied by the monthly rate.

        2) Operating Costs: The rate for operating costs includes fuel, lubricants, other operating expendibles, and preventative and field maintenance. Operating cost does not include the operator's wages. The CONTRACTOR shall be reimbursed the product of the number of hours of actual use multiplied by the Estimated Operating Cost/Hour.
        3) The geographic Area Adjustment Factor shown on the map at the beginning of each section of the Rental Rate Blue Book shall not be applied to the equipment rates subsequently listed in each section and shall not be used as a basis for payment.

4) In the event that a rate is not established in the Rental Rate Blue Book for Construction Equipment for a particular piece of equipment, truck or plant, the OWNER shall establish rates for ownership costs and operating costs for that piece of equipment, truck or plant that is consistent with its cost and expected life.

b. Rented Equipment, Trucks and Plant:

1) In the event that the CONTRACTOR does not own a specific type of equipment and must obtain it by rental, it shall be paid the actual rental rate for the equipment for the time that the equipment is used to accomplish the work or is required by the OWNER to be present, not to exceed the adjusted rental rate in the Rental Rate Blue Book, plus the reasonable cost of moving the equipment onto and away from the project site.
2) The CONTRACTOR shall also be reimbursed for the operating cost of the equipment unless reflected in the rental price. Such operating costs shall be determined in the same manner as specified for Contractor Owned Equipment above.
3) In the event that area practice dictates the rental of equipment with an operator or fully fueled and maintained equipment, truck or plants, payment will be made on the basis of an invoice for the rental of the equipment with an operator, fully fueled and/or maintained equipment, trucks or plants including all costs incidental to its use, including costs of moving to and from the site, provided the rate is substantiated by area practice.

c. Maximum Amount Payable: The maximum amount of reimbursement for the ownership costs of CONTRACTOR owned or the rental cost of rented equipment, trucks or plant is limited to the original purchase price of the equipment, truck or plant for any CHANGE ORDER work as listed in the Green Guide for Construction Equipment published by the Dataquest, Inc. In the specific event when the ownership or rental reimbursement is limited by the original purchase price, the CONTRACTOR shall, nevertheless, be reimbursed for the operating Cost/hour for each hour of actual use.

5. Profit and Overhead: Fifteen percent (15%) of the total of material and labor costs only, shall be all owed as compensation for all items of overhead including, but not limited to; administration, clerical or stenographic employees; home office supervision; all salary and expenses of executive officers, home office personnel, project managers, estimators, superintendents and supervisors (other than foremen in direct charge of the specific operations); bond premium; watchmen; insurance premiums (other than workers' compensation insurance); materials used on a temporary basis and use of small tools, all charges for used, damaged or lost minor equipment and tools, including shovels, picks, axes, saws, bars, sledges, lanterns, jacks, cables, pails, wrenches, etc., other miscellaneous supplies and services; office supplies and equipment, and for profit.

G. The term "net cost" of the work shall not include salaries or other compensation of Contractor's officers, general superintendents, estimators or principal office employees. When both additions and credits covering related changed work or substitutions are involved, the allowances for overhead and profit shall be figured on the basis of the net increase, if any, with respect to that change. The OWNER shall not pay for any costs due to the negligence of the CONTRACTOR or a subcontractor.

H. If any of the changed work is performed by a Subcontractor, the CONTRACTOR shall be paid the actual and reasonable cost of such subcontracted work computed as outlined above, or on such other basis as might be approved by the OWNER, plus an additional allowance of ten percent (10%) of materials and labor costs as specified under 1.14.F(1) and 1.14.F(2), hereinabove to cover the CONTRACTOR's profit and overhead (limitations as further defined under 1.14.F(5), hereinabove). The cost of transportation of materials shall be excluded when computing the above described charges for profit and overhead for subcontracted work.

I. When the quantity of work for a unit price item of the proposal is increased in excess of 125 percent of the estimated quantity of the Contract, the Owner reserves the right to effect an adjustment (decrease) to the unit price of the effected item. The basis for the adjustment (decrease) shall be agreed upon prior to the performance of the work. If a basis cannot be agreed upon prior to the performance of the work, upon issuance of a CONSTRUCTION CHANGE ORDER DIRECTIVE by the OWNER or a FIELD ORDER by the ENGINEER, the Contractor shall proceed with the work and as soon as practicable thereafter (subject to time limitations noted hereinabove) submit a fair and equitable adjusted unit price to the OWNER and ENGINEER, based on supporting information to be submitted by the Contractor.

J. With respect to a change involving an overrun (increase) in quantity of a unit price item for which the Contractor desires an increase in the unit price, the Contractor must notify, in writing, the Owner of the existence of the change in quantity of the item it desires to adjust the contract price of. The Contractor's notification to the Owner must be prior to performing work on the quantity exceeding 125 percent of the estimated quantity for the involved unit price item. If the CONTRACTOR receives a written order or letter from the Owner to perform the work, or field order from the Engineer that could lead to a change in contract item quantity and its unit price, the CONTRACTOR shall notify the OWNER of any desired change in the unit price within seven (7) days or prior to performing work on the quantity exceeding 125 percent of the estimated quantity (whichever comes first).

K. Any adjustment in unit price for an increase in quantity shall apply only to that portion in excess of 125 percent of original contract item quantity.

1.15 TIME FOR COMPLETION, LIQUIDATED DAMAGES AND EXCUSABLE DELAYS

A. The date of beginning and the time for completion of the WORK are essential conditions of the CONTRACT DOCUMENTS and the WORK embraced shall be commenced on a date specified in the NOTICE TO PROCEED.

B. The CONTRACTOR will proceed with the WORK at such rate of progress to insure full completion within the CONTRACT TIME. It is expressly understood and agreed, by and between the CONTRACTOR and the OWNER, that the CONTRACT TIME for the completion of the WORK described herein is a reasonable time, taking into consideration average climatic and economic conditions and other factors prevailing in the locality of the WORK.

C. If the CONTRACTOR shall fail to complete the WORK within the CONTRACT TIME, or extension of time granted by the OWNER, then the CONTRACTOR will pay to the OWNER:

1. The amount for liquidated damages as specified in the INSTRUCTIONS TO BIDDERS for each calendar day that the CONTRACTOR shall be in default after the time stipulated in the CONTRACT DOCUMENTS.

2. The CONTRACTOR agrees that due to the inherent difficulty in establishing or calculating the actual damages incurred by the OWNER in the event of delays the completion of the project caused by the CONTACTOR, the amount stipulated with respect to liquidated damages in the instructions to bidders represents a reasonable estimate and amount of compensation payable to the OWNER in the event of such delay, given the nature and magnitude of the project, and is not intended as a penalty. Notwithstanding the foregoing, nothing herein shall be construed to be a waiver of any rights the OWNER may have to claim or prove actual damages, with respect to which the OWNER expressly reserves all rights.
3. All costs of engineering field work and construction observation and project administration between the contractual specified date of completion (including extensions) and the actual date of completion of all the work set forth in the Contract; at the Engineer's set chargeable hourly rates.

D. EXCUSABLE DELAYS. The CONTRACTOR shall not be charged with liquidated damages or any excess cost when the delay in completion of the WORK is due to the following, and the CONTRACTOR has given WRITTEN NOTICE and documentation of such delay to the OWNER in accordance with Section 14A of the Instructions to Bidders.

1. To any preference, priority or allocation order duly issued by the OWNER.
2. To unforeseeable causes beyond the control and without the fault or negligence of the CONTRACTOR, including but not restricted to, acts of God, or of the public enemy, acts of the OWNER, acts of another CONTRACTOR in performance of a contract with the OWNER, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, and abnormal and unforeseeable weather; and
3. To any delays of SUBCONTRACTORS occasioned by any of the causes specified in paragraphs 1.15.D.1 and 1.15.D.2 of this article.
4. To any delays pursuant to a CHANGE ORDER, with the extension in time for completion to be as agreed to by the OWNER and CONTRACTOR on the CHANGE ORDER, if such extra work cannot reasonably be done simultaneously with other parts of the work.

E. WINTER CONSTRUCTION. Should the actual date of the NOTICE TO PROCEED and the CONTRACT TIME cause work to be anticipated to occur during winter months, the CONTRACTOR should include in his bid appropriate plant, materials and provisions to accomplish the CONTRACT WORK during weather conditions which may occur during such winter season. Should the OWNER determine that such winter conditions are such that extreme adverse weather conditions make work impossible, at the sole discretion of the OWNER, such adverse conditions shall be excusable and shall not be assessed as liquidated damages.

1.16 CORRECTION OF WORK

A. The CONTRACTOR shall promptly remove from the premises all WORK rejected by the ENGINEER for failure to comply with the CONTRACT DOCUMENTS, whether incorporated in the construction or not, and the CONTRACTOR shall promptly replace and re-execute the WORK in accordance with the CONTRACT DOCUMENTS and without expense to the OWNER and shall bear the expense of making good all WORK of other CONTRACTORS destroyed or damaged by such removal or replacement.

B. All removal and replacement WORK shall be done at the CONTRACTOR'S expense. If the CONTRACTOR does not take action to remove such rejected WORK within ten (10) days after

receipt of WRITTEN NOTICE, the OWNER may remove such WORK and store the materials at the expense of the CONTRACTOR.

1.17 SUBSURFACE CONDITIONS

A. The CONTRACTOR shall promptly, and before such conditions are disturbed, except in the event of an emergency, notify the OWNER by WRITTEN NOTICE of:

1. Subsurface or latent physical conditions at the site differing materially from those indicated in the CONTRACT DOCUMENTS; or
2. Unknown physical conditions at the site, of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in the WORK of the character provided for in the CONTRACT DOCUMENTS.

B. The OWNER shall promptly investigate conditions, and if he finds that such conditions do so materially differ and cause an increase or decrease in the cost of, or in the time required for, performance of the WORK, an equitable adjustment shall be made and the CONTRACT DOCUMENTS shall be modified by a CHANGE ORDER. Any claim of the CONTRACTOR for adjustment hereunder shall not be allowed unless he has given the required WRITTEN NOTICE, provided that the OWNER may, if he determines the facts so justify, consider and adjust any such claims asserted before the date of final payment.

1.18 SUSPENSION OF WORK, TERMINATION AND DELAY

A. The OWNER may suspend the WORK or any portion thereof for a period of not more than ninety (90) days or such further time as agreed upon by the CONTRACTOR, by WRITTEN NOTICE to the CONTRACTOR and the ENGINEER which notice shall fix the date on which WORK shall be resumed. The CONTRACTOR will resume that WORK on the date so fixed.

B. If the CONTRACTOR is adjudged bankrupt or insolvent, or if he makes a general assignment for the benefit of his creditors, or if a trustee or receiver is appointed for the CONTRACTOR or for any of his property, or if he files a petition to take advantage of any debtor's act, or to reorganize under bankruptcy or applicable laws, or if he repeatedly fails to supply sufficient skilled workmen or suitable materials or equipment, or if he repeatedly fails to make prompt payments to SUBCONTRACTORS or for labor, materials or equipment or if he disregards laws, ordinances, rules, regulations or orders of any public body having jurisdiction of the WORK or if he disregards the authority of the ENGINEER, or if he otherwise violates any provision of the CONTRACT DOCUMENTS, then the OWNER may, without prejudice to any other right or remedy and after giving the CONTRACTOR and his surety a minimum of ten (10) days from delivery of a WRITTEN NOTICE, to cure to the satisfaction of the OWNER and ENGINEER the specified defaults (or in the event the specified defaults cannot be fully cured with the ten day period, the CONTRACTOR commences curing the defaults during that period and continues to make reasonable progress to cure fully), terminate services of the CONTRACTOR and take possession of the PROJECT and of all materials, equipment, tools, construction equipment and machinery thereon owned by the CONTRACTOR, and finish the WORK by whatever method he may deem expedient.

C. In such case the CONTRACTOR shall not be entitled to receive any further payment until the WORK is finished. If the unpaid balance of the CONTRACT PRICE exceeds the direct and

indirect costs of completing the PROJECT, including compensation for additional professional services, such excess shall be paid to the CONTRACTOR. If such costs exceed such unpaid balance, the CONTRACTOR will pay the difference to the OWNER. Such costs incurred by the OWNER will be determined by the ENGINEER and incorporated in a CHANGE ORDER.

D. Where the CONTRACTOR'S services have been so terminated by the OWNER, pursuant to Section 1.18.B above, said termination shall not affect any right of the OWNER against the CONTRACTOR then existing or which may thereafter accrue. Any retention or payment of monies by the OWNER due the CONTRACTOR will not release the CONTRACTOR from compliance with the CONTRACT DOCUMENTS.

E. After ten (10) days from delivery of a WRITTEN NOTICE to the CONTRACTOR and the ENGINEER, the OWNER may, without cause and without prejudice to any other right or remedy, elect to abandon the PROJECT and terminate the Contract. In such case, the CONTRACTOR shall be paid for all Work executed as a percentage of completion of the CONTRACT PRICE together with termination expenses necessarily incurred. CONTRACOR shall not be entitled to recover any lost overhead or profits upon WORK not performed.

F. If, through no act or fault of the CONTRACTOR, the WORK is suspended for a period of more than ninety (90) days by the OWNER or under an order of court or other public authority, or the ENGINEER fails to act on any request for payment within thirty (30) days after is it submitted, or the OWNER fails to pay the CONTRACTOR substantially the sum approved by the ENGINEER or awarded by legal procedures within thirty (30) days of its approval and presentation, then the CONTRACTOR may, after ten (10) days from delivery of a WRITTEN NOTICE to the OWNER and the ENGINEER, terminate the CONTRACT and recover from the OWNER payment for all WORK executed and all termination expenses sustained as provided in Section 18.4, above. In addition and in lieu of terminating the CONTRACT, if the ENGINEER has failed to act on a request for payment or if the OWNER has failed to act on a request for payment or if the OWNER has failed to make any payment as aforesaid, the CONTRACTOR may upon ten (10) days written notice to the OWNER and the ENGINEER stop the WORK until he has been paid all amounts then due, in which event and upon resumption of the WORK, CHANGE ORDERS shall be issued for adjusting the CONTRACT PRICE or extending the CONTRACT TIME or both to compensate for the costs and delays attributable to the stoppage of the WORK.

1. If the performance of all or any portion of the WORK is suspended, delayed, interrupted or interfered with, the CONTRACTOR agrees to make no claim for damages for delay, impact, acceleration, interference or disruption in the performance of this CONTRACT occasioned by any changes, suspensions, acts, failures to act or omissions of the OWNER, ENGINEER, any of their representatives, other contractors, subcontractors or suppliers, court orders or any other cause and agrees that any such claim shall be fully compensated for by an extension of time to complete performance of the WORK, as provided herein. CONTRACTOR acknowledges that delays are often inherent in the performance of construction contracts and that any such delays are within the contemplation of the parties.
2. The CONTRACTOR understands that the OWNER is a public corporation with a fixed budget for the project, and accordingly agrees to make no claims for damages for delay against the OWNER or ENGINEER except as to delays caused by the intentional wrongdoing, gross negligence or malicious bad faith on the part of the OWNER or its agents. In appropriate circumstances where the CONTRACTOR is not at fault in causing those delays, the CONTRACTOR may be entitled to an extension of time in which to complete its performance of the work, including without limitation delays caused by

unanticipated subsurface or groundwater conditions in the location of underground structures or utilities. The CONTRACTOR nonetheless agrees that whether or not it is granted an extension of time, the CONTRACTOR waives any and all rights to claim damages for delay and represents that it has taken into consideration the risk of loss and damage from delay in preparing and submitting its bid, and assumes all risk of loss therefrom, except to the extent caused by the intentional wrongdoing, gross negligence or malicious bad faith of the OWNER or its agents.

1.19 PAYMENTS TO CONTRACTORS

A. PROGRESS PAYMENTS At least ten (10) days before each progress payment falls due (but not more often than once a month), the CONTRACTOR will submit to the ENGINEER a partial payment estimate filled out on such forms as furnished by the Owner and Engineer and signed by the CONTRACTOR covering the WORK performed during the period covered by the partial payment estimate and supported by such data as the ENGINEER may reasonably require. If payment is requested on the basis of the materials and equipment not incorporated in the WORK but delivered and suitably stored at or near the site (at an approved location), the partial payment estimate shall also be accompanied by such supporting data, satisfactory to the OWNER, as will establish the OWNER'S title to the material and equipment and protect his interest therein, which includes applicable insurance.

B. The ENGINEER will, within ten (10) days after receipt of each partial payment estimate, either indicate in writing his recommendation of payment and present the partial payment estimate to the OWNER or return the partial payment estimate to the CONTRACTOR indicating in writing his reasons for refusing to recommend payment. In the latter case, the CONTRACTOR may make the necessary corrections and resubmit the partial payment estimate. The OWNER will, within thirty (30) days of presentation to him of the recommendation of payment with attached partial payment estimate, pay the CONTRACTOR a progress payment on the basis of the estimate as approved by the Owner. The OWNER shall retain five percent (5%) of the amount of each payment until final completion and acceptance of all the work covered by the CONTRACT DOCUMENTS.

C. RELEASE OF RETAINER When the WORK is substantially complete (operational or beneficial occupancy), the retained amount shall be reduced to two times the value of any remaining work items to be completed, as estimated by the ENGINEER, plus any amount the OWNER deems necessary to satisfy any claims, liens or judgments which have not been suitably discharged.

D. Unless otherwise directed in writing by the OWNER, each application for payment shall include the certified payrolls of the CONTRACTOR and all subcontractors for the periods since the prior application for payment.

E. Each application or requisition for payment by the CONTRACTOR shall constitute a representation that the work and materials reflected therein have been actually furnished; that the quantities and prices therefore are true and accurate; that the CONTRACTOR has no knowledge of any mechanic’s liens having been filed against the project except as otherwise identified; that all of the contractor’s employees and laborers have been paid all wages, benefits contributions and wage supplements in full for the period in question; that the contractor is current in payment of all unemployment insurance contributions, withholding and payroll taxes; and that all employees, laborers, subcontractors and materials suppliers have been paid in full less any agreed

upon retainage for all labor and materials furnished up to the date of the most recent requisition for which payment has been made by the OWNER. The CONTRACTOR shall furnish upon demand proof that it has paid all employees, laborers, subcontractors, material suppliers, labor organizations and taxing authorities including without limitation payroll records and receipts; and shall retain all such records as well as all other project records for at least three years after substantial completion.

F. The request for payment may also include an allowance for the cost of such major materials and equipment which are suitably stored either at or near the site (at an approved location), in a location determined acceptable to the OWNER. Any such request shall include copies or invoices for each item of material or equipment for which payment is requested.

G. Prior to SUBSTANTIAL COMPLETION, the OWNER, with recommendation of the ENGINEER and with the concurrence of the CONTRACTOR, may use any completed or substantially completed portions of the WORK. Such use shall not constitute an acceptance of such portions of the WORK.

H. The OWNER shall have the right to enter the premises for the purpose of doing work not covered by the CONTRACT DOCUMENTS. This provision shall not be construed as relieving the CONTRACTOR of the sole responsibility for the care and protection of the WORK, or the restoration of any damaged WORK except such as may be caused by agents or employees of the OWNER.

I. Upon completion and acceptance of the WORK, the ENGINEER shall issue a certificate of substantial completion attached to the final payment request that the WORK has been accepted by him under the conditions of the CONTRACT DOCUMENTS. The entire balance found to be due the CONTRACTOR, including the retained percentages, but except such sums as may be lawfully retained by the OWNER (twice the value of incomplete work plus amounts of cover claims made to the OWNER), shall be paid to the CONTRACTOR within thirty (30) days of completion and acceptance of the WORK. Estimate of value for incomplete work shall be prepared by the ENGINEER. The Contractor shall also be required to complete an Affidavit as referenced under Section 9 of the Agreement.

J. The CONTRACTOR will indemnify and save the OWNER or the OWNER's agents harmless from all claims growing out of the lawful demands of SUBCONTRACTORS, laborers, workmen, mechanics, material men, and furnishers of machinery and parts thereof, equipment, tools and all supplies, incurred in the furtherance of the performance of the WORK. The CONTRACTOR shall, at the OWNER'S request, furnish satisfactory evidence that all obligations of the nature designated above have been paid, discharged or waived. If the CONTRACTOR fails to do so the OWNER may, after having notified the CONTRACTOR, either pay unpaid bills or withhold from the CONTRACTOR'S unpaid compensation a sum of money deemed reasonably sufficient to pay any and all such lawful claims until satisfactory evidence is furnished that all liabilities have been fully discharged whereupon payment to the CONTRACTOR shall be resumed, in accordance with the terms of the CONTRACT DOCUMENTS, but in no event shall the provisions of this sentence be construed to impose any obligations upon the OWNER to either the CONTRACTOR, his Surety, or any third party. In payment of any unpaid bills of the CONTRACTOR, any payment so made by the OWNER shall be considered as a payment made under the CONTRACT DOCUMENTS by the OWNER to the CONTRACTOR and the OWNER shall not be liable to the CONTRACTOR for any such payments made in good faith.

K. If the OWNER fails to make payment thirty (30) days after recommendation by the ENGINEER, in addition to other remedies available to the CONTRACTOR, there shall be added to each such payment interest at the maximum legal rate commencing on the first day after said payment is due and continuing until the payment is received by the CONTRACTOR.

1.20 ACCEPTANCE OF FINAL PAYMENT AS RELEASE

A. The acceptance by the CONTRACTOR of final payment shall be and shall operate as a release to the OWNER of all claims and all liability to the CONTRACTOR for all things done or furnished in connection with this WORK and for every act and neglect of the OWNER and others relating to or arising out of this WORK. Any payment, however, final or otherwise, shall not release the CONTRACTOR or his sureties from any obligations under the CONTRACT DOCUMENTS or the Performance BOND and Labor and Material Payment BONDS.

B. At the time of Final Payment, the Contractor shall execute an Affidavit for Release of Retainage and/or Final Payment, as provided by the Engineer.

1.21 INSURANCE

A. The CONTRACTOR shall purchase and maintain such insurance as will protect him from claims set forth below, which may arise out of or result from the CONTRACTOR'S execution of the WORK whether such execution be by himself or by any SUBCONTRACTOR or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable:

1. Claims under workers compensation, disability benefit and other similar employee benefit acts;
2. Claims for damages because of bodily injury, occupational sickness or disease, or death of employees;
3. Claims for damages because of bodily injury, sickness or disease, or death of any person other than his employees;
4. Claims for damages insured by usual personal injury liability coverage which are sustained (1) by any person as a result of an offense directly or indirectly related to employment of such person by the CONTRACTOR, or (2) by any other person; and
5. Claims for damages because of injury to or destruction of tangible property, including the loss of use resulting therefrom.

B. Certificates of Insurance acceptable to the OWNER shall be filed with the OWNER at the time of execution of the Agreement, but no later than fifteen (15) days from the date of Notification of Award. These Certificates shall contain a provision that coverages afforded under the policies will not be cancelled unless at least thirty (30) days prior WRITTEN NOTICE (by Certified Mail) has been given to the OWNER.

C. A recitation in such provision that the insurer will not be responsible for failure of the OWNER to receive such notice will not be acceptable. If such recitation is on the Certificate utilized, it shall be omitted or stricken from such Certificate and the required provisions noted thereon.

D. The CONTRACTOR shall procure and maintain, at his own expense, during the CONTRACT PERIOD, liability insurance as hereinafter specified;

1. CONTRACTOR'S General Public Liability and Property Damage Insurance including vehicle coverage issued to the CONTRACTOR and protecting him from all claims for personal injury, including death and all claims for destruction of or damage to property, arising out of or in connection with any operations under the CONTRACT DOCUMENTS, whether such operations be by himself or by any SUBCONTRACTOR under him, or anyone directly or indirectly employed by the CONTRACTOR or by a SUBCONTRACTOR under him. Insurance shall be written with a limit of liability of not less than $2,000,000 for all damages arising out of bodily injury, including death, at any time resulting therefrom, sustained by any one person in any one accident; and a limit of liability of not less than $2,000,000 aggregate for any such damages sustained by two or more persons in any one accident. Insurance shall be written with a limit of liability of not less than $2,000,000 for all property damage sustained by any one person in any one accident; and a limit of liability of not less than $2,000,000 aggregate for any such damage sustained by two or more persons in any one accident.
2. The CONTRACTOR shall acquire and maintain Fire and Extended Coverage insurance upon the PROJECT to the full insurable value thereof for the benefit of the OWNER, the CONTRACTOR, and SUBCONTRACTORS as their interest may appear. This provision shall in no way release the CONTRACTOR or CONTRACTOR'S surety from obligations under the CONTRACT DOCUMENTS to fully complete the PROJECT.

E. The CONTRACTOR shall procure and maintain, at his own expense, during the CONTRACT PERIOD, in accordance with the provisions of the laws of the state in which the work is performed, Workmen's Compensation Insurance, including occupational disease provisions, for all of his employees at the site of the PROJECT and in case any work is sublet, the CONTRACTOR shall require such SUBCONTRACTOR similarly to provide Workmen's Compensation Insurance, including occupational disease provisions for all of the latter's employees unless such employees are covered by the protection afforded by the CONTRACTOR. In case any class of employees engaged in hazardous work under this contract at the site of the PROJECT is not protected under Workmen's Compensation statute, the CONTRACTOR shall provide, and shall cause each SUBCONTRACTOR to provide, adequate and suitable insurance for the protection of his employees not otherwise protected.

F. The CONTRACTOR shall secure, "All Risk" type Builder's Risk Insurance for WORK to be performed. Unless specifically authorized by the OWNER, the amount of such insurance shall not be less than the CONTRACT PRICE totaled in the BID. The policy shall cover not less than the losses due to fire, explosion, hail, lightning, vandalism, malicious mischief, wind, collapse, riot, aircraft, and smoke during CONTRACT PERIOD, and until the WORK is accepted by the OWNER.

G. The policy shall name as insured the Contractor. In addition, all policies shall name as additional insured the OWNER, and BLAKE ENGINEERING PLLC. Listing the above entities as "certificate holder" is NOT acceptable.

1.22 CONTRACT SECURITY

A. The CONTRACTOR shall, not later than fifteen (15) days from the date of the NOTICE OF AWARD furnish the OWNER with a Performance Bond and a Labor and Material Payment Bond in penal sums equal to the amount of the CONTRACT PRICE, conditioned upon the performance by the CONTRACTOR of all undertakings, covenants, terms, conditions and agreements of the CONTRACT DOCUMENTS, and upon the prompt payment by the CONTRACTOR to all

persons supplying labor and materials in the prosecution of the WORK provided by the CONTRACT DOCUMENTS. Such BONDS shall be executed by the CONTRACTOR and a corporate bonding company licensed to transact such business in the state in which the WORK is to be performed and named on the current list of "Surety Companies Acceptable on Federal Bonds" as published in the Treasury Department Circular Number 570. The expense of these BONDS shall be borne by the CONTRACTOR. If at any time a surety on any such BOND is declared a bankrupt or loses its right to do business in the state in which the WORK is to be performed or is removed from the list of Surety Companies accepted on Federal BONDS, the CONTRACTOR shall within ten (10) days after notice from the OWNER to do so, substitute an acceptable BOND (or BONDS) in such form and sum and signed by such other surety or sureties as may be satisfactory to the OWNER. The premiums on such BOND shall be paid by the CONTRACTOR. No further payments shall be deemed due nor shall be made until the new surety or sureties shall have furnished an acceptable BOND to the OWNER.

1.23 ASSIGNMENTS

A. Neither the CONTRACTOR nor OWNER shall sell, transfer, assign or otherwise dispose of the Contract or any portion thereof, or of his right, title or interest therein, or his obligations thereunder, without written consent of the other party.

1.24 INDEMNIFICATION

A. The CONTRACTOR will indemnify and hold harmless the OWNER and the ENGINEER and their agents and employees from and against all claims, damages, losses and expenses including attorney's fees arising out of or resulting from the performance of the WORK, provided that any such claims, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property including the loss of use resulting therefrom; and is caused in whole or in part by any negligent or willful act or omission of the CONTRACTOR, and SUBCONTRACTOR, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable.

B. In any and all claims against the OWNER or the ENGINEER, or any of their agents or employees, by any employee of the CONTRACTOR, any SUBCONTRACTOR, anyone directly or indirectly employed by any of them, or anyone for whose acts any of them may be liable, the indemnification obligation shall not be limited in any way by any limitation on the amount or type of damages, compensation or benefits payable by or for the CONTRACTOR or any SUBCONTRACTOR under workmen's compensation acts, disability benefit acts or other employee benefits acts.

C. The obligation of the CONTRACTOR under this paragraph shall not extend to the liability of the ENGINEER, his agents or employees arising out of the preparation or approval of maps, DRAWINGS, opinions, reports, surveys, CHANGE ORDERS, designs or SPECIFICATIONS.

1.25 SEPARATE CONTRACTS

A. The OWNER reserves the right to let other contracts in connection with this PROJECT. The CONTRACTOR shall afford other CONTRACTORS reasonable opportunity for the introduction and storage of their materials and the execution of their WORK and shall properly connect and

coordinate his WORK with theirs. If, the proper execution or results of any part of the CONTRACTOR'S WORK depends upon the WORK of any other CONTRACTOR, the CONTRACTOR shall inspect and promptly report to the ENGINEER any defects in such WORK that render it unsuitable for such proper execution and results.

B. The OWNER may perform additional WORK related to the PROJECT by himself, or he may let other contracts containing provisions similar to these. The CONTRACTOR will afford the other CONTRACTORS who are parties to such Contracts (or the OWNER, if he is performing the additional WORK himself), reasonable opportunity for the introduction and storage of materials and equipment and the execution of WORK and shall properly connect and coordinate his WORK with theirs.

C. If the performance of additional WORK by other CONTRACTORS or the OWNER is not noted in the CONTRACT DOCUMENTS prior to the execution of the CONTRACT, written notice thereof shall be given to the CONTRACTOR prior to starting any such additional WORK. If the CONTRACTOR believes that the performance of such additional WORK by the OWNER or others involves him in additional expense or entitles him to an extension of the CONTRACT TIME, he may make a claim therefore as provided in Sections 1.14 and 1.15.

D. The CONTRACTOR understands that to the extent other contractors or trades are engaged to perform work on the project, the CONTRACTOR shall cooperate with such other CONTRACTOR shall cooperate with such other contractors and trades and shall coordinate its work so as to cause no delay in the progress or completion of the project.

1.26 SUBCONTRACTING

A. The CONTRACTOR may utilize the services of specialty SUBCONTRACTORS on those parts of the WORK which, under normal contracting practices, are performed by specialty SUBCONTRACTORS.

B. The CONTRACTOR shall not award WORK to SUBCONTRACTOR(s), in excess of fifty (50%) percent of the CONTRACT PRICE, without prior written approval of the OWNER.

C. The CONTRACTOR shall be fully responsible to the OWNER for the acts and omissions of his SUBCONTRACTORS, and of persons either directly or indirectly employed by them, as he is for the acts and omissions of persons directly employed by him.

D. The CONTRACTOR shall cause appropriate provisions to be inserted in all subcontracts relative to the WORK to bind SUBCONTRACTORS to the CONTRACTOR by the terms of the CONTRACT DOCUMENTS insofar as applicable to the WORK of SUBCONTRACTORS and to give the CONTRACTOR the same power as regard terminating any subcontract that the OWNER may exercise over the CONTRACTOR under any of the provisions of the CONTRACT DOCUMENTS.

E. Nothing contained in this CONTRACT shall create any contractual relation between any SUBCONTRACTOR and the OWNER.

F. The CONTRACTOR shall notify the OWNER and the ENGINEER by written notice of all SUBCONTRACTORS to be utilized, with a description of the subcontract scope of work, prior to the SUBCONTRACTOR performing such work on-site.

1.27 ENGINEER'S AUTHORITY

A. The ENGINEER shall act as the OWNER'S representative during the construction period. He shall decide questions which may arise as to quality and acceptability of materials furnished and WORK performed. He shall interpret the intent of the CONTRACT DOCUMENTS in a fair and unbiased manner. The ENGINEER will make visits to the site and will endeavor to determine, in general, if the WORK is proceeding in accordance with the CONTRACT DOCUMENTS.

B. The CONTRACTOR will be held strictly to the intent of the CONTRACT DOCUMENTS in regard to the quality of materials, workmanship and execution of the WORK. Inspections may be made at the factory or fabrication plant of the source of material supply.

C. The ENGINEER will not be responsible for the construction means, controls, techniques, sequences, procedures, or construction safety.

D. Pursuant to requests in conformance with Section 1.2.C of the General Conditions, the ENGINEER shall promptly make decisions relative to interpretation of the CONTRACT DOCUMENTS.

1.28 GUARANTY

A. The CONTRACTOR shall guarantee all materials and equipment furnished and WORK performed for a period of one (1) year from the date of SUBSTANTIAL COMPLETION. The CONTRACTOR warrants and guarantees for a period of one (1) year from the date of SUBSTANTIAL COMPLETION of the work that the completed work is free from all defects due to faulty materials or workmanship and the CONTRACTOR shall promptly make such corrections as may be necessary by reason of such defects including the repairs of any damage to other parts of the project resulting from such defects. Where no Certificate of Substantial Completion is issued, the one (1) year guarantee shall run from the date of approval of final payment by the OWNER. The OWNER will give notice of observed defects with reasonable promptness. In the event that the CONTRACTOR should fail to make such repairs, adjustments, or other WORK that may be made necessary by such defects, the OWNER may do so and the CONTRACTOR agrees to fully reimburse the OWNER for the cost thereby incurred. OWNER'S rights set forth in this paragraph are in addition to, and not in limitation of, any rights of the OWNER under this contract or as otherwise provided by law.

B. The PERFORMANCE BOND and all insurance policies shall remain in full force and effect through the guarantee period. If acceptable to the OWNER, the CONTRACTOR may provide a Maintenance Bond in lieu of the Performance Bond for the guarantee period. The surety bond shall be delivered simultaneously with the request for final payment. The surety on such bond shall be a duly authorized surety company to do business in the State of New York, satisfactory to the OWNER.

C. As part of the work required during the guaranty period, the Contractor shall maintain, fully at his cost, all trenches, work areas or other such affected areas, and all work required in compliance with (as a minimum) Section 01570, Maintenance and Protection of Traffic, at no expense to the Owner.

1.29 TAXES

A. The CONTRACTOR will pay all applicable sales, consumer, use and other similar taxes required by the law of the place where WORK is performed.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 007216

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SECTION 007343 – WAGE RATES

PART 1 - GENERAL

A. The initial New York State minimum wage rate schedules for this project are bound herewith.

B. The labor on this contract shall be performed in all respects in full accordance with the Labor Law of the State of New York. In accordance with Section 220, Subdivision 3, and Section 220-D, of the Labor Law, the Industrial Commissioner has designated as the minimum hourly rates to be paid to employees on the work the rates shown on the attached schedules which shall be posted in a prominent and convenient place for the inspection of the Contractor's employees. Article 8, Section 220 of the Labor Law, as amended by Chapter 750 of the Laws of 1956, provides, among other things, that it shall be the duty of the fiscal officer to make a determination of the schedule of wages and supplemental(s) to be paid to all laborers, workmen and mechanics employed on public works projects. The amount of supplemental(s) listed on the enclosed schedule does not necessarily include all types of prevailing supplements.

C. The Contractor shall make provision for disability benefits, workman's compensation, unemployment insurance and social security, as required by law.

D. Per the New York State Education Department's directive in its Office of Facilities Planning Newsletter #106 – May 2011, the Contractor is responsible for obtaining updated copies of the prevailing wage schedule and the list of employers ineligible to bid on or be awarded public work contracts directly from the Department of Labor's Bureau of Public Work's web site at:

1. http://wpp.labor.state.ny.us/wpp/showFindProject.do?method=showIt
   a. Enter the PRC number: 2022003429
   b. Select Submit.
   c. Select the first link "Wage Schedule" at the top right.
2. In the event that the Contractor does not have web access or is unable to access the Department's website, please fax a written request for a printed copy of the schedule to the Central Office of the Bureau of Public Works at (518) 485-1870.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 007343

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SECTION 011100 – MILESTONE SCHEDULE

PART 1 - GENERAL

1.1 MASTER SCHEDULE

A. The following milestone schedule serves as a basis for bidding. A Master Schedule will be developed at a general meeting of the awarded contractor within 10 days of Award of the Contract. This Master Schedule will incorporate the milestones listed below.

1.2 SUBSTANTIAL COMPLETION & MILESTONE DATES

A. Award Contracts on or about MONDAY, DECEMBER 19, 2022

B. Start Construction – Date of Award of Contracts

C. Milestone Dates

1. Commence Construction – MONDAY, JUNE 26, 2023
2. Substantial Completion – FRIDAY, AUGUST 18, 2023
3. Completion of Punchlist – FRIDAY, SEPTEMBER 1, 2023

D. Final Close-out of Contract

1. Final close out of contract shall be within 30 days of the substantial completion dates established above. All work including, but not limited to punch lists, project closeout, testing, balancing, owner's operation training, O&M manuals, as-builts, warranties, etc. shall be complete.
2. All work required by the Owner or Engineer to execute final closeout of contracts after dates noted above, if determined to be caused by Contractor, shall result in payment to the Owner in the form of a change order deduct to the base contract.

E. School District/School Operation and Custodial Hours

1. During the Summer, work will be permitted between 7:00 a.m. and 4:00 p.m. all days except Saturday and Sundays. Any special work arrangements must be made through the Owner. Work during the School Year must be scheduled after school hours.
2. During the school year, the schools will be open until 11:00 p.m. Any work during the school year must be performed after school hours and end before 11:00 p.m. No work may occur in the school during occupied times unless there is a separation and separate access to the work area and noise is restricted to max 60 db. Any requests to work during school hours must be submitted in writing to the School District for approval. The submission must include a diagram showing how the construction area will be separated from occupied areas. Additionally, it must show temporary measures to be installed such as ventilation, screening, dust protection, fire separation, etc. The School District reserves it's right to accept or reject the request at their discretion.

END OF SECTION 011100

SECTION 011100 – MILESTONE SCHEDULE – **ALTERNATE #1**

PART 1 - GENERAL

1.1 MASTER SCHEDULE

A. The following milestone schedule serves as a basis for bidding. A Master Schedule will be developed at a general meeting of the awarded contractor within 10 days of Award of the Contract. This Master Schedule will incorporate the milestones listed below.

1.2 SUBSTANTIAL COMPLETION & MILESTONE DATES

A. Award Contracts on or about FRIDAY, DECEMBER 19, 2022

B. Start Construction – Date of Award of Contracts

C. Milestone Dates

1. Commence Construction – MONDAY, APRIL 3, 2023
2. Substantial Completion – FRIDAY, MAY 26, 2023
3. Completion of Punchlist – FRIDAY, JUNE 9, 2023

D. Final Close-out of Contract

1. Final close out of contract shall be within 30 days of the substantial completion dates established above. All work including, but not limited to punch lists, project closeout, testing, balancing, owner's operation training, O&M manuals, as-builts, warranties, etc. shall be complete.
2. All work required by the Owner or Engineer to execute final closeout of contracts after dates noted above, if determined to be caused by Contractor, shall result in payment to the Owner in the form of a change order deduct to the base contract.

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END OF SECTION 011100

SECTION 011200 – MULTIPLE CONTRACT SUMMARY

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. The Scope of Work related to the public-school building(s) in this Project includes but is not limited to; Athletic running track and baseball field reconstruction, including UG drainage, fencing replacement, and asphalt paving work. Storm water facilities and Sanitary lift station upgrades to support building renovations are also part of the Site Work scope. Renovations include interior classroom and support room renovations, extensive swimming pool reconstruction, select roofing replacement, exterior envelope reconstruction, hazardous materials abatement, removal and replacement of existing heating plant(s), infrastructure, terminal equipment and BMS temperature controls. Physical plant support work and electrical infrastructure upgrades are also part of the scope.

B. This Section includes a summary of each Prime Contract, including general requirements for Work, coordination, and specific temporary facilities and controls responsibilities. One set of Construction Documents is issued covering the Work of multiple Prime Contracts.

C. Specific requirements of Work of each Prime Contract are also indicated in individual paragraphs of this Section and may also be indicated in individual Specification Sections and on drawings. Each Prime Contractor is responsible to review all Construction Documents of the Project for specific requirements, and for a general understanding and knowledge of the Work of other Prime Contractors.

D. Prime Contractors are responsible for all Work of their Contract, no matter on what drawing the Work appears. Should a conflict or contradiction in assignment of Work be indicated elsewhere in the Construction Documents, this Section shall take precedence over all other assignments of Work.

1.3 DEFINITIONS

A. Project Identification: Project consists of all labor, materials, equipment, appliances, services, and incidentals necessary for layout, installing, and performing the cooling tower replacement at the Cornwall Central High School as shown on the Contract Drawings and described in the Specifications.

B. Building Site(s): The Building Site(s) shall be defined in the Construction Documents, as the building(s) footprint, and all related construction within a five-foot (5’0”) distance of the building’s exterior face, unless noted or assigned otherwise.

1. Prime Contractors shall be aware of, and coordinate, specific exceptions to the 5’0” limit indicated within each Scope of Work outline.

C. Permanent Enclosure: As determined by the Engineer, the condition at which roofing is installed and weather tight; exterior walls are weather tight and insulated; and all openings are closed with permanent construction or substantial temporary closures equivalent in weather protection to permanent construction.

1. All costs associated with failure to provide and maintain described installations that result in any damage or contamination to the Owner’s property, shall be borne by the Prime Contract responsible for the installation.

1.4 GENERAL REQUIREMENTS OF PRIME CONTRACTS

A. Prime Contracts: The context used in this Section are separate Prime Contracts that represent significant elements of Work that is to be performed concurrently and in close coordination with the Work of other Prime Contracts for the benefit of the Owner. Each Prime Contract is recognized to be a significant, integrated part of the Work.

B. Layout and Installation: Each Prime Contractor shall schedule, layout and install their Work in such manner as not to delay or interfere with, but to compliment the execution of the Work of other Prime Contractors, utility companies and Owner’s operations.

C. Extent of Contract: The Construction Documents, comprised of drawings and specifications, contain more specific descriptions of the Work, indicating which Prime Contract shall provide specific elements of the Project Work.

1. Work provided by each Prime Contract shall mean complete and operable systems and assemblies, including products, components, accessories and installations required by the Construction Documents, respective manufactured product, or indicated otherwise.
2. Prime Contractors shall exercise good judgment and perform all Work according to related industry standards.
3. The Owner is exempt from payment of Federal, State and local taxes, including sales and compensating use taxes on all materials and supplies incorporated in completing the Work; these taxes are not to be included in the Bid. This exemption does not apply to tools, machinery, equipment or other property leased by, or to, the Prime Contractor or subcontractor, or to supplies and materials, which even though consumed are not permanently incorporated into the completed Work.
    a. Prime Contractors, and their subcontractors, shall be responsible for paying all applicable taxes on said tools, machinery, equipment or property, and upon all said unincorporated supplies and materials, whether purchased or leased.
4. Prime Contractors shall understand that time is of the essence and will adequately staff the Project by employing the appropriate trade’s people to perform the Work; these people shall be experienced in their respective trades. A shortage of labor in the industry shall not be accepted as an excuse for not properly staffing the Project; all efforts shall be made to meet or exceed the schedule, including additional staff and/or labor hours necessary. All cost associated with this item shall be included within the Prime Contract’s Bid.
5. Local custom and trade union jurisdictional agreements or settlements will not control the scope of the Work of each Prime Contract.

a. When a potential jurisdictional dispute or similar interruption of Work is first identified or threatened, the affected Prime Contractor(s) shall promptly negotiate a reasonable settlement to avoid or minimize the pending interruption and/or delays.
b. Contractor's trade-related issues shall not be grounds for modification or extension of scheduled completion date(s).

6. The Work of all Prime Contractors requires close coordination with other Prime Contractors and construction personnel. Maintain flexibility and cooperation through the Project. "Out of Sequence" and "Delay" claims will only be considered when requirements of Division 01 "Project Management and Coordination" have been adhered to.
   a. Delay claims must be in writing and forwarded to the Engineer per the requirements of the Conditions of the Contract. Claims not submitted per these requirements will be rejected and/or denied.
7. The intention of the Work is to follow a logical sequence, however, a Prime Contractor may be required by the Engineer, to temporarily install, omit or leave out a section(s) of Work, out of sequence. All such out of sequence Work, and come back time, at these areas shall be performed at no additional cost to the Owner.

D. Construction Sequencing: Prime Contractors shall understand that concurrent construction on multiple areas/sites of this Project are a requirement. Should an area of construction not be complete per incremental milestones of the schedule included in the Contract Documents, the responsible Prime Contractor shall immediately augment the labor force, whether self-preformed of subcontracted, to recover such lost time.

E. Existing Conditions: Each Prime Contractor shall verify existing conditions in the field and per the Conditions of the Contract, immediately report conditions to the Architect that are not represented correctly by the Construction Documents.

1. Each Prime Contractor is responsible for familiarizing himself with Project Site Logistics, whether represented in the Construction Documents, or in real time.
2. Each Prime Contractor has been given ample opportunity to review existing conditions related to the Project. Existing conditions not noted in the Construction Documents that could be easily recognized during pre-bid review that interfere with the respective Prime Contractor's Work, shall be the responsibility of the respective Prime Contractor, including related costs associated with removal, patching, relocation or re-fabrication of installations.
3. Owner shall be responsible for removing Owner's contents of spaces for construction during unoccupied periods. Prime Contractors shall be responsible for removing and/or protecting, and re-placing Owner's contents during occupied periods, where contractor needs to perform work (ie: second-shift). The contractor shall ensure that spaces worked in are clean, and as encountered when they entered the space, prior to the next business day.

F. Protection of Installations: Each Prime Contractor is responsible for protecting their installations at all times. All costs incurred to repair, replace or clean insufficiently protected materials/installations shall be the responsibility of the installing Prime Contractor.

1. The Construction Site Representative(s) shall be notified, in writing, immediately upon material/installation being damaged. Notification shall support indication of the responsible party.
2. The Owner will not be liable for damaged materials and/or installations by "others", when "others" cannot be identified.

3. Repair damaged Work, clean exposed surfaces or replace construction installations that cannot be repaired.
4. Each Prime Contractor shall be responsible for removing all labels not required to remain, from their installations.
5. Installations shall be wiped clean and proper protection then installed.

G. Daily Cleaning: All Prime Contractors are responsible for any and all debris and refuse generated by their Work, including the Work of their subcontractors. A daily clean up and disposal is required by each Prime Contractor for the periods which that Prime Contractor, or its subcontractors, are performing Work on site(s).

1. All Prime Contractors shall be responsible for waste management (dumpsters, off-site disposal of demolished/removed materials, construction waste, etc.), for their own respective purposes, and for use by Mechanical, Electrical, and Plumbing Prime Contracts.
2. Final Cleaning: Following Substantial Completion of each area of construction, each Prime Contractor shall wipe/vacuum clean all respective installations.

1.5 GENERAL TEMPORARY FACILITIES AND CONTROLS OF PRIME CONTRACTS

A. Conditions of Use: Keep temporary services or conditions clean and neat in appearance. Operate in a safe and efficient manner. Relocate temporary facilities as required as Work progresses; do not overload facilities or permit them to interfere with progress. Take necessary fire prevention measures; do not allow hazardous, dangerous, or unsanitary conditions to develop or persist on the Project site(s).

1. Installation, operation, maintenance, and removal of each temporary service or condition are considered part of the respective Prime Contractor's own construction activity, as are costs and use charges associated with each facility.
2. Locate service or condition where they will serve the Project adequately and with minimum interference of the Work, coordinate with the Construction Site Representative(s) and the other Prime Contractors prior to installation.

B. Temporary Use of Permanent Facilities: Prime Contractor, as installer of each permanent service or condition, shall assume responsibility for its operation, maintenance and protection during use as a construction facility prior to the Owner's acceptance, regardless of previously assigned temporary facilities and controls responsibility.

C. Owner's Facilities: Contractors are not allowed to use the Owner's facilities (toilets, telephones, food service, etc.) for their own benefit or convenience. Prime Contractor Superintendents shall enforce this policy with their respective Work forces.

1. Construction personnel parking will be restricted to an area(s) indicated on the Site Logistics Plans (if included), or otherwise requested by the Owner. The Owner reserves the right to remove from their property, unauthorized vehicles occupying unauthorized areas, at respective vehicle owner's expense.

D. Storage on the Project Site: Each Prime Contractor shall provide sufficient secure weather-tight storage facilities for their materials and equipment. The Owner's facilities and the Project's building areas shall not be used for storage, unless agreed upon in advance via the Construction Site Representative(s).

1. Until permanently incorporated into the Work, all materials on the Project site(s) are the Prime Contractor's responsibility for protection, security and insuring thereof.
2. Prime Contractors and their subcontractors shall coordinate deliveries with the Construction Site Representative(s) to ensure that disruptions and Owner inconvenience are avoided.

E. Tools and Equipment: Each Prime Contractor shall provide all tools and equipment necessary for its own activities and shall be responsible for secure lock-up and storage for all items on the Project Site(s).

1. Each Prime Contractor shall provide all construction aids and miscellaneous services and facilities necessary, exclusively for its own construction activities including any additional supplementary power, ventilation, dehumidification, lighting requirements and weather protection.

F. Welding: Any Prime Contractor performing welding, cutting or other activities with open flames or producing sparks shall at a minimum:

1. Coordinate interruption/shutdown of detection system(s) to avoid creating false alarms.
2. Protect the area and surrounding areas from fire and damage.
3. Maintain fire extinguishers, compatible with activity, at the location of the activity.
4. Provide a continuous Fire Watch during the activity and one-half hour beyond the completion of the activity.
5. Provide all necessary fans and ventilation required for the activity.

1.6 MECHANICAL CONSTRUCTION (MC) – CONTRACT NO. 1

A. Project Site Superintendent: MC shall provide a full-time on-site Project Site Superintendent while any Work related to this Contract is being performed on site(s), including the activities of their subcontractors, while other Prime Contracts are installing Work, or require the coordination of Work related to this Contract, and/or as requested by the Construction Site Representative(s).

B. Scope of Work: The Work of this Prime Contract includes but is not limited to, the following:

1. Work delineation between building and site(s) is at five feet (5') outside of the face of building, existing and new, unless noted or assigned otherwise.
2. Prime Contract shall understand that renovation Work may require Work to proceed while existing systems are required to be maintained; all cost associated with this sequence shall be anticipated and incorporated into the Bid.
3. The HVAC Drawings are schematic in nature, and the MC will make adequate provisions to accommodate the actual field conditions without additional cost to the Owner.
4. Document on the Record Drawings all ductwork openings and penetrations larger than 2 ½" in diameter.
5. Provide all demolition of Mechanical Systems indicated in the Construction Documents, and/or required for Work of this Prime Contract.
    a. Coordinate with all other Prime Contracts regarding all removals required for the Project.
    b. Demolition of a system shall mean any and all components, removed in their entirety, to the point of origin or source.

6. Provide valves, whether permanent or temporary, to permit shutoff and/or cap systems to achieve the Work of this Prime Contract.
7. Prime Contractor shall provide concrete housekeeping and structural pads for equipment provided under this Prime Contract.
8. Prime Contractor shall provide all Work associated with creating structural openings or penetrations requiring lintels, whether for their own Work.
9. Prime Contractor shall provide all cut & patch Work, related to that of their Prime Contract.
10. Provide installation of new HVAC system(s), or modifications of existing system(s) as indicated in the Construction Documents, complete and fully operational.
    a. MC shall furnish all related electrical disconnects, variable speed drives and motor starters (including related "heaters, fuses, and phase protection relays") for all equipment provided under this Contract, for coordinated installation by EC.
    b. Owner shall provide DDC Temperature Controls as a function of the Building Automation System, as referenced in the Construction Documents. MC shall install controls and instrumentation devices, including but not limited to control valves, control dampers, thermowells, pressure probes, flow switches, airflow metering stations, insertion flow meters, and ultrasonic flow meters, required for system operations and as indicated. Such devices will be furnished by vendor [Automated Logic] to the MC for coordinated installation in HVAC systems.
        1) Temperature Controls System vendor/installer shall provide line voltage power wiring to its own head-end, regionally located control panels, and line voltage valves, actuated dampers, motors, etc. that are not indicated in the E drawings.
        2) Temperature Controls System vendor/installer shall provide all low voltage wiring of controls, transformers, actuated dampers, motors, etc., as required for a complete operational system.
11. Provide thermal insulation and identification of all HVAC system/components provided/installed by this Prime Contract.
12. Provide all access doors/panels to access inaccessible installations (i.e. valves) provided by this Prime Contract, such as above hard ceilings or in walls.
13. Provide sleeves required for piping penetrating walls, slabs and/or decks.
14. Provide through-penetration fire stop systems at all penetrations made by this Prime Contract, maintaining listed ratings of indicated assemblies. Provide repair of existing through-penetration fire stopping damaged by Work of this Prime Contract.
    a. Sleeves with fire stopping are to be installed in sequence with fire-rated construction. This Prime Contract shall be responsible for installing fire stopping material at intersection of sleeve and constructed materials.
15. Provide coordination with, and notification to, the Construction Site Representative(s) for all specified testing, training, commissioning, etc., of the Work of this Prime Contract.
16. Substantial Completion: Clean all MC installations and provided equipment at the time of Substantial Completion or as directed by Construction Site Representative(s).
17. Coordinate all the preceding requirements, accordingly, with all applicable Alternates indicated in Division 01 Section "Alternates".

C. Applicable Specifications Sections: All specification Sections itemized are to be provided complete by this Prime Contract, unless noted otherwise as follows:

1. Division 00 – Procurement and Contracting Requirements
2. Division 01 - General Requirements
3. Division 07 Sections 078413, related to Work of this Prime Contract
4. Division 23 – HVAC

5. Division 26, related to Work of this Prime Contract

D. Supplemental Temporary Facilities and Controls by MC include, but are not limited to, the following:

1. Waste Disposal Facilities:
   a. General debris/refuse/construction waste containers (dumpsters) shall be provided by each Prime Contractor.
   b. It shall be the responsibility of this Prime Contract to recycle metals generated by its Work, and the Work of its subcontracts.
      1) Joint effort recycling by all Prime Contracts is encouraged.

2. Indoor air quality management at all areas of Work by this Prime Contract.
   a. Provide all necessary dust partitions, fans, temporary ducts, and barricades to properly contain and ventilate all Work area fumes and odors, created by demolition and new construction or alterations, directly to the outside. Ventilate to an area outside the building, sufficiently away from the building, as not to contaminate other areas. There will be no additional claims honored if the Construction Site Representative(s) requests additional ventilation or requirements.
   b. Provide and exhaust air system for the project indoor areas that could produce fumes, VOC's, off gasses, dusts, mists, or other emissions.

E. Provide all shoring required for Work of this Contract, including but not limited to.
   a. Cutting or altering of existing construction.
   b. Provide protection of all new and existing surfaces during the Work. Do not stand, walk, or work off of any unprotected finished surface above the floor.

F. Maintain temporary fencing and barricading to keep unauthorized persons away from excavations and hazardous areas for which this Prime Contract is responsible.

G. Traffic Controls: Provide flagman while any operations of this Prime Contract interfere with traffic flow on adjacent roadways.

1.7 ELECTRICAL CONSTRUCTION (EC) – CONTRACT NO. 2

A. Project Site Superintendent: EC shall provide a full-time on-site Project Site Superintendent while any Work related to this Contract is being performed on site(s), including the activities of their subcontractors, while other Prime Contracts are installing Work, or require the coordination of Work related to this Contract, and/or as requested by the Construction Site Representative(s).

B. Scope of Work: The Work of this Prime Contract includes but is not limited to, the following:

1. Work delineation between building and site(s) is at five feet (5') outside of the face of building, existing and new, unless noted or assigned otherwise.
2. Prime Contract shall understand that renovation Work may require Work to proceed while existing systems are required to be maintained; all cost associated with this sequence shall be anticipated and incorporated into the Bid.
3. The Electrical Drawings are schematic in nature, and the EC will make adequate provisions to accommodate the actual field conditions without additional cost to the Owner.

a. EC shall install Work in accordance with the National Electrical Code requirements. No additional compensation will be made for extra offsets in conduit or retro-fit Work due to improper component location, or lack of Prime Contractor's coordination.

4. Provide re-routing of existing power distribution as indicated in the Construction Documents, specifically to allow for progression of the Work sequence.
5. Provide all demolition of Electrical Systems indicated in the Construction Documents, and/or required for Work of this Prime Contract.
   a. Coordinate with all other Prime Contracts regarding all removals required for the Project.
   b. Demolition of a system shall mean any and all components, removed in their entirety, to the point of origin or source.
6. Provide all lighting, including fixtures, switching devices, circuits, etc.
   a. Provide new fixtures as scheduled.
   b. Provide removal and complete reinstallation of fixtures scheduled for salvage and re-use.
   c. Contractor shall be responsible to tie-up and support existing fixtures and ceiling-mounted electrical devices to structure above Acoustic Panel Ceiling systems, when ceilings are to be removed as early-work, and the space is scheduled to remain occupied during continued Work.
7. Prime Contractor shall provide concrete housekeeping and structural pads for equipment provided under this Prime Contract.
8. Prime Contractor shall provide all Work associated with creating structural openings or penetrations requiring lintels, whether for their own Work.
9. Prime Contractor shall provide all cut & patch Work, related to that of their Prime Contract.
10. Provide complete electrical requirements, materials and methods including but not limited to:
    a. Service and distribution including bus-way, switchgear, panel boards, and disconnect switches.
    b. Provide grounding protection for all circuits and outlets and as required by applicable codes and authorities having jurisdiction. Properly ground building equipment provided by this project.
    c. Coordinate any electrical switchover as to least impact the Project Schedule, and/or as indicated in the Construction Documents.
    d. Immediately after installation, provide and maintain temporary ID of all circuit breakers and at all shut offs/disconnects until permanent ID is in place.
    e. Interior and exterior lighting and lighting control equipment; provide occupancy sensors and/or timing devices as indicated.
    f. Provide raceways, boxes, cabinets and sleeves through existing and new construction.
    g. Provide wire, cable, conduit, boxes, and wiring devices.
    h. Provide permanent electrical identification.
       1) Provide type written panel board schedules.
       2) Clearly label all panel boards, disconnects, relays, junction boxes, and other electrical devices and equipment.
11. Final connection of utilities, installations or equipment by others are by MC, EC and PC, unless noted or assigned otherwise.
    a. MC shall furnish all disconnects, variable speed drives and motor starters (including related "heaters, fuses, and phase protection relays"), for all equipment provided under their respective Prime Contract, for coordinated installation by EC.

b. Provide all line voltage circuits and connections to points of demarcation indicated and/or equipment provided by MC.

12. Provide all access doors/panels to access inaccessible installations (i.e. junction boxes) provided by this Prime Contract, such as above hard ceilings or in walls.
13. Provide sleeves required for piping penetrating walls, slabs and/or decks.
14. Provide through-penetration fire stop systems at all penetrations made by this Prime Contract, maintaining listed ratings of indicated assemblies. Provide repair of existing through-penetration fire stopping damaged by Work of this Prime Contract.
    a. Sleeves with fire stopping are to be installed in sequence with fire-rated construction. This Prime Contract shall be responsible for installing fire stopping material at intersection of sleeve and constructed materials.
15. Provide coordination with, and notification to, the Construction Site Representative(s) for all specified testing, training, commissioning, etc., of the Work of this Prime Contract.
16. Provide all testing and adjusting, instruction and guarantees for materials and equipment of this Prime Contract.
    a. Substantial Completion: Clean all light fixtures and electrical equipment at the time of installation or at Substantial Completion, whichever is later, or as directed by Construction Site Representative(s).
17. Coordinate all the preceding requirements, accordingly, with all applicable Alternates indicated in Division 01 Section "Alternates".

C. Applicable Specifications Sections: All specification Sections itemized are to be provided complete by this Prime Contract, unless noted otherwise as follows:

1. Division 00 – Procurement and Contracting Requirements
2. Division 01 - General Requirements
3. Division 07 Sections 078413, related to Work of this Prime Contract
4. Division 23, related to Work of this Prime Contract
5. Division 26 - Electrical

D. Supplemental Temporary Facilities and Controls by EC include, but are not limited to, the following:

1. Waste Disposal Facilities:
    a. General debris/refuse/construction waste containers (dumpsters) shall be provided by each Prime Contractor.
    b. It shall be the responsibility of this Prime Contract to recycle metals generated by its Work, and the Work of its subcontracts.
        1) Joint effort recycling by all Prime Contracts is encouraged.

2. Indoor air quality management at all areas of Work by this Prime Contract.
    a. Provide all necessary dust partitions, fans, temporary ducts, and barricades to properly contain and ventilate all Work area fumes and odors, created by demolition and new construction or alterations, directly to the outside. Ventilate to an area outside the building, sufficiently away from the building, as not to contaminate other areas. There will be no additional claims honored if the Construction Site Representative(s) requests additional ventilation or requirements.
    b. Provide and exhaust air system for the project indoor areas that could produce fumes, VOC's, off gasses, dusts, mists, or other emissions.

E. Provide all shoring required for Work of this Contract, including but not limited to.

a. Cutting or altering of existing construction.
b. Provide protection of all new and existing surfaces during the Work. Do not stand, walk, or work off of any unprotected finished surface above the floor.

F. Maintain temporary fencing and barricading to keep unauthorized persons away from excavations and hazardous areas for which this Prime Contract is responsible.

G. Traffic Controls: Provide flagman while any operations of this Prime Contract interfere with traffic flow on adjacent roadways.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 011200

SECTION 011400 – WORK RESTRICTIONS

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 administrative provisions for Project site work restrictions including, but not limited to, the following;

1. Occupancy requirements.
2. Use of premises.
3. Area available for use.
4. Travel not obstructed.
5. Sequencing.
6. Identification badges.
7. Smoking policy.
8. Product delivery, storage and handling.

1.3 OCCUPANCY REQUIREMENTS

A. Owner Occupancy: Owner will occupy site and existing building during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations.

1. Engineer will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied before Owner occupancy.
   a. The occupied portion of any school building shall always comply with the minimum requirements necessary to maintain a certificate of occupancy.
2. Obtain a Certificate of Occupancy from authorities having jurisdiction before Owner occupancy.
3. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of building.

1.4 USE OF PREMISES

A. Use of Site: Limit use of premises to work in areas indicated. Confine operations to areas within Contract limits indicated. Do not disturb portions of site beyond areas in which the Work in indicated. No signs or advertising are allowed except as approved by Engineer or as required by laws, regulations or the Prime Contractor’s protection as persons and property.

1. Limits: Prime Contractors shall comply with Owner occupancy, and phasing requirements if any.
    a. Prime Contractors shall limit operations including storage of materials and prefabrication to areas within the Contract Limit Lines unless otherwise permitted by the Engineer at the Owner's option.
        1) All construction material shall be stored in a safe and secure manner.
    b. Prime Contractors shall limit use of the premises for Work and for storage, to allow for:
        1) Owner occupancy.
        2) Work by other Prime Contractors.

2. Lock automotive-type vehicles such as passenger cars and trucks and other types of mechanized and motorized construction equipment when parked and unattended, to prevent unauthorized use. Do not leave such vehicles unattended, with engine running or ignition key in place.

B. Use of Existing Building: Maintain existing building in a weathertight condition throughout construction period. Repair damage caused by construction operations. Protect building and its occupants during construction period.

1. Keep all areas free from accumulation of waste material, rubbish or construction debris on daily basis.
2. Prime Contractors shall provide temporary closures at all openings in outside walls to maintain weather protection and security as directed by Engineer.
3. Open fires are not permitted.
4. Prime Contractors shall be responsible for control of chemical fumes, gases, and other contaminates produced by welding, gasoline or diesel engines, roofing, paving, painting, etc. to ensure they do not enter occupied portions of the building or air intakes.
5. Prime Contractors shall be responsible to ensure that activities and materials which result in off-gassing of volatile organic compounds such as glues, paints, furniture, carpeting, wall covering, drapery, etc., are scheduled, cured or ventilated in accordance with manufacturers recommendations before a space can be occupied.
6. Large and small asbestos abatement projects as defined by 12NYCRR56 shall not be performed while that area of the building is occupied.
7. Construction and maintenance operations shall not produce noise in excess of 60 dba in occupied spaces or shall be scheduled for times when the building or affected building spaces are not occupied or acoustical abatement measures shall be taken.

C. Prime Contractors shall coordinate the use of premises with the Owner and shall move any stored products under Prime Contractor's control, including excavated material, which interfere with operations of the Owner or separate contractors, at no expense to Owner.

D. Prime Contractors shall assume full responsibility for the protection and safekeeping of products under Contract, stored on the site and shall cooperate with the Owner to insure security for the Owner's property.

1. Fencing with lockable gates shall surround construction supplies or debris of construction activities.
    a. Gates shall always be locked unless a worker is in attendance to prevent unauthorized entry.

2. During exterior renovation work, overhead protection shall be provided for any sidewalks or areas immediately beneath the work site or such areas shall be fenced off and provided with warning signs to prevent entry.

E. Lockout Tagout Policy: Each Prime Contractor shall follow this policy in addition to requirements of regulating authorities. Prime Contractors shall not circumvent or complicate Lockout Tagout Policy.

1. At progress meetings, each Prime Contractor shall indicate extent of their Work with Owner's representative for the period up to the next progress meeting.

a. Each Prime Contractor shall identify all valves, disconnect devices or other devices requiring manipulation or turn off/on to District's Superintendent of Buildings and Grounds.
b. District's maintenance personnel will manipulate devices per Superintendent's directive only.
c. District's maintenance personnel will use Lockout Tagout procedure on all valves, disconnect devices and other devices.
d. Devices not coordinated during progress meeting shall be coordinated through Engineer. Provide 48-hour notice of required action.

F. Protection of Equipment Material: Each Prime Contractor shall assume full and complete responsibility for protection and safekeeping of products and equipment stored and install at Project.

G. Each Prime Contractor shall obtain and pay for the use of additional storage or work areas needed for operations.

1.5 AREA AVAILABLE FOR USE

A. Prime Contractors shall confine operations to those portions of the Owner's property, and to the rights-of-way or easements, temporary or permanent, acquired or designated for the work of the Contract as shown on the Drawings. Private property adjacent the Site shall not be entered upon or used by the Prime Contractors for any purpose without the written consent of the Owner thereof. A copy of such consent shall be filed with the Construction Site Coordinator.

B. Separation of Construction Areas from Occupied Space: Construction areas which are under the control of a contractor and therefore not occupied by Owner shall be separated from occupied areas. Provisions shall be made to prevent the passage of dust and contaminants into occupied parts of the building. Periodic inspection and repairs of the containment barriers must be made to prevent exposure to dust or contaminants. Gypsum board must be used in exit ways or other areas that require fire rated separation. Heavy-duty plastic sheeting may be used only for a vapor, fine dust or air infiltration barrier, and shall not be used to separate occupied spaces from construction areas.

1. Assign a specific stairwell or elevator for construction worker use during hours of Owner operation. Do not use corridors, stairs or elevators being occupied by Owner.
2. Use enclosed chutes to remove large amounts of debris.
3. Do not move debris though occupied spaces of the building.
4. Do not drop or throw material outside walls of building.

C. Clean all occupied parts of the building at the close of each workday. Maintain required health, safety and educational capabilities at all times during construction operations in cooperation with the Owner's requirements.

1.6 TRAVEL NOT OBSTRUCTED

A. 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.

1. Schedule deliveries to minimize use of driveways and entrances.
2. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

B. Each Prime Contractor shall not needlessly hinder or inconvenience travel on any public or private way, nor wholly obstruct a traveled way, and shall provide plain, appropriately worded signs, adequate barricades and lighting announcing such obstruction at the nearest cross streets, and at each end of the obstructed portion, directing traffic to and along an approved detour.

1.7 SEQUENCING

A. Prime Contractors shall assume full responsibility for Project Sequencing requirements. Coordinate with Engineer/Construction Manager, and Owner the following:

1. Deliveries.
2. Testing and inspection agency requirements.

B. Notify Engineer of Construction Schedule modifications in writing at each progress meeting per Division 1 Section "Project Management and Coordination."

1.8 IDENTIFICATION BADGES

A. General: All construction personnel of the Site shall wear photo-identification badges. Securely attach badge to outer clothing and/or for easy recognition of Site personnel name and company.

B. Each Prime Contractor shall supply to its employees and other retained construction personnel, an identification badge. Include company name, Owner's name and provide a number on each badge.

1. Prime Contractor shall maintain a listing of the badge numbers and the associated employee's name to which the corresponding badge number is assigned.

C. Maintain a running list of badges, submitted to the Engineer/Construction Manager.

1.9 SMOKING POLICY

A. Use of tobacco related products at all Work sites, job offices, and parking lots and within fifty (50) feet of Owner's property is prohibited by laws and regulations. Use of tobacco related products will result in removal from Owner's property, and potentially termination of employment on this project.

1. Tobacco related products include electronic cigarettes and similar apparatus.

B. This policy shall apply to all persons entering a Work site or Owner's property including, but not limited to, part-time personnel, consultants, and employees of other companies or Prime Contractor's employees, sub-consultants, installers, etc., working on Project site.

PART 2 - PRODUCTS

2.1 PRODUCT DELIVERY STORAGE AND HANDLING

A. Deliver, store and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturers written instructions.

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are, flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instruction for handling, storing, unpacking, protecting, and installing.
4. Prime Contractor to inspect products on delivery to ensure correct products have been delivered and are in compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
5. Store materials in a manner that will not endanger Project structure.
6. Store products to allow for inspection and measurement of quantity or counting of units.
7. Store products that are subject to damage by the elements, under cover in a weather tight enclosure above ground, with ventilation adequate to prevent condensation.
8. Comply with product manufacturer's written instruction for temperature, humidity, ventilation, and weather-protection requirements for storage.
9. Protect stored products from damage.

PART 3 - EXECUTION (NOT USED)

END OF SECTION 011400

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SECTION 011410 – NYSED 155.5 UNIFORM SAFETY STANDARDS FOR SCHOOL CONSTRUCTION AND MAINTENANCE PROJECTS

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 specifies requirements of 8NYCRR155.5, Uniform Safety Standards for School Construction and Maintenance Projects that are required in construction documents. The Contractor shall comply with these requirements in addition to any and all similar requirements in the Contract Documents.

1. Occupied portions of the building.
2. General safety and security standards.
3. Separation of construction areas from occupied spaces.
4. Control of noise.
5. Control of contaminates.
6. Control of volatile organic compounds.
7. Asbestos abatement projects.
8. Lead remediation projects
9. Temporary heat of occupied spaces

B. These are requirements of Section 155.5 of the Commissioner of Education’s regulations to protect the health and safety of occupants of the building during construction. This is not the text of the regulations

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 OCCUPIED PORTIONS OF THE BUILDING

A. The occupied portion of any school building shall always comply with the minimum requirements necessary to maintain a certificate of occupancy. In addition, the following shall be strictly enforced and cooperated with:

1. No smoking or use of tobacco-related products are allowed within fifty feet (50ft) of a public-school property, including construction areas.

2. During construction, daily inspections of district occupied areas shall be conducted by school district personnel to assure that construction materials, equipment or debris do not block fire exits or emergency egress windows.
3. Proper operation of fire extinguishers, fire alarm, and smoke/fire detection systems shall be maintained throughout the project.

3.2 GENERAL SAFETY AND SECURITY STANDARDS FOR CONSTRUCTION PROJECTS

A. All construction materials shall be stored in a safe and secure manner.

B. Fences around construction supplies or debris shall be maintained.

C. Gates shall always be locked unless a worker is in attendance to prevent unauthorized entry.

D. During exterior renovation work, overhead protection shall be provided for any sidewalks or areas immediately beneath the work site or such areas shall be fenced off and provided with warning signs to prevent entry.

E. Workers shall be required to wear photo-identification badges at all times for identification and security purposes while working at occupied sites."

3.3 SEPARATION OF CONSTRUCTION AREAS FROM OCCUPIED SPACES

A. Separation of construction areas from occupied spaces. Construction areas which are under the control of a contractor and therefore not occupied by district staff or students shall be separated from occupied areas. Provisions shall be made to prevent the passage of dust and contaminants into occupied parts of the building. Periodic inspection and repairs of the containment barriers must be made to prevent exposure to dust or contaminants. Gypsum board must be used in exit ways or other areas that require fire rated separation. Heavy duty plastic sheeting may be used only for a vapor, fine dust or air infiltration barrier, and shall not be used to separate occupied spaces from construction areas.

1. A specific stairwell and/or elevator should be assigned for construction worker use during work hours. In general, workers may not use corridors, stairs or elevators designated for students or school staff.
2. Large amounts of debris must be removed by using enclosed chutes or a similar sealed system. There shall be no movement of debris through halls of occupied spaces of the building. No material shall be dropped or thrown outside the walls of the building.
3. All occupied parts of the building affected by renovation activity shall be cleaned at the close of each workday. School buildings occupied during a construction project shall maintain required health, safety and educational capabilities; at all times, that classes are in session.

3.4 CONTROL OF NOISE

A. Construction and maintenance operations shall not produce noise in excess of 60 dba in occupied spaces or shall be scheduled for times when the building or affected building spaces are not occupied or acoustical abatement measures shall be taken

3.5 CONTROL OF CONTAMINATES

A. The contractor shall be responsible for the control of chemical fumes, gases, and other contaminates produced by welding, gasoline or diesel engines, roofing, paving, painting, etc. to ensure they do not enter occupied portions of the building or air intakes.

3.6 CONTROL OF VOLATILE ORGANIC COMPOUNDS

A. The contractor shall be responsible to ensure that activities and materials which result in "off-gassing" of volatile organic compounds such as glues, paints, furniture, carpeting, wall covering, drapery, etc. are scheduled, cured or ventilated in accordance with manufacturers recommendations before a space can be occupied.

3.7 HAZARDOUS MATERIALS

A. Verify that all school areas to be disturbed during renovation or demolition have been or will be tested for lead and for asbestos. For any project work that disturbs surfaces that contain lead or asbestos, follow the plans and specifications prepared by a certified Lead Risk Assessor or Supervisor which details provisions for occupant protection, worksite preparation, work methods, cleaning, and clearance testing; which are in general accordance with HUD Guidelines.

1. All asbestos abatement projects shall comply with all applicable federal and State laws including but not limited to the New York State Department of Labor industrial code rule 56(12NYCRR56), and the federal Asbestos Hazard Emergency Response Act (AHERA), 40 CFR Part 763 (Code of Federal Regulations, 1998 Edition); available at the Office of Facilities Planning, Education Building Annex, Room 1060, State Education Department, Albany, NY 12234.
2. Any construction or maintenance operations which will disturb lead-based paint will require abatement of those areas pursuant to protocols detailed in the "Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing," June 1995; U.S. Department of Housing and Urban Development (HUD), Washington, D.C. 20410; available at the Office of Facilities Planning, Education Building Annex, Room 1060, State Education Department, Albany, NY 12234.

B. Asbestos Abatement Projects

1. All school areas to be disturbed during renovation or demolition have been or will be tested for lead and asbestos.
2. Large and small asbestos abatement projects as defined by 12NYCRR56 shall not be performed while the building is occupied." Note: It is our interpretation that the term "building," as referenced in this section, means a wing or major section of a building that can be completely isolated from the rest of the building with sealed non-combustible construction. The isolated portion of the building must contain exits that do not pass through the occupied portion and ventilation systems must be physically separated and sealed at the isolation barrier.
3. Exterior work such as roofing, flashing, siding, or soffit work may be performed on occupied buildings provided proper variances are in place as required and complete

isolation of ventilation systems and at windows is provided. Care must be taken to schedule work so that classes are not disrupted by noise or visual distraction.

C. Lead Remediation Projects

1. Surfaces that will be disturbed by reconstruction must have a determination made as to the presence of lead. Projects which disturb surfaces that contain lead shall have in the specifications a plan prepared by a certified Lead Risk Assessor or Supervisor which details provisions for occupant protection, worksite preparation, work methods, cleaning and clearance testing which are in general accordance with the HUD Guidelines.

3.8 EXITING

A. All prime contractors shall prepare and maintain a plan detailing how exiting, required by the applicable building code, shall be maintained during construction.

1. The plan shall indicate temporary construction required to isolate construction equipment, materials, people, dust, fumes, odors, and noise during the construction period.
2. Temporary construction details shall meet code-required fire ratings for separation and corridor enclosure.
3. At a minimum, required exits, temporary stairs, ramps, exit signs, and door hardware shall be provided at all times.
4. The fire exiting plan shall be reviewed and approved by the Engineer.

3.9 VENTILATION

A. Prepare a plan detailing how adequate ventilation will be maintained during construction.

1. The plan shall indicate ductwork which must be rerouted, disconnected, or capped in order to prevent contaminants from the construction area from entering the occupied areas of the building.
2. The plan shall also indicate how required ventilation to occupied spaces affected by construction will be maintained during the project.

3.10 HEAT

A. The contractor shall maintain a minimum temperature of 65° in all occupied interior spaces from September 15th to May 31st. Direct fired fuel-burning heating units shall not be used in any space of pupil occupancy.

3.11 PESTICIDE

A. Pesticide applications may only be performed by individuals currently certified by the State Department of Environmental Conservation (DEC) per DEC Part 325.7 as a pesticide applicator or by a certified pesticide technician or an apprentice working under the direct on-site

supervision of a certified applicator. It is illegal for any individual other than those noted above to apply any pesticide products in a school building or on school grounds.

END OF SECTION 011410

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SECTION 012900 – PAYMENT PROCEDURES

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 specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.

1.3 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

A. Use the approved Schedule of Values form for each Application for Payment.

1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated revisions to alternates.

C. Execute accepted alternates under the same conditions as other work of the Contract.

D. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

1.5 APPLICATIONS FOR PAYMENT

A. Submit Applications for Payment only after Schedule of Values have been approved.

B. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. Schedule of Values.

3. Contractor's Construction Schedule (preliminary if not final.)
4. Products list.
5. Schedule of unit prices.
6. Submittals Schedule (preliminary if not final.)
7. List of Contractor's staff assignments.
8. List of Contractor's principal consultants.
9. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
10. Initial progress report.
11. Report of preconstruction conference.
12. Certificates of insurance and insurance policies.
13. Performance and payment bonds.
14. Data needed to acquire Owner's insurance.
15. Initial settlement survey and damage report if required.

C. Each Application for Payment shall be consistent with previous applications and payments as certified by Engineer as to the actual value of the Work, which will be completed by the end of the month and paid for by Owner.

1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

D. Payment Application Times: The date for each progress payment is the 30th day of each month.

1. This date is a basis of cycle time, and shall be confirmed at the Pre-Construction Conference, based on the owner’s requirements for processing Applications for Payment. The owner reserves the right to adjust this cycle if necessary, with payments executed net 30 days.”

E. Draft copies (pencil copies) shall be submitted to the Engineer, by the same day of the month, for the duration of the project. This day shall be established at the Pre-Construction Conference, based on the owner’s requirements for processing Applications for Payment. This day may be modified from time to time to accommodate the owners schedule.

1. Reflect an accurate accounting of the Work completed and material stored at the time of the pencil copy submission. Projections of work anticipated to be completed or stored is not allowed.
2. Final copies, including review adjustments, shall be submitted to Engineer by the 27th day of the month.
    a. Provided that a fully executed and complete Application for Payment is submitted on the 27th day of each month, the Owner will receive requisitions by the 10th day of the next month.

F. Payment Application Forms: Use approved Schedule of Values for as form for Application for Payment.

1. Provide itemized data on the Continuation Sheet. Format, schedules, line items and values shall be those of the approved Schedule of Values.

G. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Engineer will return incomplete applications without action.

1. Entries shall match data of the approved Schedule of Values.

2. Provide updated Prime Contractor Construction Schedule with each application.
3. Include only amounts of fully executed Change Orders issued before last day of construction period covered by application.

H. Transmittal: Submit 4 signed and notarized original copies of each Application for Payment to Engineer by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information related to the application in acceptable manner discussed with Engineer.

I. Certified Payrolls: With each Application for Payment, submit certified payrolls from the Prime Contractor's own forces and subcontractors for the construction period covered by the previous application.

J. All substantiating data and attachments required by the Contract Documents shall accompany each Application for Payment upon submission in the form required by the Engineer.

K. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from every entity who is lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
2. When an application shows completion of an item, submit final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to Owner.
5. An Affidavit of Payments to Subcontractors and Suppliers on a form approved by Engineer.
    a. Forms are for previous month's application and are to be submitted with every application through and including the latest pay period prior to the date of submittal of the application.
6. When Engineer requires additional substantiating data, Prime Contractor shall promptly submit suitable information with a cover letter.

L. Monthly Application for Payment: Administrative actions and submittals for each monthly application for payment include the following:

1. Change Orders: Submit only fully executed, including signatures by all parties, documenting approval.

M. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

N. Final Payment Application: Submit final Application for Payment with executed releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements.
2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
3. Updated final statement, accounting for final changes to the Contract Sum.
4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
6. AIA Document G707, "Consent of Surety to Final Payment."
7. Evidence that claims have been settled.

O. Full and Final Payment will not be made until the following have been supplied, approved and accepted by the Owner and Engineer.

1. The required number of copies of all written guarantees, warranties, bonds, operating and maintenance manuals, and test results.
2. Documentation that all verbal and written instructions and training sessions required by the Contract has been completed.
3. The required number of copies of all Project Record Documents (“as-built” drawings) has been received.
4. All materials and equipment required as stock is delivered.
5. Any other requirement of the Contract Documents which remains outstanding.

PART 2 - PRODUCTS (Not Used)

PART 3 - Execution (Not Used)

END OF SECTION 012900

SECTION 012973 – SCHEDULE OF VALUES

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 administrative and procedural requirements for the Schedule of Values.

B. Provide summary for all scheduled values as approved by the Engineer.

1.3 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 FORMS

A. Use the following form:

1. Schedule of Values: Provide an AIA Document G703 – Continuation Sheet, 1992 edition.

PART 2 - PRODUCTS (Not Used)

PART 3 - Execution

3.1 SCHEDULE OF VALUES

A. Coordination: Each Prime Contract shall coordinate preparation of its Schedule of Values for its portion of the Construction Schedule and the Work.

1. Correlate line items in the Schedule of Value with other required administrative forms and schedules, including the following:
    a. Application for Payment forms with Continuation Sheets.
    b. Submittals Schedule.
    c. Material/Equipment status report.
    d. Contractor’s Construction Schedule.

B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Section under Division 01,

including, but not limited to, those indicated within Prime Contract scope under Division 01 Section 011250 "Summary of Work."

1. Include and complete all header information on the Schedule of Values forms.
2. Provide a breakdown of the Contract Sum in enough detail and as follows to facilitate continued evaluation of Applications for Payment and progress reports. Provide several line items for principal subcontract amounts, where appropriate and as indicated.
3. Provide breakdowns for each phase of construction, addition and building.
4. Provide itemized Schedule of Value line items for Renovation work and New Construction. Assign these scope items to the specific SED project number(s).
    a. Schedule a separate line item in the Schedule of Values for each part of the work related to General Requirements as follows:
        1) Performance and Payment Bonds.
        2) Project Insurance.
        3) Mobilization & Demobilization.
        4) Field supervision and layout.
        5) Temporary facilities.
        6) Submittals: Schedule 2% of total Contract amount for line item.
        7) Meeting Attendance: Schedule 1% of total Contract amount for line item.
        8) Project Closeout: 1% of total contract amount for line item.
        9) Record Drawings and Construction Progress Documentation.
        10) Punch list: Schedule 1.5%of total Contract amount for line item.
        11) Clean-up: Schedule 1% of total Contract amount for line item.
        12) Testing or Balancing (if applicable)
        13) System Commissioning (if applicable)
        14) Allowances: Provide a separate line item for each Allowance (if applicable)
        15) Alternates: Provide a separate line item for each Alternate (if applicable)
        16) Unit Prices: Itemize each unit price for the Prime Contract (if applicable)
        17) Change Orders: On separate G703 sheet, add each Change Order for the Prime Contract, as cumulatively issued/approved through duration of project.
    b. Itemize separate line item cost for work required by each basic activity or operation by specification Section numbers.
        1) Take each line item cost and breakout into separate labor and material for work required by each basic activity or operation by specification Section numbers.
5. For each line of work in the Schedule of Values to be performed by a subcontractor to the Prime Contractor, the line shall clearly identify the legal name of the subcontractor performing the work. All subcontractors shall be identified prior to the approval of the Schedule of Values.
6. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
    a. Show total costs including overhead and profit.
    b. Percentage of total Contract Sum adjusted to equal 100 percent.
7. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include progress payments for materials or equipment purchased or fabricated and stored, but not yet installed.
    a. Differentiate between items stored on-site and items stored off-site. Include evidence of insurance or bonded warehousing.
8. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.

9. Provide additional separate line items for Specification Sections that have construction that can be identified as a separate system, like structural steel, that will have separate lines items for;
    a. Anchor Bolts.
    b. Columns & Beams.
10. After review by the Engineer, revise and resubmit Schedule of Values if required by the Engineer as many times as required until approval by the Engineer is received.

C. Schedule of Value Times:

1. Within ten (10) days of Notice to Proceed, submit to the Engineer, a fully outlined draft Schedule of Values on AIA Docs. G702 and G703.
2. Based on the Engineer's approval, revise and resubmit the final approved Schedule of Values on AIA Docs. G702 and G703 at least ten (10) days prior to the first application for payment.
3. First Application for Payment will not be approved until the Engineer approves Schedule of Value format.
4. Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

END OF SECTION 012973

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SECTION 013150 – SAFETY AND HEALTH

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 PROJECT SITE SAFETY

A. The Prime Contractor, not the Engineer, or the entity recognized as Construction Site Representative, is responsible for Project site safety.

1.3 SAFETY AND HEALTH REGULATIONS

A. The Prime Contractor, and any entity working for the Prime Contractor, shall comply with the U.S. Department of Labor Safety and Health Regulations for construction promulgated under the Occupational Safety and Health Act of 1970 (PL 91-54), latest revisions and with the latest requirements of the "Right to Know" laws and the New York State Labor Law.

B. In order to protect the general public and the lives and health of his/her employees under the Contract, the Prime Contractor shall comply with all pertinent provisions of the latest issues of the Federal Register, Bureau of Labor Standards, Safety and Health Regulations; New York State Industrial Code Rule 30 pertaining to Tunneling Operations; New York State Industrial Code Rule 23 pertaining to Trenching Operations; and the "Manual of Accident Prevention in Construction" issued by the Associated General Contractors of America, Inc., and shall maintain an accurate record of all cases of death, occupational disease, and injury requiring medical attention or causing loss of time from work under this Contract. In case of a conflict between the above noted authorities, the most stringent shall prevail.

C. The Prime Contractor shall have on the project site at all times while work is in progress, an individual recognized as a "Competent Person", who is skilled in safety and health procedures and familiar with State and Federal safety and health regulations whose responsibility shall be to observe methods and procedures. This person shall have the duty and authority to stop and correct all unsafe and unhealthy conditions.

D. Toxic, noxious or otherwise hazardous fumes, gases or dusts, etc. from welding, cadwelding, painting, grinding, sawing, sweeping or any other operations shall be kept to the absolute minimum and shall be vented directly to the outside by the Contractor, and only used when authorized by the Engineer.

E. The Prime Contractor are to submit to the Owner via the Engineer/Construction Manager, prior to first payment application approval, a copy of Material Safety and Data Sheets (MSDS) for all material used on site. The Prime Contractor shall also keep one (1) complete set of Material Safety and Data Sheets (MSDS) onsite at all times.

1. These reference materials shall be updated continuously throughout the Project, as additional materials are added to/brought to the Project site.

1.4 SAFETY AND FIRST AID

A. The Prime Contractor shall at all times exercise caution of his/her operations and shall be responsible for the safety and protection of all persons on or about the site arising out of or relating to his/her Work. All hazards shall be avoided or guarded in accordance with the provisions of the Manual of Accident Prevention in Construction of the AGCA, unless such provisions contravene local law. The safety provisions of all applicable laws, codes and ordinances shall be observed.

B. The Prime Contractor shall provide and maintain at the Site, at each location where work is in progress, as part of his/her plant, an approved first aid kit. Ready access thereto shall be provided at all times when persons are employed on the work site.

C. The Prime Contractor shall take due precautions against infectious diseases and shall arrange for the immediate isolation and removal from the Site of any employee who becomes ill or is injured while engaged on the work site.

D. The Prime Contractor shall, upon request of the Engineer/Construction Manager, immediately correct all conditions that constitute a clear and present danger to persons as interpreted by the Engineer. If such danger is not so corrected, the Owner or the Engineer will employ other persons to do such work and the expense thereof shall be deducted from any monies due or to become due to the Prime Contractor.

E. Clean up of the Prime Contractor’s, and/or their subcontractor’s, materials and/or debris shall be deemed a safety & health issue.

1.5 ACCIDENTS AND ACCIDENT REPORTS

A. Notify Engineer immediately of any accidents involving Prime Contractor, subcontractor or supplier personnel on site.

B. Within 24 hours of the occurrence, the Prime Contractor shall submit a written accident report, to the Engineer, fully detailing the occurrence.

1.6 TOOL BOX SAFETY MEETINGS

A. The Prime Contractor shall hold weekly toolbox safety meetings with his/her own workers. Records of these meetings shall be forwarded to the Owner, through the Construction Site Representative’s office, each week.

1. Failure to comply with this requirement shall result in Applications for Payment not being reviewed and processed.

END OF SECTION 013150

SECTION 014000 – QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-assurance and control services required by Engineer, Construction Site Representative, Owner, or authorities having jurisdiction are not limited by provisions of this Section
    a. All Prime Contracts: Verify all Specification Sections for testing requirements in addition to the following:
        1) Testing done for the convenience of the Prime Contractor or their Sub-Contractors.
        2) Testing related to remedial operations or possible defects.

1.3 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Engineer or Construction Site Representative.

C. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified

installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.

E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

F. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.

G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).

J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five (5) previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONSTRUCTION TESTING

A. Prime Contractor Responsibilities: Unless otherwise indicated as the responsibility of another identified entity, each Prime Contractor shall provide inspections, tests, and other quality- control services specified elsewhere in the Contract Documents and required by authorities having jurisdiction. Costs for these services are to be included in the Contract Sum.

1. Where individual Sections specifically indicate that certain inspections, tests, and other quality-control services are Prime Contractor's responsibility, Prime Contractor shall employ and pay a qualified independent testing agency to perform quality-control services.
2. Where individual Sections specifically indicate that certain inspections, tests, and other quality-control services are the Owner's responsibility, the Owner will employ and pay a qualified independent testing agency to perform those services.
    a. Where the Owner has engaged a testing agency and Prime Contractor is also required to engage an entity for the same or related element, the Prime Contractor shall not employ the entity engaged by the Owner, unless agreed to in writing by the Owner.

B. Retesting: Prime Contractor is responsible for retesting where results of inspections, tests, or other quality-control services prove unsatisfactory and indicate noncompliance with Contract Document requirements, regardless of whether the original test was Prime Contractor's responsibility.

1. Cost of retesting construction, revised or replaced by Prime Contractor, is Prime Contractor's responsibility where required tests performed on original construction indicated noncompliance with Contract Document requirements.

C. Associated Services: Cooperate with agencies performing required inspections, tests, and similar services, and provide reasonable auxiliary services as requested. Notify the agency sufficiently in advance of operations to permit assignment of personnel. Auxiliary services required include, but are not limited to, the following:

1. Provide access to the Work.
2. Furnish incidental labor and facilities necessary to facilitate inspections and tests.
3. Ladders.
4. Provide facilities for storage and curing of test samples.
5. Delivery of samples to testing laboratories.
6. Provide design mix documentation.
7. Provide security and protection of samples and test equipment at the Project Site.

D. Duties of the Testing Agency: The independent agency engaged to perform inspections, sampling, and testing of materials and construction specified in individual Sections shall cooperate with the Construction Manager and Prime Contractor in performance of the agency's duties. The testing agency shall provide qualified personnel to perform required inspections and tests.

1. The agency shall notify the Engineer, Construction Site Representative and Prime Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. The agency is not authorized to release, revoke, alter, or enlarge requirements of the Contract Documents or approve or accept any portion of the Work.
3. The agency shall not perform any duties of Prime Contractor.

E. Coordination: Coordinate the sequence of activities to accommodate required services with a minimum of delay. Coordinate activities to avoid the necessity of removing and replacing construction to accommodate inspections and tests.

1. Each Prime Contractor is responsible for scheduling times for inspections, tests, taking samples, and similar activities through the Construction Site Representative.

1.5 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Engineer for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the

minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Engineer for a decision before proceeding.

1.6 ACTION SUBMITTALS

A. Shop Drawings: For integrated exterior mockups, provide plans, sections, and elevations, indicating materials and size of mockup construction.

1. Indicate manufacturer and model number of individual components.
2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

1.7 INFORMATIONAL SUBMITTALS

A. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:

1. Seismic-force-resisting system, designated seismic system, or component listed in the designated seismic system quality-assurance plan prepared by Engineer.
2. Main wind-force-resisting system or a wind-resisting component listed in the wind-force-resisting system quality-assurance plan prepared by Engineer.

B. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

C. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Entity responsible for performing tests and inspections.
3. Description of test and inspection.
4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

1.8 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency or inspecting agency.

4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection methods, citing ASTM reference standard used.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and re-inspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, and telephone number of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement weather conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement weather conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.9 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or products that are similar in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

1. Each independent inspection and testing agency engaged shall be authorized by jurisdiction to operate in the state where Project is located.
2. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
3. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
4. Testing agency qualifications must be approved by the Engineer prior to proceeding with work.

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

1. Contractor responsibilities include the following:
    a. Provide test specimens representative of proposed products and construction.
    b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
    c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
    d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
    e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
    f. When testing is complete, remove test specimens, assemblies, mockups, and laboratory mockups; do not reuse products on Project.

K. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Engineer, through Construction Manager, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

1.10 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
2. Costs for retesting and re-inspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.

1. Unless otherwise indicated, provide quality-control services specified.
2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
    a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
3. Notify testing agencies at least twenty-four (24) hours in advance of time when Work that requires testing or inspecting will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in triplicate, of each quality-control service.
5. Contractor shall furnish to the Laboratory such samples of materials as may be necessary for testing purposes.
6. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
7. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 01 Section "Submittal Procedures."

D. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in pre-installation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

E. Re-testing/Re-inspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and re-inspecting, for construction that replaced Work that failed to comply with the Contract Documents.

F. Testing Agency and Special Inspector Responsibilities: Cooperate with Engineer, Construction Manager, and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Engineer, Construction Site Representative, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Does not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of the Contractor.
7. Submit reports to the Engineer, Construction Manager, and Contractor within seven (7) calendar days of the test.

G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Provide safe access to items to be tested. This includes sheeting and ladders for deep excavation; scaffolding and ladders for inspection and testing of superstructure items. Incidental labor and facilities necessary to facilitate tests and inspections.
2. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
3. Facilities for storage and field curing of test samples.
4. Delivery of samples to testing agencies.
5. Preliminary design mix proposed for use for material mixes that require control by testing agency.
6. Security and protection for samples and for testing and inspecting equipment at Project site.

H. Coordination: Coordinate sequence of 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.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.

1. Distribution: Distribute schedule to Owner, Engineer, Construction Manager, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.
2. Provide and maintain, for the sole use of the Testing Agency, adequate facilities for safe storage and proper curing of concrete test cylinders on the project site for the first 24 hours as required by ASTM C31-69.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Engineer.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Engineer's and Construction Site Representative’s reference during normal working hours.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Division 01 Section "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 017300 – EXECUTION

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 general procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. General installation of products.
4. Coordination of Owner-installed products.
5. Progress cleaning and protection during construction.
6. Starting and adjusting.
7. Protection of installed construction.
8. Correction of the Work.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 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: 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.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility and/or 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. 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.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. 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 Engineer. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents. Submit requests for information (RFI) on standard form included in this Project Manual.

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Engineer and Construction Site Representative promptly.

B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
3. Inform installers of lines and levels to which they must comply.
4. Check the location, level and plumb, of every major element as the Work progresses.
5. Notify Engineer and Construction Site Representative when deviations from required lines and levels exceed allowable tolerances.
6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Engineer and Construction Site Representative.

3.4 FIELD ENGINEERING

A. Identification: Owner will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Engineer and Construction Site Representative. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Engineer and Construction Site Representative before proceeding.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and site work.

E. Final Property Survey: Prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by [land surveyor] [professional engineer], that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.

1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 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.
3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
4. Maintain minimum headroom clearance of 8 feet Insert dimension in spaces without a suspended ceiling.

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: Do not use tools or equipment that produce harmful noise levels.

F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

G. 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 Engineer.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with

integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

H. 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.

I. Hazardous Materials.

1. Use products, cleaners, and installation materials that are not considered hazardous.

3.6 OWNER INSTALLED PRODUCTS

A. Site Access: Provide access to Project site for Owner's construction forces.

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction forces.

1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
2. Pre-installation Conferences: Include Owner's construction forces at pre-installation conferences covering portions of the Work that are to receive Owner's work. Attend pre-installation conferences conducted by Owner's construction forces if portions of the Work depend on Owner's construction.

3.7 PROGRESS CLEANING AND PROTECTION DURING CONSTRUCTION

A. General: Each Subcontractor shall clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly among Subcontractor’s employees. This includes sweeping floors clean as may be deemed necessary by Construction Site Representative. Dispose of material lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Each Prime Contractor shall clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate and when directed by Construction Site Representative.

D. Installed Work: Prime Contractor shall keep all installed work clean for subcontractors retained who are no longer required to be present on site. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

1. Provide cleaning products compliant with VOC requirements.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

K. Each day Prime Contractor shall affect the following:

1. Areas of intense activity, such as cutting and sawing must be swept clean and reorganized at the end of each day.
2. Areas of moderate activity such as installation of plumbing, ductwork, electrical work must be returned to good order at the end of each day.
3. Debris below scaffolds (and shoring/reshoring) must at all times, be kept sufficiently consolidated to keep walkways free of tripping hazards. These work areas must also be swept clean immediately upon removal of scaffolds.
4. All swept up debris, waste materials, and packing must be removed and placed in the dumpster by noon of the following workday.
5. All stored materials must be kept in good order.
6. As portions of the work are completed, all used and excess materials must be removed promptly.
7. Daily clean-up and good housekeeping is the responsibility of each Prime Contractor individually and will be monitored by the Construction Site Representative.
8. Prime Contractors and their retained subcontractors, Installers or manufacturers shall promptly comply with requests of Construction Site Representative to organize scattered materials.

L. Vacuum clean interior building areas when ready to receive finish painting and continue vacuum cleaning on an as-needed basis or as directed by Construction Site Representative until building is ready for Substantial Completion or occupancy.

M. Schedule cleaning operations so that dust and other contaminants resulting from cleaning process will not fall on wet, newly painted surfaces.

3.8 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 01 Section "Quality Requirements."

3.9 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

C. Clean and protect construction in progress and adjoining materials in place, during handling and installation. Apply protective covering where required to assure protection from damage or deterioration at Substantial Completion.

D. Clean and provide maintenance on completed construction as frequently as necessary or as requested by Construction Site Representative, through the remainder of the construction period. Adjust and lubricate operable components to assure operability without damaging effects.

E. Limiting Exposure: Each Prime Contractor to supervise construction operations to assure that no part of the construction, complete or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period. Where applicable, such exposures include, but are not limited to, the following:

1. Excessive static or dynamic loading.
2. Excessive internal or external pressures.
3. Excessive high or low temperatures.
4. Thermal shock.
5. Excessive high or low humidity.
6. Air contamination or pollution.
7. Ice or water.

8. Solvents or chemicals.
9. Light.
10. Radiation.
11. Puncture.
12. Abrasion.
13. Heavy traffic.
14. Soiling, staining and corrosion.
15. Bacteria.
16. Rodent and insect infestation.
17. Combustion.
18. Electrical current.
19. High-speed operation.
20. Improper lubrication.
21. Unusual wear or misuse.
22. Contact between incompatible materials.
23. Destructive testing.
24. Misalignment.
25. Excessive weathering.
26. Unprotected storage.
27. Improper shipping and handling.
28. Vandalism or theft.

F. Each Prime Contractor for its Work shall provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

G. Comply with manufacturer's written instructions for temperature and relative humidity.

3.10 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 01 Section "Cutting and Patching."

1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Restore permanent facilities used during construction to their specified condition.

C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017300

SECTION 017329 – CUTTING AND PATCHING

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 procedural requirements for cutting and patching.

B. When demolition leaves a construction surface unfinished, and the documents do not specify a finish, patch the remaining surface to match the existing adjacent surface

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other Work.

B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

C. Demolition: Removal, Cutting.

1.4 SUBMITTALS

A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:

1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
3. Products: List products to be used and firms or entities that will perform the Work.
4. Dates: Indicate when cutting and patching will be performed.
5. Utility Services and Mechanical/Electrical Systems: List services/systems that cutting and patching procedures will disturb or affect. List services/systems that will be relocated and those that will be temporarily out of service. Indicate how long services/systems will be disrupted.
6. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.

7. Engineer's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.5 QUALITY ASSURANCE

A. Maintain existing interior nonstructural elements (interior walls, doors, floor coverings, and ceiling systems) not indicated to be removed; do not cut such existing construction beyond indicated limits.

B. Maintain existing non-shell, nonstructural components (walls, flooring, and ceilings) not indicated to be removed; do not cut such existing construction beyond indicated limits.

C. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.

D. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operating elements include the following:

1. Primary operational systems and equipment.
2. Air or smoke barriers.
3. Fire-suppression systems.
4. Mechanical systems piping and ducts.
5. Control systems.
6. Communication systems.
7. Conveying systems.
8. Electrical wiring systems.

E. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Miscellaneous elements include the following:

1. Water, moisture, or vapor barriers.
2. Membranes and flashings.
3. Exterior curtain-wall construction.
4. Equipment supports.
5. Piping, ductwork, vessels, and equipment.
6. Noise- and vibration-control elements and systems.

F. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Engineer's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

G. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential

interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.6 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.

1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated or abandoned, bypass such services/systems before cutting to minimize and prevent interruption to occupied areas.

3.3 PERFORMANCE

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
    a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    b. Restore damaged pipe covering to its original condition.
3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
    a.
    b. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface

containing the patch. Provide additional coats until patch blends with adjacent surfaces.

c. Where demolition of a wall leaves a remaining perpendicular wall unfinished, restore the wall finish with similar materials blending the finishes into each other flush and seamlessly.
d. At masonry walls, cut any protruding reinforcing back below the finished surface. Remove enough masonry material to provide finished masonry faces within the existing coursing.
e. At masonry walls cut any protruding reinforcing back below the finished surface. Remove enough masonry material to provide finished masonry faces within the existing coursing.
f. Where demolition of a wall leaves a remaining end of the wall unfinished, restore the wall finish with similar materials blending the finishes into each other flush and seamlessly.
g. Where demolition of a wall leaves a remaining column exposed, provide 18ga. aluminum column enclosure.
h. Where demolition of a wall leaves a remaining perpendicular window system unfinished, provide 18ga. aluminum enclosure at the window and extend the sill material across the void.
i. Where the removal of a wall, equipment and/or furnishing leaves an unfinished condition at the floor, patch the floor and extend the finished floor system across the demolition area.
j. Where the removal of a wall, equipment and/or furnishing leaves an unfinished condition at the ceiling, patch the floor and extend the finished ceiling system across the demolition area.
k. Where the removal of a louver, grill, ductwork or other construction in a finished space or elsewhere, fill the opening with material that matches the existing adjacent materials and finishes.
l. Where the removal leaves a raised painted edge, remove raised edge and feather paint finish to the extent that the raised painted edge is not detected.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials. Insert specific installation requirements if not specified elsewhere. Specific installation requirements are better specified in individual Sections.

END OF SECTION 017329

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SECTION 017700 – CLOSEOUT PROCEDURES

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 administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Inspection procedures.
2. Warranties.
3. Final cleaning.

B. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.

1.3 DEFINITIONS

A. Standard Product Warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.

B. Special Warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.

1.4 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following:

1. In Application for Payment that coincides with, or first follows, the date of Substantial Completion is claimed, show 100 percent completion got portion of Work claimed on substantially complete.
    a. Include supporting documentation for completion as indicated and a statement showing accounting of changes to the Contract Sum.
    b. If 100 percent completion cannot be shown, include a list of the value of incomplete Work.
    c. Application shall reflect Certificates of Partial Completion issued previously for Owner occupancy of designated portions of Work.

2. Administrative actions and submittals that shall precede or coincide with this application include, but are not limited to, the following:
   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.
   b. Advise Owner of pending insurance changeover requirements.
   c. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
   d. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
   e. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs, damage or settlement surveys, property surveys, and similar final record information.
   f. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
   g. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
   h. Complete startup testing of systems.
   i. Submit test/adjust/balance records.
   j. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
   k. Advise Owner of changeover in heat and other utilities.
   l. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
   m. Complete final cleaning requirements, including touchup painting.
   n. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
   o. Maintenance instructions.
   p. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents to be turned over to Owner.
   q. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
   r. Prepare and submit Project Record Documents, operation and maintenance manuals.
   s. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
   t. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
   u. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
   v. Remove surplus materials rubbish and similar elements as directed by Construction Site Representative.

B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Engineer will either proceed with inspection or notify Prime Contractor of unfulfilled requirements. Engineer will prepare the Certificate of Substantial Completion after inspection or will notify Prime Contractor of items, either on Contractor's list or additional items identified by Engineer, that must be completed or corrected before certificate will be issued. Engineer will prepare and issue a Certificate of Substantial Completion, AIA G704, complete with signatures of Owner and Prime Contractor.

1. Re-inspection: When Engineer is required to perform second and additional inspections because of failure of Work to comply with certifications of Prime Contractor, Owner will compensate Engineer for additional services and deduct amount paid from Final Payment to Prime Contractor.
2. Results of completed inspection will form the basis of requirements for Final Completion.

C. Should Engineer consider that Work is finally complete in accordance with the requirements of the Contract Documents, he shall request Prime Contractor to make Project Closeout submittals.

D. Should Engineer consider that Work is not finally complete:

1. Punch list: Engineer shall notify Prime Contractor, in writing, stating reasons.
2. Prime Contractor shall take immediate steps to remedy the stated deficiencies and send second written notice to Engineer certifying that Work is complete.
3. Engineer will re-inspect Work per “Re-inspection” paragraph.

1.5 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:

1. Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include insurance certificates for products and complete operations where required according to Division 01 Section "Payment Procedures."
2. Submit certified copy of Engineer's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Engineer. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance and the punch list has been endorsed and dated by the Prime Contractor.
3. Submit pest-control final inspection report and warranty.
4. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training videotapes.
5. Specified warranties, workmanship bonds, maintenance agreements, final certifications, and similar documents in required formats.
6. Insurance certificates for products and completed operation in effect for 12 months from date of final Application for Payment.

B. Request: Submit in writing to Engineer listing incomplete items of preliminary procedures.

1. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.

C. Evidence of Payments and Release of Liens: Submittals shall be duly executed before delivery to Construction Site Representative.

1. Contractor’s Affidavit of Payment of Debts and Claims: AIA G706.
2. Contractor’s Affidavit of Release of Liens: AIA G706A, with the following:
   a. Consent of Surety to Final Payment: AIA G707.
   b. Prime Contractor’s release of waiver of liens.

c. Separate releases of waivers of liens for subcontractors, suppliers, and others with lien rights against property of Owner, together with list of these parties.

D. Final Adjustment of Accounts: Engineer will prepare final Change Order, reflecting approved adjustments to Contract Sum not previously made by Change Orders.

1. Submit final statement of accounting to Engineer.
2. Statement shall reflect all adjustments.
   a. Original Contract Sum.
   b. Additional and deductions resulting from:
      1) Previous Change Orders.
      2) Contingency Allowances: Credit unused remaining balance back to Owner by Change Order.
      3) Other Adjustments.
      4) Deductions for Uncorrected Work.
      5) Deductions for Re-inspection Payments.
   c. Total Contract Sum, as adjusted.
   d. Previous Payments.
   e. Sum remaining due.

E. Final Application for Payment: Construction Site Representative shall notify Engineer when all required closeout submittals are received and acceptable for Final Payment.

F. Final Certification for Payment: Engineer will issue final Certificate in accordance with provisions of General and Supplementary Conditions.

G. Miscellaneous Record Submittals: Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

H. Provide copies of each warranty to include in operation and maintenance manuals.

1.6 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Preparation: Submit one copy of list. 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.

1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:
   a. Project name.
   b. Date.
   c. Name of Engineer.
   d. Name of Contractor.
   e. Page number.

1.7 WARRANTIES

A. Submittal Time: Submit written warranties on request of Engineer for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.

1. Submit written warranties to the Engineer prior to the date certified for Substantial Completion. If the Engineer Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the Work, or a designated portion of the Work, submit written warranties upon request of the Engineer.
    a. When a designated portion of the Work is completed and occupied or used by the Owner, by separate agreement with the Prime Contractor during the construction period, submit properly executed warranties to the Engineer within 15 days of completion of that designated portion of the Work.
2. Prepare a written document utilizing the appropriate form, ready for execution by the Prime Contractor, or the Contractor and subcontractor, supplier or manufacturer.
3. Form of Submittal: At Final Completion compile two copies of each required warranty and bond properly executed by the Prime Contractor, or by the Prime Contractor's, subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.
4. Upload/input warranties and bonds into the Project information exchange system per Engineer's direction, OR Bind warranties and bonds in heavy-duty, commercial quality, durable 3-ring vinyl covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2 by 11 inch paper. Consult with Engineer in advance.
    a. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a type description of the product or installation, including the name of the product, and the name, address and telephone number of the installer.
    b. Identify each binder on the front and the spine with the typed or printed title "WARRANTIES", the Project title or name, and the name of the Contractor.
5. When operating and maintenance manuals are required for warranted construction, provide warranty, for inclusion in that required manual.

B. Related Damages and Losses: When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.

C. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

D. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. The Prime Contractor providing Work is responsible for the cost of replacing or rebuilding defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.

E. Owner's Recourse: Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, right and remedies otherwise available under the law,

nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.

1. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.

F. The Owner reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or part of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.

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: Provide final cleaning. Conduct cleaning and waste-removal 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 portion of Project:
    a. 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.
    b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
    c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
    d. Remove tools, construction equipment, machinery, and surplus material from Project site.
    e. Remove snow and ice to provide safe access to building.
    f. 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.

g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
h. Sweep concrete floors broom clean in unoccupied spaces.
i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
k. Remove labels that are not permanent.
l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
    1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
m. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
n. Replace parts subject to unusual operating conditions.
o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
q. Clean ducts, blowers, and coils if units were operated without filters during construction.
r. 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.
s. Leave Project clean and ready for occupancy.

C. 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.

END OF SECTION 017700

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SECTION 078413 – PENETRATION FIRESTOPPING

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. Penetrations in fire-resistance-rated walls.
2. Penetrations in horizontal assemblies.
3. Penetrations in smoke barriers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system and design designation of qualified testing and inspecting agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer

B. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:

    a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.
        1) UL in its "Fire Resistance Directory."
        2) Intertek Group in its "Directory of Listed Building Products."
        3) FM Global in its "Building Materials Approval Guide."

2.2 PENETRATION FIRESTOPPING SYSTEMS

A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

1. 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:

    a. 3M Fire Protection Products.
    b. A/D Fire Protection Systems Inc.
    c. Hilti, Inc.
    d. RectorSeal.

e. Specified Technologies, Inc.
f. Tremco, Inc.

B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.

1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.

1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.

D. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg.

1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at and no more than 50-cfm cumulative total for any 100 sq. ft. at both ambient and elevated temperatures.

E. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.

F. VOC Content: Penetration firestopping sealants and sealant primers shall comply with the following limits for VOC content:

1. Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

G. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

1. Permanent forming/damming/backing materials.
2. Substrate primers.
3. Collars.
4. Steel sleeves.

2.3 FILL MATERIALS

A. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

B. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

C. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.

D. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.

E. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

F. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

G. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

H. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

I. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

2.4 MIXING

A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.

C. Install fill materials by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.

1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet from end of wall and at intervals not exceeding 30 feet.

B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

A. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.

B. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

END OF SECTION 078413

SECTION 230500 - GENERAL MECHANICAL REQUIREMENTS

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 and all Division 23 Sections.

1.2 PLANS AND SPECIFICATIONS

A. All work under this title, on drawings or specified, is subject to the general and special contract conditions for the entire project, and the contractor for this portion of the work is required to refer especially thereto, and to the architectural drawings.

B. Drawings are diagrammatic and specifications are complementary and must be so interpreted to determine the full scope of work under this heading. Wherever any material, article, operation or method is either specified or shown on the drawings, this contractor is required to provide each item and perform each prescribed operation according to the designate quality, qualification or condition, furnishing all necessary labor, equipment or incidentals.

C. Wherever the designation "Architect" appears, it shall imply Architect or Engineer. Wherever the term “Contractor” or “MC” appears, it shall imply the Contractor responsible for Division 23, Mechanical Work.

1.3 CONFLICTS

A. If, in the interpretation of contract documents, it appears that the drawings and specifications are not in agreement, the Contractor is to contact the Engineer. The Engineer shall be the final authority. Addenda supersede the provisions which they amend.

B. In the absence of a written clarification by the engineer, the Contractor must install his work in accordance with the more stringent and/or costly condition. Contractor assumes full responsibility for any and all items furnished and installed without the written approval by the Architect or Engineer. Under no circumstances will a change order be approved for work installed that was not approved by the Architect or Engineer.

1.4 DIMENSIONS, LAYOUTS AND OBSTACLES

A. Verify dimensions and elevations from actual field measurements after building construction has sufficiently progressed.

B. Assume full and final responsibility for the accuracy of any or all work performed under this Division and make repairs and corrections as required or directed at no extra cost to the Owner.

C. Layouts of piping, ductwork, and equipment shown on drawings are diagrammatic and shall be construed as such. **DO NOT SCALE DRAWINGS.** Contractor shall field verify all existing conditions prior to fabrication and installation of material. It is recommended that the contractor

verify all existing conditions prior to submitting a proposal. Lack of field verification does not constitute a basis for additional monies during construction. Contractor assumes full responsibility for completeness of installation including coordination of work with other trades.

D. Make actual installations in accord with said layouts, but with necessary deviations as directed or required by job conditions and field measurements in order to produce a thoroughly integrated and practical job upon completing, but make deviations only with specific approval of the Engineer/Architect.

1. Take particular care to coordinate all piping and ductwork under this Division to prevent conflict and remove and relocate work as may be made necessary by such conflict at no extra cost to the Owner.
2. Unless expressly permitted by the Engineer/Architect or shown otherwise on the Drawings, all piping, ducts and similar items shall be installed so that they are concealed except as permitted by the Engineer/Architect in service rooms noted on the Drawings.

E. The Owner or Owner's Representative reserves the right to relocate terminal equipment six (6) feet in any direction from locations indicated on plans, before roughing-in, with no change in contract price.

1.5 REVIEW OF MATERIAL

A. Items specified have been checked by the Engineer for performance and space limitation.

B. In order for Engineer to consider "equal", Contactor must certify by letter that he has checked the product for conformance to specifications and space limitations and assumes full responsibility thereafter.

C. Engineer, not Contractor or Vendor, shall be the final judge of equal materials.

D. Substitutions are defined as any manufacturer and/or model not indicated in drawings or specifications. Requests for substitutions must be made in writing ten (10) days prior to bid date so that an addendum may reach all contractors.

E. If substitutions are proposed after the bids are received, the Contractor shall state amount of credit to the Owner for substitution. Substitutions that are considered equal by the Contractor and carried in bid without approval by Engineer shall be the responsibility of the Contractor. The Engineer and/or Owner shall not be made liable or responsible for losses incurred by the Contractor, due to the rejection of said items for installation.

F. Where equipment requiring different arrangement or connections other than as indicated is acceptable, it shall be the responsibility of this Contractor to furnish revised layouts, and install the equipment to operate properly and in harmony with the intent of the drawings and specifications. All changes in the work required by the different arrangement shall be done at no additional cost to the Owner, including but not limited to structural steel modifications. Control and power wiring modifications required by Contractor, imposed modifications, and the additional cost of these modifications, shall be the responsibility of this Contractor.

G. Upon review of equipment list by Engineer, copies of submittal prints shall be forwarded to Engineer within 30 days.

1.6 PERMITS, CODES AND ORDINANCES

A. The Contractor shall arrange and pay for all permits, inspections, etc., as required by local utilities or applicable agencies.

B. All work and material shall be in complete accordance with the ordinances, regulations, codes, etc., of all political entities exercising jurisdictions, specifically including the NYS Energy Code.

1.7 COORDINATION WITH OTHER TRADES

A. Check mechanical drawings with all other trades including electrical, plumbing, fire protection and general construction.

B. Anticipate and avoid interferences with other trades.

C. Take particular care to coordinate all piping, ductwork, plumbing and major electrical components above ceiling, to prevent conflict. Remove and relocate work as may be made necessary by such conflict, at no extra cost to the Owner. The use of coordination drawings is recommended but may not be required (refer to Division 1 for additional requirements). Lack of coordination drawings assumes contractor has verified and coordinated all work associated with installation.

D. Obtain decision for approval from project Engineer for proposed group installation before proceeding, and for clearance in structure and finish of the building.

E. Verify with drawings all ductwork and equipment layout in concealed areas.

F. Running pipe and ductwork over electrical equipment and in elevator machine rooms is prohibited.

G. The Contractor to coordinate with, receive and install, Owner furnished equipment where indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials: Make provisions for delivery and safe storage of all materials. Check and properly receipt material to be "furnished by others" to contractor, and assume full responsibility for all materials while in storage with full visible identification and information.

1.9 PROJECT CONDITIONS

A. Existing Conditions: Field verify existing conditions that will determine exact locations, distances, levels, dimensions, elevations, etc. Review all drawings of other trades and report any conflicts to the Architect/Engineer which will affect the project cost. Lack of field verification does not constitute a basis for additional monies during construction. Contractor assumes full responsibility for completeness of installation including coordination of work with other trades.

B. The existing facility will be occupied and functioning during the entire duration of construction. Care shall be taken when working in or around occupied spaces. There will be no interruption in mechanical systems or utilities without written approval from the Owner.

1.10 MISCELLANEOUS SUPPORT

A. Mechanical Contractor is responsible for providing all miscellaneous support components necessary for properly supporting equipment including hangers, rods, anchors, steel, etc.

END OF SECTION 230500

SECTION 230502 - MECHANICAL DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Description of Work: Provide mechanical removal work as indicated and as required for removal and/or abandonment of systems, equipment and devices, etc. made obsolete by this Project, and as required for removal and remodeling by other trades.

1.2 EXISTING CONDITIONS

A. General: In general, existing mechanical systems, equipment and devices are not shown on the Drawings unless pertinent to the demolition and/or remodeling work. Existing conditions, where indicated, are based on casual field observations and/or historical plans prepared as part of original building fit-out, and must be verified. Report any discrepancies to the Engineer before disturbing the existing installation.

B. Examination: Prior to bidding, examine the site to determine all actual observable conditions. No additional compensation will be granted on account of extra work made necessary by the Contractor's failure to investigate such existing conditions.

1.3 COORDINATION

A. Adjoining Areas: It is expected that the Contractor understands that adjoining areas of the building (or project site) must remain in operation and mechanical systems and services must remain in operation at all times, unless specifically approved otherwise.

B. Scheduling: Mechanical removal work shall be scheduled in conjunction with the other trades. Contractor cooperation will be expected under all conditions.

C. Area Limits: Construction traffic and removal of debris will be limited to specific areas and routes. Confirm with the Owner.

1.4 ADJACENT MATERIALS

A. Protection: During execution of removal work, primary consideration shall be given to protecting from damage, building structure, furnishings, finishes and the like, which are not specifically indicated to be removed.

B. Repairs: Existing items or surfaces to remain, which are damaged as a result of this work shall be refinished, repaired or replaced to the satisfaction of the Owner, at no cost to the Contract.

1.5 TRANSIENT SERVICES

A. Locate and identify any and all mechanical services passing through the project area which serve areas outside the work limits.

B. Maintain all mechanical services to areas outside the work limits unless specifically authorized otherwise in writing by the Engineer or Owner's Representative. When transient services must be interrupted, provide temporary services for affected areas outside the work limits.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Patching: Materials used for patching shall be in conformance with the applicable sections of the Project Manual. Where materials are not specifically described, but required for proper completion of the Work, they shall be as selected by the Contractor, subject to approval of the Engineer.

PART 3 - EXECUTION

3.1 INSPECTION/VERIFICATION

A. Inspection: Before commencing work of this Section, carefully inspect the project site and become familiar with existing systems and conditions.

B. Items to be Salvaged: Verify with the Engineer and Owner's Representative, all systems, materials and equipment which are to be salvaged, and those which must be removed. The Owner reserves the right to salvage any or all existing mechanical materials and equipment at the project site. Items to be salvaged include, but are not limited to, the following:
   1. [insert specific items here].

3.2 COORDINATION

A. Coordinate removal work with other trades, where applicable.

3.3 DEMOLITION

A. General: Remove mechanical equipment, ductwork, piping, controls and related materials within the project work limits, as indicated.

B. Disconnections: Disconnect all electrical devices and equipment located in wall, ceilings or floors scheduled for removal and other equipment, as indicated. Disconnect electrical connections to mechanical and other equipment being removed by other trades.

C. Protection: Perform all removal work in such a manner so that damage to adjacent items and surfaces is minimized.

D. Patching: When mechanical materials are removed, patch and finish surfaces to remain to match surrounding surfaces.

3.4 EXISTING MECHANICAL WORK TO REMAIN

A. General: Protect and maintain access to existing mechanical work which must remain. Reinstall existing mechanical work disturbed.

B. Reconnections: Where mechanical work in adjoining areas or mechanical work indicated to remain, becomes disconnected or affected by demolition work, reconnect as required, to restore original operation. Restoration work to comply with requirements for new work.

3.5 EXISTING MECHANICAL WORK TO BE RELOCATED

A. General: Disconnect, remove, reinstall and reconnect existing equipment indicated to be relocated and where require to accommodate remodeling or new construction. Extend existing installations as required. Materials and methods used for relocations and extensions to conform to requirements for new work.

3.6 SHUTDOWNS

A. General: All shutdowns to existing mechanical services to be scheduled and approved, in writing, by the Owner.

3.7 DISPOSITION OF EXISTING MATERIALS AND EQUIPMENT

A. Items to Salvage: Material and equipment which is indicated (or directed by Owner) to be salvaged, shall be carefully removed and stored where directed on the site.

B. Items to Reuse/Relocate: Carefully remove and store on site, all material and equipment indicated to be reused or relocated. Thoroughly clean, and make any necessary minor repairs to such equipment, prior to installation.

C. Items to Remove: Remove and legally dispose of all other materials and debris resulting from demolition work on a daily basis.

3.8 CLEANING

Remove from the Project Site all dirt, dust and debris resulting from removal operations on a daily basis. Refuse shall not be allowed to block or otherwise impair circulation in corridors, stairs, sidewalks, roadways or other traffic areas.

END OF SECTION 230502

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SECTION 230529 – SUPPORTS AND SLEEVES

PART 1 - GENERAL

1.1 SUMMARY

A. Perform all Work required to provide and install supports, hangers, anchors, sleeves and bases for all pipe, duct, equipment, system components and accessories, indicated by the Contract Documents with all supplementary items necessary for complete, code compliant and approved installation

1.2 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and Workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. International Mechanical Code.
2. International Plumbing Code.
3. International Fuel Gas Code.
4. ASME B31.2 - Fuel Gas Piping.
5. ASME B31.9 - Building Services Piping.
6. ASTM F708 - Design and Installation of Rigid Pipe Hangers.
7. MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
8. MSS SP69 - Pipe Hangers and Supports - Selection and Application.
9. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
10. MSS SP-90 - Guidelines on Terminology for Pipe Hangers and Supports.
11. NFPA 13 - Installation of Sprinkler Systems.
12. NFPA 14 - Installation of Standpipe and Hose Systems.
13. NFPA 99 - Standard for Health Care Facilities.
14. UL 203 - Pipe Hanger Equipment for Fire Protection Service.
15. SMACNA - HVAC Duct Construction Standards.
16. Underwriters Laboratories Standards and Listings.

1.3 QUALITY ASSURANCE

A. Materials and application of pipe hangers and supports shall be in accordance with MSS-SP-58 and SP-69 unless noted otherwise.

B. Support and sleeve materials and installation shall not interfere with the proper functioning of equipment.

C. Contractor shall be responsible for structural integrity of all hangers, supports, anchors, guides, inserts and sleeves. All structural hanging materials shall have a minimum safety factor of five.

D. Installer Qualifications: Utilize an installer experienced in performing Work of this Section who is experienced in installation of Work similar to that required for this Project and per the minimum requirements of MSS SP-89. Field welding of supports shall be by certified welders qualified in accordance with ASME Boiler and Pressure Vessel Code, Section IX using welding procedures per the minimum requirements of MSS SP-58.

1.4 SUBMITTALS

A. Product Data: Provide manufacturer's catalog data including code compliance, load capacity, and intended application.

B. Manufacturer's Installation Instructions: Indicate special procedures and assembly of components.

C. Shop Drawings: Submit detailed Drawings of all shop or field fabricated supports, anchors and sleeves, signed and sealed by a qualified State of New York registered professional engineer. Indicate size and characteristics of components and fabrication details and all loads exceeding 750 pounds imposed on the base building structure.

1.5 DELIVERY, STORAGE AND HANDLING

A. Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.

B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact. Maintain in place until installation.

C. Store materials protected from exposure to harmful weather conditions.

PART 1 - PRODUCTS

1.1 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

1.2 MANUFACTURERS

A. Hangers and Supports:

1. Anvil International.
2. Kinder.
3. Cooper B-Line.
4. C & S Mfg. Corp.
5. Hubbard Enterprises/Holdrite
6. National Pipe Hanger Corporation.
7. Power Strut.

1.3 HANGERS AND SUPPORTS

A. General:

1. Refer to individual system and equipment Specification Sections for additional support requirements. Comply with MSS SP-69 for support selections and applications that are not addressed within these Specifications.
2. Utilize hangers and supports to support systems under all conditions of operation, allowing free expansion and contraction, and to prevent excessive stresses from being introduced into the structure, piping or connected equipment.
3. All pipe supports shall be of the type and arrangement to prevent excessive deflection, to avoid excessive bending stresses between supports, and to eliminate transmission of vibration.
4. Design hangers to impede disengagement by movement of supported pipe.
5. Install building attachments within concrete slabs or attach to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, and at changes in direction of piping.
6. Wire or perforated strap iron will not be acceptable as hanger material.
7. Hanger rods shall be threaded on both ends, threaded one end, or continuous threaded, complete with adjusting and lock nuts.
8. Fasteners requiring explosive powder (shooting) or pneumatic-driven actuation will not be acceptable under any circumstances.
9. Plastic anchors or plastic expansion shields will not be permitted under any circumstances.
10. Hangers and clamps supporting and contacting individual non-insulated brass or copper lines shall be copper or copper plated. Where non-insulated brass or copper lines are supported on trapeze hangers or channels, the pipes shall be isolated from these supports with approved flexible elastomeric/thermoplastic isolation cushion material to completely encircle the piping and avoid contact with the channel or clamp. Plastic tape is not acceptable.
11. Hangers and clamps supporting and contacting glass piping shall be in accordance with the piping manufacturer's published recommendations and shall be fully lined with minimum 1/4 inch neoprene padding. The padding material and the configuration of its installation shall be submitted for approval.
12. Hangers and clamps supporting and contacting plastic piping shall be in accordance with the piping manufacturer's published recommendations and shall be factory coated or padded to prevent damage to piping.
13. Field fabricated supports shall be constructed from ASTM A36/A36M, steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.

B. Finishes: All ferrous hangers, rods, inserts, clamps, stanchions, and brackets on piping within interior non-corrosive environments, shall be dipped in Zinc Chromate Primer before installation. Rods may be galvanized or cadmium plated after threading, in lieu of dipping zinc chromate. All hangers and supports exposed to the weather, including roofs and building crawl space areas, shall be galvanized or manufactured from materials that will not rust or corrode due to moisture. All hangers and supports located within corrosive environments shall be constructed from or coated with materials manufactured for installation within the particular environment.

C. Vertical Piping:

1. Supports for vertical riser piping in concealed areas shall utilize double bolt riser clamps, with each end having equal bearing on the building structure at each floor level.
2. Supports for vertical riser piping at floor levels in exposed areas (such as fire protection standpipe in stairwells) shall be attached to the underside of the penetrated structure

utilizing drilled anchors, two hanger rods (sized as specified), and socket clamp with washers.

3. Two-hole rigid pipe clamps or four-hole socket clamps with washers may be used to support pipe directly from adequate structural members where floor-to-floor distance exceeds required vertical support spacing and lines are not subject to expansion and contraction.

D. Trapezes: Where multiple lines are run horizontally at the same elevation and grade, they may be supported on manufactured channel, suspended on rods or pipes. Trapeze members including suspension rods shall be properly sized for the quantity, diameters, and loaded weight of the lines they are to support.

E. Ductwork: All ductwork shall be supported in accordance with SMACNA recommendations for the service involved. Horizontal ducts supported using galvanized steel bands shall extend up both sides and onto the construction above, where they shall turn over and be secured with bolts and nuts fitted in inserts set in the concrete, bolted to angles secured to the construction above, or secured in another approved manner.

F. Terminal Units:

1. Terminal units weighing up to 150 pounds shall be supported by four (4) 1 inch wide sheet metal straps with ends turned under bottom of unit at corners.
2. Each band shall be secured by not over 3/4 inch in length, 1/4 inch diameter sheet metal screws – two (2) on bottom of unit and one (1) on each side.
3. The other strap end shall be attached to the structure by 1/4 inch diameter threaded bolt into the concrete insert or into drilled-hole threaded concrete expansion anchor.
4. Where interference occurs, overhead of the box, not allowing direct vertical support by straps, provide trapeze channels suspended by 1/4 inch diameter galvanized threaded rods providing such channels do not block access panels of units.
5. Terminal units weighing more than 150 pounds shall be supported per the terminal unit manufacturer's installation instructions using threaded rod and hanger brackets located per manufacturer's drawing.

G. Fixture and Equipment Service Piping:

1. Piping at local connections to plumbing fixtures and equipment shall be supported to prevent the weight of the piping from being transmitted to fixtures and equipment.
2. Makeshift, field-devised methods of plumbing pipe support, such as with the use of scrap framing materials, are not allowed. Support and positioning of piping shall be by means of engineered methods that comply with IAPMO PS 42-96. These shall be Hubbard Enterprises/Holdrite support systems, C & S Mfg. Corp. or Owner-approved equivalent.
3. Supports within chases and partitions shall be corrosion resistant metal plate, clamps, angles or channels, and aligned with structure in the vertical or horizontal position. Plastic supports are not allowed unless approved by Owner.
4. Horizontal supports within chases and partitions that are attached to studs shall be attached at both ends. Drywall shall not be relied upon to support the piping.
5. Supports for plumbing fixture water service piping within chases and partitions may be attached to cast iron drain and vent pipe with approved brackets and pipe clamps.
6. Piping exposed on the face of drywall shall be supported with corrosion resistant metal channels that are attached to wall studs. Drywall shall not be relied upon to support the piping.
7. Piping supported from the floor shall utilize corrosion resistant metal channels or brackets that are anchored to the floor slab.

8. All water piping shall be isolated from building components to prevent the transmission of sound.
9. All copper or brass lines shall be isolated from ferrous metals with dielectric materials to prevent electrolytic action. Plastic tape is not an acceptable isolation material.

H. Inserts:

1. Cast-in-place concrete inserts shall comply with MSS-SP-69, U.L. and F.M. approved, and sized to suit threaded hanger rods.
2. Inserts shall have malleable iron case with galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods. Suitable concrete inserts for pipe and equipment hangers shall be set and properly located for all pipe and equipment to be suspended from concrete construction. If the inserts are later found not to be in the proper location for the placement of hangers, then drilled anchors shall be installed. Drilled anchors in concrete or masonry shall be submitted for the approval.
3. Manufactured inserts for metal deck construction shall have legs custom fit to rest in form valleys.
4. Shop fabricated inserts shall be submitted and approved by Owner prior to installation.
5. Inserts shall be of a type that will not interfere with structural reinforcing and that will not displace excessive amounts of structural concrete.

I. Pipe Shields: Provide pipe shields in accordance with insulation manufacturer's published recommendations. Install MSS SP-58, Type 39 protection saddles, if insulation without vapor barrier is indicated. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier.

J. Concrete Pads and Equipment Bases:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases 4 inches high unless otherwise indicated; and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.
3. Minimum Compressive Strength: 3000 psi at 28 days.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor them into structural concrete substrate.
6. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
7. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

1.4 PIPE AND DUCT PENETRATIONS

A. General:

1. Seal penetrations through all rated partitions, walls and floors with U.L. tested assemblies to provide and maintain a rating equal to or greater than the partition, wall or floor.

2. Inside diameter of all sleeves or cored holes shall provide sufficient annular space between outside diameter of pipe, duct or insulation to allow proper installation of required fire and water proofing materials and allow for movement due to expansion and contraction.
3. Exposed ceiling, floor and wall pipe penetrations within finished areas (including exterior wall faces) shall be provided with chrome plated, brass or stamped steel, hinged, split-ring escutcheon with set screw or snap-on type. Inside diameter shall closely fit pipe outside diameter or outside of pipe insulation where pipe is insulated. Outside diameter shall completely cover the opening in floors, walls, or ceilings. In exterior, damp, or corrosive environments, use Type 302 stainless steel escutcheons.

B. Floor Pipe Penetrations:

1. Seal penetrations through all floors to provide and maintain a watertight installation.
2. Sleeves cast in the slab for pipe penetrations shall be Schedule 40 steel, ASTM A53, with 2 inch wide annular fin water-stop continuously welded at midpoint. Entire assembly shall be hot-dipped galvanized after fabrication. Water-stop shall be same thickness as sleeve.
3. Cored holes in the slab for pipe penetrations shall be provided with a Schedule 40 steel, ASTM A53, sleeve with 2 inch wide annular fin water-stop continuously welded at point on sleeve to allow countersinking into slab and waterproofing. Entire sleeve assembly shall be hot-dipped galvanized after fabrication. Water-stop shall be same thickness as sleeve.
4. All sleeves shall extend a minimum of two inches above finished floor.
5. Where job conditions prevent the use of a sleeve that extends two inches above the slab, Link-Seal mechanical casing seals manufactured by Thunderline Corporation may be installed to provide a watertight penetration. Mechanical casing seals can be used only for relatively small diameter pipe penetrations. Verify that slab thickness allows proper installation of the link-seal assembly and the required fire stopping prior to applying this exception.

C. Wall Penetrations:

1. Where piping or ductwork passes through non-rated partition, close off space between pipe or duct and construction with gypsum wallboard and repair plaster smoothed and finished to match adjacent wall area.
2. Pipe penetrations through interior rated partitions shall be provided with adjustable prefabricated U.L. listed fire rated galvanized sheet metal sleeves having gauge thickness as required by wall fire rating, 20 gauge minimum. EXCEPTION: When U.L. Listed assembly does not require a sleeve,
3. Pipe penetrations through exterior walls and walls below grade shall be provided with “Link-Seal” mechanical casing seal manufactured by Thunderline Corporation.
4. Ductwork penetrations through rated partitions, walls and floors shall be provided with sleeves that are manufactured integral with the damper assembly installed.

D. Flashing:

1. Coordinate flashing material and installation required for pipe and duct roof penetrations with Owner and roofing Contractor.
2. Provide flexible flashing and metal counter-flashing where ductwork penetrates exterior walls. Seal penetration water and air tight.
3. Provide acoustical flashing around ducts and pipes penetrating equipment rooms, with materials and installation in accordance with manufacturer's instructions for sound control.

E. Roof Curbs: Coordinate roof curb material and installation with Owner and roofing Contractor.

PART 2 - EXECUTION

2.1 PREPARATION

A. Conduct a pre-installation meeting prior to commencing Work of this Section to verify Project requirements, coordinate with other trades, establish condition and completeness of substrate, review manufacturer's installation instructions and manufacturer's warranty requirements.

2.2 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. Application, sizing and installation of piping, supports, anchors and sleeves shall be in accordance with manufacturer's printed installation instructions.

C. Provide for vertical adjustments after erection and during commissioning, where feasible, to ensure pipe is at design elevation and slope.

D. Install hangers and supports to allow controlled thermal movement of piping systems, permitting freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

E. Install hanger so that rod is vertical under operating conditions.

F. Supports, hangers, anchors, and guides shall be fastened to the structure only at such points where the structure is capable of restraining the forces in the piping system.

G. The load and spacing on each hanger and/or insert shall not exceed the safe allowable load for any component of the support system, including the concrete that holds the inserts. Reinforcement at inserts shall be provided as required to develop the strength required. Contractor shall be responsible for engaging a structural engineer as required for design and review at support systems.

H. Do not hang pipe, duct or any mechanical/plumbing item directly from a metal deck or locate on the bottom chord of any truss or joist unless approved by the Structural Engineer of Record.

I. All supports shall be designed and installed to avoid interference with other piping, hangers, ducts, electrical conduit, supports, building structures, equipment, etc.

J. Piping supports shall be independent from ductwork supports. Combining supports is not permitted.

K. Provide all supporting steel required for the installation of mechanical equipment and materials, including angles, channels, beams, etc. to suspended or floor supported tanks and equipment. All of this steel may not be specifically indicated on the Drawings.

L. All piping and ductwork supports shall be designed and installed to allow the insulation to be continuous through the hangers.

M. Adjustable clevis hangers shall be supported at rods with a nut above and below the hanger.

N. All hanger rods shall be trimmed neatly so that 1 inch of excess hanger rod protrudes beyond the hanger nut. In the event a rod is intentionally but temporarily left excessively long (for sloped or

insulated lines for example), the Contractor shall take appropriate measures to protect the pipe or other materials from damage.

O. Install hangers to provide minimum ½ inch space between finished covering and adjacent structures, materials, etc.

P. Horizontal and vertical piping in chases and partitions shall be supported to prevent movement and isolated from the supports to prevent transmission of sound.

Q. Locate hangers within 12 inches of each horizontal elbow.

R. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

S. Support riser piping independently of connected horizontal piping. Riser piping is defined as vertical piping extending through more than one floor level.

T. Support riser piping at each floor level and provide additional supports where floor-to-floor distance exceeds required vertical support spacing. Installation of riser clamps and welded steel riser supports shall not allow weight of piping to be transmitted to floor sleeves.

U. Steel Bar Joists: Hanger rods shall be secured to angle irons of adequate size; each angle shall span across two or more joists as required to distribute the weight properly and shall be welded or otherwise permanently fixed to the top of joists.

V. Steel Beams: Where pipes and loads are supported under steel beams, approved type beam clamps shall be used.

W. Pre-Cast Tee Structural Concrete: Hanger supports, anchors, etc. attached to the precast, double tee, structural concrete system shall be installed in accordance with approved Shop Drawings only. Holes required for hanger rods shall be core drilled in the "flange" of the double tee only; impact type tools are not allowed under any circumstances. Core drilling in the "stem" portions of the double tee is not allowed. Holes core drilled through the "flange" for hanger rods shall be no greater than 1/4 inch larger than the diameter of the hanger rod. Hanger rods shall supported by means of bearing plates of size and shape acceptable to the Architect/Engineer, with welded double nuts on the hanger rod above the bearing plate. Cinch anchors, lead shields, expansion bolts, and studs driven by explosion charges are not allowed under any circumstances in the lower 15 inches of each stem and in the "shadow" of the stem on the top side of the "double tees".

X. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

Y. Inserts:

1. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
2. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
3. Install anchors in concrete after concrete is placed and completely cured. Install anchors according to manufacturer's written instructions.

Z. Flashing:

1. Coordinate all roof flashing with requirements of Division 07.

AA. Pipe Shields:

1. Provide shields at each hanger supporting insulated pipe.
2. Provide shields of the proper length to distribute weight evenly and to prevent compression of insulation at hanger.
3. Install shield so that hanger is located at the center of the shield.
4. Attach shield to insulation with adhesive to prevent slippage or movement.

BB. Equipment Anchor Bolts:

1. Foundation bolts shall be placed in the forms when the concrete is poured, the bolts being correctly located by means of templates. Each bolt shall be set in a sleeve of sufficient size to provide ½ inch clearance around bolt.

END OF SECTION 230529

SECTION 230553 - MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Pipe labels.
3. Duct labels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

1.3 COORDINATION

A. Coordinate installation of identifying devices with locations of access panels and doors.

B. Install identifying devices before ceilings are installed.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Stainless steel, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel self-tapping screws.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment designation or tag number and service. Provide additional information where indicated or requested by Owner/Engineer.

D. Equipment Label Schedule: Include schedule in IOM manual.

2.2 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Length: 12” for piping less than or equal to 4” NPS, 24” for piping greater than 4” NPS.
3. Lettering Size: 1.25” for piping less than or equal to 4” NPS, 24” for piping greater than 4” NPS.

D. Pipe Label Color Schedule:

1. Chilled-Water Piping: Blue background with white lettering.
2. Condenser-Water Piping: Green background with white lettering.
3. Heating Hot Water Piping: Yellow background with black lettering.

2.3 DUCT LABELS

A. Stencils: Minimum letter height of 3 inches.

1. Stencil Material: Fiberboard or metal.
2. Stencil Paint: Exterior, gloss, acrylic enamel, black unless otherwise indicated. Paint may be in pressurized spray-can form.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 25 feet along each run. Reduce intervals to 10 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

3.4 DUCT LABEL INSTALLATION

A. Stenciled labels, showing service and flow direction, increase lettering size where needed for proper identification because of distance from normal location of required identification.

B. Locate labels in mechanical equipment rooms near points where ducts penetrate walls or enter into concealed spaces and at maximum intervals of 20 feet or as required to properly identify ductwork.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. All new and existing equipment shown on plans shall be included unless otherwise noted.

B. Provide testing, adjusting and balancing (TAB) for the following:

1. Air Side Equipment: All air moving equipment including ductwork, air terminals and air inlets/outlets.

1.2 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. MC: Mechanical Contractor.

C. NEBB: National Environmental Balancing Bureau.

D. TAB: Testing, adjusting, and balancing.

1.3 SUBMITTALS

A. Qualification Data: AABC or NEBB certification.

B. Written statement of coordination with sheetmetal contractor.

C. Written statement of coordination with piping contractor.

D. Written statement of acceptance of location and quantity of air and water balancing devices.

E. Final TAB reports.

1.4 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB contractor certified by AABC or NEBB.

B. TAB Procedures: Employ procedures and test methods published by AABC, NEBB or ASHRAE.

1.5 GENERAL REQUIREMENTS

A. TAB Contractor Qualifications: Engage a TAB contractor certified by AABC or NEBB.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements. Notify Engineer of any questions regarding balancing within 45 days of MC notice to proceed.

B. TAB Contractor shall review ductwork shop drawings and mark locations of all required volume dampers prior to fabrication.

1. Submit documentation of coordination with sheetmetal contractor.

2. Documentation shall include electronic copies of ductwork shop drawings including dates, names and signatures of each party.

C. TAB Contractor shall review piping drawings and mark locations of all required balancing devices prior to fabrication.

1. Submit documentation of coordination with piping contractor.

2. Documentation shall include electronic copies of piping plans including dates, names and signatures of each party.

D. Examine the approved submittals for HVAC systems and equipment.

E. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

F. Examine test reports specified in individual system and equipment Sections.

G. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

H. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

I. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.

J. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

K. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

L. Examine system pumps to ensure absence of entrained air in the suction piping.

M. Examine operating safety interlocks and controls on HVAC equipment.

N. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system-readiness checks and prepare reports. Verify the following:

1. Permanent electrical-power wiring is complete.
2. Automatic temperature-control systems are operational.
3. Equipment and duct access doors are securely closed.
4. Balance, smoke, and fire dampers are open.
5. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
6. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" and in this Section.

1. Comply with requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. After testing and balancing, install test ports and duct access doors that comply with requirements in Division 23 Section "Air Duct Accessories."
3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.
    a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
2. Measure fan static pressures as follows to determine actual static pressure:
    a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
    b. Measure static pressure directly at the fan outlet or through the flexible connection.
    c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
    d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
    a. Report the cleanliness status of filters and the time static pressures are measured.
4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
6. Obtain approval from Engineer for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow of submain and branch ducts.
   a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.

B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
3. Measure total system airflow. Adjust to within indicated airflow.
4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make

this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.

5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
    a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
    a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
8. Record final fan-performance data.

3.7 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.8 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data.

3.9 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

1. Measure and record the operating speed, airflow, and static pressure of each fan.

2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
3. Check the refrigerant charge.
4. Check the condition of filters.
5. Check the condition of coils.
6. Check the operation of the drain pan and condensate-drain trap.
7. Check bearings and other lubricated parts for proper lubrication.
8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:

1. New filters are installed.
2. Coils are clean and fins combed.
3. Drain pans are clean.
4. Fans are clean.
5. Bearings and other parts are properly lubricated.
6. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

1. Compare the indicated airflow of the renovated work to the measured fan airflows and determine the new fan speed and the face velocity of filters and coils.
2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
3. If calculations increase or decrease the air flow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
4. Balance each air outlet.

3.10 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.
3. Heating-Water Flow Rate: Plus or minus 10 percent.
4. Cooling-Water Flow Rate: Plus or minus 10 percent.

3.11 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: Prepare biweekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.12 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

a. Indicated versus final performance.
b. Notable characteristics of systems.
c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:
    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:
    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Sheave make, size in inches, and bore.
    i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
    j. Number, make, and size of belts.
    k. Number, type, and size of filters.

2. Motor Data:
    a. Motor make, and frame type and size.
    b. Horsepower and rpm.
    c. Volts, phase, and hertz.
    d. Full-load amperage and service factor.
    e. Sheave make, size in inches, and bore.
    f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
3. Test Data (Indicated and Actual Values):
    a. Total air flow rate in cfm.
    b. Total system static pressure in inches wg.
    c. Fan rpm.
    d. Discharge static pressure in inches wg.
    e. Filter static-pressure differential in inches wg.
    f. Preheat-coil static-pressure differential in inches wg.
    g. Cooling-coil static-pressure differential in inches wg.
    h. Heating-coil static-pressure differential in inches wg.
    i. Outdoor airflow in cfm.
    j. Return airflow in cfm.
    k. Outdoor-air damper position.
    l. Return-air damper position.
    m. Vortex damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:
    a. System identification.
    b. Location.
    c. Coil type.
    d. Number of rows.
    e. Fin spacing in fins per inch o.c.
    f. Make and model number.
    g. Face area in sq. ft..
    h. Tube size in NPS.
    i. Tube and fin materials.
    j. Circuiting arrangement.
2. Test Data (Indicated and Actual Values):
    a. Air flow rate in cfm.
    b. Average face velocity in fpm.
    c. Air pressure drop in inches wg.
    d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
    e. Return-air, wet- and dry-bulb temperatures in deg F.
    f. Entering-air, wet- and dry-bulb temperatures in deg F.

g. Leaving-air, wet- and dry-bulb temperatures in deg F.
h. Water flow rate in gpm.
i. Water pressure differential in feet of head or psig.
j. Entering-water temperature in deg F.
k. Leaving-water temperature in deg F.
l. Refrigerant expansion valve and refrigerant types.
m. Refrigerant suction pressure in psig.
n. Refrigerant suction temperature in deg F.

G. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:
   a. System identification.
   b. Location.
   c. Make and type.
   d. Model number and size.
   e. Manufacturer's serial number.
   f. Arrangement and class.
   g. Sheave make, size in inches, and bore.
   h. Center-to-center dimensions of sheave, and amount of adjustments in inches.
2. Motor Data:
   a. Motor make, and frame type and size.
   b. Horsepower and rpm.
   c. Volts, phase, and hertz.
   d. Full-load amperage and service factor.
   e. Sheave make, size in inches, and bore.
   f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
   g. Number, make, and size of belts.
3. Test Data (Indicated and Actual Values):
   a. Total airflow rate in cfm.
   b. Total system static pressure in inches wg.
   c. Fan rpm.
   d. Discharge static pressure in inches wg.
   e. Suction static pressure in inches wg.

H. Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:
   a. System and air-handling-unit number.
   b. Location and zone.
   c. Traverse air temperature in deg F.
   d. Duct static pressure in inches wg.

e. Duct size in inches.
f. Duct area in sq. ft..
g. Indicated air flow rate in cfm.
h. Indicated velocity in fpm.
i. Actual air flow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

I. Air-Terminal-Device Reports:

1. Unit Data:
   a. System and air-handling unit identification.
   b. Location and zone.
   c. Apparatus used for test.
   d. Area served.
   e. Make.
   f. Number from system diagram.
   g. Type and model number.
   h. Size.
   i. Effective area in sq. ft..
2. Test Data (Indicated and Actual Values):
   a. Air flow rate in cfm.
   b. Air velocity in fpm.
   c. Preliminary air flow rate as needed in cfm.
   d. Preliminary velocity as needed in fpm.
   e. Final air flow rate in cfm.
   f. Final velocity in fpm.
   g. Space temperature in deg F.

J. Instrument Calibration Reports:

1. Report Data:
   a. Instrument type and make.
   b. Serial number.
   c. Application.
   d. Dates of use.
   e. Dates of calibration.

3.13 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:
   a. Measure airflow of at least 10 percent of air outlets.
   b. Measure water flow of at least [5] <Insert number> percent of terminals.
   c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
   d. Verify that balancing devices are marked with final balance position.
   e. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by the Engineer.
2. Engineer shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
3. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
4. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.

D. Prepare test and inspection reports.

3.14 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

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SECTION 230719 - PIPE INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulating the following mechanical piping systems:

1. Condensate drain piping.
2. Heating hot-water piping.
3. Chilled water piping.
4. Refrigerant piping.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1. Include insulation schedule indicating applications and methods of compliance with specified performance.

1.3 COORDINATION

A. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.4 SCHEDULING

A. Schedule insulation application after pressure and leak testing systems. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 PIPE INSULATION SCHEDULE

A. Heating Hot Water Piping: Insulation Type A.

1. Pipe Sizes less than 1.5 NPS: 1.5-inches thick.
2. Pipe Sizes 1.5 NPS and larger: 2-inches thick.
3. Pre-Molded PVC Fitting Covers; Zeston or equal.
4. Provide high impact strength PVC pipe jacketing for piping exposed in finished spaces.

B. Chilled Water Piping: Insulation Type A.

1. Pipe Sizes less than 1.5 NPS: 1.5-inches thick.
2. Pipe Sizes 1.5 NPS and larger: 2-inches thick.
3. Pre-Molded PVC Fitting Covers; Zeston or equal.
4. Provide high impact strength PVC pipe jacketing for piping exposed in finished spaces.

C. Condensate Drainage Piping: Insulation Type B.

1. All Pipe Sizes: 0.5-inches thick.
2. Provide manufacturer recommended insulation adhesive for all joints. Seal butt joints with approved tape system.

D. Refrigerant Piping: Insulation Type B.

1. Pipe Sizes less than 1.5 NTS: 1.0-inches thick.
2. Pipe Sizes 1.5 NTS and larger: 1.5-inches thick.
3. Provide manufacturer recommended insulation adhesive for all joints. Seal butt joints with approved tape system.
4. Provide high impact strength PVC pipe jacketing for exterior piping.

2.2 PIPE INSULATION MATERIALS

A. Products shall not contain asbestos, lead, mercury, or mercury compounds.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following. No substitutions will be permitted without written approval prior to receipt of bids:

1. CertainTeed Corp.
2. Johns Manville.
3. Knauf Insulation.
4. Manson Insulation Products Ltd.
5. Armacell, LLC.

C. Pipe insulating materials shall be as follows:

1. Type A: Fiberglass pipe insulation jacketed with a reinforced white all service vapor retarder jacket (ASJ) and factory applied longitudinal acrylic adhesive closure system. UL rated for maximum flamespread 25 and smoke developed 50.
   a. Thermal Conductivity: 0.23 (Btu-in./h-sf) at 75F mean temperature.
2. Type B: Closed Cell Foam Pipe Insulation. Pre-slit foamed plastic pipe insulation, rated for maximum flame spread 25 and smoke developed 50, with slit positioned at side and vapor sealed with adhesive on all joints.
   a. Thermal Conductivity: 0.28 (Btu-in./h-sf) at 75F mean temperature and 1.5-inch wall thickness.
   b. AP Armaflex Black LapSeal or approved equal.

D. High Impact Strength Jacketing: Furnish PVC jacketing and fitting covers, conforming to ASTM E-84; flame spread 25, smoke developed 50, white high gloss finish, 0.02" minimum thickness.

E. Furnish pre-molded PVC jacketing and fitting covers, lo-smoke type, as manufactured by Proto Corp.; or an approved equal.

1. PVC: Conform with FS L-P-535C, Composition A, Type II, Grade GU.
2. Fiberglass: Conform with FS HH-I-558C, Form B, Type I, Class 7&8.
3. Subject to compliance with requirements, provide one of the following:
   a. Johns Manville; Zeston.
   b. Proto Corporation; LoSmoke.
   c. Speedline Corporation; SmokeSafe.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Comply with the manufacturer's installation instructions.

3.2 PENETRATIONS

A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

C. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.3 INSTALLATION OF FIBERGLASS INSULATION

A. Insulation on all cold surfaces must be applied with a continuous, unbroken vapor seal. Hangers, supports, anchors, etc., that are secured directly to cold surfaces must be adequately insulated and vapor sealed to prevent condensation.

3.4 INSTALLATION AT HANGERS

A. Reset and realign hangers and supports if they are displaced while installing the piping insulation.

B. Fiberglass Insulation: Install high density insulation filler pieces, at all points of support, between pipe insulation shields and pipe or tubing not supported by an insulation shield and insulating saddle unit. Do not install high density insulation filler pieces on hot service piping 6" and larger scheduled to have steel saddles. Install filler pieces of the same thicknesses as adjoining pipe insulation x 12” length.

1. Install high density molded polyurethane or high-density polystyrene filler pieces.

C. Galvanized metal shields shall be applied between hangers or supports and the pipe insulation. Shields shall be formed to fit the insulation and shall extend up to the centerline of the pipe and 8” length.

END OF SECTION 230719

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SECTION 230900 - BUILDING AUTOMATION SYSTEM

PART 1 - GENERAL

1.1 OVERVIEW

A. Expand existing BAS system to provide the control sequences specified on drawings and in the specifications. The system shall provide control and monitoring of the equipment indicated.

B. Provide controllers and communications infrastructure to match existing Campus-Wide building automation system. Provide seamless integration with existing control network and user interfaces. Network gateways and protocol interface equipment are not acceptable.

1. Contact Information:

Brian Johnson
Eastern Heating & Cooling
880 Broadway
Albany, NY 12207-1316
518-470-6831
Bj@ehchvac.com

C. Provide instrumentation, sensors, valves, dampers, actuators and wiring as required to provide specified operating sequences.

D. Modify existing graphic user interfaces to include all equipment/systems included in this project.

E. Replace the existing BAS server hardware and upgrade the software to the latest version of web-enabled graphical user interface with a seamless integration of the new and existing control points.

1.2 SCOPE OF WORK

A. The Contractor shall furnish and install all necessary software and hardware, wiring, and computing equipment in compliance with this specification. Any variances from this specification or related documentation shall be submitted in writing at the time of bid.

B. System Requirements

1. Standard Material/Products. All material and equipment used shall be standard components, regularly manufactured and available, and not custom designed especially for this project
2. Modular Design. The system architecture shall be fully modular permitting expansion of application software, system peripherals, and field hardware.
3. Performance. The system, upon completion of the installation and prior to acceptance of the project, shall perform all operating functions as detailed in this specification.
4. Equipment: The Contractor shall provide the following system hardware:
   a. All sensing devices, relays, switches, indicating devices, and transducers required to perform the functions as listed in I/O Summary Tables.
   b. All monitoring and control wiring.

1.3 CODES AND STANDARDS

A. Work, materials, and equipment shall comply with the most restrictive of local, state, and federal authorities' codes and ordinances or these plans and specifications. As a minimum, the installation shall comply with current editions in effect 30 days prior to receipt of bids of the following codes:

1. National Electric Code (NEC)
2. New York State Building Codes
3. ANSI/ASHRAE 135-2004: Data Communication Protocol for Building Automation and Control Systems (BACnet)

B. Conflict of Codes. Where two or more codes conflict, the most restrictive shall apply. Nothing in this specification or related documentation shall be construed to permit work not conforming to applicable codes.

1.4 SYSTEM PERFORMANCE

A. Performance Standards. System shall conform to the following minimum standards.

1. Performance. Programmable controllers shall be able to completely execute DDC PID control loops at a frequency adjustable down to once per sec. Select execution times consistent with the mechanical process under control.
2. Reporting Accuracy. System shall report values with minimum end-to-end accuracy listed in Table 1.
3. Control Stability and Accuracy. Control loops shall maintain measured variable at setpoint within tolerances listed in Table 2.

Table 1 - Reporting Accuracy

Measured Variable	Reported Accuracy
Space Temperature	±0.5ºC (±1ºF)
Ducted Air	±0.5ºC (±1ºF)
Outside Air	±1.0ºC (±2ºF)
Dew Point	±1.5ºC (±3ºF)
Water Temperature	±0.5ºC (±1ºF)
Delta-T	±0.15ºC (±0.25ºF)
Relative Humidity	±5% RH
Water Flow	±2% of full scale
Airflow (terminal)	±10% of full scale (see Note 1)
Airflow (measuring stations)	±5% of full scale
Airflow (pressurized spaces)	±3% of full scale
Air Pressure (ducts)	±25 Pa (±0.1 in. w.g.)
Air Pressure (space)	±3 Pa (±0.01 in. w.g.)
Water Pressure	±2% of full scale (see Note 2)
Electrical (A, V, W, Power Factor)	±1% of reading (see Note 3)
Carbon Monoxide (CO)	±5% of reading
Carbon Dioxide (CO_2)	±50 ppm

Note 1: Accuracy applies to 10% - 100% of scale
Note 2: For both absolute and differential pressure
Note 3: Not including utility-supplied meters

Table 2 - Control Stability and Accuracy

Controlled Variable	Control Accuracy	Range of Medium
Air Pressure	±50 Pa (±0.2 in. w.g.) ±3 Pa (±0.01 in. w.g.)	0-1.5 kPa (0-6 in. w.g.) -25 to 25 Pa (-0.1 to 0.1 in. w.g.)
Airflow	±10% of full scale	
Space Temperature	±1.0ºC (±2.0ºF)	
Duct Temperature	±1.5ºC (±3ºF)	
Humidity	±5% RH	
Fluid Pressure	±10 kPa (±1.5 psi) ±250 Pa (±1.0 in. w.g.)	MPa (1-150 psi) 0-12.5 kPa (0-50 in. w.g.) differential

1.5 SUBMITTALS, DOCUMENTATION, ACCEPTANCE AND TRAINING

A. Submittals:

1. Shop Drawings. Include a complete list of equipment, materials, manufacturer's technical literature, cut-sheets, and installation instructions. Drawings shall contain proposed layout, complete wiring, routing, schematic diagrams, tag number of devices, software descriptions, calculations, installation details, and any other details required to demonstrate that the system will function properly.
2. Graphical Programming Documentation: The Contractor shall submit for approval, all proposed graphic displays in full color hard copy and an electronic copy in HTML format viewable on any web browser for all Graphical Displays, identifying the specific subsystem being controlled. Provide no later than 45 calendar days after contract award.
3. As Built Drawings. All drawings shall be reviewed after the final system checkout and updated or corrected to provide 'as-built' drawings to show exact installation. All shop drawings will be acknowledged in writing by Architect/Engineer before installation is started and again after the final checkout of the system. The system will not be considered complete until the 'as-built' drawings have received their final approval. The Contractor shall as-built drawings in electronic format as PDF documents.

B. Documentation:

1. Operating and Maintenance (O&M) manuals for the system shall be made available electronically (PDF) and include the following categories: Project Engineering Handbook, Software Documentation.
2. Project Engineering Manual shall contain as a minimum:
   a. System architecture overview
   b. Hardware cut-sheets and product descriptions.
   c. The Contractor shall deliver six (6) sets of 'as-built' drawings. All drawings shall be reviewed after the final system checkout and updated to provide 'as-built' drawings. The system will not be considered complete until the 'as-built' drawings have received their final approval.

d. Installation, mounting and connection details for all field hardware and accessories
e. Commissioning, setup and backup procedures for all control modules/accessories, BAS server software, and database.
f. Listing of basic terminology, alarms/messages, error messages and frequently used commands or shortcuts.
g. Operator training 'video' submitted on CD or DVD format.

3. Acceptance Test
   a. Acceptance Testing. Upon completion of the installation, the Contractor shall start up the system and perform all necessary calibration, testing, and debugging operations. The Contractor in the presence of the Owner's representative shall perform an acceptance test.
   b. Notice of Completion. When the system performance is deemed satisfactory, the system parts will be accepted for beneficial use and placed under warranty. At this time, Architect/Engineer shall issue a "notice of substantial completion" and the warranty period shall start.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Use new products the manufacturer is currently manufacturing and selling for use in new installations. Do not use this installation as a product test site unless explicitly approved in writing by Owner. Spare parts shall be available for at least five years after completion of this contract.

2.2 COMMUNICATION

A. Install new wiring and network devices as required to provide a complete and workable control network.

2.3 FIELD HARDWARE/INSTRUMENTATION

A. Temperature Sensing Devices

1. Type & Accuracy. Temperature sensors shall be of the type and accuracy indicated for the application. Sensors shall have an accuracy rating within 1% of the intended use temperature range.
2. Outside Air Temperature Sensors. Outside air temperature sensors' accuracy shall be within +1°F in the range of -52°F to 152°F.
3. Room Temperature Sensors. Room temperature sensors shall have an accuracy of +0.36°F in the range of 32°F to 96°F.
4. Chilled Water and Condenser Water Sensors. Chilled water and condenser water sensors shall have an accuracy of +0.25°F in their range of application.
5. Hot Water Temperature Sensors. Hot water temperature sensors shall have an accuracy of +0.75°F over the range of their application.

B. Pressure Instruments

1. Differential Pressure and Pressure Sensors: Sensors shall have a 4-20 MA output proportional signal with provisions for field checking. Sensors shall withstand up to 150% of rated pressure, without damaging the device. Accuracy shall be within +2% of full scale. Sensors shall be manufactured by Leeds & Northrup, Setra, Robertshaw, Dwyer Instruments, Rosemont, or be approved equal.
2. Pressure Switches: Pressure switches shall have a repetitive accuracy of +2% of range and withstand up to 150% of rated pressure. Sensors shall be diaphragm or bourdon tube design. Switch operation shall be adjustable over the operating pressure range. The switch shall have an application rated Form C, snap-acting, self-wiping contact of platinum alloy, silver alloy, or gold plating.

C. Flow Switches:

1. Flow switches shall have a repetitive accuracy of +1% of their operating range. Switch actuation shall be adjustable over the operating flow range. Switches shall have snap-acting Form C contacts rated for the specific electrical application.

D. Humidity Sensors:

1. Sensors shall have an accuracy of +2.5% over a range of 20% to 95% RH.

E. Current Sensing Relays

1. Relays shall monitor status of motor loads. Switch shall have self-wiping, snap-acting Form C contacts rated for the application. The setpoint of the contact operation shall be field adjustable.

F. Output Relays

1. Control relay contacts shall be rated for 150% of the loading application, with self-wiping, snap-acting Form C contacts, enclosed in dustproof enclosure. Relays shall have silver cadmium contacts with a minimum life span rating of one million operations. Relays shall be equipped with coil transient suppression devices.

G. Solid State Relays

1. Input/output isolation shall be greater than 10 billion ohms with a breakdown voltage of 15 V root mean square, or greater, at 60 Hz. The contact operating life shall be 10 million operations or greater. The ambient temperature range of SSRs shall be 20□F-140□F. Input impedance shall be greater than 500 ohms. Relays shall be rated for the application. Operating and release time shall be 10 milliseconds or less. Transient suppression shall be provided as an integral part of the relays.

H. Valve and Damper Actuators

1. Electronic Direct-Coupled: Electronic direct-coupled actuation shall be provided.
2. Actuator Mounting: The actuator shall be direct-coupled over the shaft, enabling it to be mounted directly to the damper shaft without the need for connecting linkage. The fastening clamp assemble shall be of a 'V' bolt design with associated 'V' shaped toothed cradle attaching to the shaft for maximum strength and eliminating slippage. Spring return actuators shall have a 'V' clamp assembly of sufficient size to be directly mounted to an integral

jackshaft of up to 1.05 inches when the damper is constructed in this manner. Single bolt or screw type fasteners are not acceptable

3. Electronic Overload Sensing: The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the entire rotation of the actuator. Mechanical end switches or magnetic clutch to deactivate the actuator at the end of rotation are not acceptable.
4. Power Failure/Safety Applications: For power failure/safety applications, an internal mechanical spring return mechanism shall be built into the actuator housing. Non-mechanical forms of fail-safe operation are not acceptable.
5. Spring Return Actuators: All spring return actuators shall be capable of both clockwise or counterclockwise spring return operation by simply changing the mounting orientation.
6. Proportional Actuators: Proportional actuators shall accept a 0 to 10VDC or 0 to 20mA control input and provide a 2 to 10VDC or 4 to 20mA operating range. An actuator capable of accepting a pulse width modulating control signal and providing full proportional operation of the damper is acceptable. All actuators shall provide a 2 to 10VDC position feedback signal.
7. 24 Volts (AC/DC) actuators: All 24VAC/DC actuators shall operate on Class 2 wiring and shall not require more than 10VA for AC or more than 8 watts for DC applications. Actuators operating on 120VAC power shall not require more than 10VA. Actuators operating on 230VAC shall not require more than 11VA.
8. Non-Spring Return Actuators: All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 60 in-lb torque shall have a manual crank for this purpose.
9. Modulating Actuators: All modulating actuators shall have an external, built-in switch to allow reversing direction of rotation.
10. Conduit Fitting & Pre-Wiring: Actuators shall be provided with a conduit fitting and a minimum 3ft electrical cable, and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.
11. U.L. Listing: Actuators shall be Underwriters Laboratories Standard 873 listed and Canadian Standards Association Class 4813 02 certified as meeting correct safety requirements and recognized industry standards.
12. Warranty: Actuators shall be designed for a minimum of 60,000 full stroke cycles at the actuator's rated torque and shall have a 2-year manufacturer's warranty, starting from the date of installation. Manufacturer shall be ISO9001 certified.

I. Control Valves: Provide factory fabricated U.S. forged and assembled electric control valves of type, body material, and pressure class indicated. Where type or body material is not indicated, provide selection as determined by manufacturer for installation requirements and pressure class, based on maximum pressure and temperature in piping system. Provide valve size in accordance with scheduled or specified maximum pressure drop across control valve. Except as otherwise indicated, provide valves which mate and match material of connecting piping. Equip control valves with control valve motor actuators, with proper shutoff rating for each individual application.

1. Water Service Valves: Equal percentage characteristics with rangeability of 50 to 1, Class 150 at 250°F and maximum full flow pressure drop 5 psig. Globe type with replaceable plugs and seats of stainless steel or brass. Select operators to close valves against pump shutoff head.
2. Double Seated Valves: Balanced plug type, with caged type trim providing seating and guiding surfaces on “top and bottom” guided plugs.

3. Valve Trim and Stems: Polished stainless steel.
4. Packing: Spring-loaded teflon, self-adjusting.
5. Terminal Unit Control Valves: Provide control ball valves for control of terminal units including, but not necessarily limited to, convectors, thinned tube radiation, and fan coil - units that are of integral motor type. Provide 2-position or modulating type valves, electrically actuated by line voltage or by 24VAC.

J. Dampers: Provide automatic control low leakage, opposed blade dampers, with damper frames not less than formed 13-gauged galvanized steel. Provide mounting holes for enclosed duct mounting. Provide damper blades not less than formed 16-gauged galvanized steel, with maximum blade width of 8-inch. Equip dampers with motors of proper rating of each application.

1. Secure blades to ½ inch diameter zinc-plated axles using zinc-plated hardware. Seal off against spring stainless steel blade bearings. Provide blade bearings Nylon and provide thrust bearings at each end of every blade. Construct blade linkage hardware of zinc-plated steel and brass. Submit leakage and flow characteristics plus size schedule for controlled dampers.
2. Operating Temperature Range: From –20° to 200°F (-29° to 93°C).
3. For low leakage application or opposed blade design (as selected by manufacturers sizing techniques) with inflatable steel blade edging or replaceable rubber seals, rated for leakage less than 10 cfm per square foot of damper area, AR differential pressure of 4-inch w.g. when damper is being held by torque 50 inch-pounds.

PART 3 - EXECUTION

3.1 COORDINATION

A. Provide power from existing electrical distribution system as necessary for control system. Comply with the National Electrical Code.

3.2 INSTALLATION

A. Connect and configure equipment and software to achieve sequence of operation specified.

B. Verify location of exposed control sensors with architect prior to installation. Install devices 60 inches above the floor.

C. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

3.3 ELECTRICAL WIRING SCOPE

A. This contractor shall be responsible for power that is not shown on the electrical drawings, to controls furnished by this contractor. If power circuits are shown on the electrical drawings, this contractor shall continue the power run to the control device. If power circuits are not shown, this contractor shall coordinate with the electrical contractor to provide breakers at distribution panels for power to controls. This contractor is then responsible for power from the distribution panel.

1. Coordinate panel locations. If enclosures for panels are shown on the electrical drawings, furnish the enclosures according to the electrician’s installation schedule.

B. This contractor shall not be responsible for power to control panels and control devices that are furnished by others, unless it is part of the control interlock wiring.

C. Refer to Coordination section for what devices this contractor is responsible to mount and which are turned over to others to mount.

D. This contractor shall be responsible for wiring of any control device that is furnished as part of this section of specification.

E. Wiring for controls furnished by others:

1. Provide control wiring for HVAC controls furnished by others. Wiring may include, but not limited to, the following items:
    a. Thermostats
    b. Condensers
    c. Chiller control devices shipped loose
    d. Leak detectors
    e. Humidifier controls
    f. Refrigerant leak monitoring systems
    g. Exhaust or Purge fans
    h. Manual switches for HVAC equipment (not shown on electrical drawings)
    i. Emergency ventilation switches (not shown on electrical drawings)
    j. Emergency shutdown switches (not shown on electrical drawings)
2. Provide control wiring for the following non-HVAC controls furnished by others if they are called for in this project:
    a. Electrical vault fans
    b. Emergency generator dampers
    c. Water treatment
    d. Interlock to fire suppression system
    e. Leak detection system
    f. Fuel oil monitoring system
    g. Fuel oil fill system

F. Interlock wiring shall be run in separate conduits from BAS associated wiring.

G. Provide network wiring for equipment that is called to be integrated to the BAS.

3.4 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Install raceways, boxes, and cabinets according to Section 260533 "Raceways and Boxes for Electrical Systems."

B. Install building wire and cable according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Install signal and communication cable according to Section 271500 "Communications Horizontal Cabling."

1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
2. Install exposed cable in raceway.
3. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
4. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
5. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
6. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

D. Connect manual reset limit controls independent of manual control switch positions.

E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.5 COMMUNICATION WIRING

A. All cabling shall be installed in a neat and workmanlike manner. Follow manufacturer's installation recommendations for all communication cabling.

B. Do not install communication wiring in raceway and enclosures containing Class 1 wiring.

C. Maximum pulling, tension, and bend radius for cable installation, as specified by the cable manufacturer, shall not be exceeded during installation.

D. Contractor shall verify the integrity of the entire network following the cable installation. Use appropriate test measures for each particular cable.

E. Cable bundling:

1. RS485 cabling run open air in accessible areas can be bundled with other class 2 low voltage cabling.
2. RS485 cabling run between terminal units in conduits above ceilings or under floors or in inaccessible areas can be bundled with other class 2 low voltage cabling.
3. RS485 cabling run between floors shall be in a communication only conduit.
4. RS485 conduit run long distances between utility rooms or between buildings shall be in a communication only conduit.
5. Ethernet cabling shall be in a communication only conduit.
6. Ethernet and RS485 can be run together.
7. Fiber optics can be run with Ethernet and RS485 cabling as long as the conduit is bent to fiber optic standards and junction boxes are sized for fiber optic use.

F. FLN or BACnet BACnet MS/TP Cabling

1. RS485 cabling shall be used for BACnet MS/TP networks.
2. RS485 shall use low capacitance, 20-24 gauge, twisted shielded pair.
3. The shields shall be tied together at each device.
4. The shield shall be grounded at one end only and capped at the other end.
5. Provide end of line (EOL) termination devices at each end of the RS485 network or subnetwork run, to match the impedance of the cable, 100 to 120ohm.

G. Ethernet Cabling

1. Ethernet shall not be run with any Class 1 or low voltage Class 2 wiring.
2. CAT6, unshielded twisted pair (UTP) cable shall be used for BAS Ethernet.
3. Solid wire shall be used for long runs, between mechanical rooms and between floors. Stranded cable can be used for patch cables and between panels in the same mechanical room up to 50 feet away.
4. When the BAS Ethernet connects to an Owner's network switch, document the port number on the BAS As-builts.

H. When a cable enters or exits a building, a lightning arrestor must be installed between the lines and ground. The lighting arrestor shall be installed according to the manufacturer's instructions.

I. All runs of communication wiring shall be unspliced length when that length is commercially available.

J. All communication wiring shall be labeled to indicate origination and destination data.

K. Grounding of coaxial cable shall be in accordance with NEC regulations article on "Communications Circuits, Cable, and Protector Grounding."

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
2. Test and adjust controls and safeties.
3. Test each point through its full operating range to verify that safety and operating control set points are as required.
4. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
5. Test each system for compliance with sequence of operation.
6. Test software and hardware interlocks.

C. DDC Verification:

1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
2. Check instruments for proper location and accessibility.
3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
4. Check flow instruments. Inspect tag number and line and bore size and verify that inlet side is identified and that meters are installed correctly.
5. Check control valves. Verify that they are in correct direction.
6. Check DDC system as follows:
    a. Verify that wires at control panels are tagged with their service designation and approved tagging system.
    b. Verify that DDC controllers are protected from power supply surges.

D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.7 SYSTEM COMMISSIONING, DEMONSTRATION AND TURNOVER

A. The BAS Contractor shall prepare and submit for approval a complete acceptance test procedure including submittal data relevant to point index, functions, sequence, inter-locks, and associated parameters, and other pertinent information for the operating system. Prior to acceptance of the BAS by the Owner and Engineer, the BAS contractor shall completely test the BAS using the approved test procedure.

B. After the BAS contractor has completed the tests and certified the BAS is 100% complete, the Engineer shall be requested, in writing, to approve the satisfactory operation of the system, sub-systems and accessories. The BAS contractor shall submit Maintenance and Operating manuals at this time for approval. An acceptance test in the presence of the Engineer and Owner's representative shall be performed. The Owner will then shake down the system for a fixed period of time (30 days).

C. The BAS contractor shall fix punch list items within 30 days of acceptance.

D. When the system performance is deemed satisfactory in whole or in part by these observers, the system parts will be accepted for beneficial use and placed under warranty.

3.8 PROJECT RECORD DOCUMENTS

A. Project Record Documents: Submit three (3) copies of record (as-built) documents upon completion of installation. Submittal shall consist of:

1. Project Record Drawings. As-built versions of the submittal shop drawings provided as AutoCAD compatible files in electronic format and as 11 x 17 inch prints.
2. Testing and Commissioning Reports and Checklists. Completed versions of reports, checklists, and trend logs used to meet requirements in the Control System Demonstration and Acceptance section of this specification.
3. Operation and Maintenance (O & M) Manual.
    a. As-built versions of the submittal product data.
    b. Names, addresses, and 24-hour telephone numbers of installing contractors and service representatives for equipment and control systems.
    c. Operator’s Manual with procedures for operating control systems, logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing setpoints and variables.
    d. Programming manual or set of manuals with description of programming language and of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
    e. Engineering, installation, and maintenance manual or set of manuals that explains how to design and install new points, panels, and other hardware; how to perform preventive maintenance and calibration; how to debug hardware problems; and how to repair or replace hardware.
    f. Documentation of all programs created using custom programming language, including setpoints, tuning parameters, and object database.
    g. Graphic files, programs, and database on electronic media.
    h. List of recommended spare parts with part numbers and suppliers.

i. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware, including computer equipment and sensors.

j. Complete original original-issue copies of furnished software, including operating systems, custom programming language, operator workstation software, and graphics software.

k. Licenses, guarantees, and warranty documents for equipment and systems.

B. Operating manual to serve as training and reference manual for all aspects of day-to-day operation of the system. As a minimum include the following:

1. Sequence of operation for automatic and manual operating modes for all building systems. The sequences shall cross-reference the system point names.
2. Description of manual override operation of all control points in system.
3. BMS system manufacturers complete operating manuals.

C. Provide maintenance manual to serve as training and reference manual for all aspects of day-to-day maintenance and major system repairs. As a minimum include the following:

1. Complete as-built installation drawings for each building system.
2. Overall system electrical power supply schematic indicating source of electrical power for each system component. Indicate all battery backup provisions.
3. Photographs and/or drawings showing installation details and locations of equipment.
4. Routine preventive maintenance procedures, corrective diagnostics troubleshooting procedures, and calibration procedures.
5. Parts list with manufacturer's catalog numbers and ordering information.
6. Lists of ordinary and special tools, operating materials supplies, and test equipment recommended for operation and servicing.
7. Manufacturer's operation, set-up, maintenance and catalog literature for each piece of equipment.
8. Maintenance and repair instructions.
9. Recommended spare parts.

D. Provide Programming Manual to serve as training and reference manual for all aspects of system programming. As a minimum include the following:

1. Complete programming manuals, and reference guides.
2. Details of any custom software packages and compilers supplied with system.
3. Information and access required for independent programming of system.

3.9 TRAINING

A. During System commissioning and at such time as acceptable performance of the Building Automation System hardware and software has been established, the BAS contractor shall provide on-site operator instruction to the owner's operating personnel. Operator instruction during normal working hours shall be performed by a competent building automation contractor representative familiar with the Building Automation System's software, hardware and accessories.

B. At a time mutually agreed upon, during System commissioning as stated above, the BAS contractor shall give 16-hours of onsite training on the operation of all BAS equipment. Describe its intended use with respect to the programmed functions specified. Operator orientation of the automation system shall include, but not be limited to:

1. Explanation of drawings and operator’s maintenance manuals.

2. Walk-through of the job to locate all control components.
3. Operator workstation and peripherals.
4. DDC Controller and ASC operation/sequence.
5. Operator control functions including scheduling, alarming, and trending.
6. Explanation of adjustment, calibration and replacement procedures.

C. Additional 8-hours of training shall be given after the 30-day shakedown period.

D. Since the Owner may require personnel to have more comprehensive understanding of the hardware and software, additional training must be available from the Contractor. If the Owner requires such training, it will be contracted at a later date. Provide description of available local and factory customer training. Provide costs associated with performing training at an off-site classroom facility and detail what is included in the manufacturer's standard pricing such as transportation, meals, etc.

END OF SECTION 230900

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SECTION 230993 - SEQUENCE OF OPERATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes building automation monitoring and operating sequences for building systems and equipment as described herein.

1.2 DEFINITIONS

ADJ	Operator Adjustable
AI	Analog input.
AO	Analog Output.
DDC	Direct digital control.
DI	Digital input.
DO	Digital output.
EAT	Entering air temperature.
EWT	Entering water (fluid) temperature.
LAT	Leaving air temperature.
LWT	Leaving water (fluid) temperature.
OA	Outdoor air.
OAF	Outdoor Airflow (cfm)
OAT	Outdoor air temperature
VFD	Variable frequency drive.
WP	Water proof/weather resistant.

1.3 ACTION SUBMITTALS

A. Product Data:
   1. An instrumentation list for each controlled system. Label each element of the controlled system in table format. Show, in the table element name, type of device, manufacturer, model number, and control device product data sheet number.
   2. A complete description of the operation of the control system, including sequences of operation. Include and reference a schematic diagram of the controlled system.

B. Shop Drawings:
   1. Riser diagrams showing control network layout, communication protocol, and wire types.
   2. Schematic diagram of each controlled system. Include all control points labeled with point names shown or listed. Show the location of control elements in the system.

3. Wiring diagram for each controlled system. Show all control elements labels. Where a control element is the same as that shown on the control system schematic, label with the same name. Label all terminals.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 GENERAL:

A. Setpoints and schedules described in the operation of building systems shall be operator adjustable unless otherwise indicated.

B. Unless otherwise noted the space temperature setpoints for each system shall be as follows:

Operating Mode	**Space Temperature Setpoint**
Occupied Heating	70°F
Occupied Cooling	75°F
Unoccupied Heating	60°F
Unoccupied Cooling	85°F

C. Provide digital input from fire alarm system to indicate activation of system. Coordinate interface with the EC.

D. Data Log
1. BAS shall be able to trend all monitored values within a period of 1 year. The frequency of recording shall be adjustable from every 1 minute to 1 hour. The trends shall be able to be printed in the Microsoft Excel format with clearly defined headings.

3.2 VARIABLE REFRIGERANT FLOW SYSTEM AIR CONDITIONING

A. Provide factory installed and wired microprocessor based controls with split systems, interfaced with the BAS. Install any manufacturer supplied devices and provide any field supplied devices to complete this sequence of operation.

B. Provide BACnet communications interface. Controls are built into the units and shall communicate with the BAS. Display all available points on system graphic user interface.

C. Units shall operate in occupied or unoccupied as scheduled.

D. Occupied Mode: Indoor unit supply fan shall adjust speed and/or cycle as necessary via integral programming logic based on indoor conditions. Existing unit ventilator or energy recovery ventilator serving each space shall run continuously using the existing sequence of operations while split systems are in occupied mode.

1. Space Temperature Control:
   a. Air conditioner shall operate in cooling mode via integral control sequences as required to maintain space temperature setpoint.
   b. Space temperature setpoint shall be user adjustable from BAS.
      1) Cooling Setpoint = 75°F (adj.)
   c. Provide remote wall mounted thermostat with override capability and limited setpoint adjustment +/- 3°F.

E. Unoccupied Mode: Indoor and outdoor unit operation shall cycle integral control sequences as required to maintain unoccupied space temperature setpoint (default = 65°F (adj.) in heating mode and 80°F (adj.) in cooling mode).

F. Alarms:

1. Monitor and display air filter runtime. Generate filter change alarm when runtime reaches setpoint (default = 1,200 hours).
2. Low DAT (default = 40°F).
3. Low space temperature (default = 50°F).

G. Safety Controls:

1. On a signal from the respective fire alarm system the unit supply fan shall stop.

H. Point Summary (typ./each unit):

	Description	Type	Remarks
1.	Zone Temperature	AI	
2.	Zone Temperature Setpoint Adjust	AI	
3.	Supply Fan Start/Stop	DO	
4.	Supply Fan Status	AI	
5.	Supply Fan Speed	AO	
6.	Discharge Air Temperature	AI	
7.	Unit Status – Operating Mode	AI	

END OF SECTION 230993

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SECTION 232300 - REFRIGERANT PIPING

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. Refrigerant pipes and fittings.
2. Refrigerant piping valves and specialties.
3. Refrigerants.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of valve, refrigerant piping, and piping specialty.

1. Include pressure drop, based on manufacturer's test data, for the following:

a. Thermostatic expansion valves.
b. Solenoid valves.
c. Hot-gas bypass valves.
d. Filter dryers.
e. Strainers.
f. Pressure-regulating valves.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to 2010 ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.7 PRODUCT STORAGE AND HANDLING

A. Store piping with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R-410A:

1. Suction Lines for Air-Conditioning Applications: 300 psig
2. Suction Lines for Heat-Pump Applications: 535 psig
3. Hot-Gas and Liquid Lines: 535 psig

2.2 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 88, Type K or L.

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.

E. Brazing Filler Metals: AWS A5.8/A5.8M.

F. Flexible Connectors:

1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
2. End Connections: Socket ends.
3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-) long assembly.
4. Working Pressure Rating: Factory test at minimum 500 psig.
5. Maximum Operating Temperature: 250 deg F

2.3 VALVES AND SPECIALTIES

A. Diaphragm Packless Valves:
1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.

2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
3. Operator: Rising stem and hand wheel.
4. Seat: Nylon.
5. End Connections: Socket, union, or flanged.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 275 deg F

B. Packed-Angle Valves:
1. Body and Bonnet: Forged brass or cast bronze.
2. Packing: Molded stem, back seating, and replaceable under pressure.
3. Operator: Rising stem.
4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
5. Seal Cap: Forged-brass or valox hex cap.
6. End Connections: Socket, union, threaded, or flanged.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 275 deg F.

C. Check Valves:
1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
3. Piston: Removable polytetrafluoroethylene seat.
4. Closing Spring: Stainless steel.
5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
6. End Connections: Socket, union, threaded, or flanged.
7. Maximum Opening Pressure: 0.50 psig
8. Working Pressure Rating: 500 psig
9. Maximum Operating Temperature: 275 deg F

D. Service Valves:

1.
2. Body: Forged brass with brass cap including key end to remove core.
3. Core: Removable ball-type check valve with stainless-steel spring.
4. Seat: Polytetrafluoroethylene.
5. End Connections: Copper spring.
6. Working Pressure Rating: 500 psig

E. Solenoid Valves: Comply with AHRI 760 and UL 429; listed and labeled by a National Recognized Testing Laboratory (NRTL).
1. Body and Bonnet: Plated steel.
2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and 24-V ac coil.
6. Working Pressure Rating: 400 psig
7. Maximum Operating Temperature: 240 deg F

F. Safety Relief Valves: Comply with 2010 ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.

2. Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Working Pressure Rating: 400 psig
6. Maximum Operating Temperature: 240 deg F

G. Thermostatic Expansion Valves: Comply with AHRI 750.
1. Body, Bonnet, and Seal Cap: Forged brass or steel.
2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.
4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
5. Suction Temperature: 40 deg F
6. Superheat: Adjustable.
7. Reverse-flow option (for heat-pump applications).
8. End Connections: Socket, flare, or threaded union.
9. Working Pressure Rating: 700 psig.

H. Hot-Gas Bypass Valves: Comply with UL 429; listed and labeled by an NRTL.
1. Body, Bonnet, and Seal Cap: Ductile iron or steel.
2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.
4. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
5. Seat: Polytetrafluoroethylene.
6. Equalizer: Internal
7. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter and 24-V ac coil.
8. End Connections: Socket.
9. Throttling Range: Maximum 5 psig
10. Working Pressure Rating: 500 psig
11. Maximum Operating Temperature: 240 deg F

I. Straight-Type Strainers:
1. Body: Welded steel with corrosion-resistant coating.
2. Screen: 100-mesh stainless steel.
3. End Connections: Socket or flare.
4. Working Pressure Rating: 500 psig
5. Maximum Operating Temperature: 275 deg F

J. Angle-Type Strainers:
1. Body: Forged brass or cast bronze.
2. Drain Plug: Brass hex plug.
3. Screen: 100-mesh monel.
4. End Connections: Socket or flare.
5. Working Pressure Rating: 500 psig
6. Maximum Operating Temperature: 275 deg F

K. Moisture/Liquid Indicators:
1. Body: Forged brass.
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in parts per million (ppm).

4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig
7. Maximum Operating Temperature: 240 deg F

L. Replaceable-Core Filter Dryers: Comply with AHRI 730.
1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated charcoal
4. End Connections: Socket.
5. Access Ports: NPS ¼ connections at entering and leaving sides for pressure differential measurement.
6. Maximum Pressure Loss: 2 psig
7. Working Pressure Rating: 500 psig
8. Maximum Operating Temperature: 240 deg F

M. Permanent Filter Dryers: Comply with AHRI 730.
1. Body and Cover: Painted-steel shell.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated charcoal
4. End Connections: Socket.
5. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
6. Maximum Pressure Loss: 2 psig
7. Working Pressure Rating: 500 psig
8. Maximum Operating Temperature: 240 deg F

N. Mufflers:
1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or flare.
3. Working Pressure Rating: 500 psig
4. Maximum Operating Temperature: 275 deg F

O. Receivers: Comply with AHRI 495.
1. Comply with UL 207; listed and labeled by an NRTL.
2. Body: Welded steel with corrosion-resistant coating.
3. Tappings: Inlet, outlet, liquid level indicator, and safety relief valve.
4. End Connections: Socket or threaded.
5. Working Pressure Rating: 500 psig
6. Maximum Operating Temperature: 275 deg F

P. Liquid Accumulators: Comply with AHRI 495.
1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or threaded.
3. Working Pressure Rating: 500 psig
4. Maximum Operating Temperature: 275 deg F

2.4 REFRIGERANTS

A. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT R-410A

A. Suction Lines NPS 1-1/2 and Smaller: for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.

B. Hot-Gas and Liquid Lines:

1. NPS 5/8 and Smaller,: Copper, Type L, annealed- or drawn-temper tubing and wrought-copper fittings with brazed or solderedjoints.

C. Safety-Relief-Valve Discharge Piping:

1. NPS 5/8 and Smaller: Copper, Type L, annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
2. [

3.2 VALVE AND SPECIALTY APPLICATIONS

A. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.

B. Except as otherwise indicated, install diaphragm packless or packed-angle valves on inlet and outlet side of filter dryers.

C. Install a full-size, three-valve bypass around filter dryers.

D. Install thermostatic expansion valves as close as possible to distributors on evaporators.

1. Install valve so diaphragm case is warmer than bulb.
2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

E. Install safety relief valves where required by 2010 ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.

F. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

G. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for the device being protected:

1. Solenoid valves.
2. Thermostatic expansion valves.
3. Hot-gas bypass valves.
4. Compressor.

H. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.

I. Install receivers sized to accommodate pump-down charge.

J. Install flexible connectors at compressors.

3.3 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

B. Install refrigerant piping according to ASHRAE 15.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping adjacent to machines to allow service and maintenance.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 083113 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.

L. Install refrigerant piping in protective conduit where installed belowground.

M. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

N. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
2. Install horizontal suction lines with a uniform slope downward to compressor.
3. Install traps and double risers to entrain oil in vertical runs.
4. Liquid lines may be installed level.

O. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

P. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

Q. Identify refrigerant piping and valves according to Section 230553 "Identification for HVAC Piping and Equipment."

R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

3.4 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.

D. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."

1. Use Type BCuP (copper-phosphorus) alloy for joining copper socket fittings with copper pipe.
2. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze or steel.

F. Threaded Joints: Thread steel pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and to restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry-seal threading is specified.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Steel pipe can be threaded, but threaded joints must be seal brazed or seal welded.

H. Welded Joints: Construct joints according to AWS D10.12M/D10.12.

I. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.5 HANGERS AND SUPPORTS

A. Comply with requirements for pipe hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod diameters:

1. NPS 1/2: Maximum span, 60 inches; minimum rod, 1/4 inch.
2. NPS 5/8): Maximum span, 60 inches; minimum rod, 1/4 inch.

D. Support multifloor vertical runs at least at each floor.

3.6 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in "Performance Requirements" Article.

    a. Fill system with nitrogen to the required test pressure.
    b. System shall maintain test pressure at the manifold gage throughout duration of test.
    c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.

d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

B. Prepare test and inspection reports.

3.7 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
4. Charge system with a new filter-dryer core in charging line.

3.8 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:

1. Open shutoff valves in condenser water circuit.
2. Verify that compressor oil level is correct.
3. Open compressor suction and discharge valves.
4. Open refrigerant valves except bypass valves that are used for other purposes.
5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 232300

SECTION 233113 – DUCTWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Sealants and gaskets.
5. Hangers and supports.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.
3. Factory fabricated ducts and fittings.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Shop fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement type and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.

12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which ducts will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:
    a. Lighting fixtures.
    b. Air outlets and inlets.
    c. Speakers.
    d. Fire alarm devices.
    e. Sprinklers.
    f. Access panels.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver products to the Project Site and store in dry, covered and protected location. Do not store products outdoors.

B. Protect materials from rust both before and after installation. Ductwork and fittings shall be sealed from dirt and debris.

1.5 WARRANTY

A. All ductwork systems shall be constructed and erected in a first class workmanlike manner.

B. The Work shall be guaranteed for a period of one (1) year from the Project Substantial Completion date against noise, chatter, whistling, vibration, and free from pulsation under all conditions of operation. After the system is in operation, should these defects occur, they shall be corrected as directed by the Owner at Contractor’s expense.

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

a. Lindab Inc.

b. McGill AirFlow LLC.

c. SEMCO Incorporated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse joints in ducts larger than 30 inches diameter shall be flanged type.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for

static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.

2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.

D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.

2. Base: Synthetic rubber resin.

3. Solvent: Toluene and heptane.

4. Solids Content: Minimum 60 percent.

5. Shore A Hardness: Minimum 60.

6. Water resistant.

7. Mold and mildew resistant.

8. Maximum Static-Pressure Class: 10-inch wg, positive or negative.

9. Service: Indoor or outdoor.

C. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

E. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.5 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

K. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Penetration of the concrete slab is not permitted.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum interval of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 23 33 00.

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer.

3.7 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

B. Supply Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and similar terminal unit equipment less than 2,000 cfm capacity.

a. Pressure Class: Positive 2-inch wg.

b. Minimum SMACNA Seal Class: B.

2. Ducts Connected to Air-Handling Units:

a. Pressure Class: Positive 3-inch wg.

b. Minimum SMACNA Seal Class: A.

3. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive 2-inch wg.

b. Minimum SMACNA Seal Class: A.

C. Return Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and similar terminal unit equipment less than 2,000 cfm capacity.

a. Pressure Class: Positive or negative 2-inch wg.

b. Minimum SMACNA Seal Class: B.

2. Ducts Connected to Air-Handling Units:

a. Pressure Class: Positive or negative 2-inch wg.

b. Minimum SMACNA Seal Class: B.

3. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive or negative 2-inch wg.

b. Minimum SMACNA Seal Class: A.

D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:

a. Pressure Class: Negative 2-inch wg.

b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.

2. Ducts Connected to Air-Handling Units :

a. Pressure Class: Positive or negative 2-inch wg.

b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.

E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:

1. Ducts Connected to Air-Handling Units :

a. Pressure Class: Positive or negative 2-inch wg.

b. Minimum SMACNA Seal Class: A.

F. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Velocity 1000 fpm or Lower:

1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.

b. Velocity 1000 to 1500 fpm:

1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.

2) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

c. Velocity 1500 fpm or Higher:

1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.

2) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.

2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.

3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.

4) Radius-to Diameter Ratio: 1.5.

b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.

c. Round Elbows, 14 Inches and Larger in Diameter: Welded.

G. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

a. Rectangular Main to Rectangular Branch: 45-degree entry.

b. Rectangular Main to Round Branch: Spin in.

2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.

a. Velocity 1000 fpm or Lower: 90-degree tap.

b. Velocity 1000 to 1500 fpm: Conical tap.

c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 233113

SECTION 233713 - REGISTERS, GRILLES AND DIFFUSERS

PART 1 - GENERAL

1.1 SUMMARY

A. Scope of work is indicated by drawings and by requirements of this section.

1.2 ACTION SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for air outlets and inlets including the following:

1. Schedule of diffusers, registers, and grilles indicating drawing designation, room location, number furnished, model number, size, and accessories furnished.
2. Data sheet for each type of air outlet and inlet, and accessory furnished; indicating construction, finish, and mounting details.
3. Performance data for each type of air outlet and inlet furnished, including aspiration ability, temperature and velocity traverses, throw and drop, and noise criteria ratings. Indicate selections on data.

B. Samples: When requested by the Engineer, submit one (1) sample of each diffuser, register and grille specified. Samples will not be returned.

1.3 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide registers, grilles and diffusers from the following list of approved manufacturers:

1. Metalaire.
2. Nailor.
3. Price.
4. Titus.

B. Substitutions: Prior approval required as indicated under the general and/or supplemental conditions of these specifications.

2.2 GENERAL

A. Provide registers, grilles and diffusers having capacities, characteristics and accessories as indicated on the Drawings and specified in this Section.

B. Provide registers, grilles and diffusers having border types and mounting characteristics compatible with ceiling, wall and floor construction. Refer to Architectural Drawings for materials and methods of construction.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

3.2 INSTALLATION

A. Unless otherwise shown or specified, install the Work of this section in accordance with the manufacturer's printed installation instructions and applicable SMACNA Standards.

B. Visible ductwork behind registers shall be painted using one coat of flat black metal paint after proper cleaning.

C. Install diffusers, registers, and grilles level and plumb.

D. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

E. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

SECTION 238129 – VARIABLE-REFRIGERANT-FLOW HVAC 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. Section includes complete VRF HVAC system(s) including, but not limited to the following components to make a complete operating system(s) according to requirements indicated:

1. Indoor, concealed, ceiling-mounted units for ducting.
2. Indoor, recessed, ceiling-mounted units.
3. Indoor, exposed, wall-mounted units.
4. Outdoor, air-source, heat-pump units.
5. System controls.
6. System refrigerant and oil.
7. System control cable and raceways.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for indoor and outdoor units.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
3. Include operating performance at design conditions and at extreme maximum and minimum outdoor ambient conditions.
4. Include description of system controllers, dimensions, features, control interfaces and connections, power requirements, and connections.
5. Include system operating sequence of operation in narrative form for each unique indoor- and outdoor-unit control.
6. Include description of control software features.
7. Include total refrigerant required and a comprehensive breakdown of refrigerant required by each system installed.
8. Include refrigerant type and data sheets showing compliance with requirements indicated.
9. For system design software.
10. Indicate location and type of service access.

B. Shop Drawings: For VRF HVAC systems.

1. Include plans, elevations, sections, and mounting details.

2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams and details of refrigerant piping and tubing showing installation requirements for manufacturer-furnished divided flow fittings.
4. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data:

1. For Installer: Certificate from VRF HVAC system manufacturer certifying that Installer has successfully completed prerequisite training administered by manufacturer for proper installation of systems, including but not limited to, equipment, piping, controls, and accessories indicated and furnished for installation.

    a. Retain copies of Installer certificates on-site and make available on request.

2. For VRF HVAC system manufacturer.
3. For VRF HVAC system provider.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For VRF HVAC systems to include in emergency, operation, and maintenance manuals.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store products in a clean and dry place.

B. Comply with manufacturer's written rigging and installation instructions for unloading and moving to final installed location.

C. Handle products carefully to prevent damage, breaking, denting, and scoring. Do not install damaged products.

D. Protect products from weather, dirt, dust, water, construction debris, and physical damage.

1. Retain factory-applied coverings on equipment to protect finishes during construction and remove just prior to operating unit.
2. Cover unit openings before installation to prevent dirt and dust from entering inside of units. If required to remover coverings during unit installation, reapply coverings over openings after unit installation and remove just prior to operating unit.

E. Replace installed products damaged during construction.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace equipment and components that fail(s) in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures.
b. Faulty operation.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period:

a. For Compressor: Seven year(s) from date of Substantial Completion.
b. For Parts, Including Controls: 10 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hitachi. (Basis of Design)
2. Samsung HVAC.
3. Daikin.

2.2 SYSTEM DESCRIPTION

A. Direct-expansion (DX) VRF HVAC system(s) with variable capacity in response to varying cooling and heating loads. System shall consist of multiple indoor units, outdoor unit(s), piping, controls, and electrical power to make complete operating system(s) complying with requirements indicated.

1. System(s) operation, heat pump as indicated on Drawings.
2. Each system with one refrigerant circuit shared by all indoor units connected to system.

B. 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.

C. AHRI Compliance: System and equipment performance certified according to AHRI 1230 and products listed in AHRI directory.

D. ASHRAE Compliance:

1. ASHRAE/IES 90.1 Compliance: For system and component energy efficiency.

E. UL Compliance: Comply with UL 1995.

2.3 INDOOR, CONCEALED, CEILING-MOUNTED UNITS FOR DUCTING

A. Description: Factory-assembled complete unit with components, piping, wiring, and controls required for mating to ductwork, piping, power, and controls field connections.

B. Cabinet:

1. Material: Galvanized or painted steel.
2. Insulation: Manufacturer's standard internal insulation, complying with ASHRAE 62.1, to provide thermal resistance and prevent condensation.
3. Duct Connections: Extended collar or flange, or designated exterior cabinet surface, designed for attaching field-installed ductwork.
4. Mounting: Manufacturer-designed provisions for field installation.
5. Internal Access: Removable panels or hinged doors of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

C. DX Coil Assembly:

1. Coil Casing: Aluminum, galvanized, or stainless steel.
2. Coil Fins: Aluminum, mechanically bonded to tubes, with arrangement required by performance.
3. Coil Tubes: Copper, of diameter and thickness required by performance.
4. Expansion Valve: Electronic modulating type with linear or proportional characteristics.
5. Unit Internal Tubing: Copper tubing with brazed joints.
6. Unit Internal Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
7. Field Piping Connections: Manufacturer's standard.
8. Factory Charge: Dehydrated air or nitrogen.
9. Testing: Factory pressure tested and verified to be without leaks.

D. Drain Assembly:

1. Pan: Non-ferrous material, with bottom sloped to low point drain connection.
2. Condensate Removal: Unit-mounted pump or other integral lifting mechanism, capable of lifting drain water to an elevation above top of cabinet.
3. Field Piping Connection: Non-ferrous material with threaded NPT.

E. Fan and Motor Assembly:

1. Fan(s):

a. Direct-drive arrangement.
b. Single or multiple fans connected to a common motor shaft and driven by a single motor.
c. Fabricated from non-ferrous components or ferrous components with corrosion-resistant finish.
d. Wheels statically and dynamically balanced.

2. Motor: Brushless dc or electronically commutated with permanently lubricated bearings.
3. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.

4. Speed Settings and Control: Two (low, high), three (low, medium, high), or more than three speed settings or variable speed with a speed range of least 50 percent.
5. Vibration Control: Integral isolation to dampen vibration transmission.

F. Filter Assembly:

1. Access: Bottom, side, or rear to accommodate field installation without removing ductwork and to accommodate filter replacement without need for tools.
2. Efficiency: ASHRAE 52.2, MERV 13
3. Media:

a. Replaceable: Extended surface, panel, or cartridge with antimicrobial treatment fiber media.

G. Unit Controls:

1. Enclosure: Manufacturer's standard, and suitable for indoor locations.
2. Field-Installed Controller: Hardwired.
3. Features and Functions: Self-diagnostics, time delay, auto-restart, auto operation mode, manual operation mode, filter service notification.
4. Communication: Network communication with other indoor units and outdoor unit(s).

H. Unit Electrical:

1. Enclosure: Metal, suitable for indoor locations.
2. Field Connection: Single point connection to power unit and integral controls.
3. Disconnecting Means: Factory-mounted circuit breaker or switch.
4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
6. Raceways: Enclose line voltage wiring in metal raceways.

2.4 INDOOR, RECESSED, CEILING-MOUNTED UNITS

A. Description: Factory-assembled complete unit with components, piping, wiring, and controls required for mating to ductwork, piping, power, and controls field connections.

B. Cabinet:

1. Material: Painted steel, or coated steel frame covered by a plastic cabinet, with an architectural acceptable finish suitable for tenant occupancy on exposed surfaces.
2. Insulation: Manufacturer's standard internal insulation, complying with ASHRAE 62.1, to provide thermal resistance and prevent condensation.
3. Mounting: Manufacturer-designed provisions for field installation.
4. Internal Access: Removable panels of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

C. DX Coil Assembly:

1. Coil Casing: Aluminum, galvanized, or stainless steel.
2. Coil Fins: Aluminum, mechanically bonded to tubes, with arrangement required by performance.
3. Coil Tubes: Copper, of diameter and thickness required by performance.
4. Expansion Valve: Electronic modulating type with linear or proportional characteristics.
5. Internal Tubing: Copper tubing with brazed joints.
6. Internal Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
7. Field Piping Connections: Manufacturer's standard.
8. Factory Charge: Dehydrated air or nitrogen.
9. Testing: Factory pressure tested and verified to be without leaks.

D. Drain Assembly:

1. Pan: Non-ferrous material, with bottom sloped to low point drain connection.
2. Condensate Removal: Unit-mounted pump or other integral lifting mechanism, capable of lifting drain water to an elevation above top of cabinet.
3. Field Piping Connection: Non-ferrous material with threaded NPT.

E. Fan and Motor Assembly:

1. Fan(s):

    a. Direct-drive arrangement.
    b. Single or multiple fans connected to a common motor shaft and driven by a single motor.
    c. Fabricated from non-ferrous components or ferrous components with corrosion protection finish.
    d. Wheels statically and dynamically balanced.

2. Motor: Brushless dc or electronically commutated with permanently lubricated bearings.
3. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
4. Speed Settings and Control: Two (low, high), three (low, medium, high), or more than three speed settings or variable speed with a speed range of least 50 percent.
5. Vibration Control: Integral isolation to dampen vibration transmission.

F. Filter Assembly:

1. Access: Bottom, to accommodate filter replacement without the need for tools.
2. Media:

    a. Replaceable: Extended surface, panel, or cartridge with antimicrobial treatment fiber media.
    b. Washable: Manufacturer's standard filter with antimicrobial treatment.

G. Discharge-Air Grille Assembly: Mounted in bottom of unit cabinet.

1. Discharge Pattern: One-, two-, three-, or four-way throw as indicated on Drawings.

    a. Discharge Pattern Adjustment: Field-adjustable limits for up and down range of motion.

b. Discharge Pattern Closure: Ability to close individual discharges of units with multiple patterns.

2. Motorized Vanes: Modulating up and down flow pattern for uniform room air distribution.

H. Return-Air Grille Assembly: Manufacturer's standard grille mounted in bottom of unit cabinet.

I. Outdoor Air Ventilation Connection: Sheet metal knockout for optional connection to outdoor air ventilation duct.

J. Unit Accessories:

1. Remote Controller: Wall-mounted, hardwired remote controller.
2. Condensate Pump: Integral reservoir and control with electrical power connection through unit power.

K. Unit Controls:

1. Enclosure: Manufacturer's standard, and suitable for indoor locations.
2. Field-Installed Controller: Hardwired.
3. Features and Functions: Self-diagnostics, time delay, auto-restart, auto operation mode, manual operation mode, filter service notification.
4. Communication: Network communication with other indoor units and outdoor unit(s).

L. Unit Electrical:

1. Enclosure: Manufacturer's standard, and suitable for indoor locations.
2. Field Connection: Single point connection to power entire unit and integral controls.
3. Disconnecting Means: Field installed disconnect switch furnished and installed by Electrical Contractor.
4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
5. Raceways: Enclose line voltage wiring in raceways to comply with NFPA 70.

2.5 INDOOR, EXPOSED, WALL-MOUNTED UNITS

A. Description: Factory-assembled complete unit with components, piping, wiring, and controls required for mating to piping, power, and controls field connections.

B. Cabinet:

1. Material: Painted steel, or coated steel frame covered by a plastic cabinet, with an architectural acceptable finish suitable for tenant occupancy on exposed surfaces.
2. Insulation: Manufacturer's standard internal insulation, complying with ASHRAE 62.1, to provide thermal resistance and prevent condensation.
3. Mounting: Manufacturer-designed provisions for field installation.
4. Internal Access: Removable panels of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

C. DX Coil Assembly:

1. Coil Casing: Aluminum, galvanized, or stainless steel.
2. Coil Fins: Aluminum, mechanically bonded to tubes, with arrangement required by performance.
3. Coil Tubes: Copper, of diameter and thickness required by performance.
4. Expansion Valve: Electronic modulating type with linear or proportional characteristics.
5. Unit Internal Tubing: Copper tubing with brazed joints.
6. Unit Internal Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
7. Field Piping Connections: Manufacturer's standard.
8. Factory Charge: Dehydrated air or nitrogen.
9. Testing: Factory pressure tested and verified to be without leaks.

D. Drain Assembly:

1. Pan: Non-ferrous material, with bottom sloped to low point drain connection.
2. Condensate Removal: Gravity.

    a. If a floor drain is not available at unit, provide unit with field-installed condensate pump accessory.

3. Field Piping Connection: Non-ferrous material with threaded NPT.

E. Fan and Motor Assembly:

1. Fan(s):

    a. Direct-drive arrangement.
    b. Single or multiple fans connected to a common motor shaft and driven by a single motor.
    c. Fabricated from non-ferrous components or ferrous components with corrosion protection finish.
    d. Wheels statically and dynamically balanced.

2. Motor: Brushless dc or electronically commutated with permanently lubricated bearings.
3. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
4. Speed Settings and Control: Two (low, high), three (low, medium, high), or more than three speed settings or variable speed with a speed range of least 50 percent.
5. Vibration Control: Integral isolation to dampen vibration transmission.

F. Filter Assembly:

1. Access: Front, to accommodate filter replacement without the need for tools.
2. Washable Media: Manufacturer's standard filter with antimicrobial treatment.

G. Grille Assembly: Manufacturer's standard discharge grille with field-adjustable air pattern mounted in top or front face of unit cabinet.

H. Unit Accessories:

1. Remote Room Temperature Sensor Kit: Wall-mounted, hardwired room temperature sensor kit for use in rooms that do not have room temperature measurement.

2. Condensate Pump: Integral reservoir and control with electrical power connection through unit power.

I. Unit Controls:

1. Enclosure: Manufacturer's standard, and suitable for indoor locations.
2. Field-Installed Controller: Hardwired.
3. Features and Functions: Self-diagnostics, time delay, auto-restart, auto operation mode, manual operation mode, filter service notification.
4. Communication: Network communication with other indoor units and outdoor unit(s).

J. Unit Electrical:

1. Enclosure: Manufacturer's standard, and suitable for indoor locations.
2. Field Connection: Single point connection to power entire unit and integral controls.
3. Disconnecting Means: Factory-mounted circuit breaker or switch, complying with NFPA 70.
4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
6. Raceways: Enclose line voltage wiring in metal raceways to comply with NFPA 70.

2.6 OUTDOOR, AIR-SOURCE HEAT-PUMP UNITS

A. Description: Factory-assembled and -tested complete unit with components, piping, wiring, and controls required for mating to piping, power, and controls field connections.

1. Specially designed for use in systems with either all heating or all cooling demands, but not for use in systems with simultaneous heating and cooling.
2. Systems shall consist of one unit, or multiple unit modules that are designed by variable refrigerant system manufacturer for field interconnection to make a single refrigeration circuit that connects multiple indoor units.
3. All units installed shall be from the same product development generation.

B. Cabinet:

1. Galvanized steel and coated with a corrosion-resistant finish.
2. Mounting: Manufacturer-designed provisions for field installation.
3. Internal Access: Removable panels or hinged doors of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

C. Compressor and Motor Assembly:

1. One or more positive-displacement, direct-drive and hermetically sealed scroll compressor(s) with inverter drive and turndown to 15 percent of rated capacity or lower.
2. Speed Control: Variable to automatically maintain refrigerant suction and condensing pressures while varying refrigerant flow to satisfy system cooling and heating loads.
3. Vibration Control: Integral isolation to dampen vibration transmission.
4. Oil management system to ensure safe and proper lubrication over entire operating range.

5. Crankcase heaters with integral control to maintain safe operating temperature.
6. Fusible plug.

D. Condenser Coil Assembly:

1. Plate Fin Coils:

a. Casing: Aluminum, galvanized, or stainless steel.
b. Fins: Aluminum or copper, mechanically bonded to tubes, with arrangement required by performance.
c. Tubes: Copper, of diameter and thickness required by performance.

E. Condenser Fan and Motor Assembly:

1. Fan(s): Propeller type.

a. Direct-drive arrangement.
b. Fabricated from non-ferrous components or ferrous components with corrosion protection finish to match performance indicated for condenser coil.
c. Statically and dynamically balanced.

2. Fan Guards: Removable safety guards complying with OSHA regulations. If using metal materials, coat with corrosion-resistant coating to match performance indicated for condenser coil.
3. Motor(s): Brushless dc or electronically commutated with permanently lubricated bearings and rated for outdoor duty.
4. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
5. Speed Settings and Control: Variable speed with a speed range of least 75 percent.
6. Vibration Control: Integral isolation to dampen vibration transmission.

F. Drain Pan: If required by manufacturer's design, provide unit with non-ferrous drain pan with bottom sloped to a low point drain connection.

G. Unit Controls:

1. Enclosure: Manufacturer's standard, and suitable for unprotected outdoor locations.
2. Field Installed Controller: Hardwired.
3. Features and Functions: Self-diagnostics, time delay, auto-restart, auto operation mode, manual operation mode, filter service notification.
4. Communication: Network communication with indoor units and other outdoor unit(s).

H. Unit Electrical:

1. Enclosure: Metal, similar to enclosure, and suitable for unprotected outdoor locations.
2. Field Connection: Single point connection to power entire unit and integral controls.
3. Disconnecting Means: Field installed disconnect switch furnished and installed by Electrical Contractor.
4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
5. Raceways: Enclose line voltage wiring in raceways to comply with NFPA 70.

I. Unit Hardware: Zinc-plated steel, or stainless steel.

J. Unit Piping:

1. Unit Tubing: Copper tubing with brazed joints.
2. Unit Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
3. Field Piping Connections: Manufacturer's standard.
4. Factory Charge: Dehydrated air or nitrogen.
5. Testing: Factory pressure tested and verified to be without leaks.

2.7 SYSTEM CONTROLS

A. General Requirements:

1. Network: Indoor units and outdoor units shall include integral controls and connect through a TIA-485A control network.
2. Network Communication Protocol: Open control communication between interconnected units.
3. Integration with Building Automation System: ASHRAE 135, BACnet IP and certified by BACnet Testing Lab (BTL), including the following:

    a. Ethernet connection via RJ-45 connectors and port with transmission at 100 Mbps or higher.

B. Central Controllers:

1. Centralized control for all indoor and outdoor units from a single central controller location.

    a. Include multiple interconnected controllers as required.

2. Controls operation mode of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units. Operation modes available through central controller shall match those operation modes of controllers for indoor units.
3. Schedule operation of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units.

    a. Sets schedule for daily, weekly, and annual events.
    b. Schedule options available through central controller shall at least include the schedule options of controllers for indoor units.

4. Changes operating set points of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units.
5. Optimized start feature to start indoor units before scheduled time to reach temperature set-point at scheduled time based on operating history.
6. Night setback feature to operate indoor units at energy-conserving heating and cooling temperature set-points during unoccupied periods.
7. Service diagnostics tool.
8. Able to disable and enable operation of individual controllers for indoor units.

9. Information displayed on individual controllers shall also be available for display through central controller.
10. Information displayed for outdoor units, including refrigerant high and low pressures.
11. Multiple RJ-45 ports for direct connection to a local PC and an Ethernet network switch.
12. Operator interface through a backlit, high-resolution color display touch panel and web accessible through standard web browser software.

C. Wired Controllers for Indoor Units:

1. Single controller capable of controlling multiple indoor units as group.
2. Auto Timeout Touch Screen LCD: Timeout duration shall be adjustable.
3. Temperature Units: Fahrenheit.
4. On/Off: Turns indoor unit on or off.
5. Hold: Hold operation settings until hold is released.
6. Operation Mode: Cool, Heat, Auto, Dehumidification, Fan Only, and Setback.
7. Temperature Display: 1-degree increments.
8. Temperature Set-Point: Separate set points for Cooling, Heating, and Setback. Adjustable in 1-degree increments.
9. Relative Humidity Display: 1 percent increments.
10. Relative Humidity Set-Point: Adjustable in 1 percent increments.
11. Fan Speed Setting: Select between available options furnished with the unit.
12. Airflow Direction Setting: If applicable to unit, select between available options furnished with the unit.
13. Seven-day programmable operating schedule with up to five events per day. Operations shall include On/Off, Operation Mode, and Temperature Set-Point.
14. Auto Off Timer: Operates unit for an adjustable time duration and then turns unit off.
15. Occupancy detection.
16. Service Notification Display: "Filter"
17. Service Run Tests: Limit use by service personnel to troubleshoot operation.
18. Error Code Notification Display: Used by service personnel to troubleshoot abnormal operation and equipment failure.
19. User and Service Passwords: Capable of preventing adjustments by unauthorized users.
20. Setting stored in nonvolatile memory to ensure that settings are not lost if power is lost. Battery backup for date and time only.
21. Low-voltage power required for controller shall be powered through non-polar connections to indoor unit.

2.8 SYSTEM REFRIGERANT AND OIL

A. Refrigerant:

1. As required by VRF HVAC system manufacturer for system to comply with performance requirements indicated.
2. ASHRAE 34, Class A1 refrigerant classification.
3. R-410a.

B. Oil:

1. As required by VRF HVAC system manufacturer and to comply with performance requirements indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine products before installation. Reject products that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for piping and tubing to verify actual locations of connections before equipment installation.

D. Examine roughing-in for wiring and conduit to verify actual locations of connections before equipment installation.

E. Examine walls, floors, roofs, and outdoor pads for suitable conditions where equipment will be installed.

F. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

G. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION, GENERAL

A. Clearance:

1. Maintain manufacturer's recommended clearances for service and maintenance.
2. Maintain clearances required by governing code.

B. Loose Components: Install components, devices, and accessories furnished by manufacturer, with equipment, that are not factory mounted.

1. Loose components shall be installed by system Installer under supervision of manufacturer's service representative.

3.3 INSTALLATION OF INDOOR UNITS

A. Install units to be level and plumb while providing a neat and finished appearance.

B. Unless otherwise required by VRF HVAC system manufacturer, support ceiling-mounted units from structure above using threaded rods; minimum rod size of 3/8 inch.

C. Adjust supports of exposed and recessed units to draw units tight to adjoining surfaces.

D. Protect finished surfaces of ceilings, floors, and walls that come in direct contact with units. Refinish or replaced damaged areas after units are installed.

E. In rooms with ceilings, conceal piping and tubing, controls, and electrical power serving units above ceilings.

F. In rooms without ceiling, arrange piping and tubing, controls, and electrical power serving units to provide a neat and finished appearance.

G. Provide lateral bracing if needed to limit movement of suspended units to not more than 0.25 inch.

H. For wall-mounted units that are exposed, conceal piping and tubing, controls, and electrical power serving units within walls.

I. Attachment: Install hardware for proper attachment to supported equipment.

3.4 INSTALLATION OF OUTDOOR UNITS

A. Install units to be level and plumb while providing a neat and finished appearance.

B. Install outdoor units on support structures indicated on Drawings.

C. Roof-Mounted Installations: Install outdoor units on equipment supports typical of nVent CADDY Pyramid or acceptable equal. Anchor units to supports with removable, stainless-steel fasteners.

3.5 GENERAL REQUIREMENTS FOR PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping and tubing systems. Install piping and tubing as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping and tubing in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping and tubing at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping and tubing above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping and tubing to permit valve servicing.

F. Install piping and tubing at indicated slopes.

G. Install piping and tubing free of sags.

H. Install fittings for changes in direction and branch connections.

I. Install piping and tubing to allow application of insulation.

J. Install groups of pipes and tubing parallel to each other, spaced to permit applying insulation with service access between insulated piping and tubing.

K. Install sleeves for piping and tubing penetrations of walls, ceilings, and floors.

L. Install escutcheons for piping and tubing penetrations of walls, ceilings, and floors.

3.6 INSTALLATION OF SYSTEM CONDENSATE DRAIN PIPING

A. General Requirements for Drain Piping and Tubing:

1. Install a union in piping at each threaded unit connection.
2. Install an adjustable stainless-steel hose clamp with adjustable gear operator on unit hose connections. Tighten clamp to provide a leak-free installation.
3. If required for unit installation, provide a trap assembly in drain piping to prevent air circulated through unit from passing through drain piping. Comply with more stringent of the following:

    a. Details indicated on Drawings.
    b. Manufacturer's requirements.
    c. Governing codes.
    d. In the absence of requirements, comply with requirements of ASHRAE handbooks.

4. Extend drain piping from units with drain connections to drain receptors as indicated on Drawings. If not indicated on Drawings, terminate drain connection at nearest accessible location that is not exposed to view by occupants.
5. Provide each 90-degree change in direction with a Y- or T-fitting. Install a threaded plug connection in the dormant side of fitting or future use as a service cleanout.

B. Pumped Drains:

1. If unit condensate pump or lift mechanism is not included with an integral check valve, install a full-size check valve in each branch pipe near unit connection to prevent backflow into unit.

3.7 ELECTRICAL INSTALLATION

A. Comply with requirements indicated on Drawings and in applicable Division 26 Sections.

B. Connect field electrical power source to each separate electrical device requiring field electrical power. Coordinate termination point and connection type with Installer.

C. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

D. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems" for grounding connections.

E. Install nameplate or acrylic label with self-adhesive back for each electrical connection indicating electrical equipment designation and circuit number feeding connection.

1. Nameplate shall be laminated phenolic layers of black with engraved white letters. Letters at least 1/2 inch high.
2. Locate nameplate or label where easily visible.

F. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for raceway selection and installation requirements for boxes, conduits, and wireways as supplemented or revised in this Section.

G. Install manufactured conduit sweeps and long-radius elbows if possible.

H. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

3.8 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage VRF HVAC system manufacturer's service representative to advise and assist installers; witness testing; and observe and inspect components, assemblies, and equipment installations, including controls and connections.

1. Field service shall be performed by a factory-trained and -authorized service representative of VRF HVAC system manufacturer whose primary job responsibilities are to provide direct technical support of its products.

B. Perform the following tests and inspections with the assistance of manufacturer's service representative:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Refrigerant Tubing Positive Pressure Testing:

1. Comply with more stringent of VRF HVAC system manufacturer's requirements and requirements indicated.
2. After completion of tubing installation, pressurize tubing systems to a test pressure of not less than 1.2 times VRF HVAC system operating pressure, but not less than 600 psig, using dry nitrogen.
3. Successful testing shall maintain a test pressure for a continuous and uninterrupted period of 1 hour. Allowance for pressure changes attributed to changes in ambient temperature are acceptable.
4. Submit test reports for Project record.

D. Refrigerant Tubing Evacuation Testing:

1. Comply with more stringent of VRF HVAC system manufacturer's requirements and requirements indicated.
2. After completion of tubing positive-pressure testing, evacuate tubing systems to a pressure of 500 microns.
3. Successful testing shall maintain a test pressure for a continuous and uninterrupted period of one hour(s) with no change.
4. Submit test reports for Project record.
5. Upon successful completion of evacuation testing, system shall be charged with refrigerant.

E. System Refrigerant Charge:

1. Using information collected from the refrigerant tubing evacuation testing, system Installer shall consult variable refrigerant system manufacturer to determine the correct system refrigerant charge.
2. Installer shall charge system following VRF HVAC system manufacturer's written instructions.
3. System refrigerant charging shall be witnessed by system manufacturer's representative.
4. Total refrigerant charge shall be recorded and permanently displayed at the system's outdoor unit.

F. Products will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports.

3.9 STARTUP SERVICE

A. Engage a VRF HVAC system manufacturer's service representative to perform system(s) startup service.

1. Service representative shall be an employee or a factory-trained and -authorized service representative of VRF HVAC system manufacturer.
2. Complete startup service of each separate system.
3. Complete system startup service according to manufacturer's written instructions.

B. Installer shall accompany manufacturer's service representative during startup service and provide manufacturer's service representative with requested documentation and technical support during startup service.

1. Installer shall correct deficiencies found during startup service for reverification.

C. System Operation Report:

1. After completion of startup service, manufacturer shall issue a report for each separate system.
2. Report shall include complete documentation describing each startup check, the result, and any corrective action required.

3.10 ADJUSTING

A. Adjust equipment and components to function smoothly and lubricate as recommended by manufacturer.

B. Adjust initial temperature and humidity set points. Adjust initial airflow settings and discharge airflow patterns.

C. Set field-adjustable switches and circuit-breaker trip ranges according to VRF HVAC system manufacturer's written instructions, and as indicated.

D. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.11 PROTECTION

A. Protect products from moisture and water damage. Remove and replace products that are wet, moisture damaged, or mold damaged.

B. Protect equipment from physical damage. Replace equipment with physical damage that cannot be repaired to new condition. Observable surface imperfections shall be grounds for removal and replacement.

C. Protect equipment from electrical damage. Replace equipment suffering electrical damage.

D. Cover and seal openings of equipment to keep inside of equipment clean. Do not remove covers until finish work is complete.

3.12 DEMONSTRATION

A. Engage a VRF HVAC system manufacturer's factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain entire system.

B. Schedule and Duration:

1. Schedule training with Owner at least 10 business days before first training session.
2. Training shall be held at mutually agreed date and time during normal business hours.

C. Location: Owner shall provide a suitable on-site location to host classroom training.

D. Training Materials: Provide training materials in electronic format to each attendee.

1. Include instructional videos showing general operation and maintenance that are coordinated with operation and maintenance manuals.
2. Video record each classroom training session and submit an electronic copy to Owner before requesting Owner acceptance of training.

E. Acceptance: Obtain Owner written acceptance that training is complete, and requirements indicated have been satisfied.

END OF SECTION 238129

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SECTION 260500 – GENERAL ELECTRICAL REQUIREMENTS

PART 1 – GENERAL

1.1 SUMMARY

A. The General and Supplementary Conditions are a part of the requirements for the work under this Division of the Specifications.

1.2 WORK INCLUDED

A. Provide labor and materials required to install, test and place into operation the electrical systems as called for in the Contract Documents, and in accordance with applicable codes and regulations.

B. Provide labor, materials, and accessories required to provide complete, operating electrical systems. Labor, materials, or accessories not specifically called for in the Contract Documents, but required to provide complete, operating electrical systems shall be provided without additional cost to the Owner.

1.3 QUALITY ASSURANCE

A. Comply with the current applicable codes, ordinances, and regulations of the Authority or Authorities Having Jurisdiction, the rules, regulations and requirements of the utility companies serving the project, and the Owner’s insurance underwriter.

B. Drawings, specifications, codes and standards are minimum requirements. Where requirements differ, the most stringent apply.

C. Should any change in drawings or specifications be required to comply with governing regulations, notify the Engineer prior to submitting bid.

D. All electrical equipment, materials, devices and installations shall meet or exceed minimum requirements of ADA, ANSI, ASTM, IEEE, IES, NEC, NEMA, NETA, NFPA, OSHA, SMACNA, UL, and the State Fire Marshal.

E. Execute work in strict accordance with the best practices of the trades in a thorough, substantial, workperson-like manner by competent workpeople. Provide a competent, experienced, full-time Superintendent who is authorized to make decisions on behalf of the Contractor.

F. Equipment shall be certified for use in the state of New York and shall meet the New York State energy code.

1.4 ABBREVIATIONS AND DEFINITIONS

A. Abbreviations:

1.	ADA	Americans with Disabilities Act
2.	ANSI	American National Standards Institute
3.	ASA	Acoustical Society of America
4.	ASTM	American Society for Testing and Materials
5.	BIL	Basic Impulse Level
6.	CBM	Certified Ballast Manufacturers
7.	ECC	Engineer's Control Center
8.	EIA	Electronic Industries Alliance
9.	ETL	Electrical Testing Laboratories, Inc.
10.	FCC	Fire Control Center
11.	FM	Factory Mutual
12.	IEEE	Institute of Electrical and Electronic Engineers
13.	IES	Illuminating Engineering Society
14.	IPCEA	International Power Cable Engineers Association
15.	LED	Light Emitting Diode
16.	NEC	National Electric Code
17.	NEMA	National Electrical Manufacturers Association
18.	NETA	National Electrical Testing Association
19.	NFPA	National Fire Protection Association
20.	OEM	Original Equipment Manufacturer
21.	OSHA	Occupational Safety and Health Administration
22.	SCC	Security Control Center
23.	SMACNA	Sheet Metal and Air Conditioning Contractors National Association
24.	TIA	Telecommunications Industry Association
25.	UL	Underwriters Laboratories Inc.

B. Definitions:

1. Where it is stated in these specifications to submit to Engineer for review, refer to Architectural General and Supplementary Conditions for proper procedures.
2. FURNISH means to supply all materials, labor, equipment, testing apparatus, controls, tests, accessories and all other items customarily required for the proper and complete application.
3. INSTALL means to join, unite, fasten, link, attach, set up or otherwise connect together before testing and turning over to Owner, complete and ready for regular operation.
4. PROVIDE means to FURNISH and INSTALL.
5. AS DIRECTED means as directed by the Engineer, or the Engineer's Representative.
6. CONCEALED means embedded in masonry or other construction, installed behind wall furring or within drywall partitions, or installed within hung ceilings.
7. SUBMIT means submit to Engineer for review.

1.5 GUARANTEE

A. Submit a single guarantee stating that the work is in accordance with the Contract Documents. Guarantee work against faulty and improper material and workmanship for a period of one year from the date of final acceptance by the Owner, except that where guarantees or warranties for longer terms are provided or specified herein, the longer term shall apply. Manufacturer's warranty/guarantee on equipment shall be begin at time of equipment startup not upon receipt of equipment. Correct any deficiencies, which

occur during the guarantee period, within 24 hours of notification, without additional cost to the Owner, to the satisfaction of the Owner. Obtain similar guarantees from subcontractors, manufacturers, suppliers and subtrade specialists.

1.6 USE OF THE ARCHITECT'S AND ENGINEER'S DRAWINGS

A. The Contractor shall obtain, at the Contractor's expense, from the Architect or Engineer a set of AutoCAD or compatible format architectural and engineering drawings on electronic media where desired by the Contractor and/or required by the Specifications for use in preparing the shop drawings, coordination drawings, and record drawings. The Contractor shall provide to the Architect and Engineer a written release of liability acceptable to the Architect and Engineer prior to receiving the electronic media.

PART 2 – PRODUCTS

2.1 EQUIPMENT AND MATERIALS

A. Provide products and materials that are new, clean, free of defects, and free of damage and corrosion.

B. Products and materials shall not contain asbestos, PCB, or any other material that is considered hazardous by the Environmental Protection Agency or any other Authority Having Jurisdiction.

C. Replace materials of less than specified quality and relocate work incorrectly installed as directed by the Architect or Engineer at no additional cost to the Owner.

D. Provide name/data plates on major components of equipment with manufacturer's name, model number, serial number, capacity data and electrical characteristics attached in a conspicuous place.

E. Install materials and equipment with qualified trades people.

F. Maintain uniformity of manufacturer for equipment used in similar applications and sizes.

G. Fully lubricate equipment where required.

H. Follow manufacturer's instructions for installing, connecting, and adjusting equipment. Provide a copy of such instructions at the equipment during installation.

I. Where factory testing of equipment is required to ascertain performance, and attendance by the Owner's Representative is required to witness such tests, associated travel costs and subsistence shall be paid for by the Contractor.

J. Equipment capacities, ratings, etc., are scheduled or specified for job site operating conditions. Equipment sensitive to altitude shall be derated with the method of derating identified on the submittals.

K. Enclosures for electrical equipment installed in mechanical and electrical equipment rooms shall be NEMA type 1 gasketed. Enclosures for electrical equipment installed outdoors shall be NEMA type 3R.

L. Energy consuming equipment shall be certified for use in the state of New York and shall meet the New York State Energy Code and local energy ordinances.

2.2 SUBSTITUTIONS

A. Contract Documents are based on equipment manufacturers as called out in the Specifications and indicated on the Drawings. Acceptance of substitute equipment manufacturers does not relieve Contractor of the responsibility to provide equipment and materials, which meet the performance as, stated or implied in the Contract Documents.

B. Submit proposals to provide substitute materials or equipment, in writing, with sufficient lead time for review prior to the date equipment must be ordered to maintain project schedule. Reimburse Owner for costs associated with the review of the proposed substitution whether substitution is accepted or rejected.

C. Indicate revisions required to adapt substitutions including revisions by other trades. Substitutions that increase the cost of the work and related trades are not permitted.

D. The proposed substitution shall conform to the size, ratings, and operating characteristics of the equipment or systems as specified and shown on the Drawings.

E. Proposals for substitutions shall include the following information:

1. A description of the difference between the Contract Document requirements and that of the substitution, the comparative features of each, and the effect of the change on the end result performance. Include the impact of all changes on other contractors and acknowledge the inclusion of additional costs to the other trades.
2. Schematic drawings and details.
3. List of revisions to the Contract Documents that must be made if the substitution is accepted.
4. Estimate of costs the Owner may incur in implementing the substitution, such as test, evaluation, operating and support costs.
5. Statement of the time by which a Contract modification accepting the substitution must be issued, noting any effect on the Contract completion time or the delivery schedule.
6. A statement indicating the reduction to the Contract price if the Owner accepts the substitution. Include required modifications to all related trades.

PART 3 – EXECUTION

3.1 FEES AND PERMITS

A. Pay all required fees and obtain all required permits related to the electrical installation.

B. Pay royalties or fees in connection with the use of patented devices and systems.

C. Provide controlled inspection where required by Authorities Having Jurisdiction or by these specifications.

3.2 SUBMITTALS AND REVIEWS

A. Submit shop drawings, manufacturer's product data sheets, samples, and test reports as specified.

B. After execution of Owner/Contractor Agreement, submit a complete typed list of all electrical equipment manufacturers and material suppliers for the equipment proposed to be provided on this project, as well as names of all subcontractors.

C. After execution of Owner/Contractor Agreement, prepare an index of all submittals for the project. Include a submittal identification number, a cross-reference to the Specification sections or Drawing number, and an item description. Prefix the submittal identification number by the Specification sections to which they apply. Indicate on each submittal, the submittal identification number in addition to the other data specified. All subcontractors shall utilize the assigned submittal identification number.

D. After the Contract is awarded, obtain complete shop drawings, product data and samples from the manufacturers, suppliers, vendors, and all subcontractors, for all materials and equipment as specified. Submit data and details of such materials and equipment for review. Prior to submission, certify that the shop drawings, product data and samples are in compliance with the Contract Documents. Check all materials and equipment upon their arrival on the job site and verify their compliance with the Contract Documents. Modify any work, which proceeds prior to receiving accepted shop drawings as required to comply with the Contract Documents and the shop drawings.

E. Review of submittals is for general compliance with the design concept and Contract Documents. Comments or absence of comments shall not relieve the Contractor from compliance with the Contract Documents. The Contractor remains solely responsible for details and accuracy, for confirming and correlating all quantities and dimensions, for selecting fabrication processes, for techniques of construction, for performing the work in a safe manner, and for coordinating the work with that of other trades.

F. No part of the work shall be started in the shop or in the field until the shop drawings and samples for that portion of the work have been submitted and accepted.

G. A minimum period of ten working days, exclusive of transmittal time, will be required in the Engineer's office each time a shop drawing, product data and/or samples are submitted for review. This time period must be considered by the Contractor in the scheduling of the work.

H. Submit electronic copies, preferably in PDF format, of all items requiring shop drawings.

I. Submit materials and equipment by manufacturer, trade name, and model number. Include copies of applicable brochure or catalog material. Maintenance and operating manuals are not acceptable substitutes for shop drawings.

J. Identify each sheet of printed submittal pages (using arrows, underlining or circling) to show applicable sizes, types, model numbers, ratings, capacities and options actually

being proposed. Cross out non-applicable information. Note specified features such as materials or paint finishes.

K. Include dimensional data for roughing in and installation and technical data sufficient to verify that equipment meets the requirements of the Contract Documents. Include wiring, piping and service connection data.

L. Maintain a complete set of reviewed and stamped shop drawings and product data on site.

M. For each room or area of the building containing electrical equipment, submit the following:

1. Floor Plans: Plan and elevation layout drawings indicating the equipment in the exact location in which it is intended to be installed. These plans shall be of a scale not less than 1/4 inch to 1 foot. They shall be prepared in the following manner:
   a. Indicate the physical boundaries of the space including door swings and ceiling heights and ceiling types (as applicable).
   b. Illustrate all electrical equipment proposed to be contained therein. Include top and bottom elevations of all electrical equipment. The Drawings shall be prepared utilizing the dimensions contained in the individual equipment submittals. Indicate code and manufacturer's required clearances.
   c. Illustrate all other equipment therein such as conduits, detectors, luminaries, ducts, registers, pull boxes, wireways, structural elements, etc.
   d. Indicate the operating weight of each piece of equipment.
   e. Indicate the heat release from each piece of electrical equipment in terms of BTU per hour. This information shall be that which is supplied by the respective manufacturers.
   f. Illustrate concrete pads, curbs, etc.
   g. Indicate dimensions to confirm compliance with code-required clearances.
   h. Indicate maximum normal allowable operating temperature for each piece of equipment (as per each respective manufacturer's recommendation).
   i. Equipment removal routes.

N. The work described in shop drawing submissions shall be carefully checked by all trades for clearances (including those required for maintenance and servicing), field conditions, maintenance of architectural conditions and coordination with other trades on the job. Each submitted shop drawing shall include a certification that related job conditions have been checked by the Contractor and each Subcontractor and that conflicts do not exist.

O. The Contractor is not relieved of the responsibility for dimensions or errors that may be contained on submissions, or for deviations from the requirements of the Contract Documents. The noting of some errors but overlooking others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the shop drawings, product data and samples, the Contract Documents govern the work and are neither waived nor superceded in any way by the review of shop drawings, product data and samples.

P. Inadequate or incomplete shop drawings, product data and/or samples will not be reviewed and will be returned to the Contractor for resubmittal.

3.3 COORDINATION OF WORK

A. The Contract Documents establish scope, materials and quality but are not detailed installation instructions. Drawings are diagrammatic.

B. Coordinate work with related trades and furnish, in writing, any information necessary to permit the work of related trades to be installed satisfactorily and with the least possible conflict or delay.

C. The electrical drawings show the general arrangement of equipment and appurtenances. Follow these drawings as closely as the actual construction and the work of other trades will permit. Provide offsets, fittings, and accessories, which may be required but not shown on the Drawings. Investigate the site, and review drawings of other trades to determine conditions affecting the work, and provide such work and accessories as may be required to accommodate such conditions.

D. The locations of lighting fixtures, outlets, panels and other equipment indicated on the Drawings are approximately correct, but they are understood to be subject to such revision as may be found necessary or desirable at the time the work is installed in consequence of increase or reduction of the number of outlets, or in order to meet field conditions, or to coordinate with modular requirements of ceilings, or to simplify the work, or for other legitimate causes.

E. Exercise particular caution with reference to the location of panels, outlets, switches, etc., and have precise and definite locations accepted by the Engineer before proceeding with the installation.

F. The Drawings show only the general run of raceways and approximate locations of outlets. Any significant changes in location of outlets, cabinets, etc., necessary in order to meet field conditions shall be brought to the immediate attention of the Engineer for review before such alterations are made. Modifications shall be made at no additional cost to the Owner.

G. Verify with the Architect the exact location and mounting height of outlets and equipment not dimensionally located on the Drawings prior to installation.

H. Circuit tags in the form of numbers are used where shown to indicate the circuit designation numbers in electrical panels. Show the actual circuit numbers on the as-built Record Drawings and on the associated typed panelboard directory card. Where circuiting is not indicated, provide required circuiting in accordance with the loading indicated on the Drawings and/or as directed.

I. The Drawings generally do not indicate the number of wires in conduit for the branch circuit wiring of fixtures and outlets, or the actual circuiting. Provide the correct wire size and quantity as required by the indicated circuiting and/or circuit numbers indicated, the control intent, referenced wiring diagrams (if any), the specified voltage drop or maximum distance limitations, and the applicable requirements of the NEC.

J. Carefully check space requirements with other trades to ensure that equipment can be installed in the spaces allotted.

K. Wherever work interconnects with work of other trades, coordinate with other trades to ensure that they have the information necessary so that they may properly install the necessary connections and equipment. Identify items (remote ballast, pull boxes, etc.) requiring access in order that the ceiling trade will know where to install access doors and panels.

L. Consult with other trades regarding equipment so that, wherever possible, motor controls and distribution equipment are of the same manufacturer.

M. Furnish and set sleeves for passage of electrical risers through structural masonry and concrete walls and floors and elsewhere as required for the proper protection of each electrical riser passing through building surfaces.

N. Provide firestopping around all pipes, conduits, ducts, sleeves, etc. which pass through rated walls, partitions and floors.

O. Provide detailed information on openings and holes required in precast members for electrical work.

P. Provide required supports and hangers for conduit and equipment, designed so as not to exceed allowable loadings of structures.

Q. Examine and compare the Contract Documents with the drawings and specifications of other trades, and report any discrepancies between them to the Engineer and obtain written instructions for changes necessary in the work. Install and coordinate the work in cooperation with other related trades. Before installation, make proper provisions to avoid interferences.

R. Wherever the work is of sufficient complexity, prepare additional detail drawings to scale to coordinate the work with the work of other trades. Detailed work shall be clearly identified on the Drawings as to the area to which it applies. Submit these drawings to the Engineer for review. At completion include a set of these drawings with each set of Record Drawings.

S. Furnish services of an experienced Superintendent, who shall be in constant charge of all work, and who shall coordinate work with the work of other trades. No work shall be installed before coordinating with other trades.

T. Coordinate with the local electric utility company and the local telecommunications company as to their requirements for service connections and provide all necessary metering provisions, grounding, materials, equipment, labor, testing, and appurtenances.

U. Before commencing work, examine adjoining work on which this work is in any way affected and report conditions, which prevent performance of the work. Become thoroughly familiar with actual existing conditions to which connections must be made or which must be changed or altered.

V. Adjust location of conduits, panels, equipment, etc., to accommodate the work to prevent interferences, both anticipated and encountered. Determine the exact route and location of each conduit prior to fabrication.

1. Right-of-Way: Lines which pitch have the right-of-way over those which do not pitch. For example: condensate, steam, and plumbing drains normally have right-of-way. Lines whose elevations cannot be changed have right-of-way over lines whose elevations can be changed.
2. Provide offsets, transitions and changes in direction of conduit as required to maintain proper headroom and pitch on sloping lines.

W. In cases of doubt as to the work intended, or in the event of need for explanation, request supplementary instructions from the Engineer.

3.4 CONTRACTOR'S COORDINATION DRAWINGS

A. The Contractor shall coordinate efforts of all trades and shall furnish (in writing, with copies to the Engineer) any information necessary to permit the work of all trades to be installed satisfactorily and with the least possible interference or delay.

B. The Contractor and all trade contractors shall prepare a complete set of construction Coordination Drawings indicating the equipment actually purchased and the exact routing for all lines such as busway, conduit, piping, ductwork, etc., including conduit embedded in concrete floors and walls. The Coordination Drawings shall be submitted complete to the Architect and the Engineer, within three months after notice to proceed is given, and in compliance with the construction schedule for the project. The sheet metal drawings, at a scale of not less than 1/4 inch to 1 foot, shall serve as the base drawings to which all other Contractors shall add their work. Each separate trade contractor shall draw their work on separate layers with different color assignments to facilitate coordination. Each Coordination Drawing shall be completed and signed off by the other Trade Contractors and the Contractor prior to the installation of the HVAC, plumbing, electrical and fire sprinkler work in the area covered by the specific drawing. The Contractor's work shall be installed according to the shop drawings and coordination drawings. If the Contractor allows one trade to install their work before coordination with the work of other trades, the Contractor shall make all necessary changes to correct the condition at no additional cost to the Owner.

C. The Contractors' Coordination Drawings shall indicate structural loads at support points for all piping 10 inch and larger, racked piping, racked conduit, busway, and suspended electrical equipment. Submit to Structural Engineer for review and approval. The elevation, location, support points, static, dynamic and expansion forces and loads imposed on the structure at support and anchor points shall be indicated. All beam penetrations and slab penetrations shall be indicated and sized and shall be coordinated. Work routed underground or embedded in concrete shall be indicated by dimension to column and building lines and shall be coordinated. Coordination Drawings shall document all required structural penetrations for initial construction. Penetrations shall be dimensioned for walls, floors and roofs. These structural coordination requirements require review and approval by the Structural Engineer prior to completion and submittal of the Drawings.

D. This requirement for Coordination Drawings shall not be construed as authorization for the Contractor or trade contractors to make any unauthorized changes to the Contract Documents. Contract document space allocations shall be maintained such as ceiling height, designated clearance for future construction and flexibility, chase walls, equipment room size, unless prior written authorization is received from the Engineer to change them.

E. Prior to final acceptance of the Work, the Contractor shall submit the Coordination Drawings as part of the Record Drawings submittal.

3.5 EXAMINATION OF SITE

A. Prior to the submitting of bids, visit the project site and become familiar with all conditions affecting the proposed installation and make provisions as to the cost thereof.

B. The Contract Documents do not make representations regarding the character or extent of the sub-soils, water levels, existing structural, mechanical and electrical installations, above or below ground, or other sub-surface conditions which may be encountered during the work. Evaluate existing conditions, which may affect methods or cost of performing the work, based on examination of the site or other information. Failure to examine the Drawings or other information does not relieve the Contractor of responsibility for the satisfactory completion of the work.

3.6 EXCAVATION AND BACKFILL

A. Provide excavation for the work of this Division. Excavate all material encountered, to the depths indicated on the Drawings or as required. Remove from the site excavated materials not required or suitable for backfill. Provide grading as may be necessary to prevent surface water from flowing into trenches or other excavations. Remove any water, which accumulates. Provide sheeting and shoring as may be necessary for the protection of the work and for the safety of personnel.

B. Provide trenches of widths necessary for the proper execution of the work. Grade bottom of the trenches accurately to provide uniform bearing and support the work on undisturbed soil at every point along its entire length. Except where rock is encountered, do not excavate below the depths indicated. Where rock excavations are required, excavate rock to a minimum overdepth of four inches below the trench depths indicated on the Drawings or required. Backfill overdepths in the rock excavation and unauthorized overdepths with loose, granular, moist earth, thoroughly machine-tamped to a compaction level of at least 95 percent to standard proctor density or 75 percent relative density or as specified by the Engineer. Whenever unstable soil that is incapable of properly supporting the work is encountered in the bottom of the trench, remove soil to a depth required and backfill the trench to the proper grade with coarse sand, fine gravel or other suitable material.

C. Excavate trenches for utilities that will provide the following minimum depths of cover from existing grade or from indicated finished grade, whichever is lower, unless otherwise specifically shown:

1. Electric service: Three (3) feet minimum.

2. Telephone service: Three (3) feet minimum.
3. Cable TV service: Three (3) feet minimum

D. Trenches should not be placed within ten feet of foundation or soil surfaces, which must resist horizontal forces.

E. Do not backfill trenches until all required tests have been performed and installation observed by the Engineer. Comply with the requirements of other sections of the Specifications. Backfill shall consist of non-expensive soil with limited porosity. Deposit in six layers and thoroughly and carefully tamp until the work has a cover of not less than one foot. Backfill and tamp remainder of trench at one-foot intervals until complete. Uniformly grade the finished surface.

3.7 CUTTING AND PATCHING

A. Where cutting, channeling, chasing or drilling of floors, walls, partitions, ceilings or other surfaces is necessary for the proper installation, support or anchorage of conduit or other equipment, lay out the work carefully in advance. Repair any damage to the building, piping, equipment or defaced finished plaster, woodwork, metalwork, etc., using skilled tradespeople of the trades required at no additional cost to the Owner.

B. Do not cut, channel, chase or drill unfinished masonry, tile, etc., unless permission from the Architect is obtained. If permission is granted, perform this work in a manner acceptable to the Architect.

C. Where conduit or equipment are mounted on a painted finished surface, or a surface to be painted, paint to match the surface. Cold galvanize bare metal whenever support channels are cut.

D. Provide slots, chases, openings and recesses through floors, walls, ceilings, and roofs as required. Where these openings are not provided, provide cutting and patching to accommodate penetrations at no additional cost to the Owner.

3.8 MOUNTING HEIGHTS

A. Mounting heights shall conform to ADA requirements.

B. Verify exact locations and mounting heights with the Architect before installation.

C. Electrical and telecommunications outlets shall be mounted no higher than 48 inches above finished floor to top of the outlet box and no lower than 15 inches above finished floor to bottom of the outlet box.

D. Electrical switches shall be mounted no higher than 48 inches above finished floor to top of the outlet box and no lower than 36 inches above finished floor to bottom of the outlet box.

E. Fire alarm manual pull stations shall be mounted no higher than 48 inches above finished floor to top of the outlet box and no lower than 36 inches above finished floor to bottom of the outlet box.

F. Outlets for public and other wall-mounted type telephones shall be installed so that the particular telephone installed conforms to ADA mounting height requirements.

G. Visual Alarms: Mount not less than 80 inches to the bottom or 96 inches to the top of the device.

H. Wall-Mounted Exit Signs: Two inches above top of door to bottom of sign.

I. Low-Level Exit Signs: Six inches to bottom of sign.

J. Stairwell and utility corridor wall-mounted lighting fixtures shall be mounted 8 feet-6 inches above finished floor or one foot below ceiling or structure above, whichever is lower.

3.9 CLEANING UP

A. Avoid accumulation of debris, boxes, loose materials, crates, etc., resulting from the installation of this work. Remove from the premises each day all debris, boxes, etc., and keep the premises clean and free of dust and debris.

B. Clean all fixtures and equipment at the completion of the project. Wipe clean exposed lighting fixture reflectors and trim pieces with a non-abrasive cloth just prior to occupancy.

C. All electrical equipment shall be thoroughly vacuumed and wiped clean prior to energization and at the completion of the project. Equipment shall be opened for observation by the Engineer as required.

3.10 WATERPROOFING

A. Avoid, if possible, the penetration of any waterproof membranes such as roofs, machine room floors, basement walls, and the like. If such penetration is necessary, make penetration prior to the waterproofing and furnish all sleeves or pitch-pockets required. Advise the Architect and obtain written permission before penetrating any waterproof membrane, even where such penetration is shown on the Drawings.

B. Restore waterproofing integrity of walls or surfaces after they have been penetrated without additional cost to the Owner.

3.11 SUPPORTS

A. Support work in accordance with the best industry practice. Provide supports, hangers, auxiliary structural members and supplemental hardware required for support of the work.

B. Provide supporting frames or racks extending from floor slab to ceiling slab for work indicated as being supported from walls where the walls are incapable of supporting the weight. In particular, provide such frames or racks in electric closets and mechanical equipment rooms.

C. Provide supporting frames or racks for equipment which is to be installed in a freestanding position.

D. Supporting frames or racks shall be of standard angle, standard channel or specialty support system steel members, rigidly bolted or welded together and adequately braced to form a substantial structure. Racks shall be of ample size to assure a workmanlike arrangement of all equipment mounted on them.

E. Adequate support of equipment (including outlet, pull and junction boxes and fittings) shall not depend on electric conduits, raceways, or cables for support.

F. Electrical equipment shall not rest on or depend for support on suspended ceiling media (tiles, lath, plaster, as well as splines, runners, bars and the like in the plane of the ceiling). Provide independent support of electrical equipment. Do not attach to supports provided for ductwork, piping or work of other trades.

G. Provide required supports and hangers for conduit, equipment, etc., so that loading will not exceed allowable loadings of structure. Electrical equipment and supports shall not come in contact with work of other trades.

3.12 FASTENINGS

A. Fasten equipment to building structure in accordance with the best industry practice.

B. Where weight applied to building attachment points is 100 pounds or less, conform to the following as a minimum:

1. Wood: Wood screws.
2. Concrete and solid masonry: Bolts and expansion shields.
3. Hollow construction: Toggle bolts.
4. Solid metal: Machine screws in tapped holes or with welded studs.
5. Steel decking or sub-floor: Fastenings as specified below for applied weights in excess of 100 pounds.

C. Where weight applied to building attachment points exceeds 100 pounds, but is 300 pounds or less, conform to the following as a minimum:

1. At concrete slabs provide 24-inch by 24-inch by 1/2-inch steel fishplates on top with through bolts. Fishplate assemblies shall be chased in and grouted flush with the top of slab screed line, where no fill is to be applied.
2. At steel decking or sub-floor for all fastenings, provide through bolts or threaded rods. The tops of bolts or rods shall be set at least one inch below the top fill screed line and grouted in. Suitable washers shall be used under bolt heads or nuts. In cases where the decking or sub-floor manufacturer produces specialty hangers to work with their decking or sub-floor, such hangers shall be provided.

D. Where weight applied to building attachment points exceeds 300 pounds, coordinate with and obtain the approval of Engineer and conform to the following as a minimum:

1. Provide suitable auxiliary channel or angle iron bridging between building structural steel elements to establish fastening points. Bridging members shall be

suitably welded or clamped to building steel. Provide threaded rods or bolts to attach to bridging members.

E. For items, which are shown, as being ceiling-mounted at locations where fastening to the building construction element above is not possible, provide suitable auxiliary channel or angle iron bridging tying to the building structural elements.

F. Wall-mounted equipment may be directly secured to wall by means of steel bolts. Groups or arrays of equipment may be mounted on adequately sized steel angles, channels, or bars. Prefabricated steel channels as manufactured by Kindorf or Unistrut are acceptable.

3.13 IDENTIFICATION

A. Identify electrical equipment with permanently attached black phenolic nameplates with 1/2-inch high white engraved lettering. Identification shall include equipment name or load served as appropriate. Nameplates for equipment connected to the emergency power system shall be red with white lettering. Nameplates shall be attached with cadmium-plated screws; peel-and-stick tape or glue-on type nameplates are not allowed.

B. Cable tags shall be flameproof secured with flameproof non-metallic cord.

C. Provide an engraved nameplate for each switch controlling loads, which are not local to the switch.

D. Wherever raceways for future use are terminated outside of the building, stake the location with a 2-foot long, 1-inch by 1-inch clear heart redwood stake.

E. See individual Sections for additional identification requirements.

3.14 PROHIBITED LABELS AND IDENTIFICATIONS

A. In all public areas, the inclusion or installation of any equipment or assembly which bears on any exposed surface any name, trademark, or other insignia which is intended to identify the manufacturer, the vendor, or other source(s) from which such object has been obtained, is prohibited, unless otherwise approved by Owner.

B. Required UL labels shall not be removed nor shall identification specifically required under the various technical sections of the Specifications be removed.

3.15 EQUIPMENT PADS AND ANCHOR BOLTS

A. Provide concrete pads under all floor-mounted electrical equipment. Equipment pads shall conform to the shape of the piece of equipment it serves with a minimum 1-inch margin around the equipment and supports. Pads shall be a minimum of 4 inches high and made of a minimum 28 day, 2500 psi concrete reinforced with 6-inch by 6-inch 6/6 gauge welded wire mesh. Trowel tops and sides of pad to smooth finishes, equal to those of the floors, with all external corners bullnosed to a 3/4-inch radius.

B. Provide galvanized anchor bolts for all equipment placed on concrete equipment pads, inertia blocks, or on concrete slabs. Provide bolts of the size and number recommended by the manufacturer of the equipment and locate by means of suitable templates. Equipment installed on vibration isolators shall be secured to the isolator. Secure the isolator to the floor, pad, or support as recommended by the vibration isolation manufacturer.

C. Where equipment is mounted on gypsum board partitions, the mounting screws shall pass through the gypsum board and securely attach to the partition studs. As an alternative, the mounting screws may pass through the gypsum board and be securely attached to 6 inches square, 18 gauge galvanized metal backplates, which are attached to the gypsum board with an approved non-flammable adhesive. Toggle bolts installed in gypsum board partitions are not allowed.

3.16 DELIVERY, DRAYAGE AND HAULING

A. Provide drayage, hauling, hoisting, shoring and placement in the building of equipment specified and be responsible for the timely delivery and installation of equipment as required by the construction schedule. If any item of equipment is received prior to the time that it is required, the Contractor shall be responsible for its proper storage and protection until the time it is required. Pay for all costs of drayage or storage.

B. If equipment is not delivered or installed at the project site in a timely manner as required by the project construction schedule, the Contractor shall be responsible for resulting disassembly, re-assembly, manufacturer's supervision, shoring, general construction modification, delays, overtime costs, etc., at no additional cost to the Owner.

3.17 EQUIPMENT AND MATERIAL PROTECTION

A. Protect the work, equipment, and material of other trades from damage by work or workmen of this trade, and correct damaged caused without additional cost to the Owner.

B. Take responsibility for work, materials, and equipment until finally inspected, tested and accepted. Protect work against theft, injury, or damage, and carefully store material and equipment received on site, which is not immediately installed. Close open ends of work with temporary covers or plugs during construction to prevent entry of obstructing material. Cover and protect equipment and materials from damage due to water, spray-on fireproofing, construction debris, etc. Store equipment to moisture damage in dry, heated spaces.

C. Provided adequate means for fully protecting finished parts of materials and equipment against damage from whatever cause during the progress of the work until final acceptance. Protect materials and equipment in storage and during construction in such a manner that no finished surfaces will be damaged or marred, and moving parts are kept clean and dry. Do not install damaged items; take immediate steps to obtain replacement or repair.

3.18 TESTING OF ELECTRICAL SYSTEMS

A. Comply with the project construction schedule for the date of final performance and acceptance testing, and complete work sufficiently in advance of the Contract completion date to permit the execution of the testing prior to occupancy and Contract close-out. Complete any adjustments and/or alterations, which the final acceptance tests indicate as necessary for the proper functioning of all equipment prior to the completion date. See individual Sections for extent of testing required.

B. Provide a detailed schedule of completion indicating when each system is to be completed and outlining when field testing will be performed. Submit completion schedule for review within six months after the notice to proceed by Owner's Representative has been given. Update this schedule periodically as the project progresses.

3.19 OPERATING INSTRUCTIONS

A. Provide the services of factory-trained specialists to provide an operating instructions seminar for equipment and systems. The seminar shall be conducted over a five-day (consecutive) period. Instruction time is defined as straight time working hours and does not include nights, weekends, or travel time to and from the project.

B. Submit seminar agenda, schedule and list of representatives to the Owner for approval 30 days prior to suggested date of seminar. Do not commence seminar until the Owner has issued a written acceptance of the starting time and attendees. Confirm attendance of seminar by written notification to participants.

C. Instruct Owner's operating personnel in proper starting sequences, operation, shut-down, general maintenance and preventative maintenance procedures, including normal and emergency procedures.

D. Submit final copies of Record Drawings and Operating and Maintenance Manuals to Owner at seminar.

E. Submit a written record of minutes and attendees of the seminar to the Owner.

3.20 OPERATING AND MAINTENANCE MANUALS

A. Provide Operating and Maintenance Manuals for equipment and materials furnished under this Division.

B. Submit three final copies of Operating and Maintenance Manuals for review at least ten weeks before the completion date. Assemble data in a completely indexed volume or volumes in three-ring binders and identify the size, model, and features indicated for each item. Print the project name on the outside of the binders.

C. Maintenance manuals shall include complete cleaning and servicing data compiled in a clear and easily understandable format. Show model numbers of each piece of equipment, complete lists of replacement parts, capacity ratings, and actual loads.

D. Provide the following information where applicable:

1. Identifying name and mark number
2. Locations (where several similar items are used, provide a list)
3. Complete nameplate data
4. Certified Record Drawings and Final Reviewed submittals
5. Parts list
6. Performance curves and data
7. Wiring diagrams
8. Manufacturer's recommended operating and maintenance instructions with all non-applicable information deleted
9. List of spare parts recommended for normal service requirements
10. Assembly and disassembly instructions with exploded-view drawings where necessary
11. Test reports
12. Trouble shooting diagnostic instructions, where applicable

3.21 RECORD DRAWINGS

A. The Contractor shall maintain on a daily basis at the Project site a complete set of Record Drawings. The Record Drawings shall initially consist of a set of construction drawings or AutoCAD files of the Contractor's Coordination Drawings. The prints shall be marked or the AutoCAD files electronically updated to show the precise location of all buried or concealed work and equipment, including embedded conduit, raceways and boxes, and all changes and deviations in the Electrical work from that shown on the Contract Documents. This requirement shall not be construed as authorization for the Contractor to make changes in the layout or work without definite written instructions from the Architect or Engineer. The updated Coordination Drawings shall be used to produce the final Record Drawings that shall be delivered to the Owner in AutoCAD electronic format and full-size hard copy format upon Project completion.

B. Record dimensions clearly and accurately to delineate the work as installed. Suitably identify locations of all equipment by at least two dimensions to permanent structures.

C. The Contractor and Subcontractor shall mark all in-progress Record Drawings on the front lower right hand corner with a rubber stamp impression or an AutoCAD image similar to the following:

RECORD DRAWING
(3/8-inch high letters)

To be used for recording Field Deviations and Dimensional Data Only
(5/16-inch high letters)

D. Upon completion of the work, the Contractor and Subcontractor(s) shall certify all Record Drawings on the front lower right hand corner adjacent to the above marking with a rubber stamp impression or an AutoCAD image similar to the following:

RECORD DRAWING
CERTIFIED CORRECT
(3/8-inch high letters)

(Printed Name of General Contractor)
(5/16-inch high letters)
Date:_____

(Printed Name of Subcontractor)
(5/16-inch high letters)
Date:_____

E. Prior to final acceptance of the Work of this Division, the Contractor shall submit properly certified Record Drawings to the Architect and Engineer for review and shall make changes, corrections, or additions as the Architect and/or Engineer may require to the Record Drawings. After the Architect's and Engineer's review, and any required Contractor revisions, the Record Drawings shall be delivered to the Owner on electronic media in AutoCAD format. The Architect and Engineer do not assume any responsibility for the accuracy or completeness of the Record Drawings.

3.22 FINAL PUNCHLIST

A. Prior to the Final Punchlist, certify that systems and equipment are complete, operational, and are in compliance with the Contract Documents.

B. During the Final Punchlist, provide personnel with access keys, hand held radios, and necessary expertise to operate each system and piece of equipment to demonstrate operational compliance with the Contract Documents.

C. Any deficiencies noted on the Final Punchlist shall be expeditiously corrected and certified in writing.

END OF SECTION 260500

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper building wire rated 600 V or less.
2. Metal-clad cable, Type MC, rated 600 V or less.
3. Connectors, splices, and terminations rated 600 V and less.

1.2 SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: Indicate type, use, location, and termination locations.

C. Qualification Data: For testing agency.

D. Field quality-control reports.

1.3 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

C. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

D. Conductor Insulation:

1. Type RHH and Type RHW-2: Comply with UL 44.
2. Type THHN and Type THWN-2: Comply with UL 83.
3. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
4. Type XHHW-2: Comply with UL 44.

2.2 METAL-CLAD CABLE, TYPE MC

A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.

B. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Comply with UL 1569.
3. RoHS compliant.
4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

C. Circuits:

1. Single circuit and multicircuit with color-coded conductors.

D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

E. Ground Conductor: Insulated.

F. Conductor Insulation:

1. Type TFN/THHN/THWN-2: Comply with UL 83.
2. Type XHHW-2: Comply with UL 44.

G. Armor: Steel or lightweight Aluminum, interlocked.

H. Jacket: PVC applied over armor (when Specified).

2.3 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

2.4 INSULATING TAPE

A. Provide vinyl plastic tape that meets the requirements of UL 510 and has the following characteristics:

1. 8.5 Mil minim thickness.
2. ASTM D-3005 Standard specification for low-temperature resistant vinyl Chloride plastic pressure-sensitive electrical insulating type – type1.
3. Rated 600 volts and 150°C, suitable for indoor and outdoor applications.
4. Retains flexibility, adhesion, and applicable at temperature ranges from 0 through 100°F without loss of physical or electrical properties.
5. Resistant to abrasion, moisture, alkalis, acid, corrosion, and sunlight
6. Tape manufacturer: 3M “Scotch Super 88” or approved equal.

2.5 MANUFACTURERS

A. Wire Manufacturers: subject to compliance with requirements, provide products by one of the following (no exceptions):

1. Southwire Company
2. General Cable
3. The Okonite Company
4. Belden
5. VitaLink
6. Pyrotenax

B. Connectors Manufacturers: subject to compliance with requirements, provide products by one of the following (no exceptions):

1. Hubbell
2. Thomas & Betts
3. 3M Company

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders/Branch circuits: Copper; solid for No. 10 AWG and No. 12 AWG; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN/THWN-2, single conductors in raceway; Type XHHW-2, single conductors in raceway; Type USE, single conductor in raceway.

B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway; Type XHHW-2, single conductors in raceway.

E. Feeders Installed below Raised Flooring: Type THHN/THWN-2, single conductors in raceway.

F. Exposed Branch Circuits, Including in Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

G. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway;

H. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

I. Branch Circuits Installed below Raised Flooring: Type THHN/THWN-2, single conductors in raceway.

J. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Contract drawings do not indicate size of branch circuit wiring; use No.12 AWG as a minimum wire size for branch circuit wiring. For 20 Ampere branch circuits whose length from the panel to the furthest outlet exceeds 100 feet for 120-volt circuits or 150 feet for 277-volt circuits; use No. 10 AWG or larger for the entire branch circuit installation.

C. A shared neutral may be utilized for circuits other than circuits used for dimmers, ground fault interrupter receptacles or circuit breakers, isolated ground receptacles, and isolated ground surge suppressor type devices

D. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

E. 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.

F. Do not install wire in incomplete conduit runs nor until after concrete work and plastering is completed and moisture is swabbed from the conduits. Eliminate splices where possible. Where necessary, splice in readily accessible pull, junction or outlet box.

G. Take precautions to avoid entrance of dirt and water into the conduit and cuts. Clean conduits and ducts to remove and pulling compound prior to pulling cables. Do not damage conductor insulation, braid jacket or sheet during installation. Any damaged conductors shall be replaced immediately.

H. Use pulling means, including fish tape, cable, rope, cable reels on jacks, and basket-weave wire/cable grips, that will not damage cables or raceway. Do not exceed maximum recommended pulling tension of wire and cable

I. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

J. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

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-486B.

B. Except where lugs are furnished with equipment, make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Circumferential compression type connector (provide for splices and connections No. 6 AWG and larger):

1. Use for incoming and outgoing cable connections at enclosures and for ground connections.
2. Use manufacturer’s approved tool and correct size hex head with embosses die number on the connector or lug.
3. Make crimped indentions parallel with insulation putty.
4. Fill voids and irregularities with insulation putty.
5. Cover nearly with four (4) layers of vinyl plastic tape except where insulated covers are permitted; half-lap tape in two (2) directions.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to the project specifications.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections.

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
2. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors and conductors feeding the following critical equipment and services for compliance with requirements:

3. Perform each of the following visual and electrical tests:

    a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line/riser diagram.
    b. Test bolted connections for high resistance using one of the following:

        1) A low-resistance ohmmeter.
        2) Calibrated torque wrench.
        3) Thermographic survey.

    c. Inspect compression-applied connectors for correct cable match and indentation.
    d. Inspect for correct identification.
    e. Inspect cable jacket and condition.
    f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
    g. Continuity test on each conductor and cable.
    h. Uniform resistance of parallel conductors.
    i. Insulation resistance to comply with ICEA values.

4. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.

    a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

5. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.

E. Cables will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports to record the following:

1. Procedures used.
2. Results that comply with requirements.
3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519

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SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Provide a complete grounding system in accordance with the Contract Documents and as specified herein.

1.2 SUBMITTALS

A. Minimum 1/8” scale floor plan drawings depicting the building ground electrode system as to be installed.

B. Detailed riser diagram depicting the building ground electrode system and bonding as to be installed.

C. Product data sheets (cut sheets) for all ground bus bars and other components of the grounding system.

D. Field test reports.

1.3 QUALITY ASSURANCE

A. Testing Agency Qualifications: Certified by NETA.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

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.

B. Comply with UL 467 for grounding and bonding materials and equipment.

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:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.

4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch 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 wide and 1/16 inch thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.3 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

C. Bus-Bar Connectors: Compression type, copper or copper alloy, with two wire terminals.

D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.

E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.

F. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.

G. Conduit Hubs: Mechanical type, terminal with threaded hub.

H. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.

I. Lay-in Lug Connector: Mechanical type, aluminum or copper rated for direct burial terminal with set screw.

J. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.

K. Straps: Solid copper, cast-bronze clamp or copper lugs. Rated for 600 A.

L. Tower Ground Clamps: Mechanical type, copper or copper alloy, terminal two-piece clamp.

M. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.

N. Water Pipe Clamps:

1. Mechanical type, two pieces with stainless-steel bolts.
   a. Material: Die-cast zinc alloy.
   b. Listed for direct burial.

2. U-bolt type with malleable-iron clamp and copper ground connector.

2.4 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet.

B. Ground Plates: 1/4-inch-thick, hot-dip galvanized.

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. 2/0 AWG minimum.

1. Bury at least 24 inches below grade.

C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

D. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches 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, and down; connect to horizontal bus.

E. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

B. At utility transformer, ground per utility company requirements and standards.

3.3 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

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. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

E. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

F. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

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. Ground Rods: Drive rods until tops are 2 inches 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.

C. 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 bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

D. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by 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.

E. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.

F. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each indicated item, extending around the perimeter of building area or item indicated.

1. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
2. Bury ground ring not less than 24 inches from building's foundation.

G. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; using electrically conductive coated steel reinforcing bars or rods, at least 20 feet long. If reinforcing is in multiple pieces, connect together by the usual steel tie wires or exothermic welding to create the required length.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections with the assistance of a factory-authorized service representative.

B. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.
    a. Measure ground resistance no fewer 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.

4. 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.

C. Grounding system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
3. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).
4. Substations and Pad-Mounted Equipment: 5 ohms.
5. Manhole Grounds: 10 ohms.
6. ohms.

F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

1.2 SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
   a. Hangers.
   b. Steel slotted support systems.
   c. Nonmetallic support systems.
   d. Trapeze hangers.
   e. Clamps.
   f. Turnbuckles.
   g. Sockets.
   h. Eye nuts.
   i. Saddles.
   j. Brackets.
2. Include rated capacities and furnished specialties and accessories.

B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.

1. Trapeze hangers. Include product data for components.
2. Steel slotted-channel systems.
3. Nonmetallic slotted-channel systems.
4. Equipment supports.
5. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which hangers and supports will be attached.
3. Size and location of initial access modules for acoustical tile.
4. Items penetrating finished ceiling.

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. Channel Width: 1-5/8 inches.
2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
5. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
6. Channel Dimensions: Selected for applicable load criteria.

B. Aluminum Slotted Support Systems: Comply with MFMA-4 factory-fabricated components for field assembly.

1. Channel Width: 1-5/8 inches.
2. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
3. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
4. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
5. Channel Dimensions: Selected for applicable load criteria.

C. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c., in at least one surface.

1. Channel Width: 1-5/8 inches.
2. Fittings and Accessories: Products provided by channel and angle manufacturer and designed for use with those items.
3. Fitting and Accessory Materials: Same as those for channels and angles, except metal items may be stainless steel.
4. Rated Strength: Selected to suit applicable load criteria.
5. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

D. Conduit and Cable Support Devices: Steel, Stainless-steel or Glass-fiber-resin hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as

required to suit individual conductors or cables supported. Body shall be made of malleable iron.

F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.

G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: Stainless-steel springhead type.
7. Hanger Rods: Threaded steel.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems unless requirements in this Section are stricter.

B. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

C. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMTs, IMCs, and RMCs as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

D. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.

B. 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.

C. 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. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
6. To Light Steel: Sheet metal screws.
7. 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.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for 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.

END OF SECTION 260529

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Surface raceways.
6. Boxes, enclosures, and cabinets.

1.2 DEFINITIONS

A. EMT: Electrical metallic tubing

B. FMC: Flexible metal conduit

C. GRC: Galvanized rigid steel conduit.

D. MC: Metal Clad Cable

E. LFMC: Liquid-tight flexible metal conduit

F. RNC: Rigid nonmetallic conduit

1.3 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. GRC: Comply with ANSI C80.1 and UL 6.

C. MC: Comply with UL 1569 and NEC article 330.

D. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

1. Comply with NEMA RN 1,
2. External PVC Coating Thickness: 0.040 inch, minimum.
3. Internal urethane coating Thickness: 0.002 inch, minimum.
4. Hot dipped galvanized threads
5. PVC Coating shall be of the same manufacturer of the conduit.

E. EMT: Comply with ANSI C80.3 and UL 797.

F. FMC: Comply with UL 1; single strip, continuous, flexible interlocked double-wrapped steel, galvanized inside and outside forming smooth internal wiring channel.

G. LFMC: Flexible steel conduit with PVC jacket, UV stable, machine tool gray in color, lightweight aluminum core internal construction and complying with UL 360.

H. Fittings for Metal Conduit Comply with NEMA FB 1 and UL 514:

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
2. Fittings for EMT:
   a. Material: Steel.
   b. Type: Set screw.
3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
4. Fittings for PVC-coated Rigid Steel Conduits: Minimum PVC thickness of 0.040 inch, 0.002 inch thickness of internal urethan, overlapping sleeves protecting threaded joints. All conduit bodies shall be NEMA 4x Rated with encapsulated stainless steel screws.
5. Fittings for LFMC: Body, gland and lock nut shall be steel of malleable iron. Ground cone shall be steel, sealing ring and insulator shall be blue molded thermoplastic at 150°C (221°F) maximum.
6. Fittings for GRC: Threaded rigid steel conduit fittings. Comply with NEMA FB 2.10.

I. Joint Compound for GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

A. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. RNC: Type EPC-40-PVC for 90°C, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

C. Materials must have tensile strength of 7,000-7,200 psi at 73.4°F, flexural strength of 12,000 psi and compressive strength of 9,000 psi.

D. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

E. Raceway, fittings, and cement must be produced by the same manufacturer who must have had a minimum of ten (10) years' experience in manufacturing of these products.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

C. Wireway Covers: Hinged cover secured with captive screws unless otherwise indicated.

D. Finish: Manufacturer's standard enamel finish NEMA 250 rated.

2.4 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

A. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.

C. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.

D. Solvents and Adhesives: As recommended by conduit manufacturer.

2.5 SURFACE RACEWAYS

A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Surface Metal Raceways:
   1. Refer to drawings for location(s), type(s), and quantity(s) of surface metal raceway.
      a. Surface finish: be satin, anodized #204 type clear, Class R1 mil-Spec with minimum anodized finish of .004" unless otherwise noted.

C. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.

2.6 BOXES, ENCLOSURES, AND CABINETS

A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1.

D. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

E. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.

F. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb.

   1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

I. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

J. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.

K. Gangable boxes are allowed.

L. 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.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.7 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by an independent testing agency.
2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

2.8 MANUFACTURERS

A. Raceway and Fitting Manufacturers: subject to compliance with requirements, provide products by one of the following (no exceptions):

1. Wheatland Tube
2. Allied Tube & Conduit
3. Thomas & Betts
4. Hubble
5. Legrand
6. Calbond
7. Western Tube and Conduit
8. Republic Conduit

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. The following application must be adhered to. Raceways installed that are not conforming to this listing must be removed and replace with specified material at no additional expense.

Raceway Types	Applications
Galvanized Rigid Steel Conduit (GRC)	Where exposed to mechanical injury, where specifically required; indoors where exposed to

Raceway Types	Applications
	moisture; where required by codes and for all circuits in excess of 600 volts. Outdoor locations, sump and ejector pits, elevator pits, loading docks, garage, rooftops and gymnasium.
PVC Coated Galvanized Rigid Steel Conduit (GRC)	Where exposed to extreme outdoor and indoor corrosion and or weather conditions: Stub out of Concrete applications. In applications where two (2) UL Listed Layers of Corrosion protection is required and Hot Dipped Galvanized Conduit as Primary Protection is listed PVC Coating is listed as Primary Corrosion is also UL Listed.
Electrical Metallic tubing (EMT)	Use in every instance except where another material is not specified.
Metal Clad Cable (MC)	Lighting and receptacle branch circuits concealed in dry hollow spaces of a building. May not be used in areas where it would be subjected to physical damage, or where prohibited by Code.
Flexible Metal Conduit	Use in dry areas for connections to lighting fixtures in hung ceilings, connections to equipment installed in removable panels of hung ceilings; at all transformer or equipment raceway connections where sound and vibration isolation is required.
Liquid-Tight Flexible Metal Conduit	Use in areas subject to moisture where flexible metal conduit is unacceptable, at connections to all motors, and all raised floor areas.
Rigid Non-Metallic Conduit	Schedule 40 - Where raceways are in a slab below grade levels; for raceway duct banks. Schedule 80 - For underground raceways outside of the building which are not encased in concrete.
Wireways and Auxiliary Gutters	Where indicated on the Contract Documents and as otherwise specifically required.
Boxes and Enclosures	NEMA 250, Type 1, except use NEMA 250, Type 4 in kitchens and damp/or wet locations. Outdoors use NEMA 250, Type 3R.

B. Provide separate raceways for all wiring systems, including security, data, paging, low voltage et al. All 480Y/277 volt wiring must be kept independent of 208Y/120 volt wiring. Emergency system wiring must be kept independent of the normal system wiring. Provide grounding conductor within all circuits. Minimum size 3/4-inch for home runs and 1-inch minimum for power distribution. Wiring of each type and system must be installed in separate raceways.

C. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid Galvanized Steel Conduit (GRC): Use threaded rigid steel conduit fittings. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use setscrew steel fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

D. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

E. Install surface raceways only where indicated on Drawings.

F. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.

G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. Support conduit within 12 inches of enclosures to which attached.

I. Provide one (1) empty 3/4-inch raceway for each three (3) spare unused poles or spaces of each flush-mounted panelboard. Terminate empty 3/4-inch conduits in a junction box, which after completion is accessible to facilitate future branch circuit extension. Provide pull lines in each raceway.

J. Raceways in hung ceilings shall be installed on and secured to the slab or primary structural members of the ceiling, not to lathing channels or T-bars, Z-bars or other elements which are direct supports of the ceiling panels. Secure conduit firmly to the steel with clips and fittings

designed for that purpose. Install as high as possible but not less than 1'-0" above the hung ceilings.

K. Raceways Embedded in Slabs:

1. Install no raceway in the concrete slab except with the permission of the Structural Engineer and written consent of the Owner.
2. Do not install raceways larger than 1-1/4-inch size in structural concrete slabs.
3. In no case will the installation of raceways be permitted to interfere with proper placement of principal reinforcement.
4. Place raceways in the structural slabs between the upper and lower layers of reinforcing steel. Careful bending of the conduits is required.
5. Space the raceways embedded in concrete slabs not less than eight (8) inches on centers and as widely spaced as possible where they converge at panels or junction boxes.
6. Install raceways running parallel to slabs supports, such as beams, columns and structural walls, not less than 12 inches from such supporting elements.
7. Secure saddle supports for conduit, outlet boxes, junction boxes, inserts, etc. with suitable adhesives during concrete pour of the slab to prevent displacement.
8. Arrange raceways to cross building expansion joints at right angles with expansion fittings.

L. Stub-ups to Above Recessed Ceilings:

1. Use EMT for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

M. 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.

N. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

O. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

P. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

Q. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

R. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

S. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

T. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

U. Surface Raceways:

1. Install surface raceway with a minimum 2-inch radius control at bend points.
2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

V. Install raceway sealing fittings at accessible locations according to NFPA 70 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 according to NFPA 70.

W. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Where otherwise required by NFPA 70.

X. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

Y. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
   c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

Z. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

AA. OUTLET, JUNCTION, AND PULL BOXES

1. Provide outlet, junction, and pull boxes as indicated on the Contract Documents and as required for the complete installation of the various electrical systems, and to facilitate proper pulling of the cables. Size the junction boxes and pull boxes per the NEC. Size the boxes on any empty conduit systems as if containing conductors of No.4 AWG.

2. The exact location of outlets and equipment is governed by the structural conditions and obstructions, or other equipment items. When necessary, relocate outlets so that when fixtures or equipment are installed, they will be symmetrically located according to the room layout and will not interfere with other work or equipment. Verify final location of outlets, panels equipment, etc., with the Architect prior to installation.

3. Back-to-back outlets in the same wall, or "thru-wall" type boxes are not permitted. Provide 12-inch minimum spacing for outlets shown on opposite sides of a common wall to minimize sound transmission.

4. Fit outlet boxes in finished ceilings or walls with appropriate covers, set flush with the finished surface. Where more than one (1) switch or device is located at one (1) point, use gang boxes and covers unless otherwise indicated. Sectional switch boxes or utility boxes are not permitted. Provide tile box or 4 inch square box with tile ring in masonry walls not plastered or furred. Where drywall material is utilized, provide plaster ring. Provide outlet boxes of type and size suitable for the specific application. Where outlet boxes contain two (2) or more 277 volt devices, or where devices occur of different applied voltages, or where normal and emergency devices occur in the same box, provide suitable barrier(s).

5. All outlet and device box depths shall have sufficient depth to prevent damage to the conductors when devices or utilization equipment are installed as intended in the box.

6. Types of Boxes and Fittings for Various Locations:

Location	Type
Outlet	Galvanized pressed steel
Outlet exposed to moisture or outdoors	Cast type conduit fitting
Splice	Galvanized pressed steel
Splice exposed to moisture or outdoors	Cast type conduit fitting or sheet metal (4½" x 5" x 3" minimum)
Pull or Junction	Cast type conduit fitting or sheet metal (4½" x 5" x 3" minimum)

Location	Type
Pull or Junction - Outdoors	Aluminum (4½" x 5" x 3" minimum)
Terminal	Sheet steel (6" x 6" x 3" minimum)
Terminal - Outdoors	Aluminum (6" x 6" x 3" minimum)

BB. PULL BOX SPACING

1. Provide pull boxes so no individual conduit run contains more than the equivalent of four (4) quarter bends (360° total).

2. Conduit Sizes 1¼" and Larger:
   a. Provide boxes to prevent cable from being excessively twisted, stretched or flexed during installation.
   b. Provide boxes so that maximum pulling tensions do not exceed the cable manufacturer's recommendations.
   c. Provide support racks for boxes with multiple sets of conductors so that the conductors do not rest on any metal work inside the box.
3. Conduit Sizes 1 inch and Smaller, provide boxes at every (Maximum Distances):

Distance	Run Type
150 feet	straight runs
100 feet	runs with one (1) 90° bend or equivalent
75 feet	runs with two (2) 90° bends or equivalent
50 feet	runs with three (3) or (4) four 90° bends or equivalent.

CC. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

DD. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

EE. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

FF. Locate boxes so that cover or plate will not span different building finishes.

GG. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

HH. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

II. Set metal floor boxes level and flush with finished floor surface.

JJ. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified elsewhere in the project specifications for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified elsewhere in the project specifications.
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified elsewhere in the project specifications.
4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
    a. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
5. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.5 FIRESTOPPING

A. Install firestopping at penetrations of all fire-rated floor and wall assemblies, per the project specifications.

3.6 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

1.2 SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

F. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.
2. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

2.3 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.4 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install 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.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 260544

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Color and legend requirements for raceways, conductors, and warning labels and signs.
2. Labels.
3. Bands and tubes.
4. Tapes and stencils.
5. Tags.
6. Signs.
7. Cable ties.
8. Paint for identification.
9. Fasteners for labels and signs.

1.2 SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.

B. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

C. Delegated-Design Submittal: For arc-flash hazard study.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Comply with NFPA 70E requirements for arc-flash warning labels.

F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.

1. Color shall be factory applied.
2. Colors for 208/120-V Circuits:
   a. Phase A: Black.
   b. Phase B: Red.
   c. Phase C: Blue.
3. Colors for 240-V Circuits:
   a. Phase A: Black.
   b. Phase B: Red.
4. Colors for 480/277-V Circuits:
   a. Phase A: Brown.
   b. Phase B: Orange.
   c. Phase C: Yellow.
5. Color for Neutral: White.
6. Color for Equipment Grounds: Green.
7. Colors for Isolated Grounds: Green with white stripe.

C. Warning Label Colors:

1. Identify system voltage with black letters on an orange background.

D. Warning labels and signs 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. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.3 LABELS

A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.

C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil-thick, polyester or vinyl flexible label with acrylic pressure-sensitive adhesive.

1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
2. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

D. Self-Adhesive Labels: Polyester or Vinyl, thermal, transfer-printed, 3-mil-thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

1. Minimum Nominal Size:
   a. 1-1/2 by 6 inches for raceway and conductors.
   b. 3-1/2 by 5 inches for equipment.
   c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBES

A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameters sized to suit diameters and that stay in place by gripping action.

B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at a maximum of 200 deg F. Comply with UL 224.

2.5 TAPES AND STENCILS

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.

C. Tape and Stencil: 4-inch-wide black stripes on 10-inch centers placed diagonally over orange background and is 12 inches wide. Stop stripes at legends.

D. Floor Marking Tape: 2-inch-wide, 5-mil pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

E. Underground-Line Warning Tape:

1. Tape:
   a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
   b. Printing on tape shall be permanent and shall not be damaged by burial operations.

c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.

2. Color and Printing:
   a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
   b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
   c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".

F. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.6 TAGS

A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

B. Nonmetallic Preprinted Tags: Polyethylene tags, 0.015-inch-thick, color-coded for phase and voltage level, with factory printed permanent designations; punched for use with self-locking cable tie fastener.

C. Write-on Tags:

1. Polyester Tags: 0.010-inch-thick, with corrosion-resistant grommet and cable tie for attachment.
2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.7 SIGNS

A. Baked-Enamel Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal Size: 7 by 10 inches.

B. Metal-Backed Butyrate Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal Size: 10 by 14 inches.

C. Laminated Acrylic or Melamine Plastic Signs:

1. Engraved legend.

2. Thickness:
   a. For signs up to 20 sq. in., minimum 1/16 inch.
   b. For signs larger than 20 sq. in., 1/8 inch thick.
   c. Engraved legend with black letters on white face.
   d. Punched or drilled for mechanical fasteners with 1/4-inch grommets in corners for mounting.
   e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.8 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black, except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black.

C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D 638: 7000 psi.
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F.
5. Color: Black.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

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 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of each item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.

1. Secure tight to surface of conductor, cable, or raceway.

H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

I. Emergency Operating Instruction Signs: 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.

J. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

K. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:

1. "EMERGENCY POWER."
2. "POWER."
3. "UPS."

L. Vinyl Wraparound Labels:

1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.

M. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.

N. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.

O. Self-Adhesive Labels:

1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.

P. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.

Q. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.

R. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.

S. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.

1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

T. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

U. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.

V. Underground Line Warning Tape:

1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
2. Limit use of underground-line warning tape to direct-buried cables.

W. Metal Tags:

1. Place in a location with high visibility and accessibility.

X. Nonmetallic Preprinted Tags:

1. Place in a location with high visibility and accessibility.

Y. Baked-Enamel Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2 inches high.

Z. Metal-Backed Butyrate Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.

AA. Laminated Acrylic or Melamine Plastic Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.

BB. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

END OF SECTION 260553

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Lighting and appliance branch-circuit panelboards.

1.2 DEFINITIONS

A. ATS: Acceptance testing specification.

B. GFCI: Ground-fault circuit interrupter.

C. GFEP: Ground-fault equipment protection.

D. HID: High-intensity discharge.

E. MCCB: Molded-case circuit breaker.

F. SPD: Surge protective device.

G. VPR: Voltage protection rating.

1.3 SUBMITTALS

A. Product Data: For each type of panelboard.

1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.
5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Include evidence of NRTL listing for SPD as installed in panelboard.
7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
8. Include wiring diagrams for power, signal, and control wiring.
9. Key interlock scheme drawing and sequence of operations.

10. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

C. Qualification Data: For testing agency.

D. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in other sections, include the following:
   a. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
   b. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Two spares for each type of panelboard cabinet lock.
2. Circuit Breakers Including GFCI and GFEP Types: Two spares for each panelboard.
3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: ISO 9001 or 9002 certified.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Handle and prepare panelboards for installation according to NEMA PB 1.

1.8 FIELD CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
   a. Ambient Temperature: Not exceeding 23 deg F to plus 104 deg F.
   b. Altitude: Not exceeding 6600 feet.

B. 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 five business days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without Owner's written permission.
3. Comply with NFPA 70E.

1.9 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.

PART 2 - PRODUCTS

2.1 PANELBOARDS AND LOAD CENTERS COMMON REQUIREMENTS

A. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

B. 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.

C. Comply with NEMA PB 1.

D. Comply with NFPA 70.

E. Enclosures: Flush and Surface-mounted, dead-front cabinets.

1. Rated for environmental conditions at installed location.
   a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
   b. Outdoor Locations: NEMA 250, Type 3.
   c. Kitchen and Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
   d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
   e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
2. Height: 84 inches maximum.
3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.

4. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
5. Finishes:
   a. Panels and Trim: Galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
   b. Back Boxes: Galvanized steel.
   c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.

F. Incoming Mains:

1. Location: Convertible between top and bottom.
2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.

G. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity, depending on rating of panelboard.
   a. Plating shall run entire length of bus.
   b. Bus shall be fully rated the entire length.
2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
4. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
5. Split Bus: Vertical buses divided into individual vertical sections.

H. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Terminations shall allow use of 75 deg C rated conductors without derating.
3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
6. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
7. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate on load side of main device unless otherwise noted on plans.
8. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.

I. NRTL Label: Panelboards or load centers shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers shall have meter enclosures,

wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.

J. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

1. Percentage of Future Space Capacity: See drawings.

K. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

2.2 PERFORMANCE REQUIREMENTS

A. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 1 or Type 2.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Approved manufacturers:
1. Eaton
2. Square D
3. Siemens
4. General Electric

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker or lugs only.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Electronic Trip Circuit Breakers:
   a. 100 percent rated
   b. RMS sensing.
   c. Field-replaceable rating plug or electronic trip.

d. Digital display of settings, trip targets, and indicated metering displays.
e. Multi-button keypad to access programmable functions and monitored data.
f. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
g. Integral test jack for connection to portable test set or laptop computer.
h. Field-Adjustable Settings:
1) Instantaneous trip.
2) Long- and short-time pickup levels.
3) Long and short time adjustments.
4) Ground-fault pickup level, time delay, and I squared T response.

2. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
3. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
4. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
5. Subfeed Circuit Breakers: Vertically mounted.
6. MCCB Features and Accessories:
a. Standard frame sizes, trip ratings, and number of poles.
b. Breaker handle indicates tripped status.
c. UL listed for reverse connection without restrictive line or load ratings.
d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
g. Communication Capability: Circuit-breaker-mounted or integral communication module with functions and features compatible with power monitoring and control system.
h. Shunt Trip: 24-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
i. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
j. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 amperes shall have interchangeable rating plugs or electronic adjustable trip units.
k. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
l. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
m. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.
n. Multipole units enclosed in a single housing with a single handle or factory assembled to operate as a single unit.
o. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in off position.

2.5 IDENTIFICATION

A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

C. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.

1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.

B. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.

D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Comply with NECA 1.

C. Install panelboards and accessories according to NEMA PB 1.1.

D. Equipment Mounting:

1. Attach panelboard to the vertical finished or structural surface behind the panelboard.

E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

F. Mount top of trim at a height so that the operating handle of the top-most switch or circuit breaker, in ON position, is not higher than 79 inches (2000 mm) above finished floor or grade, unless otherwise indicated.

G. Mount panelboard cabinet plumb and rigid without distortion of box.

H. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

I. Mount surface-mounted panelboards to steel slotted supports 5/8 inch in depth. Orient steel slotted supports vertically.

J. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.
2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.

K. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

L. Install filler plates in unused spaces.

M. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.

N. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with the project specification requirements for identification.

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with the project specifications.

D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with the project specifications.

E. Install warning signs complying with requirements of the project specifications.

3.4 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. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers and low-voltage surge arrestors stated in NETA ATS, Paragraph 7.6 Circuit Breakers and Paragraph 7.19.1 Surge Arrestors, Low-Voltage. Do not perform optional tests. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:
    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in the Electrical Power System Study, required per specification section 260573 and furnished by the Electrical Contractor.

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Engineer of effect on phase color coding.

1. Measure loads during period of normal facility operations.
2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Owner.
3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.
5. Update panelboard directories, accordingly, and provide updated directories to Owner within five business days of load balancing.

3.6 PROTECTION

A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416