STATE OF DELAWARE
OMB / DIVISION OF FACILITIES MANAGEMENT
OMB / DFM CONTRACT # MC5508000005A

SPECIFICATIONS
FOR

COOLING TOWER REPLACEMENT

AT

TRANSPORTATION MANAGEMENT CENTER

169 BRICK STORE LANDING ROAD
SMYRNA, DE 19977

FOR

DELAWARE DEPARTMENT OF TRANSPORTATION

PREPARED
BY

STUDIO JAED ARCHITECTS AND ENGINEERS
2500 WRANGLE HILL ROAD
BEAR, DE 19701
STUDIO JAED PROJECT # 25045

ISSUED FOR BIDDING
DECEMBER 19, 2025

NOT FOR BIDDING

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SECTION 00 01 07

SEALS PAGE

MECHANICAL ENGINEER:

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ASSOCIATE
STUDIO JAED ARCHITECTS & ENGINEERS
2500 WRANGLE HILL ROAD, SUITE 110
BEAR, DE 19701
(302) 832-1652
RESPONSIBLE FOR DIVS. 00 THROUGH 48 WITH EXCEPTIONS NOTED

ELECTRICAL ENGINEER:

JOE DONOHOE, P.E.
DE LICENSE NO. 25876
ELECTRICAL ENGINEER
STUDIO JAED ARCHITECTS & ENGINEERS
2500 WRANGLE HILL ROAD, SUITE 110
BEAR, DE 19701
(302) 832-1652
RESPONSIBLE FOR DIV. 26

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INVITATION TO BID

Sealed bids for **OMB/DFM Contract No. MC5508000005A – Transportation Management Center – Cooling Tower Replacement** will be received by the State of Delaware, Office of Management and Budget, Division of Facilities Management, by way of the Bonfire Portal at https://DFM.bonfirehub.com until **1:00 PM local time on October 13, 2026**. Bidder bears the risk of late submission.

Bids will be opened and read aloud at 2:00 PM local time on October 13, 2026 at the Haslet Armory, 122 Martin Luther King Blvd S., Dover, DE 19901.

The project involves the replacement of a cooling tower and associated modifications.

A **MANDATORY** Pre-Bid Meeting will be held at **10:00 AM local time on September 25, 2026,** at the Transportation Management Center, 169 Brick Store Landing Road, Smyrna, DE 19977, for the purpose of establishing the list of subcontractors and to answer questions. Upon arrival, attendees are to check in at reception desk for directions to pre-bid meeting room. Representatives of each party to any Joint Venture must attend this meeting. **ATTENDANCE OF THIS MEETING IS A PREREQUISITE FOR BIDDING ON THIS CONTRACT.**

Contract documents may be obtained at Reprographics Center, Inc., 298 Churchmans Road, New Castle, DE 19720, phone (302) 328-5019, upon receipt of $250.00 per paper set or $75.00 per electronic set, non-refundable. Checks are to be made payable to "StudioJAED".

Bidders will not be subject to discrimination on the basis of race, creed, color, sex, sexual orientation, gender identity or national origin in consideration of this award, and Minority Business Enterprises, Disadvantaged Business Enterprises, Women-Owned Business Enterprises and Veteran-Owned Business Enterprises will be afforded full opportunity to submit bids on this contract. Each bid must be accompanied by a bid security equivalent to ten percent of the bid amount and all additive alternates. The successful bidder must post a performance bond and payment bond in a sum equal to 100 percent of the contract price upon execution of the contract. The Owner reserves the right to reject any or all bids and to waive any informalities therein. The Owner may extend the time and place for the opening of the bids from that described in the advertisement, with not less than two calendar days' notice by certified delivery, facsimile machine or other electronic means to those bidders receiving plans.

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INSTRUCTIONS TO BIDDERS

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ARTICLE 1: GENERAL

1.1 DEFINITIONS

1.1.1 Whenever the following terms are used, their intent and meaning shall be interpreted as follows:

1.2 STATE: The State of Delaware.

1.3 AGENCY: Contracting State Agency as noted on cover sheet.

1.4 DESIGNATED OFFICIAL: The agent authorized to act for the Agency.

1.5 BIDDING DOCUMENTS: Bidding Documents include the Bidding Requirements and the proposed Contract Documents. The Bidding Requirements consist of the Advertisement for Bid, Invitation to Bid, Instructions to Bidders, Supplementary Instructions to Bidders (if any), General Conditions, Supplementary General Conditions, General Requirements, Special Provisions (if any), the Bid Form (including the Non-collusion Statement), and other sample bidding and contract forms. The proposed Contract Documents consist of the form of Agreement between the Owner and Contractor, as well as the Drawings, Specifications (Project Manual) and all Addenda issued prior to execution of the Contract.

1.6 CONTRACT DOCUMENTS: The Contract Documents consist of the, Instructions to Bidders, Supplementary Instructions to Bidders (if any), General Conditions, Supplementary General Conditions, General Requirements, Special Provisions (if any), the form of agreement between the Owner and the Contractor, Drawings (if any), Specifications (Project Manual), and all addenda.

1.7 AGREEMENT: The form of the Agreement shall be AIA Document A101, Standard Form of Agreement between Owner and Contractor where the basis of payment is a STIPULATED SUM. In the case of conflict between the instructions contained therein and the General Requirements herein, these General Requirements shall prevail.

1.8 GENERAL REQUIREMENTS (or CONDITIONS): General Requirements (or conditions) are instructions pertaining to the Bidding Documents and to contracts in general. They contain, in summary, requirements of laws of the State; policies of the Agency and instructions to bidders.

1.9 SPECIAL PROVISIONS: Special Provisions are specific conditions or requirements peculiar to the bidding documents and to the contract under consideration and are supplemental to the General Requirements. Should the Special Provisions conflict with the General Requirements, the Special Provisions shall prevail.

1.10 ADDENDA: Written or graphic instruments issued by the Owner/Architect prior to the execution of the contract which modify or interpret the Bidding Documents by additions, deletions, clarifications or corrections.

1.11 BIDDER OR VENDOR: A person or entity who formally submits a Bid for the material or Work contemplated, acting directly or through a duly authorized representative who meets the requirements set forth in the Bidding Documents.

1.12 SUB-BIDDER: A person or entity who submits a Bid to a Bidder for materials or labor, or both for a portion of the Work.

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1.13 BID: A complete and properly executed proposal to do the Work for the sums stipulated therein, submitted in accordance with the Bidding Documents.

1.14 BASE BID: The sum stated in the Bid for which the Bidder offers to perform the Work described in the Bidding Documents as the base, to which Work may be added or from which Work may be deleted for sums stated in Alternate Bids (if any are required to be stated in the bid).

1.15 ALTERNATE BID (or ALTERNATE): An amount stated in the Bid, where applicable, 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.

1.16 UNIT PRICE: An amount stated in the Bid, where applicable, as a price per unit of measurement for materials, equipment or services or a portion of the Work as described in the Bidding Documents.

1.17 SURETY: The corporate body which is bound with and for the Contract, or which is liable, and which engages to be responsible for the Contractor's payments of all debts pertaining to and for his acceptable performance of the Work for which he has contracted.

1.18 BIDDER'S DEPOSIT: The security designated in the Bid to be furnished by the Bidder as a guaranty of good faith to enter into a contract with the Agency if the Work to be performed or the material or equipment to be furnished is awarded to him.

1.19 CONTRACT: The written agreement covering the furnishing and delivery of material or work to be performed.

1.20 CONTRACTOR: Any individual, firm or corporation with whom a contract is made by the Agency.

1.21 SUBCONTRACTOR: An individual, partnership or corporation which has a direct contract with a contractor to furnish labor and materials at the job site, or to perform construction labor and furnish material in connection with such labor at the job site.

1.22 CONTRACT BOND: The approved form of security furnished by the contractor and his surety as a guaranty of good faith on the part of the contractor to execute the work in accordance with the terms of the contract.

1.23 CUSTOM FABRICATION: As defined in 29 Del. C. § 6902, the term “custom fabrication” means the offsite fabrication, assembly, or other production of non-standard goods or materials, including components, fixtures or parts thereof, specifically for a public works project. Such goods and materials shall include those used in the following trades or systems: (1) Plumbing or pipe fitting systems, including heating, ventilating, air-conditioning, refrigeration systems, sheet metal or other duct systems; (2) Electrical systems; (3) Mechanical insulation work; (4) Ornamental iron work; and (5) Commercial signage that does not attempt or appear to direct the movement of traffic on highways or roadways or interfere with, imitate, or resemble any official traffic sign, signal or device.

ARTICLE 2: BIDDER'S REPRESENTATION

2.1 PRE-BID MEETING

2.1.1 A pre-bid meeting for this project will be held at the time and place designated. Attendance at this meeting is a pre-requisite for submitting a Bid, unless this requirement is specifically waived elsewhere in the Bid Documents.

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2.2 By submitting a Bid, the Bidder represents that:

2.2.1 The Bidder has read and understands the Bidding Documents and that the Bid is made in accordance therewith.

2.2.2 The Bidder has visited the site, become familiar with existing 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.

2.2.3 The Bid is based upon the materials, equipment, and systems required by the Bidding Documents without exception.

2.2.4 Bidder has accounted for the possibility of price increases due to the direct and indirect effect of tariffs, other international events, inflation, and supply chain interruptions. Change Orders will be denied if they are based upon any of these events. Bidder is expected to account for these possibilities and include them in the bid.

2.3 JOINT VENTURE REQUIREMENTS

2.3.1 For Public Works Contracts, each Joint Venturer shall be qualified and capable to complete the Work with their own forces.

2.3.2 Included with the Bid submission, and as a requirement to bid, a copy of the executed Joint Venture Agreement shall be submitted and signed by all Joint Venturers involved.

2.3.3 All required Bid Bonds, Performance Bonds, Material and Labor Payment Bonds must be executed by both Joint Venturers and be placed in both of their names.

2.3.4 All required insurance certificates shall name both Joint Venturers.

2.3.5 Both Joint Venturers shall sign the Bid Form.

2.3.6 Both Joint Venturers shall include their Federal E.I. Number with the Bid.

2.3.7 In the event of a mandatory Pre-bid Meeting, each Joint Venturer shall have a representative in attendance.

2.3.8 Due to exceptional circumstances and for good cause shown, one or more of these provisions may be waived at the discretion of the State.

2.4 ASSIGNMENT OF ANTITRUST CLAIMS

2.4.1 As consideration for the award and execution by the Owner of this contract, the Contractor hereby grants, conveys, sells, assigns and transfers to the State of Delaware all of its right, title and interests in and to all known or unknown causes of action it presently has or may now or hereafter acquire under the antitrust laws of the United States and the State of Delaware, relating to the particular goods or services purchased or acquired by the Owner pursuant to this contract.

ARTICLE 3: BIDDING DOCUMENTS

3.1 COPIES OF BID DOCUMENTS

3.1.1 Bidders may obtain complete sets of the Bidding Documents from the Architectural/Engineering firm designated in the Advertisement or Invitation to Bid in the number and for the deposit sum, if any, stated therein.

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3.1.2 Bidders shall use complete sets of Bidding Documents for preparation of Bids. The issuing Agency nor the Architect assumes no responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

3.1.3 Any errors, inconsistencies or omissions discovered shall be reported to the Architect immediately.

3.1.4 The Agency and Architect 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

3.2.1 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 report any errors, inconsistencies, or ambiguities discovered to the Architect.

3.2.2 Bidders or Sub-bidders requiring clarification or interpretation of the Bidding Documents shall make a written request to the Architect at least seven days prior to the date for receipt of Bids. Interpretations, corrections and changes to the Bidding Documents will be made by written Addendum. Interpretations, corrections, or changes to the Bidding Documents made in any other manner shall not be binding.

3.2.3 The apparent silence of the specifications as to any detail, or the apparent omission from it of detailed description concerning any point, shall be regarded as meaning that only the best commercial practice is to prevail and only material and workmanship of the first quality are to be used. Proof of specification compliance will be the responsibility of the Bidder.

3.2.4 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for all permits, labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for the proper execution and completion of the Work.

3.2.5 The Owner will bear the costs for all impact and user fees associated with the project.

3.3 SUBSTITUTIONS

3.3.1 The materials, products and equipment described in the Bidding Documents establish a standard of quality, required function, dimension, and appearance to be met by any proposed substitution. The specification of a particular manufacturer or model number is not intended to be proprietary in any way. Substitutions of products for those named will be considered, providing that the Vendor certifies that the function, quality, and performance characteristics of the material offered is equal or superior to that specified. It shall be the Bidder's responsibility to assure that the proposed substitution will not affect the intent of the design, and to make any installation modifications required to accommodate the substitution.

3.3.2 Requests for substitutions shall be made in writing to the Architect at least ten days prior to the date of the Bid Opening. Such requests shall include a complete description of the proposed substitution, drawings, performance and test data, explanation of required installation modifications due the substitution, and any other information necessary for an evaluation. The burden of proof of the merit of the proposed substitution is upon the proposer. The Architect’s decision of approval or disapproval shall be final. The Architect is to notify Owner prior to any approvals.

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3.3.3 If the Architect approves a substitution prior to the receipt of Bids, such approval shall be set forth in an Addendum. Approvals made in any other manner shall not be binding.

3.3.4 The Architect shall have no obligation to consider any substitutions after the Contract award.

3.4 ADDENDA

3.4.1 Addenda will be mailed or delivered to all who are known by the Architect to have received a complete set of the Bidding Documents.

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

3.4.3 No Addenda will be issued later than 2 calendar days prior to the date for receipt of Bids except an Addendum withdrawing the request for Bids or one which extends the time or changes the location for the opening of bids.

3.4.4 Each bidder shall ascertain prior to submitting his Bid that they have received all Addenda issued, and shall acknowledge their receipt in their Bid in the appropriate space. Not acknowledging an issued Addenda could be grounds for determining a bid to be non-responsive.

ARTICLE 4: BIDDING PROCEDURES

4.1 PREPARATION OF BIDS

4.1.1 Submit the bids on the Bid Forms included with the Bidding Documents.

4.1.2 Submit the original Bid Form for each bid. Bid Forms may be removed from the project manual for this purpose.

4.1.3 Execute all blanks on the Bid Form.

4.1.4 Where so indicated by the makeup on the Bid Form, express sums in both words and figures, in case of discrepancy between the two, the written amount shall govern.

4.1.5 BID ALL REQUESTED ALTERNATES AND UNIT PRICES, IF ANY. If there is no change in the Base Bid for an Alternate, enter “No Change”. The Contractor is responsible for verifying that they have received all addenda issued during the bidding period. Work required by Addenda shall automatically become part of the Contract.

4.1.6 Make no additional stipulations on the Bid Form and do not qualify the Bid in any other manner.

4.1.7 Each copy of the Bid shall include the legal name of the Bidder and a statement whether the Bidder is a sole proprietor, a partnership, a corporation, or any legal entity, and each 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 agent's authority to bind the Bidder.

4.1.8 Bidder shall complete the Non-Collusion Statement form included with the Bid Forms and include it with their Bid.

4.1.9 In the construction of all Public Works projects for the State of Delaware or any agency thereof, preference in employment of laborers, workers or mechanics shall be given to bona

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fide legal citizens of the State who have established citizenship by residence of at least 90 days in the State.

4.1.10 Each bidder shall include a signed Affidavit for the Bidder certifying compliance with OMB Regulation 4104 - "Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on "Large Public Works Projects." "Large Public Works" is based upon the current threshold required for bidding Public Works as set by the Purchasing and Contracting Advisory Council.

4.2 BID SECURITY

4.2.1 All bids shall be accompanied by a deposit of either a good and sufficient bond to the agency for the benefit of the agency, with corporate surety authorized to do business in this State, the form of the bond and the surety to be approved by the agency, or a security of the bidder assigned to the agency, for a sum equal to at least 10% of the bid plus all add alternates, or in lieu of the bid bond a security deposit in the form of a certified check, bank treasurer's check, cashier's check, money order, or other prior approved secured deposit assigned to the State. The bid bond need not be for a specific sum, but may be stated to be for a sum equal to 10% of the bid plus all add alternates to which it relates and not to exceed a certain stated sum, if said sum is equal to at least 10% of the bid. The Bid Bond form used shall be the standard OMB form (attached). The bid bond may be an electronic bond and need not be transmitted as a paper document.

4.2.2 The Agency has the right to retain the bid security of Bidders to whom an award is being considered until either a formal contract has been executed and bonds have been furnished or the specified time has elapsed so the Bids may be withdrawn or all Bids have been rejected.

4.2.3 In the event of any successful Bidder refusing or neglecting to execute a formal contract and bond within 20 days of the awarding of the contract, the bid bond or security deposited by the successful bidder shall be forfeited.

4.3 SUBCONTRACTOR LIST

4.3.1 In accordance with Title 29, Chapter 69, Section 6962(d)(10)b of the Delaware Code, each Bidder shall submit with their Bid a completed List of Sub-Contractors included with the Bid Form. NAME ONLY ONE SUBCONTRACTOR FOR EACH TRADE. The bidder must list **in each category** the full name and address (City & State) of the sub-contractor that the Bidder will be using to perform the work and provide material for that subcontractor category. Should the Bidder's listed subcontractor intend to provide any of their subcontractor category of work through a third-tier contractor, the Bidder shall list that third-tier contractor's full name and address (City & State). **If the Bidder intends to perform any category of work itself, it must list its full name and address.** For clarification, if the Bidder intends to perform the work themselves, the Bidder **may not** insert "not applicable", "N/A", "self" or anything other than its own full name and address (City & State). To do so shall cause the bid to be rejected. In addition, the failure to produce a completed subcontractor list with the bid submittal shall cause the bid to be rejected. If you have more than three (3) third-tier contractors to report in any subcontractor category, print out additional page(s) containing the appropriate category, complete the rest of your list of third-tier contractors for that category, notate the addition in parentheses as (CONTINUATION) next to the subcontractor category and an asterisk (*) next to any additional third-tier contractors, and submit it with your bid.

4.3.2 It is the responsibility of the Contractor to ensure that their Subcontractors are in compliance with the provisions of this law. Also, if a Contractor elects to list themselves as a Subcontractor for any category, they must specifically name themselves on the Bid Form

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and be able to document their capability to act as Subcontractor in that category in accordance with this law.

4.4 AFFIDAVIT OF CONTRACTOR QUALIFICATIONS

4.4.1 In accordance with Title 29, Chapter 69, Section 6962(d)(10)b.3 of the Delaware Code, each Bidder shall submit with their Bid the Affidavit of Contractor Qualifications certifying that the Bidder will abide by the contractor's qualifications outlined in the construction bid specifications for the duration of the contract term. After a contract has been awarded the successful bidder shall not substitute another subcontractor whose name was submitted on the Subcontractor Form except for the reasons in the statute and not without written consent from the awarding agency. Failure to utilize the subcontractors on the list will subject the successful bidder to penalties as outlined in the General Requirements Section 5.2 of the contract.

4.5 AFFIDAVIT OF CRAFT TRAINING COMPLIANCE

4.5.1 In accordance with Title 29, Chapter 69, Section 6962(c)(13) of the Delaware Code, contractors and subcontractors must provide craft training for journeyman and apprentice levels if **all** of the following apply:

A. A project meets the prevailing wage requirement under Title 29, Chapter 69, Section 6960 of the Delaware Code.
B. The contractor employs 10 or more total employees.
C. The project is not a federal highway project

Failure to provide required craft training on the project may subject the successful contractor and/or subcontractor(s) to penalties as outlined in Title 29, Chapter 69, Section 6962(c)(13) of the Delaware Code.

Bidders shall submit the Affidavit of Craft Training Compliance prior to contract execution.

4.6 EQUALITY OF EMPLOYMENT OPPORTUNITY ON PUBLIC WORKS

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

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

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

4.7 PREVAILING WAGE REQUIREMENT

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4.7.1 Wage Provisions: For renovation and new construction projects whose costs exceed the thresholds contained in Delaware Code, Title 29, Section 6960, the minimum wage rates for various classes of laborers and mechanics shall be as determined by the Department of Labor, Division of Industrial Affairs of the State of Delaware.

4.7.2 The employer shall pay all mechanics and labors employed directly upon the site of work, or engaged in custom fabrication work, as that term is defined in Article 1.23 herein and as also as defined in 29 Del. C § 6902 and described in 29 Del. C. § 6960(b), regardless of where the work is performed, unconditionally and not less often than once a week and without subsequent deduction or rebate on any account, the full amounts accrued at time of payment, computed at wage rates not less than those stated in the specifications, regardless of any contractual relationship which may be alleged to exist between the employer and such laborers and mechanics.

4.7.3 As per 29 Del. C. § 6960(b), the scale of the wages to be paid must be posted by the employer in a prominent and easily accessible place at the site of the work. There may be withheld from the employer so much of accrued payments as may be considered necessary by the Department of Labor to pay laborers and mechanics employed by the employer the difference between the rates of wages required by the contract to be paid laborers and mechanics on the work and rates of wages received by such laborers and mechanics to be remitted to the Department of Labor for distribution upon resolution of any claims.

4.7.4 Every contract based upon these specifications shall contain a stipulation that sworn payroll information, as required by the Department of Labor, be furnished weekly. The Department of Labor shall keep and maintain the sworn payroll information for a period of 6 months from the last day of the work week covered by the payroll.

4.8 SUBMISSION OF BIDS

4.8.1 Enclose the Bid, the Bid Security, and any other documents required to be submitted with the Bid.

4.8.2 Deposit Bids at the designated location prior to the time and date for receipt of bids indicated in the Advertisement for Bids. Bids received after the time and date for receipt of bids will be marked “LATE BID” and returned.

4.8.3 Bidder assumes full responsibility for timely delivery at location designated for receipt of bids.

4.8.4 Oral, telephonic, paper or telegraphic bids are invalid and will not receive consideration.

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

4.8.6 Compliance with Federal Bureau of Investigation rules mandates training for Contractors, Subcontractors, their employees, and custodial workers with access to locations that have access to Criminal Justice Information Services (CJIS). The contract awardee must have fingerprinting and background checks done for all Subcontractors and employees.

4.9 MODIFICATION OR WITHDRAW OF BIDS

4.9.1 Prior to the closing date for receipt of Bids, a Bidder may withdraw a Bid by personal request and by showing proper identification to the Architect. A request for withdraw by letter or fax, if the Architect is notified in writing prior to receipt of fax, is acceptable. A fax directing a modification in the bid price will render the Bid informal, causing it to be ineligible for

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consideration of award. Telephone directives for modification of the bid price shall not be permitted and will have no bearing on the submitted proposal in any manner.

4.9.2 Bidders submitting Bids that are late shall be notified as soon as practicable and the bid shall be returned.

4.9.3 A Bid may not be modified, withdrawn or canceled by the Bidder during a thirty (30) day period following the time and date designated for the receipt and opening of Bids, and Bidder so agrees in submitting their Bid. Bids shall be binding for 30 days after the date of the Bid opening.

ARTICLE 5: CONSIDERATION OF BIDS

5.1 OPENING/REJECTION OF BIDS

5.1.1 Unless otherwise stated, Bids received on time will be publicly opened and will be read aloud. An abstract of the Bids will be made available to Bidders.

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

5.1.3 If the Bids are rejected, it will be done within thirty (30) calendar days of the Bid opening.

5.2 COMPARISON OF BIDS

5.2.1 After the Bids have been opened and read, the bid prices will be compared and the result of such comparisons will be made available to the public. Comparisons of the Bids may be based on the Base Bid plus desired Alternates. The Agency shall have the right to accept Alternates in any order or combination.

5.2.2 The Agency reserves the right to waive technicalities, to reject any or all Bids, or any portion thereof, to advertise for new Bids, to proceed to do the Work otherwise, or to abandon the Work, if in the judgment of the Agency or its agent(s), it is in the best interest of the State.

5.2.3 An increase or decrease in the quantity for any item is not sufficient grounds for an increase or decrease in the Unit Price.

5.2.4 The prices quoted are to be those for which the material will be furnished F.O.B. Job Site and include all charges that may be imposed during the period of the Contract.

5.2.5 No qualifying letter or statements in or attached to the Bid, or separate discounts will be considered in determining the low Bid except as may be otherwise herein noted. Cash or separate discounts should be computed and incorporated into Unit Bid Price(s).

5.2.6 Bidder must account for the possibility of price increases due to the direct and indirect effect of tariffs or other international events, inflation, and supply chain interruptions. Change Orders will be denied if they are based upon any of these events. Bidder is expected to account for these possibilities and include them in the bid.

5.3 DISQUALIFICATION OF BIDDERS

5.3.1 An agency shall determine that each Bidder on any Public Works Contract is responsible before awarding the Contract. Factors to be considered in determining the responsibility of a Bidder include:

NOT FOR BIDDING

A. The Bidder's financial, physical, personnel or other resources including Subcontracts;

B. The Bidder's record of performance on past public or private construction projects, including, but not limited to, defaults and/or final adjudication or admission of violations of the Prevailing Wage Laws in Delaware or any other state;

C. The Bidder's written safety plan;

D. Whether the Bidder is qualified legally to contract with the State;

E. Whether the Bidder supplied all necessary information concerning its responsibility; and,

F. Any other specific criteria for a particular procurement, which an agency may establish; provided however, that, the criteria be set forth in the Invitation to Bid and is otherwise in conformity with State and/or Federal law.

G. Any Bidder who is debarred in another State and/or by the United States Government is also debarred in Delaware.

5.3.2 If an agency determines that a Bidder is nonresponsive and/or nonresponsible, the determination shall be in writing and set forth the basis for the determination. A copy of the determination shall be sent to the affected Bidder within five (5) working days of said determination.

5.3.3 In addition, any one or more of the following causes may be considered as sufficient for the disqualification of a Bidder and the rejection of their Bid or Bids.

5.3.3.1 More than one Bid for the same Contract from an individual, firm or corporation under the same or different names.

5.3.3.2 Evidence of collusion among Bidders.

5.3.3.3 Unsatisfactory performance record as evidenced by past experience.

5.3.3.4 If the Unit Prices are obviously unbalanced either in excess or below reasonable cost analysis values.

5.3.3.5 If there are any unauthorized additions, interlineation, conditional or alternate bids or irregularities of any kind which may tend to make the Bid incomplete, indefinite or ambiguous as to its meaning.

5.3.3.6 If the Bid is not accompanied by the required Bid Security and other data required by the Bidding Documents.

5.3.3.7 If any exceptions or qualifications of the Bid are noted on the Bid Form.

5.4 ACCEPTANCE OF BID AND AWARD OF CONTRACT

5.4.1 A formal Contract shall be executed with the successful Bidder within twenty (20) calendar days after the award of the Contract.

5.4.2 Per Section 6962(d)(13)a., Title 29, Delaware Code, "The contracting agency shall award any public works contract within thirty (30) days of the bid opening to the lowest

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responsive and responsible Bidder, unless the Agency elects to award on the basis of best value, in which case the election to award on the basis of best value shall be stated in the Invitation To Bid. Any public school district and its board shall award public works contracts in accordance with this section's requirements except it shall award the contract within 60 days of the bid opening."

5.4.3 Each Bid on any Public Works Contract must be deemed responsive by the Agency to be considered for award. A responsive Bid shall conform in all material respects to the requirements and criteria set forth in the Contract Documents and specifications.

5.4.4 The Agency shall have the right to accept Alternates in any order or combination, and to determine the low Bidder on the basis of the sum of the Base Bid, plus accepted Alternates.

5.4.5 The successful Bidder shall execute a formal contract, submit the required Insurance Certificate, and furnish good and sufficient bonds, unless specifically waived in the General Requirements, in accordance with the General Requirement, within twenty (20) days of official notice of contract award. The successful Bidder shall provide, at least two business days prior to contract execution, copies of the Employee Drug Testing Program for the Bidder and all listed Subcontractors. Bonds shall be for the benefit of the Agency with surety in the amount of 100% of the total contract award. Said Bonds shall be conditioned upon the faithful performance of the contract. Bonds shall remain in affect for period of two (2) years after the date of the Certificate of Final Payment.

5.4.6 If the successful Bidder fails to execute the required Contract, Bond and all required information, as aforesaid, within twenty (20) calendar days after the date of official Notice of the Award of the Contract, their Bid guaranty shall immediately be taken and become the property of the State for the benefit of the Agency as liquidated damages, and not as a forfeiture or as a penalty. Award will then be made to the next lowest qualified Bidder of the Work or readvertised, as the Agency may decide.

5.4.7 Each bidder shall supply with its bid its taxpayer identification number (i.e., federal employer identification number or social security number) and should the vendor be awarded a contract, such vendor shall provide to the agency the taxpayer identification license numbers of such subcontractors. Such numbers shall be provided on the later of the date on which such subcontractor is required to be identified or the time the contract is executed. The successful Bidder shall provide to the agency to which it is contracting, within 30 days of entering into such public works contract, copies of all Delaware Business licenses of subcontractors and/or independent contractors that will perform work for such public works contract. However, if a subcontractor or independent contractor is hired or contracted more than 20 days after the Bidder entered the public works contract the Delaware Business license of such subcontractor or independent contractor shall be provided to the agency within 10 days of being contracted or hired.

5.4.8 The Bid Security shall be returned to the successful Bidder upon the execution of the formal contract. The Bid Securities of unsuccessful bidders shall be returned within thirty (30) calendar days after the opening of the Bids.

ARTICLE 6: POST-BID INFORMATION

6.1 CONTRACTOR'S QUALIFICATION STATEMENT

6.1.1 Bidders to whom an award of a Contract is under consideration shall, if requested by the Agency, submit a properly executed AIA Document A305, Contractor's Qualification Statement, unless such a statement has been previously required and submitted.

NOT FOR BIDDING

6.2 Bidders to whom an award of a Contract has been made must produce their Delaware Business License before the Contract can be executed.

ARTICLE 7: PERFORMANCE BOND AND PAYMENT BOND

7.1 BOND REQUIREMENTS

7.1.1 The cost of furnishing the required Bonds, that are stipulated in the Bidding Documents, shall be included in the Bid.

7.1.2 If the Bidder is required by the Agency to secure a bond from other than the Bidder's usual sources, changes in cost will be adjusted as provide in the Contract Documents.

7.1.3 The Performance and Payment Bond forms used shall be the standard OMB forms (attached).

7.2 TIME OF DELIVERY AND FORM OF BONDS

7.2.1 The bonds shall be dated on or after the date of the Contract.

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

7.2.3 The Performance Bond and/or the Payment Bond may be electronic bonds and need not be transmitted as paper documents.

ARTICLE 8: FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR

8.1 Unless otherwise required in the Bidding Documents, the Agreement for the Work will be written on AIA Document A101, Standard Form of Agreement Between Owner and Contractor Where the Basis of Payment is a Stipulated Sum.

END OF SECTION

NOT FOR BIDDING

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BID FORM

COOLING TOWER REPLACEMENT
TRANSPORTATION MANAGEMENT CENTER
169 BRICK STORE LANDING ROAD, SMYRNA, DE 19977
CONTRACT # MC5508000005A

For Bids Due: _____ **To:** OMB / Division of Facilities Management
122 Martin Luther King Jr Blvd South
Dover, DE 19901

Name of Bidder: _____

Delaware Business License No.: _____ **Taxpayer ID No.:** _____

(Other License Nos.): _____

Phone No.: ( ) _____ - _____ **Fax No.: ( ) _____ - _____**

The undersigned, representing that he has read and understands the Bidding Documents and that this bid is made in accordance therewith, that he has visited the site and has familiarized himself with the local conditions under which the Work is to be performed, and that his bid is based upon the materials, systems and equipment described in the Bidding Documents without exception, hereby proposes and agrees to provide all labor, materials, plant, equipment, supplies, transport and other facilities required to execute the work described by the aforesaid documents for the lump sum itemized below:

$_____
($)

NOT FOR BIDDING

BID FORM

COOLING TOWER REPLACEMENT
TRANSPORTATION MANAGEMENT CENTER
169 BRICK STORE LANDING ROAD, SMYRNA, DE 19977
CONTRACT # MC5508000005A

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ALTERNATES

Alternate prices conform to applicable project specification section. Refer to specifications for a complete description of the following Alternates. An "ADD" or "DEDUCT" amount is indicated by the crossed-out part that does not apply.

ALTERNATE No. 1: Replace chemical treatment storage shed, and perform associated work as described in the documents.

Add/Deduct: _____

($)

UNIT PRICES

There are no unit prices.

ALLOWANCES

Allowances conform to applicable project specification section. Refer to the specifications for a complete description of the following Allowances:

ALLOWANCE No. 1: For general contingencies and repairs, the remaining balance of which is to be returned to owner by credit change order at project conclusion ($10,000).

Contractor to initial in acknowledgement of project allowance(s): _____

BID FORM

COOLING TOWER REPLACEMENT
TRANSPORTATION MANAGEMENT CENTER
169 BRICK STORE LANDING ROAD, SMYRNA, DE 19977
CONTRACT # MC5508000005A

I/We acknowledge Addendums numbered _____ and the price(s) submitted include any cost/schedule impact they may have.

This bid shall remain valid and cannot be withdrawn for thirty (30) days from the date of opening of bids (60 days for School Districts and Department of Education), and the undersigned shall abide by the Bid Security forfeiture provisions. Bid Security is attached to this Bid.

The Owner shall have the right to reject any or all bids, and to waive any informality or irregularity in any bid received.

This bid is based upon work being accomplished by the Sub-Contractors named on the list attached to this bid.

Should I/We be awarded this contract, I/We pledge to achieve substantial completion of all the work within _____calendar days of the Notice to Proceed.

The undersigned represents and warrants that he has complied and shall comply with all requirements of local, state, and national laws; that no legal requirement has been or shall be violated in making or accepting this bid, in awarding the contract to him or in the prosecution of the work required; that the bid is legal and firm; that he has not, directly or indirectly, entered into any agreement, participated in any collusion, or otherwise taken action in restraint of free competitive bidding.

Upon receipt of written notice of the acceptance of this Bid, the Bidder shall, within twenty (20) calendar days, execute the agreement in the required form and deliver the Contract Bonds, and Insurance Certificates, required by the Contract Documents.

I am / We are an Individual / a Partnership / a Corporation

By _____ Trading as _____
(Individual's / General Partner's / Corporate Name)

_____
(State of Corporation)

Business Address:_____
_____
_____
_____

Witness: _____ **By:** _____
(Authorized Signature)

(SEAL)

_____
(Title)

Date: _____

ATTACHMENTS

Sub-Contractor List
Non-Collusion Statement
Affidavit of Employee Drug Testing Program
Affidavit of Contractor Qualifications
Bid Security
(Others as Required by Project Manuals)

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BID FORM

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TRANSPORTATION MANAGEMENT CENTER
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CONTRACT # MC5508000005A

SUBCONTRACTOR LIST

In accordance with Title 29, Chapter 69, Section 6962(d)(10)b of the Delaware Code, the following subcontractor listing must accompany any bid submittal. The bidder must list **in each category** the full name and address (City & State) of the sub-contractor that the bidder will be using to perform the work and provide material for that subcontractor category. Should the bidder's listed subcontractor intend to provide any of their subcontractor category of work through a third-tier contractor, the bidder shall list that third-tier contractor's full name and address (City & State). **If the bidder intends to perform any category of work itself, it must list its full name and address.** For clarification, if the bidder intends to perform the work themselves, the bidder **may not** insert "not applicable", "N/A", "self" or anything other than its own full name and address (City & State). To do so shall cause the bid to be rejected. In addition, the failure to produce a completed subcontractor list with the bid submittal shall cause the bid to be rejected. If you have more than three (3) third-tier contractors to report in any subcontractor category, print out additional page(s) containing the appropriate category, complete the rest of your list of third-tier contractors for that category, notate the addition in parentheses as (CONTINUATION) next to the subcontractor category and an asterisk (*) next to any additional third-tier contractors, and submit it with your bid.

Subcontractor Category	Subcontractor	Address (City & State)	Subcontractors tax-payer ID # or Delaware Business license #
1.			
A.			
B.			
C.			
2.			
A.			
B.			
C.			

BID FORM

COOLING TOWER REPLACEMENT
TRANSPORTATION MANAGEMENT CENTER
169 BRICK STORE LANDING ROAD, SMYRNA, DE 19977
CONTRACT # MC5508000005A

SUBCONTRACTOR LIST CONTINUED

NOT FOR BIDDING

Subcontractor Category	Subcontractor	Address (City & State)	Subcontractors tax-payer ID # or Delaware Business license #
3.			
A.			
B.			
C.			
4.			
A.			
B.			
C.			
5.			
A.			
B.			
C.			

BID FORM

COOLING TOWER REPLACEMENT
TRANSPORTATION MANAGEMENT CENTER
169 BRICK STORE LANDING ROAD, SMYRNA, DE 19977
CONTRACT # MC5508000005A

AFFIDAVIT
OF
CONTRACTOR QUALIFICATIONS

We hereby certify that we will abide by the contractor's qualifications outlined in the construction bid specifications for the duration of the contract term.

In accordance with Title 29, Chapter 69, Section 6962(d)(10)b.3 of the Delaware Code, after a contract has been awarded the successful bidder shall not substitute another subcontractor whose name was submitted on the Subcontractor Form except for the reasons in the statute and not without written consent from the awarding agency. Failure to utilize the subcontractors on the list will subject the successful bidder to penalties as outlined in the General Requirements Section 5.2 of the contract.

Contractor Name: _____

Contractor Address: _____

_____

_____

Authorized Representative (typed or printed): _____

Authorized Representative (signature): _____

Title: _____

Sworn to and Subscribed before me this _____day of _____ 20____.

My Commission expires _____. NOTARY PUBLIC _____.

NOT FOR BIDDING

THIS PAGE MUST BE SIGNED AND NOTARIZED FOR YOUR BID TO BE CONSIDERED.

BID FORM

COOLING TOWER REPLACEMENT
TRANSPORTATION MANAGEMENT CENTER
169 BRICK STORE LANDING ROAD, SMYRNA, DE 19977
CONTRACT # MC5508000005A

NON-COLLUSION STATEMENT

This is to certify that the undersigned bidder has neither directly nor indirectly, entered into any agreement, participated in any collusion or otherwise taken any action in restraint of free competitive bidding in connection with this proposal submitted this date to the Office of Management and Budget, Division of Facilities Management.

All the terms and conditions of MC5508000005A have been thoroughly examined and are understood.

NAME OF BIDDER: _____

AUTHORIZED REPRESENTATIVE (TYPED): _____

AUTHORIZED REPRESENTATIVE (SIGNATURE): _____

TITLE: _____

ADDRESS OF BIDDER: _____

_____

_____

E-MAIL: _____

PHONE NUMBER: _____

Sworn to and Subscribed before me this _____ day of _____ 20____.

My Commission expires _____. NOTARY PUBLIC _____.

NOT FOR BIDDING

THIS PAGE MUST BE SIGNED AND NOTARIZED FOR YOUR BID TO BE CONSIDERED.

BID FORM

COOLING TOWER REPLACEMENT
TRANSPORTATION MANAGEMENT CENTER
169 BRICK STORE LANDING ROAD, SMYRNA, DE 19977
CONTRACT # MC5508000005A

AFFIDAVIT
OF
EMPLOYEE DRUG TESTING PROGRAM

4104 Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on Large Public Works Projects requires that Contractors and Subcontractors implement a program of mandatory drug testing for Employees who work on Large Public Works Contracts funded all or in part with public funds.

We hereby certify that we have in place or will implement during the entire term of the contract a Mandatory Drug Testing Program for our employees on the jobsite, including subcontractors that complies with this regulation:

Contractor/Subcontractor Name: _____

Contractor/Subcontractor Address: _____

_____

_____

Authorized Representative (typed or printed): _____

Authorized Representative (signature): _____

Title: _____

Sworn to and Subscribed before me this _____day of _____ 20____.

My Commission expires _____. NOTARY PUBLIC _____.

NOT FOR BIDDING

THIS PAGE MUST BE SIGNED AND NOTARIZED FOR YOUR BID TO BE CONSIDERED.

END OF BID FORM

STATE OF DELAWARE - OFFICE OF MANAGEMENT AND BUDGET

BID BOND

TO ACCOMPANY PROPOSAL
(Not necessary if security is used)

KNOW ALL MEN BY THESE PRESENTS That: _____ _____of _____ in the County of _____ _____and State of _____as **Principal**, and _____ _____ of _____ in the County of _____ and State of _____ as **Surety**, legally authorized to do business in the State of Delaware ("**State**"), are held and firmly unto the **State** in the sum of _____ _____ Dollars ($_____), or _____ percent not to exceed _____ _____ Dollars ($_____) of amount of bid on Contract No. MC5508000005A, to be paid to the **State** for the use and benefit of ***OMB / Division of Facilities Management*** for which payment well and truly to be made, we do bind ourselves, our and each of our heirs, executors, administrators, and successors, jointly and severally for and in the whole firmly by these presents.

NOW THE CONDITION OF THIS OBLIGATION IS SUCH That if the above bonded **Principal** who has submitted to the ***OMB / Division of Facilities Management*** a certain proposal to enter into this contract for the furnishing of certain material and/or services within the **State**, shall be awarded this Contract, and if said **Principal** shall well and truly enter into and execute this Contract as may be required by the terms of this Contract and approved by the ***OMB / Division of Facilities Management*** this Contract to be entered into within twenty days after the date of official notice of the award thereof in accordance with the terms of said proposal, then this obligation shall be void or else to be and remain in full force and virtue.

Sealed with _____ seal and dated this _____day of _____ in the year of our Lord two thousand and _____ (20___).

SEALED, AND DELIVERED IN THE
Presence of

_____
Name of Bidder (Organization)

Corporate Seal

By: _____
Authorized Signature

Attest _____

_____
Title

_____
Name of Surety

Witness:_____

By: _____

_____
Title

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NOT FOR BIDDING

STANDARD FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR

The contract to be utilized on this project shall be the “Standard Form of Agreement Between Owner and Contractor” AIA Document A101-2017, including AIA Document A101 – 2017 Exhibit A, as well as Supplements to A101-2017 and Exhibit A and the State of Delaware’s General Requirements.

NOT FOR BIDDING

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AIA® Document A101™ – 2017

Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum

AGREEMENT made as of the day of in the year
(In words, indicate day, month and year.)

BETWEEN the Owner:
(Name, legal status, address and other information)

and the Contractor:
(Name, legal status, address and other information)

for the following Project:
(Name, location and detailed description)

Sample Project

The Architect:
(Name, legal status, address and other information)

The Owner and Contractor agree as follows.

ADDITIONS AND DELETIONS:
The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed. A vertical line in the left margin of this document indicates where the author has added necessary information and where the author has added to or deleted from the original AIA text.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

The parties should complete A101™–2017, Exhibit A, Insurance and Bonds, contemporaneously with this Agreement. AIA Document A201™–2017, General Conditions of the Contract for Construction, is adopted in this document by reference. Do not use with other general conditions unless this document is modified.

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(926508849)

TABLE OF ARTICLES

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2 THE WORK OF THIS CONTRACT

3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

4 CONTRACT SUM

5 PAYMENTS

6 DISPUTE RESOLUTION

7 TERMINATION OR SUSPENSION

8 MISCELLANEOUS PROVISIONS

9 ENUMERATION OF CONTRACT DOCUMENTS

EXHIBIT A INSURANCE AND BONDS

ARTICLE 1 THE CONTRACT DOCUMENTS

The Contract Documents consist of this Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, Addenda issued prior to execution of this Agreement, other documents listed in this Agreement, and Modifications issued after execution of this Agreement, all of which form the Contract, and are as fully a part of the Contract as if attached to this Agreement or repeated herein. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. An enumeration of the Contract Documents, other than a Modification, appears in Article 9.

ARTICLE 2 THE WORK OF THIS CONTRACT

The Contractor shall fully execute the Work described in the Contract Documents, except as specifically indicated in the Contract Documents to be the responsibility of others.

ARTICLE 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

§ 3.1 The date of commencement of the Work shall be:
(Check one of the following boxes.)

[ ] The date of this Agreement.

[ ] A date set forth in a notice to proceed issued by the Owner.

[ ] Established as follows:
(Insert a date or a means to determine the date of commencement of the Work.)

If a date of commencement of the Work is not selected, then the date of commencement shall be the date of this Agreement.

§ 3.2 The Contract Time shall be measured from the date of commencement of the Work.

§ 3.3 Substantial Completion

§ 3.3.1 Subject to adjustments of the Contract Time as provided in the Contract Documents, the Contractor shall achieve Substantial Completion of the entire Work:
(Check one of the following boxes and complete the necessary information.)

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[ ] Not later than ( ) calendar days from the date of commencement of the Work.

[ ] By the following date:

§ 3.3.2 Subject to adjustments of the Contract Time as provided in the Contract Documents, if portions of the Work are to be completed prior to Substantial Completion of the entire Work, the Contractor shall achieve Substantial Completion of such portions by the following dates:

Portion of Work	Substantial Completion Date

§ 3.3.3 If the Contractor fails to achieve Substantial Completion as provided in this Section 3.3, liquidated damages, if any, shall be assessed as set forth in Section 4.5.

ARTICLE 4 CONTRACT SUM

§ 4.1 The Owner shall pay the Contractor the Contract Sum in current funds for the Contractor's performance of the Contract. The Contract Sum shall be Zero Dollars and Zero Cents ($ 0.00), subject to additions and deductions as provided in the Contract Documents.

§ 4.2 Alternates

§ 4.2.1 Alternates, if any, included in the Contract Sum:

Item	Price

§ 4.2.2 Subject to the conditions noted below, the following alternates may be accepted by the Owner following execution of this Agreement. Upon acceptance, the Owner shall issue a Modification to this Agreement.
(Insert below each alternate and the conditions that must be met for the Owner to accept the alternate.)

Item	Price	Conditions for Acceptance

§ 4.3 Allowances, if any, included in the Contract Sum:
(Identify each allowance.)

Item	Price

§ 4.4 Unit prices, if any:
(Identify the item and state the unit price and quantity limitations, if any, to which the unit price will be applicable.)

Item	Units and Limitations	Price per Unit ($0.00)

§ 4.5 Liquidated damages, if any:
(Insert terms and conditions for liquidated damages, if any.)

§ 4.6 Other:
(Insert provisions for bonus or other incentives, if any, that might result in a change to the Contract Sum.)

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ARTICLE 5 PAYMENTS

§ 5.1 Progress Payments

§ 5.1.1 Based upon Applications for Payment submitted to the Architect by the Contractor and Certificates for Payment issued by the Architect, the Owner shall make progress payments on account of the Contract Sum to the Contractor as provided below and elsewhere in the Contract Documents.

§ 5.1.2 The period covered by each Application for Payment shall be one calendar month ending on the last day of the month, or as follows:

§ 5.1.3 Provided that an Application for Payment is received by the Architect not later than the day of a month, the Owner shall make payment of the amount certified to the Contractor not later than the day of the month. If an Application for Payment is received by the Architect after the application date fixed above, payment of the amount certified shall be made by the Owner not later than ( ) days after the Architect receives the Application for Payment.
(Federal, state or local laws may require payment within a certain period of time.)

§ 5.1.4 Each Application for Payment shall be based on the most recent schedule of values submitted by the Contractor in accordance with the Contract Documents. The schedule of values shall allocate the entire Contract Sum among the various portions of the Work. The schedule of values shall be prepared in such form, and supported by such data to substantiate its accuracy, as the Architect may require. This schedule of values shall be used as a basis for reviewing the Contractor's Applications for Payment.

§ 5.1.5 Applications for Payment shall show the percentage of completion of each portion of the Work as of the end of the period covered by the Application for Payment.

§ 5.1.6 In accordance with AIA Document A201™–2017, General Conditions of the Contract for Construction, and subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

§ 5.1.6.1 The amount of each progress payment shall first include:

.1 That portion of the Contract Sum properly allocable to completed Work;

.2 That portion of the Contract Sum properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction, or, if approved in advance by the Owner, suitably stored off the site at a location agreed upon in writing; and

.3 That portion of Construction Change Directives that the Architect determines, in the Architect's professional judgment, to be reasonably justified.

§ 5.1.6.2 The amount of each progress payment shall then be reduced by:

.1 The aggregate of any amounts previously paid by the Owner;

.2 The amount, if any, for Work that remains uncorrected and for which the Architect has previously withheld a Certificate for Payment as provided in Article 9 of AIA Document A201–2017;

.3 Any amount for which the Contractor does not intend to pay a Subcontractor or material supplier, unless the Work has been performed by others the Contractor intends to pay;

.4 For Work performed or defects discovered since the last payment application, any amount for which the Architect may withhold payment, or nullify a Certificate of Payment in whole or in part, as provided in Article 9 of AIA Document A201–2017; and

.5 Retainage withheld pursuant to Section 5.1.7.

§ 5.1.7 Retainage

§ 5.1.7.1 For each progress payment made prior to Substantial Completion of the Work, the Owner may withhold the following amount, as retainage, from the payment otherwise due:
(Insert a percentage or amount to be withheld as retainage from each Application for Payment. The amount of retainage may be limited by governing law.)

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§ 5.1.7.1.1 The following items are not subject to retainage:
(Insert any items not subject to the withholding of retainage, such as general conditions, insurance, etc.)

§ 5.1.7.2 Reduction or limitation of retainage, if any, shall be as follows:
(If the retainage established in Section 5.1.7.1 is to be modified prior to Substantial Completion of the entire Work, including modifications for Substantial Completion of portions of the Work as provided in Section 3.3.2, insert provisions for such modifications.)

§ 5.1.7.3 Except as set forth in this Section 5.1.7.3, upon Substantial Completion of the Work, the Contractor may submit an Application for Payment that includes the retainage withheld from prior Applications for Payment pursuant to this Section 5.1.7. The Application for Payment submitted at Substantial Completion shall not include retainage as follows:
(Insert any other conditions for release of retainage upon Substantial Completion.)

§ 5.1.8 If final completion of the Work is materially delayed through no fault of the Contractor, the Owner shall pay the Contractor any additional amounts in accordance with Article 9 of AIA Document A201–2017.

§ 5.1.9 Except with the Owner's prior approval, the Contractor shall not make advance payments to suppliers for materials or equipment which have not been delivered and stored at the site.

§ 5.2 Final Payment

§ 5.2.1 Final payment, constituting the entire unpaid balance of the Contract Sum, shall be made by the Owner to the Contractor when

.1 the Contractor has fully performed the Contract except for the Contractor's responsibility to correct Work as provided in Article 12 of AIA Document A201–2017, and to satisfy other requirements, if any, which extend beyond final payment; and

.2 a final Certificate for Payment has been issued by the Architect.

§ 5.2.2 The Owner's final payment to the Contractor shall be made no later than 30 days after the issuance of the Architect's final Certificate for Payment, or as follows:

§ 5.3 Interest

Payments due and unpaid under the Contract shall bear interest from the date payment is due at the rate stated below, or in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.
(Insert rate of interest agreed upon, if any.)

%

ARTICLE 6 DISPUTE RESOLUTION

§ 6.1 Initial Decision Maker

The Architect will serve as the Initial Decision Maker pursuant to Article 15 of AIA Document A201–2017, unless the parties appoint below another individual, not a party to this Agreement, to serve as the Initial Decision Maker.
(If the parties mutually agree, insert the name, address and other contact information of the Initial Decision Maker, if other than the Architect.)

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§ 6.2 Binding Dispute Resolution
For any Claim subject to, but not resolved by, mediation pursuant to Article 15 of AIA Document A201–2017, the method of binding dispute resolution shall be as follows:
(Check the appropriate box.)

[ ] Arbitration pursuant to Section 15.4 of AIA Document A201–2017

[ ] Litigation in a court of competent jurisdiction

[ ] Other *(Specify)*

If the Owner and Contractor do not select a method of binding dispute resolution, or do not subsequently agree in writing to a binding dispute resolution method other than litigation, Claims will be resolved by litigation in a court of competent jurisdiction.

ARTICLE 7 TERMINATION OR SUSPENSION
§ 7.1 The Contract may be terminated by the Owner or the Contractor as provided in Article 14 of AIA Document A201–2017.

§ 7.1.1 If the Contract is terminated for the Owner's convenience in accordance with Article 14 of AIA Document A201–2017, then the Owner shall pay the Contractor a termination fee as follows:
(Insert the amount of, or method for determining, the fee, if any, payable to the Contractor following a termination for the Owner's convenience.)

§ 7.2 The Work may be suspended by the Owner as provided in Article 14 of AIA Document A201–2017.

ARTICLE 8 MISCELLANEOUS PROVISIONS
§ 8.1 Where reference is made in this Agreement to a provision of AIA Document A201–2017 or another Contract Document, the reference refers to that provision as amended or supplemented by other provisions of the Contract Documents.

§ 8.2 The Owner's representative:
(Name, address, email address, and other information)

§ 8.3 The Contractor's representative:
(Name, address, email address, and other information)

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§ 8.4 Neither the Owner's nor the Contractor's representative shall be changed without ten days' prior notice to the other party.

§ 8.5 Insurance and Bonds

§ 8.5.1 The Owner and the Contractor shall purchase and maintain insurance as set forth in AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum, Exhibit A, Insurance and Bonds, and elsewhere in the Contract Documents.

§ 8.5.2 The Contractor shall provide bonds as set forth in AIA Document A101™–2017 Exhibit A, and elsewhere in the Contract Documents.

§ 8.6 Notice in electronic format, pursuant to Article 1 of AIA Document A201–2017, may be given in accordance with AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, if completed, or as otherwise set forth below:
(If other than in accordance with AIA Document E203–2013, insert requirements for delivering notice in electronic format such as name, title, and email address of the recipient and whether and how the system will be required to generate a read receipt for the transmission.)

§ 8.7 Other provisions:

ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS

§ 9.1 This Agreement is comprised of the following documents:

.1 AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor

.2 AIA Document A101™–2017, Exhibit A, Insurance and Bonds

.3 AIA Document A201™–2017, General Conditions of the Contract for Construction

.4 AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, dated as indicated below:
(Insert the date of the E203-2013 incorporated into this Agreement.)

.5 Drawings

Number	Title	Date

.6 Specifications

Section	Title	Date	Pages

.7 Addenda, if any:

Number	Date	Pages

Portions of Addenda relating to bidding or proposal requirements are not part of the Contract Documents unless the bidding or proposal requirements are also enumerated in this Article 9.

.8 Other Exhibits:
(Check all boxes that apply and include appropriate information identifying the exhibit where required.)

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[ ] AIA Document E204™–2017, Sustainable Projects Exhibit, dated as indicated below:
(Insert the date of the E204-2017 incorporated into this Agreement.)

[ ] The Sustainability Plan:

Title	Date	Pages

[ ] Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages

.9 Other documents, if any, listed below:
(List here any additional documents that are intended to form part of the Contract Documents. AIA Document A201™–2017 provides that the advertisement or invitation to bid, Instructions to Bidders, sample forms, the Contractor's bid or proposal, portions of Addenda relating to bidding or proposal requirements, and other information furnished by the Owner in anticipation of receiving bids or proposals, are not part of the Contract Documents unless enumerated in this Agreement. Any such documents should be listed here only if intended to be part of the Contract Documents.)

This Agreement entered into as of the day and year first written above.

OWNER *(Signature)*	**CONTRACTOR** *(Signature)*
(Printed name and title)	*(Printed name and title)*

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AIA® Document A101™ – 2017 Exhibit A

Insurance and Bonds

This Insurance and Bonds Exhibit is part of the Agreement, between the Owner and the Contractor, dated the day of in the year
(In words, indicate day, month and year.)

for the following **PROJECT**:
(Name and location or address)

THE OWNER:
(Name, legal status and address)

THE CONTRACTOR:
(Name, legal status and address)

TABLE OF ARTICLES

A.1 GENERAL

A.2 OWNER'S INSURANCE

A.3 CONTRACTOR'S INSURANCE AND BONDS

A.4 SPECIAL TERMS AND CONDITIONS

ARTICLE A.1 GENERAL
The Owner and Contractor shall purchase and maintain insurance, and provide bonds, as set forth in this Exhibit. As used in this Exhibit, the term General Conditions refers to AIA Document A201™–2017, General Conditions of the Contract for Construction.

ARTICLE A.2 OWNER'S INSURANCE
§ A.2.1 General
Prior to commencement of the Work, the Owner shall secure the insurance, and provide evidence of the coverage, required under this Article A.2 and, upon the Contractor's request, provide a copy of the property insurance policy or policies required by Section A.2.3. The copy of the policy or policies provided shall contain all applicable conditions, definitions, exclusions, and endorsements.

§ A.2.2 Liability Insurance
The Owner shall be responsible for purchasing and maintaining the Owner's usual general liability insurance.

ADDITIONS AND DELETIONS:
The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed. A vertical line in the left margin of this document indicates where the author has added necessary information and where the author has added to or deleted from the original AIA text.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

This document is intended to be used in conjunction with AIA Document A201™–2017, General Conditions of the Contract for Construction. Article 11 of A201™–2017 contains additional insurance provisions.

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§ A.2.3 Required Property Insurance

§ A.2.3.1 Unless this obligation is placed on the Contractor pursuant to Section A.3.3.2.1, the Owner shall purchase and maintain, from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located, property insurance written on a builder's risk "all-risks" completed value or equivalent policy form and sufficient to cover the total value of the entire Project on a replacement cost basis. The Owner's property insurance coverage shall be no less than the amount of the initial Contract Sum, plus the value of subsequent Modifications and labor performed and materials or equipment supplied by others. The property insurance shall be maintained until Substantial Completion and thereafter as provided in Section A.2.3.1.3, unless otherwise provided in the Contract Documents or otherwise agreed in writing by the parties to this Agreement. This insurance shall include the interests of the Owner, Contractor, Subcontractors, and Sub-subcontractors in the Project as insureds. This insurance shall include the interests of mortgagees as loss payees.

§ A.2.3.1.1 Causes of Loss. The insurance required by this Section A.2.3.1 shall provide coverage for direct physical loss or damage, and shall not exclude the risks of fire, explosion, theft, vandalism, malicious mischief, collapse, earthquake, flood, or windstorm. The insurance shall also provide coverage for ensuing loss or resulting damage from error, omission, or deficiency in construction methods, design, specifications, workmanship, or materials. Sub-limits, if any, are as follows:
(Indicate below the cause of loss and any applicable sub-limit.)

Causes of Loss	**Sub-Limit**

§ A.2.3.1.2 Specific Required Coverages. The insurance required by this Section A.2.3.1 shall provide coverage for loss or damage to falsework and other temporary structures, and to building systems from testing and startup. The insurance shall also cover debris removal, including demolition occasioned by enforcement of any applicable legal requirements, and reasonable compensation for the Architect's and Contractor's services and expenses required as a result of such insured loss, including claim preparation expenses. Sub-limits, if any, are as follows:
(Indicate below type of coverage and any applicable sub-limit for specific required coverages.)

Coverage	**Sub-Limit**

§ A.2.3.1.3 Unless the parties agree otherwise, upon Substantial Completion, the Owner shall continue the insurance required by Section A.2.3.1 or, if necessary, replace the insurance policy required under Section A.2.3.1 with property insurance written for the total value of the Project that shall remain in effect until expiration of the period for correction of the Work set forth in Section 12.2.2 of the General Conditions.

§ A.2.3.1.4 Deductibles and Self-Insured Retentions. If the insurance required by this Section A.2.3 is subject to deductibles or self-insured retentions, the Owner shall be responsible for all loss not covered because of such deductibles or retentions.

§ A.2.3.2 Occupancy or Use Prior to Substantial Completion. The Owner's occupancy or use of any completed or partially completed portion of the Work prior to Substantial Completion shall not commence until the insurance company or companies providing the insurance under Section A.2.3.1 have consented in writing to the continuance of coverage. The Owner and the Contractor shall take no action with respect to partial occupancy or use that would cause cancellation, lapse, or reduction of insurance, unless they agree otherwise in writing.

§ A.2.3.3 Insurance for Existing Structures

If the Work involves remodeling an existing structure or constructing an addition to an existing structure, the Owner shall purchase and maintain, until the expiration of the period for correction of Work as set forth in Section 12.2.2 of the General Conditions, "all-risks" property insurance, on a replacement cost basis, protecting the existing structure against direct physical loss or damage from the causes of loss identified in Section A.2.3.1, notwithstanding the undertaking of the Work. The Owner shall be responsible for all co-insurance penalties.

§ A.2.4 Optional Extended Property Insurance.

The Owner shall purchase and maintain the insurance selected and described below.

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(Select the types of insurance the Owner is required to purchase and maintain by placing an X in the box(es) next to the description(s) of selected insurance. For each type of insurance selected, indicate applicable limits of coverage or other conditions in the fill point below the selected item.)

[ ] **§ A.2.4.1 Loss of Use, Business Interruption, and Delay in Completion Insurance**, to reimburse the Owner for loss of use of the Owner's property, or the inability to conduct normal operations due to a covered cause of loss.

[ ] **§ A.2.4.2 Ordinance or Law Insurance**, for the reasonable and necessary costs to satisfy the minimum requirements of the enforcement of any law or ordinance regulating the demolition, construction, repair, replacement or use of the Project.

[ ] **§ A.2.4.3 Expediting Cost Insurance**, for the reasonable and necessary costs for the temporary repair of damage to insured property, and to expedite the permanent repair or replacement of the damaged property.

[ ] **§ A.2.4.4 Extra Expense Insurance**, to provide reimbursement of the reasonable and necessary excess costs incurred during the period of restoration or repair of the damaged property that are over and above the total costs that would normally have been incurred during the same period of time had no loss or damage occurred.

[ ] **§ A.2.4.5 Civil Authority Insurance**, for losses or costs arising from an order of a civil authority prohibiting access to the Project, provided such order is the direct result of physical damage covered under the required property insurance.

[ ] **§ A.2.4.6 Ingress/Egress Insurance**, for loss due to the necessary interruption of the insured's business due to physical prevention of ingress to, or egress from, the Project as a direct result of physical damage.

[ ] **§ A.2.4.7 Soft Costs Insurance**, to reimburse the Owner for costs due to the delay of completion of the Work, arising out of physical loss or damage covered by the required property insurance: including construction loan fees; leasing and marketing expenses; additional fees, including those of architects, engineers, consultants, attorneys and accountants, needed for the completion of the construction, repairs, or reconstruction; and carrying costs such as property taxes, building permits, additional interest on loans, realty taxes, and insurance premiums over and above normal expenses.

§ A.2.5 Other Optional Insurance.

The Owner shall purchase and maintain the insurance selected below.

(Select the types of insurance the Owner is required to purchase and maintain by placing an X in the box(es) next to the description(s) of selected insurance.)

[ ] **§ A.2.5.1 Cyber Security Insurance** for loss to the Owner due to data security and privacy breach,

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including costs of investigating a potential or actual breach of confidential or private information.
(Indicate applicable limits of coverage or other conditions in the fill point below.)

[ ] **§ A.2.5.2 Other Insurance**
(List below any other insurance coverage to be provided by the Owner and any applicable limits.)

Coverage	Limits

ARTICLE A.3 CONTRACTOR'S INSURANCE AND BONDS

§ A.3.1 General

§ A.3.1.1 Certificates of Insurance. The Contractor shall provide certificates of insurance acceptable to the Owner evidencing compliance with the requirements in this Article A.3 at the following times: (1) prior to commencement of the Work; (2) upon renewal or replacement of each required policy of insurance; and (3) upon the Owner's written request. An additional certificate evidencing continuation of commercial liability coverage, including coverage for completed operations, shall be submitted with the final Application for Payment and thereafter upon renewal or replacement of such coverage until the expiration of the periods required by Section A.3.2.1 and Section A.3.3.1. The certificates will show the Owner as an additional insured on the Contractor's Commercial General Liability and excess or umbrella liability policy or policies.

§ A.3.1.2 Deductibles and Self-Insured Retentions. The Contractor shall disclose to the Owner any deductible or self-insured retentions applicable to any insurance required to be provided by the Contractor.

§ A.3.1.3 Additional Insured Obligations. To the fullest extent permitted by law, the Contractor shall cause the commercial general liability coverage to include (1) the Owner, the Architect, and the Architect's consultants as additional insureds for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's operations; and (2) the Owner as an additional insured for claims caused in whole or in part by the Contractor's negligent acts or omissions for which loss occurs during completed operations. The additional insured coverage shall be primary and non-contributory to any of the Owner's general liability insurance policies and shall apply to both ongoing and completed operations. To the extent commercially available, the additional insured coverage shall be no less than that provided by Insurance Services Office, Inc. (ISO) forms CG 20 10 07 04, CG 20 37 07 04, and, with respect to the Architect and the Architect's consultants, CG 20 32 07 04.

§ A.3.2 Contractor's Required Insurance Coverage

§ A.3.2.1 The Contractor shall purchase and maintain the following types and limits of insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Contractor shall maintain the required insurance until the expiration of the period for correction of Work as set forth in Section 12.2.2 of the General Conditions, unless a different duration is stated below:
(If the Contractor is required to maintain insurance for a duration other than the expiration of the period for correction of Work, state the duration.)

§ A.3.2.2 Commercial General Liability

§ A.3.2.2.1 Commercial General Liability insurance for the Project written on an occurrence form with policy limits of not less than ($) each occurrence, ($) general aggregate, and ($) aggregate for products-completed operations hazard, providing coverage for claims including

.1 damages because of bodily injury, sickness or disease, including occupational sickness or disease, and death of any person;
.2 personal injury and advertising injury;
.3 damages because of physical damage to or destruction of tangible property, including the loss of use of such property;
.4 bodily injury or property damage arising out of completed operations; and
.5 the Contractor's indemnity obligations under Section 3.18 of the General Conditions.

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§ A.3.2.2.2 The Contractor's Commercial General Liability policy under this Section A.3.2.2 shall not contain an exclusion or restriction of coverage for the following:

.1 Claims by one insured against another insured, if the exclusion or restriction is based solely on the fact that the claimant is an insured, and there would otherwise be coverage for the claim.

.2 Claims for property damage to the Contractor's Work arising out of the products-completed operations hazard where the damaged Work or the Work out of which the damage arises was performed by a Subcontractor.

.3 Claims for bodily injury other than to employees of the insured.

.4 Claims for indemnity under Section 3.18 of the General Conditions arising out of injury to employees of the insured.

.5 Claims or loss excluded under a prior work endorsement or other similar exclusionary language.

.6 Claims or loss due to physical damage under a prior injury endorsement or similar exclusionary language.

.7 Claims related to residential, multi-family, or other habitational projects, if the Work is to be performed on such a project.

.8 Claims related to roofing, if the Work involves roofing.

.9 Claims related to exterior insulation finish systems (EIFS), synthetic stucco or similar exterior coatings or surfaces, if the Work involves such coatings or surfaces.

.10 Claims related to earth subsidence or movement, where the Work involves such hazards.

.11 Claims related to explosion, collapse and underground hazards, where the Work involves such hazards.

§ A.3.2.3 Automobile Liability covering vehicles owned, and non-owned vehicles used, by the Contractor, with policy limits of not less than ($) per accident, for bodily injury, death of any person, and property damage arising out of the ownership, maintenance and use of those motor vehicles along with any other statutorily required automobile coverage.

§ A.3.2.4 The Contractor may achieve the required limits and coverage for Commercial General Liability and Automobile Liability through a combination of primary and excess or umbrella liability insurance, provided such primary and excess or umbrella insurance policies result in the same or greater coverage as the coverages required under Section A.3.2.2 and A.3.2.3, and in no event shall any excess or umbrella liability insurance provide narrower coverage than the primary policy. The excess policy shall not require the exhaustion of the underlying limits only through the actual payment by the underlying insurers.

§ A.3.2.5 Workers' Compensation at statutory limits.

§ A.3.2.6 Employers' Liability with policy limits not less than ($) each accident, ($) each employee, and ($) policy limit.

§ A.3.2.7 Jones Act, and the Longshore & Harbor Workers' Compensation Act, as required, if the Work involves hazards arising from work on or near navigable waterways, including vessels and docks

§ A.3.2.8 If the Contractor is required to furnish professional services as part of the Work, the Contractor shall procure Professional Liability insurance covering performance of the professional services, with policy limits of not less than ($) per claim and ($) in the aggregate.

§ A.3.2.9 If the Work involves the transport, dissemination, use, or release of pollutants, the Contractor shall procure Pollution Liability insurance, with policy limits of not less than ($) per claim and ($) in the aggregate.

§ A.3.2.10 Coverage under Sections A.3.2.8 and A.3.2.9 may be procured through a Combined Professional Liability and Pollution Liability insurance policy, with combined policy limits of not less than ($) per claim and ($) in the aggregate.

§ A.3.2.11 Insurance for maritime liability risks associated with the operation of a vessel, if the Work requires such activities, with policy limits of not less than ($) per claim and ($) in the aggregate.

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§ A.3.2.12 Insurance for the use or operation of manned or unmanned aircraft, if the Work requires such activities, with policy limits of not less than ($) per claim and ($) in the aggregate.

§ A.3.3 Contractor's Other Insurance Coverage

§ A.3.3.1 Insurance selected and described in this Section A.3.3 shall be purchased from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Contractor shall maintain the required insurance until the expiration of the period for correction of Work as set forth in Section 12.2.2 of the General Conditions, unless a different duration is stated below:
(If the Contractor is required to maintain any of the types of insurance selected below for a duration other than the expiration of the period for correction of Work, state the duration.)

§ A.3.3.2 The Contractor shall purchase and maintain the following types and limits of insurance in accordance with Section A.3.3.1.
(Select the types of insurance the Contractor is required to purchase and maintain by placing an X in the box(es) next to the description(s) of selected insurance. Where policy limits are provided, include the policy limit in the appropriate fill point.)

[ ] **§ A.3.3.2.1** Property insurance of the same type and scope satisfying the requirements identified in Section A.2.3, which, if selected in this section A.3.3.2.1, relieves the Owner of the responsibility to purchase and maintain such insurance except insurance required by Section A.2.3.1.3 and Section A.2.3.3. The Contractor shall comply with all obligations of the Owner under Section A.2.3 except to the extent provided below. The Contractor shall disclose to the Owner the amount of any deductible, and the Owner shall be responsible for losses within the deductible. Upon request, the Contractor shall provide the Owner with a copy of the property insurance policy or policies required. The Owner shall adjust and settle the loss with the insurer and be the trustee of the proceeds of the property insurance in accordance with Article 11 of the General Conditions unless otherwise set forth below:
(Where the Contractor's obligation to provide property insurance differs from the Owner's obligations as described under Section A.2.3, indicate such differences in the space below. Additionally, if a party other than the Owner will be responsible for adjusting and settling a loss with the insurer and acting as the trustee of the proceeds of property insurance in accordance with Article 11 of the General Conditions, indicate the responsible party below.)

[ ] **§ A.3.3.2.2 Railroad Protective Liability Insurance**, with policy limits of not less than ($) per claim and ($) in the aggregate, for Work within fifty (50) feet of railroad property.

[ ] **§ A.3.3.2.3 Asbestos Abatement Liability Insurance**, with policy limits of not less than ($) per claim and ($) in the aggregate, for liability arising from the encapsulation, removal, handling, storage, transportation, and disposal of asbestos-containing materials.

[ ] **§ A.3.3.2.4** Insurance for physical damage to property while it is in storage and in transit to the construction site on an "all-risks" completed value form.

[ ] **§ A.3.3.2.5** Property insurance on an "all-risks" completed value form, covering property owned by the Contractor and used on the Project, including scaffolding and other equipment.

[ ] **§ A.3.3.2.6 Other Insurance**
(List below any other insurance coverage to be provided by the Contractor and any applicable limits.)

Coverage	Limits

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§ A.3.4 Performance Bond and Payment Bond

The Contractor shall provide surety bonds, from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located, as follows:
(Specify type and penal sum of bonds.)

Type	Penal Sum ($0.00)
Payment Bond	
Performance Bond	

Payment and Performance Bonds shall be AIA Document A312™, Payment Bond and Performance Bond, or contain provisions identical to AIA Document A312™, current as of the date of this Agreement.

ARTICLE A.4 SPECIAL TERMS AND CONDITIONS

Special terms and conditions that modify this Insurance and Bonds Exhibit, if any, are as follows:

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SUPPLEMENT TO AGREEMENT BETWEEN OWNER AND CONTRACTOR

The following supplements modify the "Standard Form of Agreement Between Owner and Constructor," AIA Document A101-2017. Where a portion of the Standard Form of Agreement is modified or deleted by the following, the unaltered portions of the Standard Form of Agreement shall remain in effect.

ARTICLE 3: DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

3.1 Delete paragraph 3.1 in its entirety and replace with the following:

"The date of Commencement of the Work shall be a date set forth in a notice to proceed issued by the Owner."

ARTICLE 5: PAYMENTS

5.1 PROGRESS PAYMENTS

5.1.3 Delete paragraph 5.1.3 in its entirety and replace with the following:

"Provided that a valid Application for Payment is received by the Architect that meets all requirements of the Contract, payment shall be made by the Owner not later than 30 days after the Owner receives the valid Application for Payment."

5.3 Insert the interest rate of "1% per month not to exceed 12% per annum."

ARTICLE 6: DISPUTE RESOLUTION

6.2 BINDING DISPUTE RESOLUTION

Check Other – and add the following sentence:

"Any remedies available in law or in equity."

ARTICLE 7: TERMINATION or SUSPENSION

7.1.1 Delete paragraph 7.1.1 in its entirety.

ARTICLE 8: MISCELLANEOUS PROVISIONS

8.4 Delete paragraph 8.4 in its entirety and replace with the following:

"The Contractor's representative shall not be changed without ten days written notice to the Owner."

END OF SECTION

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SUPPLEMENT TO A101-2017 – EXHIBIT A INSURANCE AND BONDS

The following supplements modify the "Standard Form of Agreement Between Owner and Contractor," AIA Document A101-2017 Exhibit A Insurance and Bonds. Where a portion of the Standard Form of Agreement is modified or deleted by the following, the unaltered portions of the Standard Form of Agreement shall remain in effect.

ARTICLE A.2 OWNER'S INSURANCE

A.2.1 General

Delete paragraph A.2.1 in its entirety.

A.2.2 Liability Insurance

Delete paragraph A.2.2 in its entirety, except in the case of school projects this paragraph shall remain.

A.2.3 Required Property Insurance

Delete paragraph A.2.3 in its entirety.

A.2.4 Optional Extended Property Insurance

Delete paragraph A.2.4 in its entirety.

A.2.5 Other Optional Insurance

Delete paragraph A.2.5 in its entirety.

ARTICLE A.3 CONTRACTORS INSURANCE AND BONDS

A.3.1.1 Strike the last sentence of the paragraph.

A.3.1.3 Additional Insured Obligations

In the first sentence after "coverage to include (1)" delete "(1) the Owner,".

Strike the remainder of the first sentence beginning at the semicolon "; and (2) the Owner" through the end of the sentence.

Delete the second sentence in its entirety.

A.3.2.2.1 Insert "$1,000,000.00" in the blank for each occurrence.
Insert "$3,000,000.00" in the blank for general aggregate.
Insert "$3,000,000.00" in the blank for aggregate for products-completed operations hazard.

A.3.2.3 Insert "$1,000,000.00" in the blank for per accident.

A.3.2.6 Insert "$500,000.00" in the blank for each accident.
Insert "$500,000.00" in the blank for each employee.
Insert "$500,000.00" in the blank for policy limit.

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A.3.2.8 Insert “$1,000,000.00” in the blank for per claim.
Insert “$3,000,000.00” in the blank for in the aggregate.

A.3.2.9 Insert “$1,000,000.00” in the blank for per claim.
Insert “$3,000,000.00” in the blank for in the aggregate.

A.3.2.10 Insert “$2,000,000.00” in the blank for per claim.
Insert “$4,000,000.00” in the blank for in the aggregate.

A.3.2.11 Strike in its entirety.

A.3.2.12 Strike in its entirety.

A.3.3.2.1 Delete paragraph 3.3.2.1 in its entirety

A.3.3.2.2 Strike in its entirety.

A.3.3.2.3 Insert “$1,000,000.00” in the blanks for per claim.
Insert “$3,000,000.00” in the blanks for in the aggregate.

A.3.4 Insert the actual contract price in both the Payment Bond and the Performance Bond Penal Sum blanks. It must be 100% of the contract price.

Strike the last sentence in this section and replace with “Payment and Performance Bonds shall be in the standard form issued by the Delaware Office of Management and Budget.”

END OF SECTION

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PERFORMANCE BOND

STATE OF DELAWARE
OFFICE OF MANAGEMENT AND BUDGET

Bond Number: _____

KNOW ALL PERSONS BY THESE PRESENTS, that we, _____, as principal ("**Principal**"), and _____, a _____ corporation, legally authorized to do business in the State of Delaware, as surety ("**Surety**"), are held and firmly bound unto the State of Delaware Office of Management & Budget ("**Owner**"), in the amount of _____ ($_____), to be paid to **Owner**, for which payment well and truly to be made, we do bind ourselves, our and each and every of our heirs, executors, administrations, successors and assigns, jointly and severally, for and in the whole, firmly by these presents.

Sealed with our seals and dated this _____ day of _____, 20__.

NOW THE CONDITION OF THIS OBLIGATION IS SUCH, that if **Principal**, who has been awarded by **Owner** that certain contract known as Contract No. MC5508000005A dated the _____ day of _____, 20__ (the "Contract"), which Contract is incorporated herein by reference, shall well and truly provide and furnish all materials, appliances and tools and perform all the work required under and pursuant to the terms and conditions of the Contract and the Contract Documents (as defined in the Contract) or any changes or modifications thereto made as therein provided, shall make good and reimburse **Owner** sufficient funds to pay the costs of completing the Contract that **Owner** may sustain by reason of any failure or default on the part of **Principal**, and shall also indemnify and save harmless **Owner** from all costs, damages and expenses arising out of or by reason of the performance of the Contract and for as long as provided by the Contract; then this obligation shall be void, otherwise to be and remain in full force and effect.

Surety, for value received, hereby stipulates and agrees, if requested to do so by **Owner**, to fully perform and complete the work to be performed under the Contract pursuant to the terms, conditions and covenants thereof, if for any cause **Principal** fails or neglects to so fully perform and complete such work.

Surety, for value received, for itself and its successors and assigns, hereby stipulates and agrees that the obligation of **Surety** and its bond shall be in no way impaired or affected by any extension of time, modification, omission, addition or change in or to the Contract or the work to be performed thereunder, or by any payment thereunder before the time required therein, or by any waiver of any provisions thereof, or by any assignment, subletting or other transfer thereof or of any work to be performed or any monies due or to become due thereunder; and **Surety** hereby waives notice of any and all such extensions, modifications, omissions, additions, changes, payments, waivers, assignments, subcontracts and transfers and hereby expressly stipulates and agrees that any and all things done and omitted to be done by and in relation to assignees, subcontractors, and other transferees shall have the same effect as to **Surety** as though done or omitted to be done by or in relation to **Principal**.

NOT FOR BIDDING

Surety hereby stipulates and agrees that no modifications, omissions or additions in or to the terms of the Contract shall in any way whatsoever affect the obligation of **Surety** and its bond.

Any proceeding, legal or equitable, under this Bond may be brought in any court of competent jurisdiction in the State of Delaware. Notices to **Surety** or Contractor may be mailed or delivered to them at their respective addresses shown below.

IN WITNESS WHEREOF, **Principal** and **Surety** have hereunto set their hand and seals, and such of them as are corporations have caused their corporate seal to be hereto affixed and these presents to be signed by their duly authorized officers, the day and year first above written.

PRINCIPAL

Name: _____

Witness or Attest: Address: _____

_____ By: _____(SEAL)
Name: Name:
Title:

(Corporate Seal)

SURETY

Name: _____

Witness or Attest: Address: _____

_____ By: _____ (SEAL)
Name: Name:
Title:

(Corporate Seal)

NOT FOR BIDDING

PAYMENT BOND

STATE OF DELAWARE
OFFICE OF MANAGEMENT AND BUDGET

Bond Number: _____

KNOW ALL PERSONS BY THESE PRESENTS, that we, _____, as principal ("**Principal**"), and _____, a _____ corporation, legally authorized to do business in the State of Delaware, as surety ("**Surety**"), are held and firmly bound unto the State of Delaware Office of Management & Budget ("**Owner**"), in the amount of _____ ($_____), to be paid to **Owner**, for which payment well and truly to be made, we do bind ourselves, our and each and every of our heirs, executors, administrations, successors and assigns, jointly and severally, for and in the whole firmly by these presents.

Sealed with our seals and dated this _____ day of_____, 20__.

NOW THE CONDITION OF THIS OBLIGATION IS SUCH, that if **Principal**, who has been awarded by **Owner** that certain contract known as Contract No. MC5508000005A dated the _____ day of _____, 20__ (the "Contract"), which Contract is incorporated herein by reference, shall well and truly pay all and every person furnishing materials or performing labor or service in and about the performance of the work under the Contract, all and every sums of money due him, her, them or any of them, for all such materials, labor and service for which **Principal** is liable, shall make good and reimburse **Owner** sufficient funds to pay such costs in the completion of the Contract as **Owner** may sustain by reason of any failure or default on the part of **Principal**, and shall also indemnify and save harmless **Owner** from all costs, damages and expenses arising out of or by reason of the performance of the Contract and for as long as provided by the Contract; then this obligation shall be void, otherwise to be and remain in full force and effect.

Surety, for value received, for itself and its successors and assigns, hereby stipulates and agrees that the obligation of **Surety** and its bond shall be in no way impaired or affected by any extension of time, modification, omission, addition or change in or to the Contract or the work to be performed thereunder, or by any payment thereunder before the time required therein, or by any waiver of any provisions thereof, or by any assignment, subletting or other transfer thereof or of any work to be performed or any monies due or to become due thereunder; and **Surety** hereby waives notice of any and all such extensions, modifications, omissions, additions, changes, payments, waivers, assignments, subcontracts and transfers and hereby expressly stipulates and agrees that any and all things done and omitted to be done by and in relation to assignees, subcontractors, and other transferees shall have the same effect as to **Surety** as though done or omitted to be done by or in relation to **Principal**.

Surety hereby stipulates and agrees that no modifications, omission or additions in or to the terms of the Contract shall in any way whatsoever affect the obligation of **Surety** and its bond.

NOT FOR BIDDING

Any proceeding, legal or equitable, under this Bond may be brought in any court of competent jurisdiction in the State of Delaware. Notices to **Surety** or Contractor may be mailed or delivered to them at their respective addresses shown below.

IN WITNESS WHEREOF, **Principal** and **Surety** have hereunto set their hand and seals, and such of them as are corporations have caused their corporate seal to be hereto affixed and these presents to be signed by their duly authorized officers, the day and year first above written.

PRINCIPAL

Name: _____

Witness or Attest: Address: _____

_____ By: _____(SEAL)
Name: Name:
Title:

(Corporate Seal)

SURETY

Name: _____

Witness or Attest: Address: _____

_____ By: _____(SEAL)
Name: Name:
Title:

(Corporate Seal)

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APPLICATION AND CERTIFICATE FOR PAYMENT FORMS

The Application and Certificate for Payment are as stated in the American Institute of Architects Document AIA G702 & AIA G703 (1992 version) entitled Application and Certificate for Payment and is part of this project manual as if herein written in full. A draft sample has been included for reference.

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AIA® Document G702™ – 1992

Application and Certificate for Payment

NOT FOR BIDDING

TO OWNER:	**PROJECT:** sample	**APPLICATION NO:** 001	**Distribution to:**
		PERIOD TO:	OWNER: ☐
		CONTRACT FOR: General Construction	ARCHITECT: ☐
FROM CONTRACTOR:	**VIA ARCHITECT:**	**CONTRACT DATE:**	CONTRACTOR: ☐
		PROJECT NOS: / /	FIELD: ☐
			OTHER: ☐

CONTRACTOR'S APPLICATION FOR PAYMENT

Application is made for payment, as shown below, in connection with the Contract.
Continuation Sheet, AIA Document G703, is attached.

1. ORIGINAL CONTRACT SUM	$	0.00
2. Net change by Change Orders	$	0.00
3. CONTRACT SUM TO DATE (Line 1 ± 2)	$	0.00
4. TOTAL COMPLETED & STORED TO DATE (Column G on G703)	$	0.00
5. RETAINAGE:		
a. 0 % of Completed Work (Column D + E on G703)	$	0.00
b. 0 % of Stored Material (Column F on G703)	$	0.00
Total Retainage (Lines 5a + 5b or Total in Column I of G703)	$	0.00
6. TOTAL EARNED LESS RETAINAGE (Line 4 Less Line 5 Total)	$	0.00
7. LESS PREVIOUS CERTIFICATES FOR PAYMENT (Line 6 from prior Certificate)	$	0.00
8. CURRENT PAYMENT DUE	$	0.00
9. BALANCE TO FINISH, INCLUDING RETAINAGE (Line 3 less Line 6)	$	0.00

CHANGE ORDER SUMMARY	ADDITIONS	DEDUCTIONS
Total changes approved in previous months by Owner	$ 0.00	$ 0.00
Total approved this Month	$ 0.00	$ 0.00
TOTALS	$ 0.00	$ 0.00
NET CHANGES by Change Order	$ 0.00	

The undersigned Contractor certifies that to the best of the Contractor's knowledge, information and belief the Work covered by this Application for Payment has been completed in accordance with the Contract Documents, that all amounts have been paid by the Contractor for Work for which previous Certificates for Payment were issued and payments received from the Owner, and that current payment shown herein is now due.

CONTRACTOR:

By: _____ Date: _____

State of:

County of:

Subscribed and sworn to before me this day of

Notary Public:

My Commission expires:

ARCHITECT'S CERTIFICATE FOR PAYMENT

In accordance with the Contract Documents, based on on-site observations and the data comprising this application, the Architect certifies to the Owner that to the best of the Architect's knowledge, information and belief the Work has progressed as indicated, the quality of the Work is in accordance with the Contract Documents, and the Contractor is entitled to payment of the AMOUNT CERTIFIED.

AMOUNT CERTIFIED ..... $ 0.00

(Attach explanation if amount certified differs from the amount applied. Initial all figures on this Application and on the Continuation Sheet that are changed to conform with the amount certified.)

ARCHITECT:

By: _____ Date: _____

This Certificate is not negotiable. The AMOUNT CERTIFIED is payable only to the Contractor named herein. Issuance, payment and acceptance of payment are without prejudice to any rights of the Owner or Contractor under this Contract

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AIA® Document G703™ – 1992

Continuation Sheet

AIA Document G702, APPLICATION AND CERTIFICATION FOR PAYMENT, containing Contractor's signed certification is attached.
In tabulations below, amounts are stated to the nearest dollar.
Use Column I on Contracts where variable retainage for line items may apply.

APPLICATION NO: 001
APPLICATION DATE:
PERIOD TO:
ARCHITECT'S PROJECT NO:

A	B	C	D	E	F	G		H	I
ITEM NO.	DESCRIPTION OF WORK	SCHEDULED VALUE	WORK COMPLETED FROM PREVIOUS APPLICATION (D + E)	WORK COMPLETED THIS PERIOD	MATERIALS PRESENTLY STORED (NOT IN D OR E)	TOTAL COMPLETED AND STORED TO DATE (D+E+F)	% (G ÷ C)	BALANCE TO FINISH (C - G)	RETAINAGE (IF VARIABLE RATE)
	GRAND TOTAL	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	0.00 %	$ 0.00	$ 0.00

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ALLOWANCE AUTHORIZATION FORM

Project: Cooling Tower Replacement at Transportation Management Center

Architect: StudioJAED Architects & Engineers **Project No.** MC5508000005A

Contractor:

AAA No.: **Initiation Date:**

The Allowance is allocated as follows:

Allowance No. 1: $10,000 for General Contingencies and Repairs.

Total original Contract Allowance was: $ 10,000
Amount of Contract Allowance Access previously authorized: $
Adjusted Contract Allowance prior to this authorization is: $
The amount of available Allowance will Decrease by this Access Authorization: $
The remaining Contract Allowance, after this Access Authorization will be: $

Recommended by:
Architect

By (Signature): _____ Date: _____

Accepted by:
Contractor

By (Signature): _____

Date: _____

Approved by:
Owner

By (Signature): _____

Date: _____

END OF SECTION

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GENERAL CONDITIONS TO THE CONTRACT FOR CONSTRUCTION

The General Conditions of this Contract are as stated in the American Institute of Architects Document AIA A201 (2017 Edition) entitled General Conditions of the Contract for Construction as revised by the Supplementary General Conditions and is part of this project manual as if herein written in full.

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AIA® Document A201™ – 2017

General Conditions of the Contract for Construction

for the following PROJECT:
(Name and location or address)

Sample

THE OWNER:
(Name, legal status and address)

THE ARCHITECT:
(Name, legal status and address)

TABLE OF ARTICLES

1 GENERAL PROVISIONS
2 OWNER
3 CONTRACTOR
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6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS
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14 TERMINATION OR SUSPENSION OF THE CONTRACT
15 CLAIMS AND DISPUTES

ADDITIONS AND DELETIONS:
The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed. A vertical line in the left margin of this document indicates where the author has added necessary information and where the author has added to or deleted from the original AIA text.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

For guidance in modifying this document to include supplementary conditions, see AIA Document A503™, Guide for Supplementary Conditions.

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ARTICLE 1 GENERAL PROVISIONS

§ 1.1 Basic Definitions

§ 1.1.1 The Contract Documents

The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Agreement, and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive, or (4) a written order for a minor change in the Work issued by the Architect. Unless specifically enumerated in the Agreement, the Contract Documents do not include the advertisement or invitation to bid, Instructions to Bidders, sample forms, other information furnished by the Owner in anticipation of receiving bids or proposals, the Contractor's bid or proposal, or portions of Addenda relating to bidding or proposal requirements.

§ 1.1.2 The Contract

The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the Contractor and the Architect or the Architect's consultants, (2) between the Owner and a Subcontractor or a Sub-subcontractor, (3) between the Owner and the Architect or the Architect's consultants, or (4) between any persons or entities other than the Owner and the Contractor. The Architect shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate performance of the Architect's duties.

§ 1.1.3 The Work

The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment, and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project.

§ 1.1.4 The Project

The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Owner and by Separate Contractors.

§ 1.1.5 The Drawings

The Drawings are the graphic and pictorial portions of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules, and diagrams.

§ 1.1.6 The Specifications

The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.

§ 1.1.7 Instruments of Service

Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Architect and the Architect's consultants under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, and other similar materials.

§ 1.1.8 Initial Decision Maker

The Initial Decision Maker is the person identified in the Agreement to render initial decisions on Claims in accordance with Section 15.2. The Initial Decision Maker shall not show partiality to the Owner or Contractor and shall not be liable for results of interpretations or decisions rendered in good faith.

§ 1.2 Correlation and Intent of the Contract Documents

§ 1.2.1 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results.

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§ 1.2.1.1 The invalidity of any provision of the Contract Documents shall not invalidate the Contract or its remaining provisions. If it is determined that any provision of the Contract Documents violates any law, or is otherwise invalid or unenforceable, then that provision shall be revised to the extent necessary to make that provision legal and enforceable. In such case the Contract Documents shall be construed, to the fullest extent permitted by law, to give effect to the parties' intentions and purposes in executing the Contract.

§ 1.2.2 Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade.

§ 1.2.3 Unless otherwise stated in the Contract Documents, words that have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

§ 1.3 Capitalization

Terms capitalized in these General Conditions include those that are (1) specifically defined, (2) the titles of numbered articles, or (3) the titles of other documents published by the American Institute of Architects.

§ 1.4 Interpretation

In the interest of brevity the Contract Documents frequently omit modifying words such as "all" and "any" and articles such as "the" and "an," but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

§ 1.5 Ownership and Use of Drawings, Specifications, and Other Instruments of Service

§ 1.5.1 The Architect and the Architect's consultants shall be deemed the authors and owners of their respective Instruments of Service, including the Drawings and Specifications, and retain all common law, statutory, and other reserved rights in their Instruments of Service, including copyrights. The Contractor, Subcontractors, Sub-subcontractors, and suppliers shall not own or claim a copyright in the Instruments of Service. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with the Project is not to be construed as publication in derogation of the Architect's or Architect's consultants' reserved rights.

§ 1.5.2 The Contractor, Subcontractors, Sub-subcontractors, and suppliers are authorized to use and reproduce the Instruments of Service provided to them, subject to any protocols established pursuant to Sections 1.7 and 1.8, solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and suppliers may not use the Instruments of Service on other projects or for additions to the Project outside the scope of the Work without the specific written consent of the Owner, Architect, and the Architect's consultants.

§ 1.6 Notice

§ 1.6.1 Except as otherwise provided in Section 1.6.2, where the Contract Documents require one party to notify or give notice to the other party, such notice shall be provided in writing to the designated representative of the party to whom the notice is addressed and shall be deemed to have been duly served if delivered in person, by mail, by courier, or by electronic transmission if a method for electronic transmission is set forth in the Agreement.

§ 1.6.2 Notice of Claims as provided in Section 15.1.3 shall be provided in writing and shall be deemed to have been duly served only if delivered to the designated representative of the party to whom the notice is addressed by certified or registered mail, or by courier providing proof of delivery.

§ 1.7 Digital Data Use and Transmission

The parties shall agree upon protocols governing the transmission and use of Instruments of Service or any other information or documentation in digital form. The parties will use AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, to establish the protocols for the development, use, transmission, and exchange of digital data.

§ 1.8 Building Information Models Use and Reliance

Any use of, or reliance on, all or a portion of a building information model without agreement to protocols governing the use of, and reliance on, the information contained in the model and without having those protocols set forth in AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, and the requisite AIA Document

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G202™–2013, Project Building Information Modeling Protocol Form, shall be at the using or relying party's sole risk and without liability to the other party and its contractors or consultants, the authors of, or contributors to, the building information model, and each of their agents and employees.

ARTICLE 2 OWNER

§ 2.1 General

§ 2.1.1 The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Owner shall designate in writing a representative who shall have express authority to bind the Owner with respect to all matters requiring the Owner's approval or authorization. Except as otherwise provided in Section 4.2.1, the Architect does not have such authority. The term "Owner" means the Owner or the Owner's authorized representative.

§ 2.1.2 The Owner shall furnish to the Contractor, within fifteen days after receipt of a written request, information necessary and relevant for the Contractor to evaluate, give notice of, or enforce mechanic's lien rights. Such information shall include a correct statement of the record legal title to the property on which the Project is located, usually referred to as the site, and the Owner's interest therein.

§ 2.2 Evidence of the Owner's Financial Arrangements

§ 2.2.1 Prior to commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract. The Contractor shall have no obligation to commence the Work until the Owner provides such evidence. If commencement of the Work is delayed under this Section 2.2.1, the Contract Time shall be extended appropriately.

§ 2.2.2 Following commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract only if (1) the Owner fails to make payments to the Contractor as the Contract Documents require; (2) the Contractor identifies in writing a reasonable concern regarding the Owner's ability to make payment when due; or (3) a change in the Work materially changes the Contract Sum. If the Owner fails to provide such evidence, as required, within fourteen days of the Contractor's request, the Contractor may immediately stop the Work and, in that event, shall notify the Owner that the Work has stopped. However, if the request is made because a change in the Work materially changes the Contract Sum under (3) above, the Contractor may immediately stop only that portion of the Work affected by the change until reasonable evidence is provided. If the Work is stopped under this Section 2.2.2, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided in the Contract Documents.

§ 2.2.3 After the Owner furnishes evidence of financial arrangements under this Section 2.2, the Owner shall not materially vary such financial arrangements without prior notice to the Contractor.

§ 2.2.4 Where the Owner has designated information furnished under this Section 2.2 as "confidential," the Contractor shall keep the information confidential and shall not disclose it to any other person. However, the Contractor may disclose "confidential" information, after seven (7) days' notice to the Owner, where disclosure is required by law, including a subpoena or other form of compulsory legal process issued by a court or governmental entity, or by court or arbitrator(s) order. The Contractor may also disclose "confidential" information to its employees, consultants, sureties, Subcontractors and their employees, Sub-subcontractors, and others who need to know the content of such information solely and exclusively for the Project and who agree to maintain the confidentiality of such information.

§ 2.3 Information and Services Required of the Owner

§ 2.3.1 Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, including those required under Section 3.7.1, the Owner shall secure and pay for necessary approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

§ 2.3.2 The Owner shall retain an architect lawfully licensed to practice architecture, or an entity lawfully practicing architecture, in the jurisdiction where the Project is located. That person or entity is identified as the Architect in the Agreement and is referred to throughout the Contract Documents as if singular in number.

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§ 2.3.3 If the employment of the Architect terminates, the Owner shall employ a successor to whom the Contractor has no reasonable objection and whose status under the Contract Documents shall be that of the Architect.

§ 2.3.4 The Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work.

§ 2.3.5 The Owner shall furnish information or services required of the Owner by the Contract Documents with reasonable promptness. The Owner shall also furnish any other information or services under the Owner's control and relevant to the Contractor's performance of the Work with reasonable promptness after receiving the Contractor's written request for such information or services.

§ 2.3.6 Unless otherwise provided in the Contract Documents, the Owner shall furnish to the Contractor one copy of the Contract Documents for purposes of making reproductions pursuant to Section 1.5.2.

§ 2.4 Owner's Right to Stop the Work

If the Contractor fails to correct Work that is not in accordance with the requirements of the Contract Documents as required by Section 12.2 or repeatedly fails to carry out Work in accordance with the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Section 6.1.3.

§ 2.5 Owner's Right to Carry Out the Work

If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a ten-day period after receipt of notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such default or neglect. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect and the Architect may, pursuant to Section 9.5.1, withhold or nullify a Certificate for Payment in whole or in part, to the extent reasonably necessary to reimburse the Owner for the reasonable cost of correcting such deficiencies, including Owner's expenses and compensation for the Architect's additional services made necessary by such default, neglect, or failure. If current and future payments are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner. If the Contractor disagrees with the actions of the Owner or the Architect, or the amounts claimed as costs to the Owner, the Contractor may file a Claim pursuant to Article 15.

ARTICLE 3 CONTRACTOR

§ 3.1 General

§ 3.1.1 The Contractor is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Contractor shall be lawfully licensed, if required in the jurisdiction where the Project is located. The Contractor shall designate in writing a representative who shall have express authority to bind the Contractor with respect to all matters under this Contract. The term "Contractor" means the Contractor or the Contractor's authorized representative.

§ 3.1.2 The Contractor shall perform the Work in accordance with the Contract Documents.

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

§ 3.2 Review of Contract Documents and Field Conditions by Contractor

§ 3.2.1 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed, and correlated personal observations with requirements of the Contract Documents.

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§ 3.2.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 2.3.4, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the Contractor shall promptly report to the Architect any errors, inconsistencies or omissions discovered by or made known to the Contractor as a request for information in such form as the Architect may require. It is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional, unless otherwise specifically provided in the Contract Documents.

§ 3.2.3 The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, but the Contractor shall promptly report to the Architect any nonconformity discovered by or made known to the Contractor as a request for information in such form as the Architect may require.

§ 3.2.4 If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Architect issues in response to the Contractor's notices or requests for information pursuant to Sections 3.2.2 or 3.2.3, the Contractor shall submit Claims as provided in Article 15. If the Contractor fails to perform the obligations of Sections 3.2.2 or 3.2.3, the Contractor shall pay such costs and damages to the Owner, subject to Section 15.1.7, as would have been avoided if the Contractor had performed such obligations. If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities.

§ 3.3 Supervision and Construction Procedures

§ 3.3.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences, and procedures, and for coordinating all portions of the Work under the Contract. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences, or procedures, the Contractor shall evaluate the jobsite safety thereof and shall be solely responsible for the jobsite safety of such means, methods, techniques, sequences, or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely notice to the Owner and Architect, and shall propose alternative means, methods, techniques, sequences, or procedures. The Architect shall evaluate the proposed alternative solely for conformance with the design intent for the completed construction. Unless the Architect objects to the Contractor's proposed alternative, the Contractor shall perform the Work using its alternative means, methods, techniques, sequences, or procedures.

§ 3.3.2 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons or entities performing portions of the Work for, or on behalf of, the Contractor or any of its Subcontractors.

§ 3.3.3 The Contractor shall be responsible for inspection of portions of Work already performed to determine that such portions are in proper condition to receive subsequent Work.

§ 3.4 Labor and Materials

§ 3.4.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

§ 3.4.2 Except in the case of minor changes in the Work approved by the Architect in accordance with Section 3.12.8 or ordered by the Architect in accordance with Section 7.4, the Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect and in accordance with a Change Order or Construction Change Directive.

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

§ 3.5 Warranty

§ 3.5.1 The Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

§ 3.5.2 All material, equipment, or other special warranties required by the Contract Documents shall be issued in the name of the Owner, or shall be transferable to the Owner, and shall commence in accordance with Section 9.8.4.

§ 3.6 Taxes

The Contractor shall pay sales, consumer, use and similar taxes for the Work provided by the Contractor that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.

§ 3.7 Permits, Fees, Notices and Compliance with Laws

§ 3.7.1 Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for the building permit as well as for other permits, fees, licenses, and inspections by government agencies necessary for proper execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded.

§ 3.7.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of the Work.

§ 3.7.3 If the Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

§ 3.7.4 Concealed or Unknown Conditions

If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the Owner and the Architect before conditions are disturbed and in no event later than 14 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if the Architect determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend that an equitable adjustment be made in the Contract Sum or Contract Time, or both. If the Architect determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall promptly notify the Owner and Contractor, stating the reasons. If either party disputes the Architect's determination or recommendation, that party may submit a Claim as provided in Article 15.

§ 3.7.5 If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately suspend any operations that would affect them and shall notify the Owner and Architect. Upon receipt of such notice, the Owner shall promptly take any action necessary to obtain governmental authorization required to resume the operations. The Contractor shall continue to suspend such operations until otherwise instructed by the Owner but shall continue with all other operations that do not affect those remains or features. Requests for adjustments in the Contract Sum and Contract Time arising from the existence of such remains or features may be made as provided in Article 15.

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§ 3.8 Allowances

§ 3.8.1 The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct, but the Contractor shall not be required to employ persons or entities to whom the Contractor has reasonable objection.

§ 3.8.2 Unless otherwise provided in the Contract Documents,

- **.1** allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;
- **.2** Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit, and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum but not in the allowances; and
- **.3** whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Section 3.8.2.1 and (2) changes in Contractor's costs under Section 3.8.2.2.

§ 3.8.3 Materials and equipment under an allowance shall be selected by the Owner with reasonable promptness.

§ 3.9 Superintendent

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

§ 3.9.2 The Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the name and qualifications of a proposed superintendent. Within 14 days of receipt of the information, the Architect may notify the Contractor, stating whether the Owner or the Architect (1) has reasonable objection to the proposed superintendent or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 3.9.3 The Contractor shall not employ a proposed superintendent to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not change the superintendent without the Owner's consent, which shall not unreasonably be withheld or delayed.

§ 3.10 Contractor's Construction and Submittal Schedules

§ 3.10.1 The Contractor, promptly after being awarded the Contract, shall submit for the Owner's and Architect's information a Contractor's construction schedule for the Work. The schedule shall contain detail appropriate for the Project, including (1) the date of commencement of the Work, interim schedule milestone dates, and the date of Substantial Completion; (2) an apportionment of the Work by construction activity; and (3) the time required for completion of each portion of the Work. The schedule shall provide for the orderly progression of the Work to completion and shall not exceed time limits current under the Contract Documents. The schedule shall be revised at appropriate intervals as required by the conditions of the Work and Project.

§ 3.10.2 The Contractor, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, shall submit a submittal schedule for the Architect's approval. The Architect's approval shall not be unreasonably delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor's construction schedule, and (2) allow the Architect reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, or fails to provide submittals in accordance with the approved submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

§ 3.10.3 The Contractor shall perform the Work in general accordance with the most recent schedules submitted to the Owner and Architect.

§ 3.11 Documents and Samples at the Site

The Contractor shall make available, at the Project site, the Contract Documents, including Change Orders, Construction Change Directives, and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and the approved Shop Drawings, Product Data, Samples, and similar required submittals. These shall be in electronic form or paper copy, available to the Architect and Owner, and

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delivered to the Architect for submittal to the Owner upon completion of the Work as a record of the Work as constructed.

§ 3.12 Shop Drawings, Product Data and Samples

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

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

§ 3.12.3 Samples are physical examples that illustrate materials, equipment, or workmanship, and establish standards by which the Work will be judged.

§ 3.12.4 Shop Drawings, Product Data, Samples, and similar submittals are not Contract Documents. Their purpose is to demonstrate how the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Review by the Architect is subject to the limitations of Section 4.2.7. Informational submittals upon which the Architect is not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Architect without action.

§ 3.12.5 The Contractor shall review for compliance with the Contract Documents, approve, and submit to the Architect, Shop Drawings, Product Data, Samples, and similar submittals required by the Contract Documents, in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of Separate Contractors.

§ 3.12.6 By submitting Shop Drawings, Product Data, Samples, and similar submittals, the Contractor represents to the Owner and Architect that the Contractor has (1) reviewed and approved them, (2) determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

§ 3.12.7 The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples, or similar submittals, until the respective submittal has been approved by the Architect.

§ 3.12.8 The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from the requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples, or similar submittals, unless the Contractor has specifically notified the Architect of such deviation at the time of submittal and (1) the Architect has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples, or similar submittals, by the Architect's approval thereof.

§ 3.12.9 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples, or similar submittals, to revisions other than those requested by the Architect on previous submittals. In the absence of such notice, the Architect's approval of a resubmission shall not apply to such revisions.

§ 3.12.10 The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures. The Contractor shall not be required to provide professional services in violation of applicable law.

§ 3.12.10.1 If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect will specify all performance and design criteria that such services must satisfy. The Contractor shall be entitled to rely

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upon the adequacy and accuracy of the performance and design criteria provided in the Contract Documents. The Contractor shall cause such services or certifications to be provided by an appropriately licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings, and other submittals prepared by such professional. Shop Drawings, and other submittals related to the Work, designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect. The Owner and the Architect shall be entitled to rely upon the adequacy and accuracy of the services, certifications, and approvals performed or provided by such design professionals, provided the Owner and Architect have specified to the Contractor the performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect will review and approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents.

§ 3.12.10.2 If the Contract Documents require the Contractor's design professional to certify that the Work has been performed in accordance with the design criteria, the Contractor shall furnish such certifications to the Architect at the time and in the form specified by the Architect.

§ 3.13 Use of Site

The Contractor shall confine operations at the site to areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, lawful orders of public authorities, and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

§ 3.14 Cutting and Patching

§ 3.14.1 The Contractor shall be responsible for cutting, fitting, or patching required to complete the Work or to make its parts fit together properly. All areas requiring cutting, fitting, or patching shall be restored to the condition existing prior to the cutting, fitting, or patching, unless otherwise required by the Contract Documents.

§ 3.14.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or Separate Contractors by cutting, patching, or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter construction by the Owner or a Separate Contractor except with written consent of the Owner and of the Separate Contractor. Consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold, from the Owner or a Separate Contractor, its consent to cutting or otherwise altering the Work.

§ 3.15 Cleaning Up

§ 3.15.1 The Contractor shall keep the premises and surrounding area free from accumulation of waste materials and rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove waste materials, rubbish, the Contractor's tools, construction equipment, machinery, and surplus materials from and about the Project.

§ 3.15.2 If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and the Owner shall be entitled to reimbursement from the Contractor.

§ 3.16 Access to Work

The Contractor shall provide the Owner and Architect with access to the Work in preparation and progress wherever located.

§ 3.17 Royalties, Patents and Copyrights

The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner and Architect harmless from loss on account thereof, but shall not be responsible for defense or loss when a particular design, process, or product of a particular manufacturer or manufacturers is required by the Contract Documents, or where the copyright violations are contained in Drawings, Specifications, or other documents prepared by the Owner or Architect. However, if an infringement of a copyright or patent is discovered by, or made known to, the Contractor, the Contractor shall be responsible for the loss unless the information is promptly furnished to the Architect.

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§ 3.18 Indemnification

§ 3.18.1 To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), but only to the extent caused by the negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss, or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity that would otherwise exist as to a party or person described in this Section 3.18.

§ 3.18.2 In claims against any person or entity indemnified under this Section 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, the indemnification obligation under Section 3.18.1 shall not be limited by a limitation on amount or type of damages, compensation, or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts, or other employee benefit acts.

ARTICLE 4 ARCHITECT

§ 4.1 General

§ 4.1.1 The Architect is the person or entity retained by the Owner pursuant to Section 2.3.2 and identified as such in the Agreement.

§ 4.1.2 Duties, responsibilities, and limitations of authority of the Architect as set forth in the Contract Documents shall not be restricted, modified, or extended without written consent of the Owner, Contractor, and Architect. Consent shall not be unreasonably withheld.

§ 4.2 Administration of the Contract

§ 4.2.1 The Architect will provide administration of the Contract as described in the Contract Documents and will be an Owner's representative during construction until the date the Architect issues the final Certificate for Payment. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

§ 4.2.2 The Architect will visit the site at intervals appropriate to the stage of construction, or as otherwise agreed with the Owner, to become generally familiar with the progress and quality of the portion of the Work completed, and to determine in general if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Architect will not have control over, charge of, or responsibility for the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents.

§ 4.2.3 On the basis of the site visits, the Architect will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and promptly report to the Owner (1) known deviations from the Contract Documents, (2) known deviations from the most recent construction schedule submitted by the Contractor, and (3) defects and deficiencies observed in the Work. The Architect will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect will not have control over or charge of, and will not be responsible for acts or omissions of, the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

§ 4.2.4 Communications

The Owner and Contractor shall include the Architect in all communications that relate to or affect the Architect's services or professional responsibilities. The Owner shall promptly notify the Architect of the substance of any direct communications between the Owner and the Contractor otherwise relating to the Project. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and suppliers shall be through the Contractor. Communications by and with Separate Contractors shall be through the Owner. The Contract Documents may specify other communication protocols.

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§ 4.2.5 Based on the Architect's evaluations of the Contractor's Applications for Payment, the Architect will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

§ 4.2.6 The Architect has authority to reject Work that does not conform to the Contract Documents. Whenever the Architect considers it necessary or advisable, the Architect will have authority to require inspection or testing of the Work in accordance with Sections 13.4.2 and 13.4.3, whether or not the Work is fabricated, installed or completed. However, neither this authority of the Architect nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect to the Contractor, Subcontractors, suppliers, their agents or employees, or other persons or entities performing portions of the Work.

§ 4.2.7 The Architect will review and approve, or take other appropriate action upon, the Contractor's submittals such as Shop Drawings, Product Data, and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect's action will be taken in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Architect's professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Sections 3.3, 3.5, and 3.12. The Architect's review shall not constitute approval of safety precautions or of any construction means, methods, techniques, sequences, or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

§ 4.2.8 The Architect will prepare Change Orders and Construction Change Directives, and may order minor changes in the Work as provided in Section 7.4. The Architect will investigate and make determinations and recommendations regarding concealed and unknown conditions as provided in Section 3.7.4.

§ 4.2.9 The Architect will conduct inspections to determine the date or dates of Substantial Completion and the date of final completion; issue Certificates of Substantial Completion pursuant to Section 9.8; receive and forward to the Owner, for the Owner's review and records, written warranties and related documents required by the Contract and assembled by the Contractor pursuant to Section 9.10; and issue a final Certificate for Payment pursuant to Section 9.10.

§ 4.2.10 If the Owner and Architect agree, the Architect will provide one or more Project representatives to assist in carrying out the Architect's responsibilities at the site. The Owner shall notify the Contractor of any change in the duties, responsibilities and limitations of authority of the Project representatives.

§ 4.2.11 The Architect will interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness.

§ 4.2.12 Interpretations and decisions of the Architect will be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings. When making such interpretations and decisions, the Architect will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either, and will not be liable for results of interpretations or decisions rendered in good faith.

§ 4.2.13 The Architect's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.

§ 4.2.14 The Architect will review and respond to requests for information about the Contract Documents. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If appropriate, the Architect will prepare and issue supplemental Drawings and Specifications in response to the requests for information.

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ARTICLE 5 SUBCONTRACTORS

§ 5.1 Definitions

§ 5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include a Separate Contractor or the subcontractors of a Separate Contractor.

§ 5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term "Sub-subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

§ 5.2 Award of Subcontracts and Other Contracts for Portions of the Work

§ 5.2.1 Unless otherwise stated in the Contract Documents, the Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the persons or entities proposed for each principal portion of the Work, including those who are to furnish materials or equipment fabricated to a special design. Within 14 days of receipt of the information, the Architect may notify the Contractor whether the Owner or the Architect (1) has reasonable objection to any such proposed person or entity or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

§ 5.2.3 If the Owner or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no reasonable objection. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor's Work. However, no increase in the Contract Sum or Contract Time shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.

§ 5.2.4 The Contractor shall not substitute a Subcontractor, person, or entity for one previously selected if the Owner or Architect makes reasonable objection to such substitution.

§ 5.3 Subcontractual Relations

By appropriate written agreement, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work that the Contractor, by these Contract Documents, assumes toward the Owner and Architect. Each subcontract agreement shall preserve and protect the rights of the Owner and Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies, and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement that may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

§ 5.4 Contingent Assignment of Subcontracts

§ 5.4.1 Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner, provided that

- **.1** assignment is effective only after termination of the Contract by the Owner for cause pursuant to Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor; and
- **.2** assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

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When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor's rights and obligations under the subcontract.

§ 5.4.2 Upon such assignment, if the Work has been suspended for more than 30 days, the Subcontractor's compensation shall be equitably adjusted for increases in cost resulting from the suspension.

§ 5.4.3 Upon assignment to the Owner under this Section 5.4, the Owner may further assign the subcontract to a successor contractor or other entity. If the Owner assigns the subcontract to a successor contractor or other entity, the Owner shall nevertheless remain legally responsible for all of the successor contractor's obligations under the subcontract.

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

§ 6.1 Owner's Right to Perform Construction and to Award Separate Contracts

§ 6.1.1 The term "Separate Contractor(s)" shall mean other contractors retained by the Owner under separate agreements. The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and with Separate Contractors retained under Conditions of the Contract substantially similar to those of this Contract, including those provisions of the Conditions of the Contract related to insurance and waiver of subrogation.

§ 6.1.2 When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term "Contractor" in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.

§ 6.1.3 The Owner shall provide for coordination of the activities of the Owner's own forces and of each Separate Contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with any Separate Contractors and the Owner in reviewing their construction schedules. The Contractor shall make any revisions to its construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, Separate Contractors, and the Owner until subsequently revised.

§ 6.1.4 Unless otherwise provided in the Contract Documents, when the Owner performs construction or operations related to the Project with the Owner's own forces or with Separate Contractors, the Owner or its Separate Contractors shall have the same obligations and rights that the Contractor has under the Conditions of the Contract, including, without excluding others, those stated in Article 3, this Article 6, and Articles 10, 11, and 12.

§ 6.2 Mutual Responsibility

§ 6.2.1 The Contractor shall afford the Owner and Separate Contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

§ 6.2.2 If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a Separate Contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly notify the Architect of apparent discrepancies or defects in the construction or operations by the Owner or Separate Contractor that would render it unsuitable for proper execution and results of the Contractor's Work. Failure of the Contractor to notify the Architect of apparent discrepancies or defects prior to proceeding with the Work shall constitute an acknowledgment that the Owner's or Separate Contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work. The Contractor shall not be responsible for discrepancies or defects in the construction or operations by the Owner or Separate Contractor that are not apparent.

§ 6.2.3 The Contractor shall reimburse the Owner for costs the Owner incurs that are payable to a Separate Contractor because of the Contractor's delays, improperly timed activities or defective construction. The Owner shall be responsible to the Contractor for costs the Contractor incurs because of a Separate Contractor's delays, improperly timed activities, damage to the Work or defective construction.

§ 6.2.4 The Contractor shall promptly remedy damage that the Contractor wrongfully causes to completed or partially completed construction or to property of the Owner or Separate Contractor as provided in Section 10.2.5.

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§ 6.2.5 The Owner and each Separate Contractor shall have the same responsibilities for cutting and patching as are described for the Contractor in Section 3.14.

§ 6.3 Owner's Right to Clean Up

If a dispute arises among the Contractor, Separate Contractors, and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and the Architect will allocate the cost among those responsible.

ARTICLE 7 CHANGES IN THE WORK

§ 7.1 General

§ 7.1.1 Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

§ 7.1.2 A Change Order shall be based upon agreement among the Owner, Contractor, and Architect. A Construction Change Directive requires agreement by the Owner and Architect and may or may not be agreed to by the Contractor. An order for a minor change in the Work may be issued by the Architect alone.

§ 7.1.3 Changes in the Work shall be performed under applicable provisions of the Contract Documents. The Contractor shall proceed promptly with changes in the Work, unless otherwise provided in the Change Order, Construction Change Directive, or order for a minor change in the Work.

§ 7.2 Change Orders

§ 7.2.1 A Change Order is a written instrument prepared by the Architect and signed by the Owner, Contractor, and Architect stating their agreement upon all of the following:

.1 The change in the Work;
.2 The amount of the adjustment, if any, in the Contract Sum; and
.3 The extent of the adjustment, if any, in the Contract Time.

§ 7.3 Construction Change Directives

§ 7.3.1 A Construction Change Directive is a written order prepared by the Architect and signed by the Owner and Architect, directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions, or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

§ 7.3.2 A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order.

§ 7.3.3 If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

.1 Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
.2 Unit prices stated in the Contract Documents or subsequently agreed upon;
.3 Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or
.4 As provided in Section 7.3.4.

§ 7.3.4 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall determine the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit as set forth in the Agreement, or if no such amount is set forth in the Agreement, a reasonable amount. In such case, and also under Section 7.3.3.3, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.4 shall be limited to the following:

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.1 Costs of labor, including applicable payroll taxes, fringe benefits required by agreement or custom, workers' compensation insurance, and other employee costs approved by the Architect;

.2 Costs of materials, supplies, and equipment, including cost of transportation, whether incorporated or consumed;

.3 Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;

.4 Costs of premiums for all bonds and insurance, permit fees, and sales, use, or similar taxes, directly related to the change; and

.5 Costs of supervision and field office personnel directly attributable to the change.

§ 7.3.5 If the Contractor disagrees with the adjustment in the Contract Time, the Contractor may make a Claim in accordance with applicable provisions of Article 15.

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

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

§ 7.3.8 The amount of credit to be allowed by the Contractor to the Owner for a deletion or change that results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Architect. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

§ 7.3.9 Pending final determination of the total cost of a Construction Change Directive to the Owner, the Contractor may request payment for Work completed under the Construction Change Directive in Applications for Payment. The Architect will make an interim determination for purposes of monthly certification for payment for those costs and certify for payment the amount that the Architect determines, in the Architect's professional judgment, to be reasonably justified. The Architect's interim determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a Claim in accordance with Article 15.

§ 7.3.10 When the Owner and Contractor agree with a determination made by the Architect concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and the Architect will prepare a Change Order. Change Orders may be issued for all or any part of a Construction Change Directive.

§ 7.4 Minor Changes in the Work

The Architect may order minor changes in the Work that are consistent with the intent of the Contract Documents and do not involve an adjustment in the Contract Sum or an extension of the Contract Time. The Architect's order for minor changes shall be in writing. If the Contractor believes that the proposed minor change in the Work will affect the Contract Sum or Contract Time, the Contractor shall notify the Architect and shall not proceed to implement the change in the Work. If the Contractor performs the Work set forth in the Architect's order for a minor change without prior notice to the Architect that such change will affect the Contract Sum or Contract Time, the Contractor waives any adjustment to the Contract Sum or extension of the Contract Time.

ARTICLE 8 TIME

§ 8.1 Definitions

§ 8.1.1 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

§ 8.1.2 The date of commencement of the Work is the date established in the Agreement.

§ 8.1.3 The date of Substantial Completion is the date certified by the Architect in accordance with Section 9.8.

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

§ 8.2 Progress and Completion

§ 8.2.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement, the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

§ 8.2.2 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, commence the Work prior to the effective date of insurance required to be furnished by the Contractor and Owner.

§ 8.2.3 The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

§ 8.3 Delays and Extensions of Time

§ 8.3.1 If the Contractor is delayed at any time in the commencement or progress of the Work by (1) an act or neglect of the Owner or Architect, of an employee of either, or of a Separate Contractor; (2) by changes ordered in the Work; (3) by labor disputes, fire, unusual delay in deliveries, unavoidable casualties, adverse weather conditions documented in accordance with Section 15.1.6.2, or other causes beyond the Contractor's control; (4) by delay authorized by the Owner pending mediation and binding dispute resolution; or (5) by other causes that the Contractor asserts, and the Architect determines, justify delay, then the Contract Time shall be extended for such reasonable time as the Architect may determine.

§ 8.3.2 Claims relating to time shall be made in accordance with applicable provisions of Article 15.

§ 8.3.3 This Section 8.3 does not preclude recovery of damages for delay by either party under other provisions of the Contract Documents.

ARTICLE 9 PAYMENTS AND COMPLETION

§ 9.1 Contract Sum

§ 9.1.1 The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents.

§ 9.1.2 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed so that application of such unit prices to the actual quantities causes substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

§ 9.2 Schedule of Values

Where the Contract is based on a stipulated sum or Guaranteed Maximum Price, the Contractor shall submit a schedule of values to the Architect before the first Application for Payment, allocating the entire Contract Sum to the various portions of the Work. The schedule of values shall be prepared in the form, and supported by the data to substantiate its accuracy, required by the Architect. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment. Any changes to the schedule of values shall be submitted to the Architect and supported by such data to substantiate its accuracy as the Architect may require, and unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's subsequent Applications for Payment.

§ 9.3 Applications for Payment

§ 9.3.1 At least ten days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment prepared in accordance with the schedule of values, if required under Section 9.2, for completed portions of the Work. The application shall be notarized, if required, and supported by all data substantiating the Contractor's right to payment that the Owner or Architect require, such as copies of requisitions, and releases and waivers of liens from Subcontractors and suppliers, and shall reflect retainage if provided for in the Contract Documents.

§ 9.3.1.1 As provided in Section 7.3.9, such applications may include requests for payment on account of changes in the Work that have been properly authorized by Construction Change Directives, or by interim determinations of the Architect, but not yet included in Change Orders.

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§ 9.3.1.2 Applications for Payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay a Subcontractor or supplier, unless such Work has been performed by others whom the Contractor intends to pay.

§ 9.3.2 Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment suitably stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner's title to such materials and equipment or otherwise protect the Owner's interest, and shall include the costs of applicable insurance, storage, and transportation to the site, for such materials and equipment stored off the site.

§ 9.3.3 The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor's knowledge, information, and belief, be free and clear of liens, claims, security interests, or encumbrances, in favor of the Contractor, Subcontractors, suppliers, or other persons or entities that provided labor, materials, and equipment relating to the Work.

§ 9.4 Certificates for Payment

§ 9.4.1 The Architect will, within seven days after receipt of the Contractor's Application for Payment, either (1) issue to the Owner a Certificate for Payment in the full amount of the Application for Payment, with a copy to the Contractor; or (2) issue to the Owner a Certificate for Payment for such amount as the Architect determines is properly due, and notify the Contractor and Owner of the Architect's reasons for withholding certification in part as provided in Section 9.5.1; or (3) withhold certification of the entire Application for Payment, and notify the Contractor and Owner of the Architect's reason for withholding certification in whole as provided in Section 9.5.1.

§ 9.4.2 The issuance of a Certificate for Payment will constitute a representation by the Architect to the Owner, based on the Architect's evaluation of the Work and the data in the Application for Payment, that, to the best of the Architect's knowledge, information, and belief, the Work has progressed to the point indicated, the quality of the Work is in accordance with the Contract Documents, and that the Contractor is entitled to payment in the amount certified. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion, and to specific qualifications expressed by the Architect. However, the issuance of a Certificate for Payment will not be a representation that the Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work; (2) reviewed construction means, methods, techniques, sequences, or procedures; (3) reviewed copies of requisitions received from Subcontractors and suppliers and other data requested by the Owner to substantiate the Contractor's right to payment; or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

§ 9.5 Decisions to Withhold Certification

§ 9.5.1 The Architect may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect's opinion the representations to the Owner required by Section 9.4.2 cannot be made. If the Architect is unable to certify payment in the amount of the Application, the Architect will notify the Contractor and Owner as provided in Section 9.4.1. If the Contractor and Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Architect may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Section 3.3.2, because of

- **.1** defective Work not remedied;
- **.2** third party claims filed or reasonable evidence indicating probable filing of such claims, unless security acceptable to the Owner is provided by the Contractor;
- **.3** failure of the Contractor to make payments properly to Subcontractors or suppliers for labor, materials or equipment;

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.4 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
.5 damage to the Owner or a Separate Contractor;
.6 reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or
.7 repeated failure to carry out the Work in accordance with the Contract Documents.

§ 9.5.2 When either party disputes the Architect's decision regarding a Certificate for Payment under Section 9.5.1, in whole or in part, that party may submit a Claim in accordance with Article 15.

§ 9.5.3 When the reasons for withholding certification are removed, certification will be made for amounts previously withheld.

§ 9.5.4 If the Architect withholds certification for payment under Section 9.5.1.3, the Owner may, at its sole option, issue joint checks to the Contractor and to any Subcontractor or supplier to whom the Contractor failed to make payment for Work properly performed or material or equipment suitably delivered. If the Owner makes payments by joint check, the Owner shall notify the Architect and the Contractor shall reflect such payment on its next Application for Payment.

§ 9.6 Progress Payments

§ 9.6.1 After the Architect has issued a Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents, and shall so notify the Architect.

§ 9.6.2 The Contractor shall pay each Subcontractor, no later than seven days after receipt of payment from the Owner, the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner.

§ 9.6.3 The Architect will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Architect and Owner on account of portions of the Work done by such Subcontractor.

§ 9.6.4 The Owner has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors and suppliers amounts paid by the Owner to the Contractor for subcontracted Work. If the Contractor fails to furnish such evidence within seven days, the Owner shall have the right to contact Subcontractors and suppliers to ascertain whether they have been properly paid. Neither the Owner nor Architect shall have an obligation to pay, or to see to the payment of money to, a Subcontractor or supplier, except as may otherwise be required by law.

§ 9.6.5 The Contractor's payments to suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.

§ 9.6.6 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

§ 9.6.7 Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors or provided by suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, create any fiduciary liability or tort liability on the part of the Contractor for breach of trust, or entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

§ 9.6.8 Provided the Owner has fulfilled its payment obligations under the Contract Documents, the Contractor shall defend and indemnify the Owner from all loss, liability, damage or expense, including reasonable attorney's fees and litigation expenses, arising out of any lien claim or other claim for payment by any Subcontractor or supplier of any tier. Upon receipt of notice of a lien claim or other claim for payment, the Owner shall notify the Contractor. If approved by the applicable court, when required, the Contractor may substitute a surety bond for the property against which the lien or other claim for payment has been asserted.

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§ 9.7 Failure of Payment

If the Architect does not issue a Certificate for Payment, through no fault of the Contractor, within seven days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within seven days after the date established in the Contract Documents, the amount certified by the Architect or awarded by binding dispute resolution, then the Contractor may, upon seven additional days' notice to the Owner and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided for in the Contract Documents.

§ 9.8 Substantial Completion

§ 9.8.1 Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use.

§ 9.8.2 When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

§ 9.8.3 Upon receipt of the Contractor's list, the Architect will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Architect's inspection discloses any item, whether or not included on the Contractor's list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Architect. In such case, the Contractor shall then submit a request for another inspection by the Architect to determine Substantial Completion.

§ 9.8.4 When the Work or designated portion thereof is substantially complete, the Architect will prepare a Certificate of Substantial Completion that shall establish the date of Substantial Completion; establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance; and fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

§ 9.8.5 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in the Certificate. Upon such acceptance, and consent of surety if any, the Owner shall make payment of retainage applying to the Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

§ 9.9 Partial Occupancy or Use

§ 9.9.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented to by the insurer and authorized by public authorities having jurisdiction over the Project. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a list to the Architect as provided under Section 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect.

§ 9.9.2 Immediately prior to such partial occupancy or use, the Owner, Contractor, and Architect shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

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§ 9.9.3 Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

§ 9.10 Final Completion and Final Payment

§ 9.10.1 Upon receipt of the Contractor's notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make such inspection. When the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's on-site visits and inspections, the Work has been completed in accordance with the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect's final Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

§ 9.10.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect, (3) a written statement that the Contractor knows of no reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment, (5) documentation of any special warranties, such as manufacturers' warranties or specific Subcontractor warranties, and (6) if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts and releases and waivers of liens, claims, security interests, or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien, claim, security interest, or encumbrance. If a lien, claim, security interest, or encumbrance remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging the lien, claim, security interest, or encumbrance, including all costs and reasonable attorneys' fees.

§ 9.10.3 If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Architect so confirms, the Owner shall, upon application by the Contractor and certification by the Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed, corrected, and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of the surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

§ 9.10.4 The making of final payment shall constitute a waiver of Claims by the Owner except those arising from

- **.1** liens, Claims, security interests, or encumbrances arising out of the Contract and unsettled;
- **.2** failure of the Work to comply with the requirements of the Contract Documents;
- **.3** terms of special warranties required by the Contract Documents; or
- **.4** audits performed by the Owner, if permitted by the Contract Documents, after final payment.

§ 9.10.5 Acceptance of final payment by the Contractor, a Subcontractor, or a supplier, shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

§ 10.1 Safety Precautions and Programs

The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Contract.

§ 10.2 Safety of Persons and Property

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

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.1 employees on the Work and other persons who may be affected thereby;

.2 the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor, a Subcontractor, or a Sub-subcontractor; and

.3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

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

§ 10.2.3 The Contractor shall implement, erect, and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards; promulgating safety regulations; and notifying the owners and users of adjacent sites and utilities of the safeguards.

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

§ 10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Sections 10.2.1.2 and 10.2.1.3 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 10.2.1.2 and 10.2.1.3. The Contractor may make a Claim for the cost to remedy the damage or loss to the extent such damage or loss is attributable to acts or omissions of the Owner or Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 3.18.

§ 10.2.6 The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner and Architect.

§ 10.2.7 The Contractor shall not permit any part of the construction or site to be loaded so as to cause damage or create an unsafe condition.

§ 10.2.8 Injury or Damage to Person or Property

If either party suffers injury or damage to person or property because of an act or omission of the other party, or of others for whose acts such party is legally responsible, notice of the injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.

§ 10.3 Hazardous Materials and Substances

§ 10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials or substances. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and notify the Owner and Architect of the condition.

§ 10.3.2 Upon receipt of the Contractor's notice, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of the material or substance or who are to perform the task of removal or safe containment of the material or substance. The Contractor and the Architect will

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promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or entities proposed by the Owner. If either the Contractor or Architect has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor and the Architect have no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. By Change Order, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable additional costs of shutdown, delay, and start-up.

§ 10.3.3 To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Subcontractors, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work in the affected area if in fact the material or substance presents the risk of bodily injury or death as described in Section 10.3.1 and has not been rendered harmless, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), except to the extent that such damage, loss, or expense is due to the fault or negligence of the party seeking indemnity.

§ 10.3.4 The Owner shall not be responsible under this Section 10.3 for hazardous materials or substances the Contractor brings to the site unless such materials or substances are required by the Contract Documents. The Owner shall be responsible for hazardous materials or substances required by the Contract Documents, except to the extent of the Contractor's fault or negligence in the use and handling of such materials or substances.

§ 10.3.5 The Contractor shall reimburse the Owner for the cost and expense the Owner incurs (1) for remediation of hazardous materials or substances the Contractor brings to the site and negligently handles, or (2) where the Contractor fails to perform its obligations under Section 10.3.1, except to the extent that the cost and expense are due to the Owner's fault or negligence.

§ 10.3.6 If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall reimburse the Contractor for all cost and expense thereby incurred.

§ 10.4 Emergencies

In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury, or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 15 and Article 7.

ARTICLE 11 INSURANCE AND BONDS

§ 11.1 Contractor's Insurance and Bonds

§ 11.1.1 The Contractor shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Contractor shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Owner, Architect, and Architect's consultants shall be named as additional insureds under the Contractor's commercial general liability policy or as otherwise described in the Contract Documents.

§ 11.1.2 The Contractor shall provide surety bonds of the types, for such penal sums, and subject to such terms and conditions as required by the Contract Documents. The Contractor shall purchase and maintain the required bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located.

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

§ 11.1.4 Notice of Cancellation or Expiration of Contractor's Required Insurance. Within three (3) business days of the date the Contractor becomes aware of an impending or actual cancellation or expiration of any insurance required by the Contract Documents, the Contractor shall provide notice to the Owner of such impending or actual cancellation or

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expiration. Upon receipt of notice from the Contractor, the Owner shall, unless the lapse in coverage arises from an act or omission of the Owner, have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by the Contractor. The furnishing of notice by the Contractor shall not relieve the Contractor of any contractual obligation to provide any required coverage.

§ 11.2 Owner's Insurance

§ 11.2.1 The Owner shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Owner shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located.

§ 11.2.2 Failure to Purchase Required Property Insurance. If the Owner fails to purchase and maintain the required property insurance, with all of the coverages and in the amounts described in the Agreement or elsewhere in the Contract Documents, the Owner shall inform the Contractor in writing prior to commencement of the Work. Upon receipt of notice from the Owner, the Contractor may delay commencement of the Work and may obtain insurance that will protect the interests of the Contractor, Subcontractors, and Sub-Subcontractors in the Work. When the failure to provide coverage has been cured or resolved, the Contract Sum and Contract Time shall be equitably adjusted. In the event the Owner fails to procure coverage, the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent the loss to the Owner would have been covered by the insurance to have been procured by the Owner. The cost of the insurance shall be charged to the Owner by a Change Order. If the Owner does not provide written notice, and the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain the required insurance, the Owner shall reimburse the Contractor for all reasonable costs and damages attributable thereto.

§ 11.2.3 Notice of Cancellation or Expiration of Owner's Required Property Insurance. Within three (3) business days of the date the Owner becomes aware of an impending or actual cancellation or expiration of any property insurance required by the Contract Documents, the Owner shall provide notice to the Contractor of such impending or actual cancellation or expiration. Unless the lapse in coverage arises from an act or omission of the Contractor: (1) the Contractor, upon receipt of notice from the Owner, shall have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by either the Owner or the Contractor; (2) the Contract Time and Contract Sum shall be equitably adjusted; and (3) the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent any loss to the Owner would have been covered by the insurance had it not expired or been cancelled. If the Contractor purchases replacement coverage, the cost of the insurance shall be charged to the Owner by an appropriate Change Order. The furnishing of notice by the Owner shall not relieve the Owner of any contractual obligation to provide required insurance.

§ 11.3 Waivers of Subrogation

§ 11.3.1 The Owner and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents, and employees, each of the other; (2) the Architect and Architect's consultants; and (3) Separate Contractors, if any, and any of their subcontractors, sub-subcontractors, agents, and employees, for damages caused by fire, or other causes of loss, to the extent those losses are covered by property insurance required by the Agreement or other property insurance applicable to the Project, except such rights as they have to proceeds of such insurance. The Owner or Contractor, as appropriate, shall require similar written waivers in favor of the individuals and entities identified above from the Architect, Architect's consultants, Separate Contractors, subcontractors, and sub-subcontractors. The policies of insurance purchased and maintained by each person or entity agreeing to waive claims pursuant to this section 11.3.1 shall not prohibit this waiver of subrogation. This waiver of subrogation shall be effective as to a person or entity (1) even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, (2) even though that person or entity did not pay the insurance premium directly or indirectly, or (3) whether or not the person or entity had an insurable interest in the damaged property.

§ 11.3.2 If during the Project construction period the Owner insures properties, real or personal or both, at or adjacent to the site by property insurance under policies separate from those insuring the Project, or if after final payment property insurance is to be provided on the completed Project through a policy or policies other than those insuring the Project during the construction period, to the extent permissible by such policies, the Owner waives all rights in accordance with the terms of Section 11.3.1 for damages caused by fire or other causes of loss covered by this separate property insurance.

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§ 11.4 Loss of Use, Business Interruption, and Delay in Completion Insurance

The Owner, at the Owner's option, may purchase and maintain insurance that will protect the Owner against loss of use of the Owner's property, or the inability to conduct normal operations, due to fire or other causes of loss. The Owner waives all rights of action against the Contractor and Architect for loss of use of the Owner's property, due to fire or other hazards however caused.

§11.5 Adjustment and Settlement of Insured Loss

§ 11.5.1 A loss insured under the property insurance required by the Agreement shall be adjusted by the Owner as fiduciary and made payable to the Owner as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause and of Section 11.5.2. The Owner shall pay the Architect and Contractor their just shares of insurance proceeds received by the Owner, and by appropriate agreements the Architect and Contractor shall make payments to their consultants and Subcontractors in similar manner.

§ 11.5.2 Prior to settlement of an insured loss, the Owner shall notify the Contractor of the terms of the proposed settlement as well as the proposed allocation of the insurance proceeds. The Contractor shall have 14 days from receipt of notice to object to the proposed settlement or allocation of the proceeds. If the Contractor does not object, the Owner shall settle the loss and the Contractor shall be bound by the settlement and allocation. Upon receipt, the Owner shall deposit the insurance proceeds in a separate account and make the appropriate distributions. Thereafter, if no other agreement is made or the Owner does not terminate the Contract for convenience, the Owner and Contractor shall execute a Change Order for reconstruction of the damaged or destroyed Work in the amount allocated for that purpose. If the Contractor timely objects to either the terms of the proposed settlement or the allocation of the proceeds, the Owner may proceed to settle the insured loss, and any dispute between the Owner and Contractor arising out of the settlement or allocation of the proceeds shall be resolved pursuant to Article 15. Pending resolution of any dispute, the Owner may issue a Construction Change Directive for the reconstruction of the damaged or destroyed Work.

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 Uncovering of Work

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

§ 12.1.2 If a portion of the Work has been covered that the Architect has not specifically requested to examine prior to its being covered, the Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, the Contractor shall be entitled to an equitable adjustment to the Contract Sum and Contract Time as may be appropriate. If such Work is not in accordance with the Contract Documents, the costs of uncovering the Work, and the cost of correction, shall be at the Contractor's expense.

§ 12.2 Correction of Work

§ 12.2.1 Before Substantial Completion

The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, discovered before Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Architect's services and expenses made necessary thereby, shall be at the Contractor's expense.

§ 12.2.2 After Substantial Completion

§ 12.2.2.1 In addition to the Contractor's obligations under Section 3.5, if, within one year after the date of Substantial Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 9.9.1, or by terms of any applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of notice from the Owner to do so, unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work within a reasonable time during

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that period after receipt of notice from the Owner or Architect, the Owner may correct it in accordance with Section 2.5.

§ 12.2.2.2 The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

§ 12.2.2.3 The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Section 12.2.

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

§ 12.2.4 The Contractor shall bear the cost of correcting destroyed or damaged construction of the Owner or Separate Contractors, whether completed or partially completed, caused by the Contractor's correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

§ 12.2.5 Nothing contained in this Section 12.2 shall be construed to establish a period of limitation with respect to other obligations the Contractor has under the Contract Documents. Establishment of the one-year period for correction of Work as described in Section 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

§ 12.3 Acceptance of Nonconforming Work

If the Owner prefers to accept Work that is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

ARTICLE 13 MISCELLANEOUS PROVISIONS

§ 13.1 Governing Law

The Contract shall be governed by the law of the place where the Project is located, excluding that jurisdiction's choice of law rules. If the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4.

§ 13.2 Successors and Assigns

§ 13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns, and legal representatives to covenants, agreements, and obligations contained in the Contract Documents. Except as provided in Section 13.2.2, neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

§ 13.2.2 The Owner may, without consent of the Contractor, assign the Contract to a lender providing construction financing for the Project, if the lender assumes the Owner's rights and obligations under the Contract Documents. The Contractor shall execute all consents reasonably required to facilitate the assignment.

§ 13.3 Rights and Remedies

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

§ 13.3.2 No action or failure to act by the Owner, Architect, or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed upon in writing.

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§ 13.4 Tests and Inspections

§ 13.4.1 Tests, inspections, and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules, and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections, and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections, and approvals. The Contractor shall give the Architect timely notice of when and where tests and inspections are to be made so that the Architect may be present for such procedures. The Owner shall bear costs of tests, inspections, or approvals that do not become requirements until after bids are received or negotiations concluded. The Owner shall directly arrange and pay for tests, inspections, or approvals where building codes or applicable laws or regulations so require.

§ 13.4.2 If the Architect, Owner, or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection, or approval not included under Section 13.4.1, the Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection, or approval, by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect of when and where tests and inspections are to be made so that the Architect may be present for such procedures. Such costs, except as provided in Section 13.4.3, shall be at the Owner's expense.

§ 13.4.3 If procedures for testing, inspection, or approval under Sections 13.4.1 and 13.4.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure, including those of repeated procedures and compensation for the Architect's services and expenses, shall be at the Contractor's expense.

§ 13.4.4 Required certificates of testing, inspection, or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Architect.

§ 13.4.5 If the Architect is to observe tests, inspections, or approvals required by the Contract Documents, the Architect will do so promptly and, where practicable, at the normal place of testing.

§ 13.4.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

§ 13.5 Interest

Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at the rate the parties agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 Termination by the Contractor

§ 14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of 30 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, for any of the following reasons:

- **.1** Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;
- **.2** An act of government, such as a declaration of national emergency, that requires all Work to be stopped;
- **.3** Because the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents; or
- **.4** The Owner has failed to furnish to the Contractor reasonable evidence as required by Section 2.2.

§ 14.1.2 The Contractor may terminate the Contract if, through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, repeated suspensions, delays, or interruptions of the entire Work by the Owner as described in Section 14.3, constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.

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§ 14.1.3 If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days' notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed, as well as reasonable overhead and profit on Work not executed, and costs incurred by reason of such termination.

§ 14.1.4 If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, or their agents or employees or any other persons or entities performing portions of the Work because the Owner has repeatedly failed to fulfill the Owner's obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days' notice to the Owner and the Architect, terminate the Contract and recover from the Owner as provided in Section 14.1.3.

§ 14.2 Termination by the Owner for Cause

§ 14.2.1 The Owner may terminate the Contract if the Contractor

- **.1** repeatedly refuses or fails to supply enough properly skilled workers or proper materials;
- **.2** fails to make payment to Subcontractors or suppliers in accordance with the respective agreements between the Contractor and the Subcontractors or suppliers;
- **.3** repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or
- **.4** otherwise is guilty of substantial breach of a provision of the Contract Documents.

§ 14.2.2 When any of the reasons described in Section 14.2.1 exist, and upon certification by the Architect that sufficient cause exists to justify such action, the Owner may, without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, seven days' notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:

- **.1** Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;
- **.2** Accept assignment of subcontracts pursuant to Section 5.4; and
- **.3** Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

§ 14.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

§ 14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Initial Decision Maker, upon application, and this obligation for payment shall survive termination of the Contract.

§ 14.3 Suspension by the Owner for Convenience

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

§ 14.3.2 The Contract Sum and Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay, or interruption under Section 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall be made to the extent

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

§ 14.4 Termination by the Owner for Convenience

§ 14.4.1 The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause.

§ 14.4.2 Upon receipt of notice from the Owner of such termination for the Owner's convenience, the Contractor shall

- **.1** cease operations as directed by the Owner in the notice;

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.2 take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and

.3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

§ 14.4.3 In case of such termination for the Owner's convenience, the Owner shall pay the Contractor for Work properly executed; costs incurred by reason of the termination, including costs attributable to termination of Subcontracts; and the termination fee, if any, set forth in the Agreement.

ARTICLE 15 CLAIMS AND DISPUTES

§ 15.1 Claims

§ 15.1.1 Definition

A Claim is a demand or assertion by one of the parties seeking, as a matter of right, payment of money, a change in the Contract Time, or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim. This Section 15.1.1 does not require the Owner to file a Claim in order to impose liquidated damages in accordance with the Contract Documents.

§ 15.1.2 Time Limits on Claims

The Owner and Contractor shall commence all Claims and causes of action against the other and arising out of or related to the Contract, whether in contract, tort, breach of warranty or otherwise, in accordance with the requirements of the binding dispute resolution method selected in the Agreement and within the period specified by applicable law, but in any case not more than 10 years after the date of Substantial Completion of the Work. The Owner and Contractor waive all Claims and causes of action not commenced in accordance with this Section 15.1.2.

§ 15.1.3 Notice of Claims

§ 15.1.3.1 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered prior to expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party and to the Initial Decision Maker with a copy sent to the Architect, if the Architect is not serving as the Initial Decision Maker. Claims by either party under this Section 15.1.3.1 shall be initiated within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later.

§ 15.1.3.2 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party. In such event, no decision by the Initial Decision Maker is required.

§ 15.1.4 Continuing Contract Performance

§ 15.1.4.1 Pending final resolution of a Claim, except as otherwise agreed in writing or as provided in Section 9.7 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents.

§ 15.1.4.2 The Contract Sum and Contract Time shall be adjusted in accordance with the Initial Decision Maker's decision, subject to the right of either party to proceed in accordance with this Article 15. The Architect will issue Certificates for Payment in accordance with the decision of the Initial Decision Maker.

§ 15.1.5 Claims for Additional Cost

If the Contractor wishes to make a Claim for an increase in the Contract Sum, notice as provided in Section 15.1.3 shall be given before proceeding to execute the portion of the Work that is the subject of the Claim. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.4.

§ 15.1.6 Claims for Additional Time

§ 15.1.6.1 If the Contractor wishes to make a Claim for an increase in the Contract Time, notice as provided in Section 15.1.3 shall be given. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay, only one Claim is necessary.

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§ 15.1.6.2 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated, and had an adverse effect on the scheduled construction.

§ 15.1.7 Waiver of Claims for Consequential Damages

The Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes

.1 damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and

.2 damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit, except anticipated profit arising directly from the Work.

This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with Article 14. Nothing contained in this Section 15.1.7 shall be deemed to preclude assessment of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

§ 15.2 Initial Decision

§ 15.2.1 Claims, excluding those where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2 or arising under Sections 10.3, 10.4, and 11.5, shall be referred to the Initial Decision Maker for initial decision. The Architect will serve as the Initial Decision Maker, unless otherwise indicated in the Agreement. Except for those Claims excluded by this Section 15.2.1, an initial decision shall be required as a condition precedent to mediation of any Claim. If an initial decision has not been rendered within 30 days after the Claim has been referred to the Initial Decision Maker, the party asserting the Claim may demand mediation and binding dispute resolution without a decision having been rendered. Unless the Initial Decision Maker and all affected parties agree, the Initial Decision Maker will not decide disputes between the Contractor and persons or entities other than the Owner.

§ 15.2.2 The Initial Decision Maker will review Claims and within ten days of the receipt of a Claim take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party, (2) reject the Claim in whole or in part, (3) approve the Claim, (4) suggest a compromise, or (5) advise the parties that the Initial Decision Maker is unable to resolve the Claim if the Initial Decision Maker lacks sufficient information to evaluate the merits of the Claim or if the Initial Decision Maker concludes that, in the Initial Decision Maker's sole discretion, it would be inappropriate for the Initial Decision Maker to resolve the Claim.

§ 15.2.3 In evaluating Claims, the Initial Decision Maker may, but shall not be obligated to, consult with or seek information from either party or from persons with special knowledge or expertise who may assist the Initial Decision Maker in rendering a decision. The Initial Decision Maker may request the Owner to authorize retention of such persons at the Owner's expense.

§ 15.2.4 If the Initial Decision Maker requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of the request, and shall either (1) provide a response on the requested supporting data, (2) advise the Initial Decision Maker when the response or supporting data will be furnished, or (3) advise the Initial Decision Maker that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Initial Decision Maker will either reject or approve the Claim in whole or in part.

§ 15.2.5 The Initial Decision Maker will render an initial decision approving or rejecting the Claim, or indicating that the Initial Decision Maker is unable to resolve the Claim. This initial decision shall (1) be in writing; (2) state the reasons therefor; and (3) notify the parties and the Architect, if the Architect is not serving as the Initial Decision Maker, of any change in the Contract Sum or Contract Time or both. The initial decision shall be final and binding on the parties but subject to mediation and, if the parties fail to resolve their dispute through mediation, to binding dispute resolution.

§ 15.2.6 Either party may file for mediation of an initial decision at any time, subject to the terms of Section 15.2.6.1.

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§ 15.2.6.1 Either party may, within 30 days from the date of receipt of an initial decision, demand in writing that the other party file for mediation. If such a demand is made and the party receiving the demand fails to file for mediation within 30 days after receipt thereof, then both parties waive their rights to mediate or pursue binding dispute resolution proceedings with respect to the initial decision.

§ 15.2.7 In the event of a Claim against the Contractor, the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor's default, the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

§ 15.2.8 If a Claim relates to or is the subject of a mechanic's lien, the party asserting such Claim may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.

§ 15.3 Mediation

§ 15.3.1 Claims, disputes, or other matters in controversy arising out of or related to the Contract, except those waived as provided for in Sections 9.10.4, 9.10.5, and 15.1.7, shall be subject to mediation as a condition precedent to binding dispute resolution.

§ 15.3.2 The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedures in effect on the date of the Agreement. A request for mediation shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the mediation. The request may be made concurrently with the filing of binding dispute resolution proceedings but, in such event, mediation shall proceed in advance of binding dispute resolution proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order. If an arbitration is stayed pursuant to this Section 15.3.2, the parties may nonetheless proceed to the selection of the arbitrator(s) and agree upon a schedule for later proceedings.

§ 15.3.3 Either party may, within 30 days from the date that mediation has been concluded without resolution of the dispute or 60 days after mediation has been demanded without resolution of the dispute, demand in writing that the other party file for binding dispute resolution. If such a demand is made and the party receiving the demand fails to file for binding dispute resolution within 60 days after receipt thereof, then both parties waive their rights to binding dispute resolution proceedings with respect to the initial decision.

§ 15.3.4 The parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

§ 15.4 Arbitration

§ 15.4.1 If the parties have selected arbitration as the method for binding dispute resolution in the Agreement, any Claim subject to, but not resolved by, mediation shall be subject to arbitration which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Arbitration Rules in effect on the date of the Agreement. The Arbitration shall be conducted in the place where the Project is located, unless another location is mutually agreed upon. A demand for arbitration shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the arbitration. The party filing a notice of demand for arbitration must assert in the demand all Claims then known to that party on which arbitration is permitted to be demanded.

§ 15.4.1.1 A demand for arbitration shall be made no earlier than concurrently with the filing of a request for mediation, but in no event shall it be made after the date when the institution of legal or equitable proceedings based on the Claim would be barred by the applicable statute of limitations. For statute of limitations purposes, receipt of a written demand for arbitration by the person or entity administering the arbitration shall constitute the institution of legal or equitable proceedings based on the Claim.

§ 15.4.2 The award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

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§ 15.4.3 The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to the Agreement, shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

§ 15.4.4 Consolidation or Joinder

§ 15.4.4.1 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may consolidate an arbitration conducted under this Agreement with any other arbitration to which it is a party provided that (1) the arbitration agreement governing the other arbitration permits consolidation, (2) the arbitrations to be consolidated substantially involve common questions of law or fact, and (3) the arbitrations employ materially similar procedural rules and methods for selecting arbitrator(s).

§ 15.4.4.2 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may include by joinder persons or entities substantially involved in a common question of law or fact whose presence is required if complete relief is to be accorded in arbitration, provided that the party sought to be joined consents in writing to such joinder. Consent to arbitration involving an additional person or entity shall not constitute consent to arbitration of any claim, dispute or other matter in question not described in the written consent.

§ 15.4.4.3 The Owner and Contractor grant to any person or entity made a party to an arbitration conducted under this Section 15.4, whether by joinder or consolidation, the same rights of joinder and consolidation as those of the Owner and Contractor under this Agreement.

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SUPPLEMENTARY GENERAL CONDITIONS TO THE CONTRACT

The following supplements modify the "General Conditions of the Contract for Construction," AIA Document A201-2017. Where a portion of the General Conditions is modified or deleted by the Supplementary Conditions, the unaltered portions of the General Conditions shall remain in effect.

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14. TERMINATION OR SUSPENSION OF THE CONTRACT
15. CLAIMS AND DISPUTES

NOT FOR BIDDING

ARTICLE 1: GENERAL PROVISIONS

1.1 BASIC DEFINITIONS

1.1.1 THE CONTRACT DOCUMENTS

Strike the last sentence of Section 1.1.1 in its entirety and replace with the following:

"The Contract Documents also include Advertisement for Bid, Instructions to Bidder, sample forms, the Bid Form, the Contractor's completed Bid and the Award Letter."

Add the following Section:

"1.1.1.1 In the event of conflict or discrepancies among the Contract Documents, the Documents prepared by the State of Delaware, Division of Facilities Management shall take precedence over all other documents."

1.1.8 INITIAL DECISION MAKER

Strike the last sentence of Section 1.1.8 in its entirety and add the following to the end of the remaining sentence:

" and certify termination of the Agreement under Section14.2.2."

1.2 CORRELATION AND INTENT OF THE CONTRACT DOCUMENTS

1.2.1.1 Insert "if possible" at the end of the second sentence.

Add the following Sections:

"1.2.4 In the case of an inconsistency between the Drawings and the Specifications, or within either document not clarified by addendum, the better quality or greater quantity of work shall be provided in accordance with the Architect's interpretation."

"1.2.5 The word "PROVIDE" as used in the Contract Documents shall mean "FURNISH AND INSTALL" and shall include, without limitation, all labor, materials, equipment, transportation, services and other items required to complete the Work."

"1.2.6 The word "PRODUCT" as used in the Contract Documents means all materials, systems and equipment."

1.5 OWNERSHIP AND USE OF DRAWINGS, SPECIFICATIONS AND OTHER INSTRUMENTS OF SERVICE

Strike Section 1.5.1 in its entirety and replace with the following:

"All pre-design studies, drawings, specifications and other documents, including those in electronic form, prepared by the Architect under this Agreement are, and shall remain, the property of the Owner whether the Project for which they are made is executed or not. Such documents may be used by the Owner to construct one or more like Projects without the approval of, or additional compensation to, the Architect. The Contractor, Subcontractors, Sub-subcontractors, and Material or Equipment Suppliers are authorized to use and reproduce applicable portions of the Drawings, Specifications and other documents prepared by the Architect and the Architect's consultants appropriate to and for use in the execution of their Work under the Contract Documents. They are not to be used by the Contractor or any Subcontractor,

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Sub-subcontractor or Material and Equipment Supplier on other Projects or for additions to this Project outside the scope of the Work without the specific written consent of the Owner, Architect and Architect's consultants.

The Architect shall not be liable for injury or damage resulting from the re-use of drawings and specifications if the Architect is not involved in the re-use Project. Prior to re-use of construction documents for a Project in which the Architect is not also involved, the Owner will remove from such documents all identification of the original Architect, including name, address and professional seal or stamp."

Strike Section 1.5.2 in its entirety.

1.7 DIGITAL DATA USE AND TRANSMISSION

Strike Section 1.7 in its entirety and replace with the following:

"The parties shall agree upon protocols governing transmission and use of Instruments of Service or any other information or documentation in digital form."

1.8 BUILDING INFORMATION MODELS USE AND RELIANCE

Strike Section 1.8 in its entirety.

ARTICLE 2: OWNER

2.2 EVIDENCE OF THE OWNERS FINANCIAL ARRANGEMENTS

Strike Section 2.2 in its entirety.

2.3 INFORMATION AND SERVICES REQUIRED OF THE OWNER

2.3.3 Strike 2.3.3 in its entirety.

2.3.4 Add the following sentence at the end of the paragraph:

"The Contractor, at their expense shall bear the costs to accurately identify the location of all underground utilities in the area of their excavation and shall bear all cost for any repairs required, out of failure to accurately identify said utilities."

Strike Section 2.3.6 in its entirety and replace with the following:

"2.3.6 The Contractor shall be furnished free of charge (1) electronic set of the Drawings and Project Manuals. Additional sets will be furnished at the cost of reproduction, postage and handling."

2.5 OWNER'S RIGHT TO CARRY OUT THE WORK

Add ", except as outlined in Section 3.15" after the reference to "Article 15" at the end of the last sentence of the Section.

ARTICLE 3: CONTRACTOR

3.2 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR

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3.2.2 Add “and Owner” after “report to the Architect” in the second sentence.

3.2.4 Strike “subject to Section 15.1.7” in the second sentence.

3.2.4 Strike the third sentence.

3.3 SUPERVISION AND CONSTRUCTION PROCEDURES

Add the following Sections:

“3.3.2.1 The Contractor shall immediately remove from the Work, whenever requested to do so by the Owner, any person who is considered by the Owner or Architect to be incompetent or disposed to be so disorderly, or who for any reason is not satisfactory to the Owner, and that person shall not again be employed on the Work without the consent of the Owner or the Architect.”

“3.3.4 The Contractor must provide suitable storage facilities at the Site for the proper protection and safe storage of their materials, or as otherwise identified by the specifications. Consult the Owner and the Architect before storing any materials.”

“3.3.5 When any room is used as a shop, storeroom, office, etc., by the Contractor or Subcontractor(s) during the construction of the Work, the Contractor making use of these areas will be held responsible for any repairs, patching or cleaning arising from such use.”

3.4 LABOR AND MATERIALS

Add the Following Sections:

“3.4.4 Before starting the Work, each Contractor shall carefully examine all preparatory Work that has been executed to receive their Work. Check carefully, by whatever means are required, to insure that its Work and adjacent, related Work, will finish to proper contours, planes and levels. Promptly notify the Architect & Owner of any defects or imperfections in preparatory Work which will in any way affect satisfactory completion of its Work. Absence of such notification will be construed as an acceptance of preparatory Work and later claims of defects will not be recognized.”

“3.4.5 Under no circumstances shall the Contractor’s Work proceed prior to preparatory Work having been completely cured, dried and/or otherwise made satisfactory to receive this Work. Responsibility for timely installation of all materials rests solely with the Contractor responsible for that Work, who shall maintain coordination at all times.”

3.5 WARRANTY

Add the following Sections:

“3.5.3 The Contractor will guarantee all materials and workmanship against original defects, except injury from proper and usual wear when used for the purpose intended, for two years after Acceptance by the Owner, and will maintain all items in perfect condition during the period of warranty.”

“3.5.4 Defects appearing during the period of warranty will be made good by the Contractor at his expense upon demand of the Owner, it being required that all work will be in perfect condition when the period of warranty will have elapsed.”

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"3.5.5 Upon notification by the Owner of a defect covered by the Contractor's warranty, the Contractor shall respond within 4 hours of the notification."

"3.5.6 In addition to the General Warranty there are other warranties required for certain items for different periods of time than the two years as above, and are particularly so stated in that part of the specifications referring to same. The said warranties will commence at the same time as the General Warranty."

"3.5.7 If the Contractor fails to remedy any failure, defect or damage within a reasonable time after receipt of notice, the Owner will have the right to replace, repair, or otherwise remedy the failure, defect or damage at the Contractor's expense."

3.8 ALLOWANCES

Add the following Section:

"3.8.1.1 For costs to be covered under a project allowance, (included in the schedule of values) the Contractor shall submit a summary of those costs anticipated and an Allowance Access Authorization Form to the Architect and Owner, reflecting the projected costs. The Allowance Access Authorization Form must be signed by the Owner prior to initiating any work associated with the allowance."

3.10 CONTRACTOR'S CONSTRUCTION AND SUBMITTAL SCHEDULES

3.10.1 Add "estimated" after "and the" and before "date of" in the second sentence.

3.10.2 Strike "and thereafter as necessary to maintain a current submittal schedule" in the first sentence.

3.11 DOCUMENTS AND SAMPLES AT THE SITE

Add the following Sections:

"3.11.1 During the course of the Work, the Contractor shall maintain a record set of drawings on which the Contractor shall mark the actual physical location of all piping, valves, equipment, conduit, outlets, access panels, controls, actuators, including all appurtenances that will be concealed once construction is complete, etc., including all invert elevations."

"3.11.2 At the completion of the project, the Contractor shall obtain a set of the conformed contract drawings from the Architect, and neatly transfer all information outlined in 3.11.1 to provide a complete record of the as-built conditions."

"3.11.3 Upon completion of the work noted in 3.11.2 the contractor shall schedule a meeting with the Architect/Engineer and Owner to review the final record drawings and closeout documents prior to submission. After this meeting the Contractor shall make adjustments per the review, and submit one (1) original markup and (2) copies of the red line drawings (as-built conditions, to the Owner and one (1) print to the Architect. In addition, attach one complete set of the as-built documents to each of the Operating and Maintenance Instructions/Manuals. The Contractor will include (2) USB drives, each containing all "red line drawings (as-built) and Closeout Documents properly tabbed in accordance with closeout requirements as defined elsewhere in the contract documents."

3.12 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

3.12.10.2 Strike "If the Contract Documents require" from the beginning of the sentence.

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3.12.10.2 Strike “to” between “professional” and certify” and replace with “shall”.

3.17 Insert “indemnify and” between “shall” and “hold” in the second sentence.

ARTICLE 4: ADMINISTRATION OF THE CONTRACT

4.2 ADMINISTRATION OF THE CONTRACT

4.2.7 Strike the first sentence and replace with the following:

“The Architect will review and approve or take other appropriate action upon the Contractor’s submittals such as Shop Drawings, Product Data and Samples for the purpose of checking for conformance with the Contract Documents.”

4.2.7 Strike the second sentence and replace with the following:

“The Architect’s action will be taken with such reasonable promptness as to cause no delay in the Work in the activities of the Owner, Contractor or separate Contractors, while allowing sufficient time in the Owner’s professional judgment to permit adequate review.”

Add the following Section:

“4.2.10.1 There will be no full-time Project Representative provided by the Owner or Architect on this project.”

“4.2.13 Add “and in compliance with all local requirements.” to the end of the sentence.”

ARTICLE 5: SUBCONTRACTORS

5.2 AWARD OF SUBCONTRACTS AND OTHER CONTRACTS FOR PORTIONS OF THE WORK

5.2.3 Strike Section 5.2.3 in its entirety and replace with the following:

“If the Owner or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no reasonable objection, subject to the statutory requirements of 29 Delaware Code § 6962(d)(10)b.3 and 4.”

5.2.4 Strike Section 5.2.4 in its entirety and replace with the following:

”The Contractor may not substitute any Subcontractor listed in its Bid unless the Contractor complies with the requirements of 29 Delaware Code § 6962(d)(10)b.3 and 4. Failure to comply with this requirement shall subject the Contractor to a penalty as outlined in Section 5.2 of the Owner’s General Requirements.”

Add the following Section:

“5.2.5 The Contractor shall comply and shall ensure all Subcontractors comply with all requirements for drug testing as set forth in TITLE 19 LABOR DELAWARE ADMINISTRATIVE CODE 4000 Office of Management and Budget 4100 Division of Facilities Management **4104 Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on Large Public Works Projects.”**

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ARTICLE 6: CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

6.1 OWNER'S RIGHT TO PERFORM CONSTRUCTION AND TO AWARD SEPARATE CONTRACTS

6.1.1 Strike "and waiver of subrogation" from the end of the second sentence.

6.1.4 Strike Section 6.1.4 in its entirety.

6.2 MUTUAL RESPONSIBILITY

6.2.3 Strike "shall" and replace with "may" in the second sentence.

ARTICLE 7: CHANGES IN THE WORK

(SEE ARTICLE 7: CHANGES IN WORK IN THE STATE OF DELAWARE DIVISION OF FACILITIES MANAGEMENT GENERAL REQUIREMENTS)

7.3.4.1 Strike "and other employee costs approved by the Architect" after "worker's compensation insurance,"

7.3.4.4 Add "work attributable to the" before "change" at the end of the sentence.

7.4 MINOR CHANGES IN WORK
Add "unless such changes are approved" at the end of the third sentence.

ARTICLE 8: TIME

8.2 PROGRESS AND COMPLETION

8.2.1 Add the following Section:

"8.2.1.1 Refer to Project Specifications Section SUMMARY OF WORK for Contract time requirements."

8.2.2 After "by the Contractor" strike "and" and insert "to".

8.2.4 Add the following Section:

"8.2.4 If the Work falls behind the Progress Schedule as submitted by the Contractor, the Contractor shall employ additional labor and/or equipment necessary to bring the Work into compliance with the Progress Schedule at no additional cost to the Owner."

8.3 DELAYS AND EXTENSION OF TIME

8.3.1 Strike "binding dispute resolution" and insert "any and all remedies at law or in equity".

Add the following Section:

"8.3.2.1 The Contractor shall update the status of the suspension, delay, or interruption of the Work with each Application for Payment. (The Contractor shall report the termination of such

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cause immediately upon the termination thereof.) Failure to comply with this procedure shall constitute a waiver for any claim for adjustment of time or price based upon said cause."

Strike Section 8.3.3 in its entirety and replace with the following:

8.3.3 "Except in the case of a suspension of the Work directed by the Owner, an extension of time under the provisions of Section 8.3.1 shall be the Contractor's sole remedy in the progress of the Work and there shall be no payment or compensation to the Contractor for any expense or damage resulting from the delay."

Add the following Section:

"8.3.4 By permitting the Contractor to work after the expired time for completion of the project, the Owner does not waive their rights under the Contract."

ARTICLE 9: PAYMENTS AND COMPLETION

9.2 SCHEDULE OF VALUES

Add the following Sections:

"9.2.1 The Schedule of Values shall be submitted using AIA Document G703, Continuation Sheet to G702."

"9.2.2 The Schedule of Values is to include a line item for Project Closeout Document Submittal. The value of this item is to be no less than 1.5% of the initial contract amount."

9.3 APPLICATIONS FOR PAYMENT

9.3.1 Strike Section 9.3.1 in its entirety and replace with the following:

"At least ten days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment prepared in accordance with the schedule of values for completed portions of the Work. The application shall be notarized, and supported by all data substantiating the Contractor's right to payment that the Owner or Architect require, such as copies of requisitions, and releases and waivers of liens from Subcontractors and suppliers, and shall reflect retainage."

Add the following Sections:

"9.3.1.3 Application for Payment shall be submitted on AIA Document G702 "Application and Certificate for Payment", supported by AIA Document G703 "Continuation Sheet". Said Applications shall be fully executed and notarized."

"9.3.4 Until Closeout Documents have been received and outstanding items completed the Owner will pay 95% (ninety-five percent) of the amount due the Contractor on account of progress payments."

"9.3.5 The Contractor shall provide a current and updated Progress Schedule to the Architect with each Application for Payment. Failure to provide Schedule will be just cause for rejection of Application for Payment."

9.5 DECISIONS TO WITHHOLD CERTIFICATION

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Add the following Subsections to 9.5.1:

.8 failure to provide a current Progress Schedule;
.9 a lien or attachment is filed;
.10 failure to comply with mandatory requirements for maintaining Record Documents.

9.6 PROGRESS PAYMENTS

9.6.1 Strike Section 9.6.1 in its entirety and replace with the following:

"9.6.1 After the Architect has approved and issued a Certificate for Payment, payment shall be made by the Owner within 30 days after Owner's receipt of the Certificate for Payment."

9.6.8 Strike "Provided the Owner has fulfilled its payment obligations under the Contract Documents," in the first sentence.

9.7 FAILURE OF PAYMENT

Strike Section 9.7 in its entirety and replace with the following:

"If the Architect does not issue a Certificate for Payment, through no fault of the Contractor, within fourteen days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within thirty days after the date established in the Contract Documents, the amount certified by the Architect, then the Contractor may, upon thirty additional days' notice to the Owner and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided for in the Contract Documents."

9.8 SUBSTANTIAL COMPLETION

9.8.3 At the end of Section 9.8.3, add the following sentence:

"If the Architect is required to make more than 2 inspections of the same portion of work, the Contractor shall be responsible for all costs associated with subsequent inspections including but not limited to any Architect's fees."

9.8.5 Strike "shall" and insert "may" in the second sentence.

9.8.5 Insert "1/2 of the" after "make payment of" in the second sentence.

9.9 PARTIAL OCCUPANCY OR USE

9.9.1 Strike the the first sentence and replace with the following (the remainder of the Section remains as written):
"The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use authorized by public authorities having jurisdiction over the Project."

9.10.2 Strike "to remain in force after final payment is currently in effect" after "required by the Contract Documents" and replace with "shall remain in force until final payment is completed" in the first sentence.

9.10.4.4 Strike "if permitted by the Contract Documents,"

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ARTICLE 10: PROTECTION OF PERSONS AND PROPERTY

10.1 SAFETY PRECAUTIONS AND PROGRAMS

Add the following Sections:

10.1.1 Each Contractor shall develop a safety program in accordance with the Occupational Safety and Health Act of 1970. A copy of said plan shall be furnished to the Owner and Architect prior to the commencement of that Contractor's Work.

10.1.2 Each Contractor shall appoint a Safety Representative. Safety Representatives shall be someone who is on site on a full time basis. If deemed necessary by the Owner or Architect, Contractor Safety meetings will be scheduled. The attendance of all Safety Representatives will be required. Minutes will be recorded of said meetings by the Contractor and will be distributed to all parties as well as posted in all job offices/trailers etc.

10.2 SAFETY OF PERSONS AND PROPERTY

Add the following Section:

10.2.4.1 As required in the Hazardous Chemical Act of June 1984, all vendors supplying any material that may be defined as hazardous must provide Material Safety Data Sheets for those products. Any chemical product should be considered hazardous if it has a caution warning on the label relating to a potential physical or health hazard, if it is known to be present in the work place, and if employees may be exposed under normal conditions or in foreseeable emergency situations. Material Safety Data Sheets shall be provided directly to the Owner, along with the shipping slips that include those products.

10.2.5 Strike the second sentence in its entirety.

10.3 HAZARDOUS MATERIALS AND SUBSTANCES

10.3.3 Strike Section 10.3.3 in its entirety.

10.3.4 Insert "hazardous" in the last sentence after "handling of such" .

10.3.6 Strike Section 10.3.6 in its entirety.

ARTICLE 11: INSURANCE AND BONDS

11.1 CONTRACTOR'S INSURANCE AND BONDS

11.1.1 Strike "Owner" from the third sentence.

11.2 OWNER'S LIABILITY INSURANCE

Strike 11.2 in its entirety, except that in the case of school projects in which case Section 11.2 shall remain.

11.3 WAIVERS OF SUBROGATION

Delete Section 11.3 in its entirety

11.4 LOSS OF USE, BUSINESS INTERRUPTION, AND DELAY IN COMPLETION INSURANCE

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Delete Section 11.4 in its entirety

ARTICLE 12: UNCOVERING AND CORRECTION OF WORK

12.2.2 AFTER SUBSTANTIAL COMPLETION

Add the following Section:

"12.2.2.1.1 At any time during the progress of the Work, or in any case where the nature of the defects will be such that it is not expedient to have corrected, the Owner, at its option, will have the right to deduct such sum, or sums, of money from the amount of the Contract as it considers justified to adjust the difference in value between the non-conforming work and that required under contract including any damage to the structure."

12.2.2.1 Strike all references to "one year" or "one-year" and replace with "two years".

12.2.2.2 Strike "one-year" and replace with "two years".

12.2.2.3 Strike "one-year" and replace with "two years".

12.2.5 Strike "one-year" and replaced with "two years".

ARTICLE 13: MISCELLANEOUS PROVISIONS

13.1 GOVERNING LAW

Strike the last sentence.

13.4 TESTS AND INSPECTIONS

13.4.1 Strike the last sentence and replace with the following:

"The Owner shall pay for tests, inspections, or approvals where building codes or applicable laws or regulations prohibit the Owner from delegating their cost to the Contractor."

13.5 INTEREST

Strike "the date payment is due at such rate as the parties may agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located" and replace with "30 days of presentment of the authorized Certificate of Payment at the annual rate of 12% or 1% per month."

Insert the following Section:

"13.6 CONFLICTS WITH FEDERAL STATUTES OR REGULATIONS

13.6.1 If any provision, specifications or requirement of the Contract Documents conflict or is inconsistent with any statute, law or regulation of the government of the United State of America, the Contractor shall notify the Architect and Owner immediately upon discovery."

ARTICLE 14: TERMINATION OR SUSPENSION OF THE CONTRACT

14.1 TERMINATION BY THE CONTRACTOR

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14.1.1.4 Insert “, upon the Contractors’ request,” after “furnish to the Contractor”.

14.1.3 Strike “and profit on Work not executed, and” after “as well as reasonable overhead” and replace with “, profit, and reasonable”

14.3 SUSPENSION BY OWNER FOR CONVENIENCE

14.3.2 Strike “Adjustment of the Contract Sum shall include profit”.

14.4 TERMINATION BY THE OWNER FOR CONVENIENCE

14.4.3 Strike Section 14.4.3 in its entirety and replace with the following:

“In case of such termination for the Owner’s convenience, the Contractor shall be entitled to receive payment for Work executed, and reasonable costs incurred by reason of such termination along with reasonable overhead.”

ARTICLE 15: CLAIMS AND DISPUTES

15.1 CLAIMS

15.1.2 TIME LIMITS ON CLAIMS

Strike the last sentence.

15.1.3 NOTICE OF CLAIM

Strike all references to “21” and replace with “45”.

15.1.5 CLAIMS FOR ADDITIONAL COSTS

Strike the first sentence and replace with the following:

“Contractor shall not proceed to execute any portion of the Work that is subject to the Claim without prior approval of the costs or method of payment for the costs associated with the Claim as determined by the Architect and approved by the Owner.”

15.1.7 WAIVER OF CLAIMS FOR CONSEQUENTIAL DAMAGES

Strike Section 15.1.7 in its entirety.

15.2 INITIAL DECISION

15.2.1 Strike “and binding dispute resolution” in the fourth sentence and replace with “or any and all remedies at law or in equity”.

15.2.5 Strike Section 15.2.5 in its entirety and replace with the following:

“The Architect will approve or reject Claims by written decision, which shall state the reasons therefore and shall notify the parties of any change in the Contract Sum or Contract Time or both. The approval or rejection of a Claim by the Architect shall be subject to mediation and any or all remedies at law or in equity.”

15.2.6 Strike Section 15.2.6 and its sub-Sections in their entirety.

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15.3 MEDIATION

15.3.1 Strike “binding dispute resolution” and replace with “any or all remedies at law or in equity”.

15.3.2 Strike “, shall be administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedure in effect on the date of the Agreement,” in the first sentence.

15.3.2 Strike all references to “binding dispute resolution” and replace with “any or all remedies at law and in equity”.

15.3.3 Strike Section 15.3.3 in its entirety.

15.4 ARBITRATION

Strike Section 15.4 and its Subsections in their entirety.

END OF SECTION

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WAGE RATE DETERMINATION SCHEDULE

The Delaware Department of Labor Division of Industrial Affairs has established the category and associated prevailing wage rate for this project. The project approved prevailing wage rate determination schedule follows.

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STATE OF DELAWARE
DEPARTMENT OF LABOR
DIVISION OF INDUSTRIAL AFFAIRS
OFFICE OF LABOR LAW ENFORCEMENT
PHONE: (302) 318-2769

Mailing Address:
252 Chapman Road
Suite 210
Newark, DE 19702

Located at:
252 Chapman Road
Suite 210
Newark, DE 19702

PREVAILING WAGES FOR **BUILDING CONSTRUCTION** EFFECTIVE MARCH 13, 2026

CLASSIFICATION	NEW CASTLE	KENT	SUSSEX
ASBESTOS WORKERS	30.70	37.78	55.01
BOILERMAKERS	91.87	46.61	68.52
BRICKLAYERS	68.29	68.29	68.29
CARPENTERS	64.06	64.06	52.30
CEMENT FINISHERS	96.91	68.92	53.44
ELECTRICAL LINE WORKERS	61.02	52.34	39.90
ELECTRICIANS	86.87	86.87	86.87
ELEVATOR CONSTRUCTORS	121.73	86.57	109.37
GLAZIERS	88.42	88.42	76.04
INSULATORS	71.54	71.54	71.54
IRON WORKERS	79.33	79.33	79.33
LABORERS	59.65	59.65	59.65
MILLWRIGHTS	91.00	91.00	73.10
PAINTERS	61.53	61.53	61.53
PILEDRIVERS	93.37	52.83	42.72
PLASTERERS	40.06	40.06	29.69
PLUMBERS/PIPEFITTERS/STEAMFITTERS	82.05	85.29	78.26
POWER EQUIPMENT OPERATORS	85.29	85.29	85.29
ROOFERS-COMPOSITION	36.41	31.28	33.64
ROOFERS-SHINGLE/SLATE/TILE	24.68	29.36	23.08
SHEET METAL WORKERS	87.84	87.84	87.84
SOFT FLOOR LAYERS	63.69	63.69	50.43
SPRINKLER FITTERS	77.63	77.63	77.63
TERRAZZO/MARBLE/TILE FNRS	73.75	73.75	84.10
TERRAZZO/MARBLE/TILE STRS	81.93	81.93	93.27
TRUCK DRIVERS	58.41	36.83	28.66

CERTIFIED: 7-13-2026

BY: Salina Crossland/fu
ADMINISTRATOR, OFFICE OF LABOR LAW ENFORCEMENT

NOTE: THESE RATES ARE PROMULGATED AND ENFORCED PURSUANT TO THE PREVAILING WAGE REGULATIONS ADOPTED BY THE DEPARTMENT OF LABOR ON APRIL 3, 1992.

CLASSIFICATIONS OF WORKERS ARE DETERMINED BY THE DEPARTMENT OF LABOR. FOR ASSISTANCE IN CLASSIFYING WORKERS, OR FOR A COPY OF THE REGULATIONS OR CLASSIFICATIONS, PHONE (302) 318-2769.

NON-REGISTERED APPRENTICES MUST BE PAID THE MECHANIC'S RATE.

PROJECT: MC5508000005 Cooling Tower Replacement at Transportation Mang Center, New Castle County

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GENERAL REQUIREMENTS

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ARTICLE 1: GENERAL

1.1 CONTRACT DOCUMENTS

1.1.1 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary and what is required by one shall be as binding as if required by all. Performance by the Contractor shall be required to an extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the intended results.

1.1.2 Work including material purchases shall not begin until the Contractor is in receipt of a bonafide State of Delaware Purchase Order. Any work performed or material purchases prior to the issuance of the Purchase Order is done at the Contractor's own risk and cost.

1.2 EQUALITY OF EMPLOYMENT OPPORTUNITY ON PUBLIC WORKS

1.2.1 For Public Works Projects financed in whole or in part by state appropriation the Contractor agrees that during the performance of this contract:

1. The Contractor will not discriminate against any employee or applicant for employment because of race, creed, sex, color, sexual orientation, gender identity or national origin. The Contractor will take positive steps to ensure that applicants are employed and that employees are treated during employment without regard to their race, creed, sex, color, sexual orientation, gender identity or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places available to employees and applicants for employment notices to be provided by the contracting agency setting forth this nondiscrimination clause.

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

ARTICLE 2: OWNER

(NO ADDITIONAL GENERAL REQUIREMENTS – SEE SUPPLEMENTARY GENERAL CONDITIONS)

ARTICLE 3: CONTRACTOR

3.1 Schedule of Values: The successful Bidder shall within twenty (20) days after receiving notice to proceed with the work, furnish to the Owner a complete schedule of values on the various items comprising the work.

3.2 Subcontracts: Upon approval of Subcontractors, the Contractor shall award their Subcontracts as soon as possible after the signing of their own contract and see that all material, their own and those of their Subcontractors, are promptly ordered so that the work will not be delayed by failure of materials to arrive on time.

3.3 Before commencing any work or construction, the General Contractor is to consult with the Owner as to matters in connection with access to the site and the allocation of Ground Areas for the various features of hauling, storage, etc.

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3.4 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract, unless the Contract Documents give other specific instructions.

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

3.6 The Contractor warrants to the Owner that materials and equipment furnished will be new and of good quality, unless otherwise permitted, and that the work will be free from defects and in conformance with the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved, may be considered defective. If required by the Owner, the Contractor shall furnish evidence as to the kind and quality of materials and equipment provided.

3.7 Unless otherwise provided, the Contractor shall pay all sales, consumer, use and other similar taxes, and shall secure and pay for required permits, fees, licenses, and inspections necessary for proper execution of the Work.

3.8 The Contractor shall comply with and give notices required by laws, ordinances, rules, regulations, and lawful orders of public authorities bearing on performance of the Work. The Contractor shall promptly notify the Owner if the Drawings and Specifications are observed to be at variance therewith.

3.9 The Contractor shall be responsible to the Owner for the acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons performing portions of the Work under contract with the Contractor.

3.10 The Contractor shall keep the premises and surrounding area free from accumulation of waste materials or rubbish caused by operations under the Contract. At completion of the Work the Contractor shall remove from and about the Project all waste materials, rubbish, the Contractor's tools, construction equipment, machinery and surplus materials. The Contractor shall be responsible for returning all damaged areas to their original conditions.

3.11 STATE LICENSE AND TAX REQUIREMENTS

3.11.1 Each Contractor and Subcontractor shall be licensed to do business in the State of Delaware and shall pay all fees and taxes due under State laws. In conformance with Section 2503, Chapter 25, Title 30, Delaware Code, "the Contractor shall furnish the Delaware Department of Finance within ten (10) days after entering into any contract with a contractor or subcontractor not a resident of this State, a statement of total value of such contract or contracts together with the names and addresses of the contracting parties."

3.12 The Contractor shall comply with all requirements set forth in Section 6962, Chapter 69, Title 29 of the Delaware Code.

3.13 During the contract Work, the Contractor and each Subcontractor, shall implement an Employee Drug Testing Program in accordance with OMB Regulation 4104 - "Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on "Large Public Works Projects". "Large Public Works" is based upon the current threshold required for bidding Public Works as set by the Purchasing and Contracting Advisory Council.

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ARTICLE 4: ADMINISTRATION OF THE CONTRACT

4.1 CONTRACT SURETY

4.1.1 PERFORMANCE BOND AND LABOR AND MATERIAL PAYMENT BOND

4.1.2 All bonds will be required as follows unless specifically waived elsewhere in the Bidding Documents.

4.1.3 Contents of Performance Bonds – The bond shall be in the form approved by the Office of Management and Budget. The bond shall be conditioned upon the faithful compliance and performance by the successful bidder of each and every term and condition of the contract and the proposal, plans, specifications, and bid documents thereof. Each term and condition shall be met at the time and in the manner prescribed by the Contract, Bid documents and the specifications, including the payment in full to every person furnishing materiel or performing labor in the performance of the Contract, of all sums of money due the person for such labor and materiel. (The bond shall also contain the successful bidder's guarantee to indemnify and save harmless the State and the agency from all costs, damages and expenses growing out of or by reason of the Contract in accordance with the Contract.)

4.1.4 Invoking a Performance Bond – The agency may, when it considers that the interest of the State so requires, cause judgement to be confessed upon the bond.

4.1.5 Within twenty (20) days after the date of notice of award of contract, the Bidder to whom the award is made shall furnish a Performance Bond and Labor and Material Payment Bond, each equal to the full amount of the Contract price to guarantee the faithful performance of all terms, covenants and conditions of the same. The bonds are to be issued by an acceptable Bonding Company licensed to do business in the State of Delaware and shall be issued in duplicate.

4.1.6 Performance and Payment Bonds shall be maintained in full force (warranty bond) for a period of two (2) years after the date of the Certificate for Final Payment. The Performance Bond shall guarantee the satisfactory completion of the Project and that the Contractor will make good any faults or defects in his work which may develop during the period of said guarantees as a result of improper or defective workmanship, material or apparatus, whether furnished by themselves or their Sub-Contractors. The Payment Bond shall guarantee that the Contractor shall pay in full all persons, firms or corporations who furnish labor or material or both labor and material for, or on account of, the work included herein. The bonds shall be paid for by this Contractor. The Owner shall have the right to demand that the proof parties signing the bonds are duly authorized to do so.

4.2 FAILURE TO COMPLY WITH CONTRACT

4.2.1 If any firm entering into a contract with the State, or Agency that neglects or refuses to perform or fails to comply with the terms thereof, the Agency which signed the Contract may terminate the Contract and proceed to award a new contract in accordance with this Chapter 69, Title 29 of the Delaware Code or may require the Surety on the Performance Bond to complete the Contract in accordance with the terms of the Performance Bond. Nothing herein shall preclude the Agency from pursing additional remedies as otherwise provided by law.

4.3 CONTRACT INSURANCE AND CONTRACT LIABILITY

4.3.1 In addition to the bond requirements stated in the Bid Documents, each successful Bidder shall purchase adequate insurance for the performance of the Contract and, by

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submission of a Bid, agrees to indemnify and save harmless and to defend all legal or equitable actions brought against the State, any Agency, officer and/or employee of the State, for and from all claims of liability which is or may be the result of the successful Bidder's actions during the performance of the Contract.

4.3.2 The purchase or nonpurchase of such insurance or the involvement of the successful Bidder in any legal or equitable defense of any action brought against the successful Bidder based upon work performed pursuant to the Contract will not waive any defense which the State, its agencies and their respective officers, employees and agents might otherwise have against such claims, specifically including the defense of sovereign immunity, where applicable, and by the terms of this section, the State and all agencies, officers and employees thereof shall not be financially responsible for the consequences of work performed, pursuant to said contract.

4.4 RIGHT TO AUDIT RECORDS

4.4.1 The Owner shall have the right to audit the books and records of a Contractor or any Subcontractor under any Contract or Subcontract to the extent that the books and records relate to the performance of the Contract or Subcontract.

4.4.2 Said books and records shall be maintained by the Contractor for a period of seven (7) years from the date of final payment under the Prime Contract and by the Subcontractor for a period of seven (7) years from the date of final payment under the Subcontract.

ARTICLE 5: SUBCONTRACTORS

5.1 SUBCONTRACTING REQUIREMENTS

5.1.1 All contracts for the construction, reconstruction, alteration or repair of any public building (not a road, street or highway) shall be subject to the following provisions:

1. A contract shall be awarded only to a Bidder whose Bid is accompanied by a statement containing, for each Subcontractor category, the name and address (city or town and State only – street number and P.O. Box addresses not required) of the subcontractor whose services the Bidder intends to use in performing the Work and providing the material for such Subcontractor category.

2. A Bid will not be accepted nor will an award of any Contract be made to any Bidder which, as the Prime Contractor, has listed itself as the Subcontractor for any Subcontractor unless:

   A. It has been established to the satisfaction of the awarding Agency that the Bidder has customarily performed the specialty work of such Subcontractor category by artisans regularly employed by the Bidder's firm;

   B. That the Bidder is duly licensed by the State to engage in such specialty work, if the State requires licenses; and

   C. That the Bidder is recognized in the industry as a bona fide Subcontractor or Contractor in such specialty work and Subcontractor category.

5.1.2 The decision of the awarding Agency as to whether a Bidder who list itself as the Subcontractor for a Subcontractor category shall be final and binding upon all Bidders,

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and no action of any nature shall lie against any awarding agency or its employees or officers because of its decision in this regard.

5.1.3 After such a Contract has been awarded, the successful Bidder shall not substitute another Subcontractor for any Subcontractor whose name was set forth in the statement which accompanied the Bid without the written consent of the awarding Agency.

5.1.4 No Agency shall consent to any substitution of Subcontractors unless the Agency is satisfied that the Subcontractor whose name is on the Bidders accompanying statement:

A. Is unqualified to perform the work required;

B. Has failed to execute a timely reasonable Subcontract;

C. Has defaulted in the performance on the portion of the work covered by the Subcontract; or

D. Is no longer engaged in such business.

5.1.5 Should a Bidder be awarded a contract, such successful Bidder shall provide to the agency the taxpayer identification license numbers of such subcontractors. Such numbers shall be provided on the later of the date on which such subcontractor is required to be identified or the time the contract is executed. The successful Bidder shall provide to the agency to which it is contracting, within 30 days of entering into such public works contract, copies of all Delaware Business licenses of subcontractors and/or independent contractors that will perform work for such public works contract. However, if a subcontractor or independent contractor is hired or contracted more than 20 days after the Bidder entered the public works contract the Delaware Business license of such subcontractor or independent contractor shall be provided to the agency within 10 days of being contracted or hired.

5.1.6 The Contractor may employ additional Subcontractors on the jobsite only after submitting a copy of the Subcontractor's Employee Drug Testing Program to the Owner for approval. A Contractor or Subcontractor shall not commence work until the Owner has concluded its review and determined that the submitted Employee Drug Testing Program complies with OMB Regulation 4104.

5.2 PENALTY FOR SUBSTITUTION OF SUBCONTRACTORS

5.2.1 Should the Contractor fail to utilize any or all of the Subcontractors in the Contractor's Bid statement in the performance of the Work on the public bidding, the Contractor shall be penalized in the amount of (project specific amount*). The Agency may determine to deduct payments of the penalty from the Contractor or have the amount paid directly to the Agency. Any penalty amount assessed against the Contractor may be remitted or refunded, in whole or in part, by the Agency awarding the Contract, only if it is established to the satisfaction of the Agency that the Subcontractor in question has defaulted or is no longer engaged in such business. No claim for the remission or refund of any penalty shall be granted unless an application is filed within one year after the liability of the successful Bidder accrues. All penalty amounts assessed and not refunded or remitted to the contractor shall be reverted to the State.

*one (1) percent of contract amount not to exceed $10,000

5.3 ASBESTOS ABATEMENT

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5.3.1 The selection of any Contractor to perform asbestos abatement for State-funded projects shall be approved by the Office of Management and Budget, Division of Facilities Management pursuant to Chapter 78 of Title 16.

5.4 STANDARDS OF CONSTRUCTION FOR THE PROTECTION OF THE PHYSICALLY HANDICAPPED

5.4.1 All Contracts shall conform with the standard established by the Delaware Architectural Accessibility Board unless otherwise exempted by the Board.

5.5 CONTRACT PERFORMANCE

5.5.1 Any firm entering into a Public Works Contract that neglects or refuses to perform or fails to comply with its terms, the Agency may terminate the Contract and proceed to award a new Contract or may require the Surety on the Performance Bond to complete the Contract in accordance with the terms of the Performance Bond.

ARTICLE 6: CONSTRUCTION BY OWNER OR SEPARATE CONTRACTORS

6.1 The Owner reserves the right to simultaneously perform other construction or operations related to the Project with the Owner's own forces, and to award separate contracts in connection with other portions of the Project or other Projects at the same site.

6.2 The Contractor shall afford the Owner and other Contractors reasonable opportunity for access and storage of materials and equipment, and for the performance of their activities, and shall connect and coordinate their activities with other forces as required by the Contract Documents.

ARTICLE 7: CHANGES IN THE WORK

7.1 The Owner, without invalidating the Contract, may order changes in the Work consisting of Additions, Deletions, Modifications or Substitutions, with the Contract Sum and Contract completion date being adjusted accordingly. Such changes in the Work shall be authorized by written Change Order signed by the Professional, as the duly authorized agent, the Contractor and the Owner.

7.2 The Contract Sum and Contract Completion Date shall be adjusted only by a fully executed Change Order.

7.3 The additional cost, or credit to the Owner resulting from a change in the Work shall be by mutual agreement of the Owner, Contractor and the Architect. In all cases, this cost or credit shall be based on the ‘DPE’ wages required and the “invoice price” of the materials/equipment needed.

7.3.1 “DPE” shall be defined to mean “direct personnel expense”. Direct payroll expense includes prevailing wage rates plus a maximum multiplier of 1.35 times DPE. For example, if the prevailing wage rate is $50/hour, the DPE would be $67.50/hour (50 x 1.35).

7.3.2 “Invoice price” of materials/equipment shall be defined to mean the actual cost of materials and/or equipment that is paid by the Contractor, (or subcontractor), to a material distributor, direct factory vendor, store, material provider, or equipment leasing entity. Rates for equipment that is leased and/or owned by the Contractor or subcontractor(s) shall not exceed those listed in the latest version of the “Means Building Construction Cost Data” publication.

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7.3.3 In addition to the above, the General Contractor is allowed a fifteen percent (15%) markup for overhead and profit for additional work performed by the General Contractor's own forces. For additional subcontractor work, the Subcontractor is allowed a fifteen (15) percent overhead and profit on change order work above and beyond the direct costs stated previously. To this amount, the General Contractor will be allowed a mark-up not exceeding seven and one half percent (7.5%) on the subcontractors work. These mark-ups shall include all costs including, but not limited to: overhead, profit, bonds, insurance, supervision, etc. No markup is permitted on the work of the subcontractors subcontractor. No additional costs shall be allowed for changes related to the Contractor's onsite superintendent/staff, or project manager, unless a change in the work changes the project duration and is identified by the CPM schedule. There will be no other costs associated with the change order.

ARTICLE 8: TIME

8.1 Time limits, if any, are as stated in the Project Manual. By executing the Agreement, the Contractor confirms that the stipulated limits are reasonable, and that the Work will be completed within the anticipated time frame.

8.2 If progress of the Work is delayed at any time by changes ordered by the Owner, by labor disputes, fire, unusual delay in deliveries, abnormal adverse weather conditions, unavoidable casualties or other causes beyond the Contractor's control, the Contract Time shall be extended for such reasonable time as the Owner may determine.

8.3 Any extension of time beyond the date fixed for completion of the construction and acceptance of any part of the Work called for by the Contract, or the occupancy of the building by the Owner, in whole or in part, previous to the completion shall not be deemed a waiver by the Owner of his right to annul or terminate the Contract for abandonment or delay in the matter provided for, nor relieve the Contractor of full responsibility

8.4 SUSPENSION AND DEBARMENT

8.4.1 Per Section 6962(d)(14), Title 29, Delaware Code, "Any Contractor who fails to perform a public works contract or complete a public works project within the time schedule established by the Agency in the Invitation To Bid, may be subject to Suspension or Debarment for one or more of the following reasons: a) failure to supply the adequate labor supply ratio for the project; b) inadequate financial resources; or, c) poor performance on the Project."

8.4.2 "Upon such failure for any of the above stated reasons, the Agency that contracted for the public works project may petition the Director of the Office of Management and Budget for Suspension or Debarment of the Contractor. The Agency shall send a copy of the petition to the Contractor within three (3) working days of filing with the Director. If the Director concludes that the petition has merit, the Director shall schedule and hold a hearing to determine whether to suspend the Contractor, debar the Contractor or deny the petition. The Agency shall have the burden of proving, by a preponderance of the evidence, that the Contractor failed to perform or complete the public works project within the time schedule established by the Agency and failed to do so for one or more of the following reasons: a) failure to supply the adequate labor supply ratio for the project; b) inadequate financial resources; or, c) poor performance on the project. Upon a finding in favor of the
Agency, the Director may suspend a Contractor from Bidding on any project funded, in whole or in part, with public funds for up to 1 year for a first offense, up to 3 years for a second offense and permanently debar the Contractor for a third offense. The Director shall issue a written decision and shall send a copy to the Contractor and the Agency.

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Such decision may be appealed to the Superior Court within thirty (30) days for a review on the record."

8.5 RETAINAGE

8.5.1 Per Section 6962(d)(5) a.3, Title 29, Delaware Code: The Agency may at the beginning of each public works project establish a time schedule for the completion of the project. If the project is delayed beyond the completion date due to the Contractor's failure to meet their responsibilities, the Agency may forfeit, at its discretion, all or part of the Contractor's retainage.

8.5.2 This forfeiture of retainage also applies to the timely completion of the punchlist. A punchlist will only be prepared upon the mutual agreement of the Owner, Architect and Contractor. Once the punchlist is prepared, all three parties will by mutual agreement, establish a schedule for its completion. Should completion of the punchlist be delayed beyond the established date due to the Contractor's failure to meet their responsibilities, the Agency may hold permanently, at its discretion, all or part of the Contractor's retainage.

ARTICLE 9: PAYMENTS AND COMPLETION

9.1 APPLICATION FOR PAYMENT

9.1.1 Applications for payment shall be made upon AIA Document G702. There will be a five percent (5%) retainage on all Contractor's monthly invoices until completion of the project. This retainage may become payable upon receipt of all required closeout documentation, provided all other requirements of the Contract Documents have been met.

9.1.2 A date will be fixed for the taking of the monthly account of work done. Upon receipt of Contractor's itemized application for payment, such application will be audited, modified, if found necessary, and approved for the amount. Statement shall be submitted to the Owner.

9.1.3 Section 6516, Title 29 of the Delaware Code annualized interest is not to exceed 12% per annum beginning thirty (30) days after the "presentment" (as opposed to the date) of the invoice.

9.2 PARTIAL PAYMENTS

9.2.1 Any public works Contract executed by any Agency may provide for partial payments at the option of the Owner with respect to materials placed along or upon the sites or stored at secured locations, which are suitable for use in the performance of the contract.

9.2.2 When approved by the agency, partial payment may include the values of tested and acceptable materials of a nonperishable or noncontaminative nature which have been produced or furnished for incorporation as a permanent part of the work yet to be completed, provided acceptable provisions have been made for storage.

9.2.2.1 Any allowance made for materials on hand will not exceed the delivered cost of the materials as verified by invoices furnished by the Contractor, nor will it exceed the contract bid price for the material complete in place.

9.2.3 If requested by the Agency, receipted bills from all Contractors, Subcontractors, and material, men, etc., for the previous payment must accompany each application for payment. Following such a request, no payment will be made until these receipted bills have been received by the Owner.

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9.3 SUBSTANTIAL COMPLETION

9.3.1 When the building has been made suitable for occupancy, but still requires small items of miscellaneous work, the Owner will determine the date when the project has been substantially completed.

9.3.2 If, after the Work has been substantially completed, full completion thereof is materially delayed through no fault of the Contractor, and without terminating the Contract, the Owner may make payment of the balance due for the portion of the Work fully completed and accepted. Such payment shall be made under the terms and conditions governing final payment that it shall not constitute a waiver of claims.

9.3.3 On projects where commissioning is included, the commissioning work as defined in the specifications must be complete prior to the issuance of substantial completion.

9.4 FINAL PAYMENT

9.4.1 Final payment, including the five percent (5%) retainage if determined appropriate, shall be made within thirty (30) days after the Work is fully completed and the Contract fully performed and provided that the Contractor has submitted the following closeout documentation (in addition to any other documentation required elsewhere in the Contract Documents):

9.4.1.1 Evidence satisfactory to the Owner that all payrolls, material bills, and other indebtedness connected with the work have been paid,

9.4.1.2 An acceptable RELEASE OF LIENS,

9.4.1.3 Copies of all applicable warranties,

9.4.1.4 As-built drawings,

9.4.1.5 Operations and Maintenance Manuals,

9.4.1.6 Instruction Manuals,

9.4.1.7 Consent of Surety to final payment.

9.4.1.8 The Owner reserves the right to retain payments, or parts thereof, for its protection until the foregoing conditions have been complied with, defective work corrected and all unsatisfactory conditions remedied.

ARTICLE 10: PROTECTION OF PERSONS AND PROPERTY

10.1 The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Contract. The Contractor shall take all reasonable precautions to prevent damage, injury or loss to: workers, persons nearby who may be affected, the Work, materials and equipment to be incorporated, and existing property at the site or adjacent thereto. The Contractor shall give notices and comply with applicable laws ordinances, rules regulations, and lawful orders of public authorities bearing on the safety of persons and property and their protection from injury, damage, or loss. The Contractor shall promptly remedy damage and loss to property at the site caused in whole or in part by the Contractor, a Subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable.

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10.2 The Contractor shall notify the Owner in the event any existing hazardous material such as lead, PCBs, asbestos, etc. is encountered on the project. The Owner will arrange with a qualified specialist for the identification, testing, removal, handling and protection against exposure or environmental pollution, to comply with applicable regulation laws and ordinances. The Contractor and Architect will not be required to participate in or to perform this operation. Upon completion of this work, the Owner will notify the Contractor and Architect in writing the area has been cleared and approved by the authorities in order for the work to proceed. The Contractor shall attach documentation from the authorities of said approval.

10.3 As required in the Hazardous Chemical Information Act of June 1984, all vendors supplying any materials that may be defined as hazardous, must provide Material Safety Data Sheets for those products. Any chemical product should be considered hazardous if it has a warning caution on the label relating to a potential physical or health hazard, if it is known to be present in the work place, and if employees may be exposed under normal conditions or in any foreseeable emergency situation. Material Safety Data Sheets must be provided directly to the Owner along with the shipping slips that include those products.

10.4 The Contractor shall certify to the Owner that materials incorporated into the Work are free of all asbestos. This certification may be in the form of Material Safety Data Sheet (MSDS) provided by the product manufacturer for the materials used in construction, as specified or as provided by the Contractor.

ARTICLE 11: INSURANCE AND BONDS

11.1 The Contractor shall carry all insurance required by law, such as Unemployment Insurance, etc. The Contractor shall carry such insurance coverage as they desire on their own property such as a field office, storage sheds or other structures erected upon the project site that belong to them and for their own use. The Subcontractors involved with this project shall carry whatever insurance protection they consider necessary to cover the loss of any of their personal property, etc.

11.2 Upon being awarded the Contract, the Contractor shall obtain a minimum of two (2) copies of all required insurance certificates called for herein, and submit one (1) copy of each certificate, to the Owner, within 20 days of contract award.

11.3 Bodily Injury Liability and Property Damage Liability Insurance shall, in addition to the coverage included herein, include coverage for injury to or destruction of any property arising out of the collapse of or structural injury to any building or structure due to demolition work and evidence of these coverages shall be filed with and approved by the Owner.

11.4 The Contractor's Property Damage Liability Insurance shall, in addition to the coverage noted herein, include coverage on all real and personal property in their care, custody and control damaged in any way by the Contractor or their Subcontractors during the entire construction period on this project.

11.5 Builders Risk (including Standard Extended Coverage Insurance) on the existing building during the entire construction period, may be provided by the Contractor under this contract. The Owner shall insure the existing building and all of its contents and all this new alteration work under this contract during entire construction period for the full insurable value of the entire work at the site. Note, however, that the Contractor and their Subcontractors shall be responsible for insuring building materials (installed and stored) and their tools and equipment whenever in use on the project, against fire damage, theft, vandalism, etc.

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11.6 Certificates of the insurance company or companies stating the amount and type of coverage, terms of policies, etc., shall be furnished to the Owner, within 20 days of contract award.

11.7 The Contractor shall, at their own expense, (in addition to the above) carry the following forms of insurance:

11.7.1 Contractor's Contractual Liability Insurance

Minimum coverage to be:

Bodily Injury		
	$1,000,000	for each occurrence
	$3,000,000	aggregate
Property Damage	$1,000,000	for each occurrence
	$3,000,000	aggregate

11.7.2 Contractor's Protective Liability Insurance

Minimum coverage to be:

Bodily Injury		
	$1,000,000	for each occurrence
	$3,000,000	aggregate
Property Damage	$1,000,000	for each occurrence
	$3,000,000	aggregate

11.7.3 Automobile Liability Insurance

Minimum coverage to be:

Bodily Injury	$1,000,000	for each person
	$1,000,000	for each occurrence
Property Damage	$500,000	per accident

11.7.4 Prime Contractor's and Subcontractors' policies shall include contingent and contractual liability coverage in the same minimum amounts as 11.7.1 above.

11.7.5 Workmen's Compensation (including Employer's Liability):

11.7.5.1 Minimum Limit on employer's liability to be as required by law.

11.7.5.2 Minimum Limit for all employees working at one site.

11.7.6 Certificates of Insurance must be filed with the Owner guaranteeing fifteen (15) days prior notice of cancellation, non-renewal, or any change in coverages and limits of liability shown as included on certificates.

11.7.7 Social Security Liability

11.7.7.1 With respect to all persons at any time employed by or on the payroll of the Contractor or performing any work for or on their behalf, or in connection with or arising out of the Contractor's business, the Contractor shall accept full and exclusive liability for the payment of any and all contributions or taxes or unemployment insurance, or old age retirement

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benefits, pensions or annuities now or hereafter imposed by the Government of the United States and the State or political subdivision thereof, whether the same be measured by wages, salaries or other remuneration paid to such persons or otherwise.

11.7.7.2 Upon request, the Contractor shall furnish Owner such information on payrolls or employment records as may be necessary to enable it to fully comply with the law imposing the aforesaid contributions or taxes.

11.7.7.3 If the Owner is required by law to and does pay any and/or all of the aforesaid contributions or taxes, the Contractor shall forthwith reimburse the Owner for the entire amount so paid by the Owner.

ARTICLE 12: UNCOVERING AND CORRECTION OF WORK

12.1 The Contractor shall promptly correct Work rejected by the Owner or failing to conform to the requirements of the Contract Documents, whether observed before or after Substantial Completion and whether or not fabricated, installed or completed, and shall correct any Work found to be not in accordance with the requirements of the Contract Documents within a period of two years from the date of Substantial Completion, or by terms of an applicable special warranty required by the Contract Documents. The provisions of this Article apply to work done by Subcontractors as well as to Work done by direct employees of the Contractor.

12.2 At any time during the progress of the work, or in any case where the nature of the defects shall be such that it is not expedient to have them corrected, the Owner, at their option, shall have the right to deduct such sum, or sums, of money from the amount of the contract as they consider justified to adjust the difference in value between the defective work and that required under contract including any damage to the structure.

ARTICLE 13: MISCELLANEOUS PROVISIONS

13.1 CUTTING AND PATCHING

13.1.1 The Contractor shall be responsible for all cutting and patching. The Contractor shall coordinate the work of the various trades involved.

13.2 DIMENSIONS

13.2.1 All dimensions shown shall be verified by the Contractor by actual measurements at the project site. Any discrepancies between the drawings and specifications and the existing conditions shall be referred to the Owner for adjustment before any work affected thereby has been performed.

13.3 LABORATORY TESTS

13.3.1 Any specified laboratory tests of material and finished articles to be incorporated in the work shall be made by bureaus, laboratories or agencies approved by the Owner and reports of such tests shall be submitted to the Owner. The cost of the testing shall be paid for by the Contractor.

13.3.2 The Contractor shall furnish all sample materials required for these tests and shall deliver same without charge to the testing laboratory or other designated agency when and where directed by the Owner.

13.4 ARCHAEOLOGICAL EVIDENCE

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13.4.1 Whenever, in the course of construction, any archaeological evidence is encountered on the surface or below the surface of the ground, the Contractor shall notify the authorities of the State Historic Preservation Office and suspend work in the immediate area for a reasonable time to permit those authorities, or persons designated by them, to examine the area and ensure the proper removal of the archaeological evidence for suitable preservation by the Division of Historical and Cultural Affairs.

13.5 GLASS REPLACEMENT AND CLEANING

13.5.1 The General Contractor shall replace without expense to the Owner all glass broken during the construction of the project. If job conditions warrant, at completion of the job the General Contractor shall have all glass cleaned and polished.

13.6 WARRANTY

13.6.1 For a period of two (2) years from the date of substantial completion, as evidenced by the date of final acceptance of the work, the contractor warrants that work performed under this contract conforms to the contract requirements and is free of any defect of equipment, material or workmanship performed by the contractor or any of his subcontractors or suppliers. However, manufacturer's warranties and guarantees, if for a period longer than two (2) years, shall take precedence over the above warranties. The contractor shall remedy, at his own expense, any such failure to conform or any such defect. The protection of this warranty shall be included in the Contractor's Performance Bond.

ARTICLE 14: TERMINATION OR SUSPENSION OF THE CONTRACT

14.1 If the Contractor defaults or persistently fails or neglects to carry out the Work in accordance with the Contract Documents or fails to perform a provision of the Contract, the Owner, after seven days written notice to the Contractor, may make good such deficiencies and may deduct the cost thereof from the payment then or thereafter due the Contractor. Alternatively, at the Owner's option, and the Owner may terminate the Contract and take possession of the site and of all materials, equipment, tools, and machinery thereon owned by the Contractor and may finish the Work by whatever method the Owner may deem expedient. If the costs of finishing the Work exceed any unpaid compensation due the Contractor, the Contractor shall pay the difference to the Owner.

14.2 “If the continuation of this Agreement is contingent upon the appropriation of adequate state, or federal funds, this Agreement may be terminated on the date beginning on the first fiscal year for which funds are not appropriated or at the exhaustion of the appropriation. The Owner may terminate this Agreement by providing written notice to the parties of such non-appropriation. All payment obligations of the Owner will cease upon the date of termination. Notwithstanding the foregoing, the Owner agrees that it will use its best efforts to obtain approval of necessary funds to continue the Agreement by taking appropriate action to request adequate funds to continue the Agreement.”

END OF SECTION

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DRUG TESTING FORMS

The Office of Management and Budget (OMB) has developed the 4014 regulations as part of the Delaware Code that requires Contractors and Subcontractors to implement a program of mandatory drug testing for Employees who work on Large Public Works Contracts funded all or in part without public funds pursuant to 29 **Del.C.** §6908(a)(6). The regulations establish the mechanism, standards and requirements of a Mandatory Drug Testing Program that will be incorporated for reference into the Contract awarded pursuant to 29 **Del.C.** §6962. Sample copies of Testing Report Forms maintained and/or submitted pursuant to the requirements of 4104 regulations for this Project are included herewith.

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EMPLOYEE DRUG TESTING REPORT FORM

Period Ending:_____

4104 Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on Large Public Works Projects requires that Contractors and Subcontractors who work on Large Public Works Contracts funded all or in part with public funds maintain testing data that includes but is not limited to the data elements below.

Project Number: _____

Project Name: _____

Contractor/Subcontractor Name: _____

Contractor/Subcontractor Address: _____
_____
_____

Number of employees who worked on the jobsite during the report period:_____

Number of employees subject to random testing during the report period:_____

Number of Negative Results _____ Number of Positive Results _____

Action taken on employee(s) in response to a failed or positive random test:
_____
_____
_____

Date: _____

This form is not required to be submitted to the Owner. Included as a reference to show information required to be maintained by the Contractor. The Owner shall have the right to periodically audit all Contractor and Subcontractor test results at the Contractor's or Subcontractor's offices (or by other means to make the data available for inspection by the Owner).

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EMPLOYEE DRUG TESTING
REPORT OF POSITIVE RESULTS

4104 Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on Large Public Works Projects requires that Contractors and Subcontractors who work on Large Public Works Contracts funded all or in part with public funds to notify the Owner in writing of a positive random drug test.

Project Number: _____

Project Name: _____

Contractor/Subcontractor Name: _____

Contractor/Subcontractor Address: _____
_____
_____

Name of employee with positive test result:_____

Last 4 digits of employee SSN:_____

Date test results received:_____

Action taken on employee in response to a positive test result:
_____
_____
_____

Authorized Representative of Contractor/Subcontractor: _____
(typed or printed)

Authorized Representative of Contractor/Subcontractor: _____
(signature)

Date:_____

This form shall be sent by mail to the Owner within 24 hours of receipt of test results.

Enclose this test results form in a sealed envelope with the notation "Drug Testing Form – DO NOT OPEN" on the face thereof and place in a separate mailing envelope.

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COOLING TOWER REPLACEMENT
TRANSPORTATION MANAGEMENT CENTER
169 BRICK STORE LANDING ROAD, SMYRNA, DE 19977
CONTRACT # MC5508000005A

AFFIDAVIT OF
CRAFT TRAINING COMPLIANCE

We, the contractor, hereby certify that we and all applicable subcontractors will abide by the contractor and subcontractor craft training requirements outlined below for the duration of the contract. Craft training must be provided by a contractor and/or subcontractor for each craft on a project for which there are Delaware Department of Labor approved and registered training programs or, if the contractor and/or subcontractor meets the requirements under Title 29, Chapter 69, Section 6960A.(b)(1)c.1.-3., payment may be made in accordance with Title 29, Chapter 69, Section 6960A.(b)(1)d. A list of crafts for which there are approved and registered training programs is maintained by the Delaware Department of Labor and can be found at: https://laborfiles.delaware.gov/main/det/apprenticeship/DE%20Craft%20Training%20Occupation%20List%20Effective%20March%201%202022.pdf. If you have questions regarding craft training programs, please submit all questions in writing to the Delaware Department of Labor at: apprenticeship@delaware.gov. ***This Affidavit of Craft Training Compliance must be submitted prior to contract execution***.

In accordance with Title 29, Chapter 69, Section 6960A.(a)(1), a contract relating to a public works project under § 6962 of Title 29 must include a craft training program for each craft in the project if at the time the contractor executes a public works contract, all of the following apply:

a. A project meets the prevailing wage requirement under Section 6960 of Title 29.
b. The contractor employs 10 or more total employees.
c. The project is not a federal highway project, except for the project under Section 6962(c)(11) of Title 29.
d. There is an apprenticeship program for a craft in the project on the list of crafts under Section 204(b)(2) of Title 19.

Pursuant to Title 29, Chapter 69, Section 6960A.(a)(2), ***a contractor must commit that all subcontractors provide craft training*** if paragraph (a)(1) of this section applies to the subcontractor. Failure to provide required craft training or payment on the project may subject the successful contractor and/or subcontractor(s) to penalties as outlined in Title 29, Chapter 69, Section 6960A.(d)(1)-(3).

Craft(s): _____

Contractor Name: _____

Contractor Address: _____

_____

_____

Contractor Program Registration Number(s) _____
On this line also indicate whether DE, Other State (identify) or US Registration Number

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Or

☐ **A payment has been made in the amount established under Section 204(b)(2)b.2. of Title 19, for the craft into the Delaware Department of Labor's Apprenticeship and Training Fund.**

Or

☐ **Craft Training requirements are not applicable because:**

_____

Authorized Representative (typed or printed): _____

Authorized Representative (signature): _____

Title: _____

State of Delaware)
) ss:
County of _____)

Before me, a notary public, in and for said county and state, personally appeared, _____, who acknowledged to me that she/he did execute the foregoing instrument on behalf of _____.

IN TESTIMONY WHEREOF, I have subscribed my name and affixed my official seal this ____ day of _____ 20___.

_____
Notary Public
Commission Expires _____

THIS PAGE MUST BE SIGNED AND NOTARIZED TO BE CONSIDERED.

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SECTION 01 10 00
SUMMARY

PART 1 GENERAL

1.01 PROJECT

A. Project Name: Cooling Tower Replacement at Transportation Management Center (TMC).

B. Owner's Name: State of Delaware Office of Management and Budget / Division of Facilities Management.

C. Architect / Engineer's Name: Studio JAED (SJ)

D. The Project consists of:
   1. Demolition of select components of existing HVAC System.
   2. Installation of new HVAC Equipment, Piping and Appurtenances.
   3. Testing and balancing of existing HVAC equipment and pumps.
   4. Associated Electrical and HVAC Controls work.

1.02 CONTRACT DESCRIPTION

A. Contract Type: A single prime contract based on a Stipulated Price as described in Division 00.

1.03 DESCRIPTION OF ALTERATIONS WORK

A. Scope of demolition and removal work is shown on drawings.

B. Scope of renovation work is shown on drawings and included in specifications.

1.04 WORK BY OWNER

A. None.

1.05 OWNER OCCUPANCY

A. Owner intends to continue to occupy portions of the existing building during the entire construction period.

B. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.

C. Schedule the Work to accommodate Owner's occupancy.

1.06 CONTRACTOR USE OF SITE AND PREMISES

A. Construction Operations: Limited to the building premises.

B. Provide access to and from site as required by law and by Owner:
   1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
   2. Do not obstruct roadways, sidewalks, or other public ways without permit.
   3. Adhere to owner's guidelines regarding entrance and egress to the site as identified during the pre-bid meeting.

C. Utility Outages and Shutdown:
   1. Prevent accidental disruption of utility services to other facilities.
   2. Coordinate any interruption and/or shutdown of utilities with the owner at least 14 days in advance of the anticipated interruption and/or shutdown. Limit any interruptions/shutdowns to the absolute minimum amount of time.
   3. Any shutdown of a critical building system (including but not limited to HVAC, sprinkler, fire alarm, water, electric) is to occur during a coordinated, off-hours shutdown (either

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daytime or overnight hours and either weekdays or weekends at owner's option). Shutdown work is to proceed continuously until the critical building system is restored.

4. The owner reserves the right to reschedule construction shutdowns with minimal warning to the contractor as required to respond to emergencies.
5. The cooling system is to remain operational during cooling season (February 15th through December 15th) with minor adjustments as required by the Owner to maintain temperature and humidity setpoints. The cooling tower is to be replaced during a scheduled heating season (December 15th through February 15th) and the new tower is to be started prior to beginning of the following cooling season. In the event the new cooling tower is not started to the satisfaction of the owner prior to the subsequent cooling season, the Contractor is to provide a temporary cooling tower of equal capacity -- including staging, temporary hoses, breakers and feeders as required by NEC -- to facilitate mechanical cooling during the scheduled cooling season.

1.07 GENERAL STANDARDS

A. General Project Requirements

1. Notify the owner in the event any existing hazardous materials, such as asbestos, pcb's, lead, etc., are encountered on the project. The owner will arrange with a qualified specialist for the identification, testing, removal, handling and protection against exposure or environmental pollution, to comply with applicable regulations, laws and ordinances.
2. Prior to submitting bid, the contractor shall visit the site and be thoroughly familiar with the existing conditions and proposed construction. Contractor shall include in their bid all material, labor, and all incidentals for a complete installation whether specifically indicated or not. All errors, discrepancies and missed items shall be brought to the attention of the engineer during the bidding process by the contractor. These items shall be included in the bid price. No extra cost will be allowed for any discrepancy which could have been noticed at the site visit by the contractor.
3. Perform work as required by applicable codes, regulations, and laws of local, state, and federal governments and other authorities with lawful jurisdiction. All work shall be in accordance with the latest edition of the national electric code.
4. Material and equipment shall be UL, NEMA, ANSI, IEEE, ADA & CMB approved for intended purpose. Material and installation shall meet requirements of national and local electrical code.
5. Provide all labor, materials, tools, equipment, coordination, additional design and all incidentals necessary to provide a complete and operable system as detailed on plans to the satisfaction of the engineer and the owner. Coordinate all work with the engineer before the start of work.
6. Prior to submitting bid, the contractor shall visit the site and be thoroughly familiar with the existing conditions and proposed construction. Contractor shall include in their bid all material, labor, and all incidentals for a complete installation whether specifically indicated or not. All errors, discrepancies and missed items shall be brought to the attention of the engineer during the bidding process by the contractor. These items shall be included in the bid price. No extra cost will be allowed for any discrepancy which could have been noticed at the site visit by the contractor.
7. Perform work as required by applicable codes, regulations, and laws of local, state, and federal governments and other authorities with lawful jurisdiction. All work shall be in accordance with the latest edition of the national electric code.
8. Material and equipment shall be ul, nema, ansi, ieee, ada & cmb approved for intended purpose. Material and installation shall meet requirements of national and local electrical code.

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9. The contractor shall be responsible for all additional costs incurred as a result of substitutions or deviations from the basis of design shown on these drawings.
10. Give notices, file plans, obtain permits, and licenses, pay fees and back charges, and obtain necessary approvals from authorities that have jurisdiction.
11. Maintain record drawings on site. Record set must be complete and current and available for inspection when requisitions for payment are submitted.
12. Guarantee work in writing per specifications, repair or replace defective materials or installation at no cost to owner during the guarantee period. Correct damage caused in making necessary repairs and replacements under guarantee at no cost to owner. Submit guarantee to owner before final payment.
13. Coordinate all electrical items with existing field conditions. Locations shown are approximate and may require minor adjustment in the field to satisfy the design intent.
14. Damage to existing facilities and equipment shall be repaired or replaced immediately by the contractor at no additional expense to the owner.
15. The locations on these plans are approximate and require coordination with all other trades and verification of existing conditions. The contractor is responsible for field verification of all existing associated conditions. Contractor is responsible for obtaining all other trade's drawings and specifications and coordinating with all other trades during bidding and construction.
16. Contractor shall be responsible for maintaining continuity of all power, control, fire alarm, security systems, and communications functions to all areas affected by demolition and/or new construction.
17. Repair and patch any disturbed areas to match adjacent construction.
18. Disconnect and make safe any equipment to be removed by others. Coordinate removal of equipment with other trades prior to demolition.
19. In any area requiring the performance of any trade's work, this contractor shall carefully remove and store any or all electrical items in path of work, reinstalling, and reconnecting same as required, in accordance with the plans and/or as directed after completion of other trade's work in that area.
20. Prior to the start of demolition, contractor shall field verify all branch circuits and maintain those circuits that extend outside the scope of work.
21. After renovating existing electrical work, the contractor shall ensure that all remaining and new equipment will operate properly, including but not limited to backfeeding of existing power and lighting circuits. Refer to single line diagram.
22. All electrical work indicated to remain shall be suitably protected to prevent any damage.
23. Where electrical systems pass through renovated areas to serve other portions of the premises, systems shall be suitably protected to prevent damage or relocated and the systems restored to normal operation. Any outages in systems shall be coordinated with owner. Restore power to existing to remain equipment if interrupted by demolished circuits in the area.
24. Contractor shall submit for review, shop drawings for all equipment and materials used on the project. Submittals shall be reviewed by the architect before purchase of materials.
25. All wiring shall be copper, 600v, 75°/90° rated, flame-retardent, heat and moisture resistant.
26. Permanently label all new electrical equipment, including but not limited to, device designation and supply circuit designation. Update or replace panel directories to include new circuit information resulting from this project.
27. Provide temporary power and lighting for all trades as required to complete the project. All temporary and interim equipment shall be installed in accordance with all applicable codes and standards including, but not limited to NFPA 110 and NFPA 70.

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28. Refer to specifications for additional information that is not shown on the drawings.
29. Openings in existing concrete walls and floors required for conduit installation shall be core drilled. Maximum core drill size shall be 5” in diameter. Core drill locations shall be spaced a minimum of 6” from each other measured from the outside edge of the core drill. All core drill openings shall be properly sealed according to their location and application.
30. All outages shall be kept to a minimum. All work that requires a sustained equipment outage shall be performed continuously around the clock until work is completed unless noted otherwise. Coordinate outages with owner representative.
31. Provide for each branch circuit and feeder circuit a dedicated equipment ground wire. For single phase branch circuits of 120 v/1ph or 277v/1 phase, provide dedicated hot, dedicated neutral and dedicated equipment ground wires. Sharing of neutral or equipment ground wires is not permitted. Wiring to all HVAC equipment or other trade equipment shall be in conduit. All equipment and feeder wiring in boiler room/electrical room shall be in rigid conduit. Use of mc cable is limited to branch circuit wiring above recessed ceiling or concealed in wall. Wiring to outlets on table shall be provide in either EMT conduit or flexible metal conduit.
32. Provide identification labels for all branch circuits and feeders circuits at junction boxes, panelboards, troughs, and splice boxes.
33. Provide unspliced feeders from panelboard or switchboard to all equipment. Splicing is permitted for single phase circuits for lighting and outlets only.
34. All wiring devices located in the basement are to be surface mounted with circuit wiring routed in surface mounted conduit per specifications. All other wiring devices shall be recessed unless noted otherwise.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

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SECTION 01 20 00
PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedures for preparation and submittal of applications for progress payments.

B. Change procedures.

1.02 SCHEDULE OF VALUES

A. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.

B. Forms filled out by hand will not be accepted.

1.03 APPLICATIONS FOR PROGRESS PAYMENTS

A. Payment Period: Submit at intervals stipulated in the Agreement.

B. Use Form AIA G702 and Form AIA G703, edition stipulated in the Agreement.

C. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.

D. Forms filled out by hand will not be accepted.

E. Execute certification by signature of authorized officer.

F. Submit three copies of each Application for Payment.

1.04 MODIFICATION PROCEDURES

A. For changes for which advance pricing is desired, Architect will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required and the period of time during which the requested price will be considered valid. Contractor shall prepare and submit a fixed price quotation within 5 days.
   1. For changes to be applied to the project allowance, form 00 63 73 - Allowance Authorizatrion Form must be utilized.
   2. No additional work may be undertaken without a modified purchase order initiated by one of the following:
      a. Fully executed Allowance Authorization Form
      b. Fully executed AIA Change Order

B. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.

C. Execution of Change Orders: Architect will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.

1.05 APPLICATION FOR FINAL PAYMENT

A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Price, previous payments, and sum remaining due.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

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SECTION 01 21 00
ALLOWANCES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Contingency allowance.

B. Payment and modification procedures relating to allowances.

1.02 RELATED REQUIREMENTS

A. Section 01 20 00 - Price and Payment Procedures: Additional payment and modification procedures.

B. Section 00 63 73 - Allowance Authorization Form.

1.03 CONTINGENCY ALLOWANCE

A. Funds will be drawn from the Contingency Allowance only by fully executed Allowance Authorization Form.

B. Contingincy allowance is not to be used for any portion of work indicated in the project documents. The allowance is to be used by written approval only for unforeseen conditions related to correction of existing condtions to conform with project requirements or code requirements.

C. At closeout of Contract, funds remaining in Contingency Allowance shall be credited to Owner by Change Order.

D. For changes to be applied to the project allowance, form 00 63 73 - Allowance Authorizatrion Form must be utilized.

1.04 ALLOWANCES SCHEDULE

A. Contingency Allowance: Include the stipulated sum/price of $10,000 for use upon Owner's instructions.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

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SECTION 01 23 00
ALTERNATES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Description of Alternates.

B. Procedures for pricing Alternates.

1.02 RELATED REQUIREMENTS

A. Document 00 21 13 - Instructions to Bidders: Instructions for preparation of pricing for Alternates.

1.03 ACCEPTANCE OF ALTERNATES

A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in the Owner-Contractor Agreement.

B. Coordinate related work and modify surrounding work to integrate the Work of each Alternate.

1.04 SCHEDULE OF ALTERNATES

A. Alternate No. 1 - Replace chemical treatment storage shed, and perform associated work as described in the documents.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

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SECTION 01 30 00
ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Preconstruction meeting.

B. Site mobilization meeting.

C. Progress meetings.

D. Submittals for review, information, and project closeout.

E. Number of copies of submittals.

F. Submittal procedures.

1.02 RELATED REQUIREMENTS

A. Section 01 60 00 - Product Requirements: General product requirements.

B. Section 01 70 00 - Execution and Closeout Requirements: Additional coordination requirements.

C. Section 01 78 00 - Closeout Submittals: Project record documents; operation and maintenance data; warranties and bonds.

1.03 REFERENCE STANDARDS

A. AIA G716 - Request for Information.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PRECONSTRUCTION MEETING

A. Owner will schedule a meeting after Notice of Award.

B. Attendance Required:
   1. Owner.
   2. Architect.
   3. Contractor.

C. Agenda:
   1. Execution of Owner-Contractor Agreement.
   2. Submission of executed bonds and insurance certificates.
   3. Distribution of Contract Documents.
   4. Submission of list of Subcontractors, list of Products, schedule of values, and progress schedule.
   5. Designation of personnel representing the parties to ContractOMB and .
   6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
   7. Scheduling.

D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.02 SITE MOBILIZATION MEETING

A. Owner will schedule a meeting at the Project site prior to Contractor occupancy.

B. Attendance Required:
   1. Contractor.

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2. Owner.
3. Architect.
4. Contractor's Superintendent.
5. Contractor's Project Manager.
6. Major Subcontractors.

C. Agenda:
1. Use of premises by Owner and Contractor.
2. Owner's requirements and occupancy prior to completion.
3. Construction facilities and controls provided by Contractor and Owner.
4. Security and housekeeping procedures.
5. Schedules.
6. Application for payment procedures.
7. Procedures for maintaining record documents.
8. Requirements for start-up of equipment.

D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.03 PROGRESS MEETINGS

A. Schedule and administer meetings throughout progress of the Work at maximum monthly intervals.

B. Attendance Required: Job superintendent, major Subcontractors and suppliers, Owner, and Architect, as appropriate to agenda topics for each meeting.

C. Agenda:
1. Review minutes of previous meetings.
2. Review of Work progress.
3. Field observations, problems, and decisions.
4. Identification of problems that impede, or will impede, planned progress.
5. Review of submittals schedule and status of submittals.
6. Maintenance of progress schedule.
7. Corrective measures to regain projected schedules.
8. Planned progress during succeeding work period.
9. Maintenance of quality and work standards.
10. Effect of proposed changes on progress schedule and coordination.
11. Other business relating to Work.

D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.04 CONSTRUCTION PROGRESS SCHEDULE

A. Within 10 days after date of the Agreement, submit preliminary schedule defining planned operations for the first 60 days of Work, with a general outline for remainder of Work.

3.05 SUBMITTALS FOR REVIEW

A. When the following are specified in individual sections, submit them for review:
1. Product data.
2. Shop drawings.
3. Samples for selection.
4. Samples for verification.

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B. Submit to Architect for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.

C. Samples will be reviewed only for aesthetic, color, or finish selection.

D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 78 00 - Closeout Submittals.

3.06 SUBMITTALS FOR INFORMATION

A. When the following are specified in individual sections, submit them for information:
   1. Design data.
   2. Certificates.
   3. Test reports.
   4. Inspection reports.
   5. Manufacturer's instructions.
   6. Manufacturer's field reports.
   7. Other types indicated.

B. Submit for Architect's knowledge as contract administrator or for Owner. No action will be taken.

3.07 SUBMITTALS FOR PROJECT CLOSEOUT

A. When the following are specified in individual sections, submit them at project closeout:
   1. Project record documents.
   2. Operation and maintenance data.
   3. Warranties.
   4. Bonds.
   5. Other types as indicated.

B. Submit for Owner's benefit during and after project completion.

3.08 NUMBER OF COPIES OF SUBMITTALS

A. Documents for Review:
   1. Small Size Sheets, Not Larger Than 8-1/2 x 11 inches: Submit the number of copies that Contractor requires, plus two copies that will be retained by Architect.

B. Documents for Information: Submit two copies.

C. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.
   1. After review, produce duplicates.
   2. Retained samples will not be returned to Contractor unless specifically so stated.

3.09 SUBMITTAL PROCEDURES

A. Transmit each submittal with approved form.

B. Sequentially number the transmittal form. Revise submittals with original number and a sequential alphabetic suffix.

C. Identify Project, Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number, as appropriate on each copy.

D. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of Products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with the requirements of the Work and Contract Documents.

E. Schedule submittals to expedite the Project, and coordinate submission of related items.

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F. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.

G. Identify variations from Contract Documents and Product or system limitations that may be detrimental to successful performance of the completed Work.

H. Provide space for Contractor and Architect review stamps.

I. When revised for resubmission, identify all changes made since previous submission.

J. Distribute reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with requirements.

K. Submittals not requested will not be recognized or processed.

END OF SECTION

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SECTION 01 40 00
QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Control of installation.

B. Tolerances.

C. Testing and inspection services.

D. Manufacturers' field services.

1.02 SUMMARY

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

B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Documents 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 Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
4. Specific test and inspection requirements are not specified in this Section.

1.03 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 Architect.

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.

1. Laboratory Mockups: Full-size physical assemblies constructed at testing facility to verify performance characteristics
2. Integrated Exterior Mockups: Mockups of the exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies.
3. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes, doors, windows, millwork, casework, specialties, furnishings and equipment, and lighting.

NOT FOR BIDDING

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 and 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/ Application/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 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.

1.04 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 Architect 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 Architect for a decision before proceeding.

1.05 ACTION SUBMITTALS

A. Shop Drawings: For 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.

1.06 INFORMATIONAL SUBMITTALS

A. Contractor's Quality- Control Plan: For quality-assurance and quality-control activities and responsibilities.

B. Qualification Data: For Contractor's quality-control personnel.

C. 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.

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

D. 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.

E. 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 method.
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.

1.07 CONTRACTOR'S QUALITY-CONTROL PLAN

A. Quality-Control Plan, General: Submit quality-control plan within ten days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.

B. Quality-Control Personnel Qualifications: Engage Qualified full-time personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
1. Project quality-control manager shall not have other Project responsibilities.

C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personal responsible for submittal review.

D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections
2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspection"
3. Owner-performed tests and inspections indicated in the Contract Documents, including tests and inspections indicated to be performed by the Commissioning Authority.

E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards or workmanship established by Contract requirements and approved mockups.

F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Architect has indicated as nonconforming or

NOT FOR BIDDING

defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.08 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.
   4. Dates and locations of samples and tests or inspection.
   5. Names of individuals making tests and inspections.
   6. Description of the Work and tests and inspection method.
   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 reinspecting.

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 whether 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 whether 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, judgements, correspondence, records, and similar documents, established for compliance with standards amd regulations bearing on performance of the Work.

NOT FOR BIDDING

1.09 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 product that are similar in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specifications 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 withy additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
   1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
   2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

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.

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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, and mockups; do not reuse products on Project.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect and Commissioning Authority, 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.

K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups in location and of size indicated orm if not indicated, as directed by Architect.
2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at Project.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
a. Allow seven days for initial review and each re-review of each mockup.
6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove the mockups when directed unless otherwise indicated.

L. Integrated Exterior Mockups: Construct integrated exterior mockup according to approved shop drawings. Coordinate installation of exterior envelope materials and products for which mockups are required in individual Specification Sections, along with supporting materials.

M. Room Mockups: Construct room mockups incorporating required materials and assemblies, finished according to requirements. Provide required lighting and additional lighting where required to enable Architect to evaluate quality of the Work. Provide room mockups of the following rooms:

N. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Specification Sections.

1.10 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owners 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. Payment for these services will be made from testing and inspecting allowances, as authorized by Change Orders.
3. Costs for retesting and reinspecting 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 Wok complies with requirements, whether specified or not.

NOT FOR BIDDING

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction , whether specified or not.
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 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 duplicate, of each quality-control service.
5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. 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 Section 013300 "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 preinstallation 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. Retesting/reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

F. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of it's 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. Do 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 Contractor.

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. Access to the Work.
2. Incidental labor and facilities necessary to facilities tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.

NOT FOR BIDDING

4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. 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, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.11 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner willl engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:

B. Special Tests and Inspections: Conducted by a qualified testing agency as required by authorities having jurisdiction, as indicated in individual Specification Sections, and as follows:
1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected work.

PART 2- PRODUCTS NOT USED

PART 3- EXECUTION

3.01 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 Architect.
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 Architect's, reference during normal working hours.

3.02 REPAIR AND PROTECTION

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

NOT FOR BIDDING

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 Section 017300 "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.

PART 3 EXECUTION

4.01 CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.

D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Have Work performed by persons qualified to produce required and specified quality.

F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

4.02 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

4.03 TESTING AND INSPECTION

A. See individual specification sections for testing required.

B. Re-testing required because of non-conformance to specified requirements shall be performed by the same agency on instructions by Architect.

C. Re-testing required because of non-conformance to specified requirements shall be paid for by Contractor.

4.04 MANUFACTURERS' FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment and operation as applicable, and to initiate instructions when necessary.

B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

NOT FOR BIDDING

4.05 DEFECT ASSESSMENT

A. Replace Work or portions of the Work not conforming to specified requirements.

B. If, in the opinion of Architect, it is not practical to remove and replace the Work, Architect will direct an appropriate remedy or adjust payment.

END OF SECTION

NOT FOR BIDDING

SECTION 01 42 16
DEFINITIONS

PART 1 GENERAL

1.01 SUMMARY

A. Other definitions are included in individual specification sections.

1.02 DEFINITIONS

A. Furnish: To supply, deliver, unload, and inspect for damage.

B. Install: To unpack, assemble, erect, apply, place, finish, cure, protect, clean, start up, and make ready for use.

C. Product: Material, machinery, components, equipment, fixtures, and systems forming the work result. Not materials or equipment used for preparation, fabrication, conveying, or erection and not incorporated into the work result. Products may be new, never before used, or re-used materials or equipment.

D. Project Manual: The book-sized volume that includes the procurement requirements (if any), the contracting requirements, and the specifications.

E. Provide: To furnish and install.

F. Supply: Same as Furnish.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

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SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Temporary sanitary facilities.

B. Security requirements.

C. Vehicular access and parking.

D. Waste removal facilities and services.

1.02 TEMPORARY SANITARY FACILITIES

A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.

B. Maintain daily in clean and sanitary condition.

1.03 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.

B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.

C. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

D. Traffic Controls: Coordinate with the Owner.

1.04 INTERIOR ENCLOSURES

A. Provide temporary partitions and ceilings as indicated to separate work areas from Owner-occupied areas, to prevent penetration of dust and moisture into Owner-occupied areas, and to prevent damage to existing materials and equipment.

B. Construction: Framing and reinforced polyethylene sheet materials with closed joints and sealed edges at intersections with existing surfaces:

1.05 SECURITY

A. Provide security and facilities to protect Work, existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.

B. Coordinate with Owner's security program.

1.06 VEHICULAR ACCESS AND PARKING

A. Coordinate access and haul routes with governing authorities and Owner.

B. Provide and maintain access to fire hydrants, free of obstructions.

C. Parking is limited in this area. Parking will be coordinated by the contractor and will be off-site.

1.07 WASTE REMOVAL

A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.

B. Provide containers with lids. Remove trash from site daily.

C. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.

NOT FOR BIDDING

D. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.08 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, materials, prior to Substantial Completion inspection.

B. Clean and repair damage caused by installation or use of temporary work.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

NOT FOR BIDDING

SECTION 01 60 00
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Transportation, handling, storage and protection.

B. Product option requirements.

C. Substitution limitations and procedures.

D. Maintenance materials, including extra materials, spare parts, tools, and software.

1.02 SUBMITTALS

A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.

B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.

1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

PART 2 PRODUCTS

2.01 NEW PRODUCTS

A. Provide new products unless specifically required or permitted by the Contract Documents.

2.02 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.

B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.

C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.03 MAINTENANCE MATERIALS

A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.

B. Deliver to Project site; obtain receipt prior to final payment.

PART 3 EXECUTION

3.01 SUBSTITUTION PROCEDURES

A. Instructions to Bidders specify time restrictions for submitting requests for substitutions during the bidding period. Comply with requirements specified in this section.

B. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents.

C. A request for substitution constitutes a representation that the submitter:

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1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
2. Will provide the same warranty for the substitution as for the specified product.
3. Will coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to Owner.
4. Waives claims for additional costs or time extension that may subsequently become apparent.

D. Substitution Submittal Procedure:
1. Submit three copies of request for substitution for consideration. Limit each request to one proposed substitution.
2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence. Burden of proof is on proposer.
3. The Architect will notify Contractor in writing of decision to accept or reject request.

3.02 TRANSPORTATION AND HANDLING

A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.

B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.

C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.

D. Transport and handle products in accordance with manufacturer's instructions.

E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.

F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.

G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.03 STORAGE AND PROTECTION

A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.

B. Store and protect products in accordance with manufacturers' instructions.

C. Store with seals and labels intact and legible.

D. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.

E. For exterior storage of fabricated products, place on sloped supports above ground.

F. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.

G. Comply with manufacturer's warranty conditions, if any.

H. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

NOT FOR BIDDING

I. Prevent contact with material that may cause corrosion, discoloration, or staining.

J. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

K. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION

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SECTION 01 70 00
EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Examination, preparation, and general installation procedures.

B. Requirements for alterations work, including selective demolition, except removal, disposal, and/or remediation of hazardous materials and toxic substances.

C. Cutting and patching.

D. Surveying for laying out the work.

E. Cleaning and protection.

F. Starting of systems and equipment.

G. Demonstration and instruction of Owner personnel.

H. Closeout procedures, except payment procedures.

I. General requirements for maintenance service.

1.02 RELATED REQUIREMENTS

A. Section 01 10 00 - Summary: Limitations on working in existing building; continued occupancy; work sequence; identification of salvaged and relocated materials.

B. Section 01 30 00 - Administrative Requirements: Submittals procedures.

C. Section 01 40 00 - Quality Requirements: Testing and inspection procedures.

D. Section 07 84 00 - Firestopping.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
   1. On request, submit documentation verifying accuracy of survey work.
   2. Submit a copy of site drawing signed by the Land Surveyor, that the elevations and locations of the work are in conformance with Contract Documents.
   3. Submit surveys and survey logs for the project record.

C. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
   1. Structural integrity of any element of Project.
   2. Integrity of weather exposed or moisture resistant element.
   3. Efficiency, maintenance, or safety of any operational element.
   4. Visual qualities of sight exposed elements.
   5. Work of Owner or separate Contractor.

1.04 QUALIFICATIONS

A. For survey work, employ a land surveyor registered in the State in which the Project is located and acceptable to Architect. Submit evidence of Surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate.

1.05 PROJECT CONDITIONS

A. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.

NOT FOR BIDDING

B. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

C. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.

D. Pest Control: Provide methods, means, and facilities to prevent pests and insects from damaging the work.

E. Rodent Control: Provide methods, means, and facilities to prevent rodents from accessing or invading premises.

1.06 COORDINATION

A. See Section 01 10 00 - Summary for occupancy-related requirements.

B. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

C. Notify affected utility companies and comply with their requirements.

D. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

E. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

F. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

G. Coordinate completion and clean-up of work of separate sections.

PART 2 PRODUCTS

2.01 PATCHING MATERIALS

A. New Materials: As specified in product sections; match existing products and work for patching and extending work.

B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.

C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.

B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.

C. Examine and verify specific conditions described in individual specification sections.

D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.

E. Verify that utility services are available, of the correct characteristics, and in the correct locations.

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F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.02 LAYING OUT THE WORK

A. Verify locations of survey control points prior to starting work.

B. Promptly notify Architect of any discrepancies discovered.

C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.

D. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.

E. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.

F. Utilize recognized engineering survey practices.

G. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
   1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
   2. Grid or axis for structures.
   3. Building foundation, column locations, ground floor elevations.

H. Periodically verify layouts by same means.

I. Maintain a complete and accurate log of control and survey work as it progresses.

3.03 GENERAL INSTALLATION REQUIREMENTS

A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.

B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.

C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.

D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.

E. Make neat transitions between different surfaces, maintaining texture and appearance.

3.04 ALTERATIONS

A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
   1. Verify that construction and utility arrangements are as shown.
   2. Report discrepancies to Architect before disturbing existing installation.
   3. Beginning of alterations work constitutes acceptance of existing conditions.

B. Remove existing work as indicated and as required to accomplish new work.
   1. Remove items indicated on drawings.
   2. Relocate items indicated on drawings.
   3. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.

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4. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.

C. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove, relocate, and extend existing systems to accommodate new construction.
   1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
   2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
   3. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
      a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
      b. Provide temporary connections as required to maintain existing systems in service.
   4. Verify that abandoned services serve only abandoned facilities.
   5. Remove abandoned pipe, ducts, conduits, and equipment , including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.

D. Protect existing work to remain.
   1. Prevent movement of structure; provide shoring and bracing if necessary.
   2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
   3. Repair adjacent construction and finishes damaged during removal work.

E. Adapt existing work to fit new work: Make as neat and smooth transition as possible.

F. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.

G. Refinish existing surfaces as indicated:
   1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
   2. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.

H. Clean existing systems and equipment.

I. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.

J. Do not begin new construction in alterations areas before demolition is complete.

K. Comply with all other applicable requirements of this section.

3.05 CUTTING AND PATCHING

A. Whenever possible, execute the work by methods that avoid cutting or patching.

B. See Alterations article above for additional requirements.

C. Perform whatever cutting and patching is necessary to:
   1. Complete the work.

NOT FOR BIDDING

2. Fit products together to integrate with other work.
3. Provide openings for penetration of mechanical, electrical, and other services.
4. Match work that has been cut to adjacent work.
5. Repair areas adjacent to cuts to required condition.
6. Repair new work damaged by subsequent work.
7. Remove samples of installed work for testing when requested.
8. Remove and replace defective and non-conforming work.

D. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.

E. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.

F. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.

G. Restore work with new products in accordance with requirements of Contract Documents.

H. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

I. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 84 00 - Firestopping, to full thickness of the penetrated element.

J. Patching:
1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
2. Match color, texture, and appearance.
3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

3.06 PROGRESS CLEANING

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.

B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.

C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.07 PROTECTION OF INSTALLED WORK

A. Protect installed work from damage by construction operations.

B. Provide special protection where specified in individual specification sections.

C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

D. Remove protective coverings when no longer needed; reuse or recycle plastic coverings if possible.

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3.08 SYSTEM STARTUP

A. Coordinate schedule for start-up of various equipment and systems.

B. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.

C. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

D. Verify that wiring and support components for equipment are complete and tested.

E. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.

F. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.09 DEMONSTRATION AND INSTRUCTION

A. See Section 01 79 00 - Demonstration and Training.

B. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner personnel in detail to explain all aspects of operation and maintenance.

C. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

3.10 ADJUSTING

A. Adjust operating products and equipment to ensure smooth and unhindered operation.

3.11 FINAL CLEANING

A. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.

B. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.

C. Clean debris from roofs, gutters, downspouts, and drainage systems.

D. Clean site; sweep paved areas, rake clean landscaped surfaces.

E. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.12 CLOSEOUT PROCEDURES

A. Make submittals that are required by governing or other authorities.

B. Notify Architect when work is considered ready for Substantial Completion.

C. Provide operation and maintenance manuals for all installed equipment and devices, as-built drawings (PDF), and all inspection certificates as two (2) bound hardcopies and two (2) archival-grade (gold foil) DVDs.

D. Submit written certification that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's review.

E. Correct items of work listed in executed Certificates of Substantial Completion and comply with requirements for access to Owner-occupied areas.

F. Notify Architect when work is considered finally complete.

G. Complete items of work determined by Architect's final inspection.

NOT FOR BIDDING

H. Provided completed documentation as follows:
   1. Consent to Surety of Final Payment
   2. Certificate of Substantial Completion
   3. Contractor Satisfaction of Debt and Claims
   4. Release of Liens for the Contractor, his Subcontractors, and his Suppliers

I. See 01 78 00 - Closeout Submittals for additional requirements.

3.13 MAINTENANCE

A. Provide service and maintenance of components indicated in specification sections.

B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than one year from the Date of Substantial Completion or the length of the specified warranty, whichever is longer.

C. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.

D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.

E. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Owner.

END OF SECTION

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SECTION 01 74 19
CONSTRUCTION WASTE MANAGEMENT

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes: Administrative and procedural requirements for construction waste management activities.

1.2 DEFINITIONS

A. Construction, Demolition, and Land clearing (CDL) Waste: Includes all non-hazardous solid wastes resulting from construction, remodeling, alterations, repair, demolition and land clearing. Includes material that is recycled, reused, salvaged or disposed as garbage.

B. Salvage: Recovery of materials for on-site reuse, sale or donation to a third party.

C. Reuse: Making use of a material without altering its form. Materials can be reused on-site or reused on other projects off-site. Examples include, but are not limited to the following: Crushing or grinding of concrete for use as sub-base material. Chipping of land clearing debris for use as mulch.

D. Recycling: The process of sorting, cleaning, treating, and reconstituting materials for the purpose of using the material in the manufacture of a new product.

E. Source-Separated CDL Recycling: The process of separating recyclable materials in separate containers as they are generated on the job-site. The separated materials are hauled directly to a recycling facility or transfer station.

F. Co-mingled CDL Recycling: The process of collecting mixed recyclable materials in one container on-site. The container is taken to a material recovery facility where materials are separated for recycling.

G. Approved Recycling Facility: Any of the following:

1. A facility that can legally accept CDL waste materials for the purpose of processing the materials into an altered form for the manufacture of a new product.

2. Material Recovery Facility: A general term used to describe a waste-sorting facility. Mechanical, hand-separation, or a combination of both procedures, are used to recover recyclable materials.

1.3 SUBMITTALS

A. Contractor shall develop a Waste Management Plan: Submit 3 copies of plan within 14 days of date established for the **Notice to Proceed**.

B. Contractor shall provide Waste Management Report: Concurrent with each Application for Payment, submit **3** copies of report.

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1.4 PERFORMANCE REQUIREMENTS

A. General: Divert a minimum of **75%** CDL waste, by weight, from the landfill by one, or a combination of the following activities:

1. Salvage
2. Reuse
3. Source-Separated CDL Recycling
4. Co-mingled CDL Recycling

B. CDL waste materials that can be salvaged, reused or recycled include, but are not limited to, the following:

1. Acoustical ceiling tiles
2. Asphalt
3. Asphalt shingles
4. Cardboard packaging
5. Carpet and carpet pad
6. Concrete
7. Drywall
8. Fluorescent lights and ballasts
9. Land clearing debris (vegetation, stumpage, dirt)
10. Metals
11. Paint (through hazardous waste outlets)
12. Wood
13. Plastic film (sheeting, shrink wrap, packaging)
14. Window glass
15. Wood
16. Field office waste, including office paper, aluminum cans, glass, plastic, and office cardboard.

1.4 QUALITY ASSURANCE

A. Waste Management Coordinator Qualifications: Experienced firm, with a record of successful waste management coordination of projects with similar requirements,that employs a LEED Accredited Professional, certified by the USGBC as waste management coordinator.

B. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.

C. Regulatory Requirements: Conduct construction waste management activities in accordance with hauling and disposal regulations of all authorities having jurisdiction and all other applicable laws and ordinances.

D. Preconstruction Conference: Schedule and conduct meeting at Project site prior to construction activities.

1. Attendees: Inform the following individuals, whose presence is required, of date and time of meeting.

a. Owner

b. Architect
c. Contractor's superintendent
d. Major subcontractors
e. Waste Management Coordinator
f. Other concerned parties

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2. Agenda Items: Review methods and procedures related to waste management including, but not limited to, the following:

   a. Review and discuss waste management plan including responsibilities of Waste Management Coordinator.
   b. Review requirements for documenting quantities of each type of waste and its disposition.
   c. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
   d. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
   e. Review waste management requirements for each trade.

3. Minutes: Record discussion. Distribute meeting minutes to all participants.

   Note: If there is a Project Architect, they will perform this role.

1.5 WASTE MANAGEMENT PLAN – Contractor shall develop and document the following:

A. Develop a plan to meet the requirements listed in this section at a minimum. Plan shall consist of waste identification, waste reduction plan and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight throughout the plan.

B. Indicate anticipated types and quantities of demolition, site-cleaning and construction waste generated by the project. List all assumptions made for the quantities estimates.

C. List each type of waste and whether it will be salvaged, recycled, or disposed of in a landfill. The plan should include the following information:

1. Types and estimated quantities, by weight, of CDL waste expected to be generated during demolition and construction.

2. Proposed methods for CDL waste salvage, reuse, recycling and disposal during demolition including, but not limited to, one or more of the following:

   a. Contracting with a deconstruction specialist to salvage materials generated,
   b. Selective salvage as part of demolition contractor’s work,
   c. Reuse of materials on-site or sale or donation to a third party.

3. Proposed methods for salvage, reuse, recycling and disposal during construction including, but not limited to, one or more of the following:

   a. Requiring subcontractors to take their CDL waste to a recycling facility;
   b. Contracting with a recycling hauler to haul recyclable CDL waste to an approved recycling or material recovery facility;
   c. Processing and reusing materials on-site;
   d. Self-hauling to a recycling or material recovery facility.

4. Name of recycling or material recovery facility receiving the CDL wastes.

5. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location on project site where materials separation will be located.

NOT FOR BIDDING

D. Cost/Revenue Analysis: Indicate total cost of waste disposal as if there was no waste management plan and net additional cost or net savings resulting from implementing waste management plan. Include the following:

1. Total quantity of waste.
2. Estimated cost of disposal (cost per unit). Include hauling and tipping fees and cost of collection containers for each type of waste.
3. Total cost of disposal (with no waste management).
4. Revenue from salvaged materials.
5. Revenue from recycled materials.
6. Savings in hauling and tipping fees by donating materials.
7. Savings in hauling and tipping fees that are avoided.
8. Handling and transportation costs. Including cost of collection containers for each type of waste.
9. Net additional cost or net savings from waste management plan.

PART 2 - PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 CONSTRUCTION WASTE MANAGEMENT, GENERAL

A. Provide containers for CDL waste that is to be recycled clearly labeled as such with a list of acceptable and unacceptable materials. The list of acceptable materials must be the same as the materials recycled at the receiving material recovery facility or recycling processor.

B. The collection containers for recyclable CDL waste must contain no more than 10% non-recyclable material, by volume.

C. Provide containers for CDL waste that is disposed in a landfill clearly labeled as such.

D. Use detailed material estimates to reduce risk of unplanned and potentially wasteful cuts.

E. To the greatest extent possible, include in material purchasing agreements a waste reduction provision requesting that materials and equipment be delivered in packaging made of recyclable material, that they reduce the amount of packaging, that packaging be taken back for reuse or recycling, and to take back all unused product. Insure that subcontractors require the same provisions in their purchase agreements.

F. Conduct regular visual inspections of dumpsters and recycling bins to remove contaminants.

3.2 SOURCE SEPARATION

A. General: Contractor shall separate recyclable materials from CDL waste to the maximum extent possible.

Separate recyclable materials by type.

1. Provide containers, clearly labeled, by type of separated materials or provide other storage method for managing recyclable materials until they are removed from Project site.
2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water and to minimize pest attraction. Cover to prevent windblown dust.
3. Stockpile materials away from demolition area. Do not store within drip line of remaining trees.

NOT FOR BIDDING

4. Store components off the ground and protect from weather.

3.3 CO-MINGLED RECYCLING

A. General: Do not put CDL waste that will be disposed in a landfill into a co-mingled CDL waste recycling container.

REMOVAL OF CONSTRUCTION WASTE MATERIALS

A. Remove CDL waste materials from project site on a regular basis. Do not allow CDL waste to accumulate on-site.

B. Transport CDL waste materials off Owner's property and legally dispose of them.

C. Burning of CDL waste is not permitted.

END OF SECTION

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WASTE MANAGEMENT PROGRESS REPORT				
	DISPOSED IN MUNICIPAL SOLID WASTE LANDFILL	**DIVERTED FROM LANDFILL BY RECYCLING, SALVAGE OR REUSE**		
MATERIAL CATEGORY		Recycled	Salvaged	Reused
1. Acoustical Ceiling Tiles				
2. Asphalt				
3. Asphalt Shingles				
4. Cardboard Packaging				
5. Carpet and Carpet Pad				
6. Concrete				
7. Drywall				
8. Fluorescent Lights and Ballasts				
9. Land Clearing Debris				
10. Metals				
11. Paint (through hazardous waste outlets)				
12. Wood				
13. Plastic Film (sheeting, shrink wrap, packaging)				
14. Window Glass				
15. Field Office Waste (office paper, aluminum cans, glass, plastic, and coffee cardboard)				
16. Other (insert description)				
17. Other (insert description)				
Total (In Weight)		(TOTAL OF ALL ABOVE VALUES – IN WEIGHT)		
		Percentage of Waste Diverted	(TOTAL WASTE DIVIDED BY TOTAL DIVERTED)	

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SECTION 01 78 00
CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Project Record Documents.

B. Operation and Maintenance Data.

C. Warranties and bonds.

1.02 RELATED REQUIREMENTS

A. Section 01 30 00 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.

B. Section 01 70 00 - Execution and Closeout Requirements: Contract closeout procedures.

C. Individual Product Sections: Specific requirements for operation and maintenance data.

D. Individual Product Sections: Warranties required for specific products or Work.

1.03 SUBMITTALS

A. Project Record Documents: Submit documents to Architect with claim for final Application for Payment.

B. Operation and Maintenance Data:
   1. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect will review draft and return one copy with comments.
   2. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
   3. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
   4. Submit two sets of revised final documents in final form within 10 days after final inspection.

C. Warranties and Bonds:
   1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
   2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
   3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:
   1. Drawings.
   2. Addenda.
   3. Change Orders and other modifications to the Contract.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Store record documents separate from documents used for construction.

NOT FOR BIDDING

D. Record information concurrent with construction progress.

E. Provide the following documents in electronic and paper media as described in 01 70 00 - Execution and Closeout Requirements:
   1. Form G704 Substantial Completion
   2. Form G706 Affadavit of Payment of Debts and Claims
   3. Form 706A Release of Liens by Contractor and Subcontractors
   4. Form 707 Consent to Surety of Final Payment
   5. Final Payment Application
   6. Warranties
   7. O&M Manuals
   8. As-Built Drawings
   9. Inspection Reports
   10. Equipment Startup Reports
   11. Substantial Completion Form
   12. Affidavit of Discharge of State Tax Liability
   13. Copy of Completed Punch List Signed by Owner's Representative
   14. Punch List Closeout Letter

F. Record Drawings : Legibly mark each item to record actual construction including:
   1. Field changes of dimension and detail.
   2. Details not on original Contract drawings.

3.02 OPERATION AND MAINTENANCE DATA

A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.

B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.

D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.03 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

A. For Each Item of Equipment and Each System:
   1. Description of unit or system, and component parts.
   2. Identify function, normal operating characteristics, and limiting conditions.
   3. Include performance curves, with engineering data and tests.
   4. Complete nomenclature and model number of replaceable parts.

B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

C. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

D. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

NOT FOR BIDDING

E. Provide servicing and lubrication schedule, and list of lubricants required.

F. Include manufacturer's printed operation and maintenance instructions.

G. Include sequence of operation by controls manufacturer.

H. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

I. Additional Requirements: As specified in individual product specification sections.

3.04 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.

B. Where systems involve more than one specification section, provide separate tabbed divider for each system.

C. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 2 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.

D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.

E. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.

F. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.

G. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.

H. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.

I. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

3.05 WARRANTIES AND BONDS

A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial completion is determined.

B. Verify that documents are in proper form, contain full information, and are notarized.

C. Co-execute submittals when required.

D. Retain warranties and bonds until time specified for submittal.

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SECTION 01 79 00
DEMONSTRATION AND TRAINING

PART 1 GENERAL

1.01 SUMMARY

A. Demonstration of products and systems where indicated in specific specification sections.

B. Training of Owner personnel in operation and maintenance is required for:
   1. All software-operated systems including HVAC controls.
   2. HVAC systems and equipment.
   3. Electrical systems and equipment.

1.02 RELATED REQUIREMENTS

A. Section 01 78 00 - Closeout Submittals: Operation and maintenance manuals.

B. Other Specification Sections: Additional requirements for demonstration and training.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Training Plan: Owner will designate personnel to be trained; tailor training to needs and skill-level of attendees.
   1. Submit to Architect for transmittal to Owner.
   2. Submit not less than four weeks prior to start of training.
   3. Revise and resubmit until acceptable.
   4. Provide an overall schedule showing all training sessions.
   5. Include at least the following for each training session:
      a. Identification, date, time, and duration.
      b. Description of products and/or systems to be covered.
      c. Name of firm and person conducting training; include qualifications.
      d. Intended audience, such as job description.
      e. Objectives of training and suggested methods of ensuring adequate training.
      f. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.
      g. Media to be used, such a slides, hand-outs, etc.
      h. Training equipment required, such as projector, projection screen, etc., to be provided by Contractor.

C. Training Manuals: Provide training manual for each attendee; allow for minimum of two attendees per training session.
   1. Include applicable portion of O&M manuals.
   2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.
   3. Provide one extra copy of each training manual to be included with operation and maintenance data.

D. Training Reports:
   1. Identification of each training session, date, time, and duration.
   2. Sign-in sheet showing names and job titles of attendees.
   3. List of attendee questions and written answers given, including copies of and references to supporting documentation required for clarification; include answers to questions that could not be answered in original training session.

NOT FOR BIDDING

1.04 QUALITY ASSURANCE

A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.
   1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.
   2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 DEMONSTRATION - GENERAL

A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.

B. Demonstration may be combined with Owner personnel training if applicable.

C. Provide demonstration in minimum two hour segments, 8 hours total.

D. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
   1. Perform demonstrations not less than two weeks prior to Substantial Completion.
   2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

E. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.
   1. Perform demonstrations not less than two weeks prior to Substantial Completion.

3.02 TRAINING - GENERAL

A. Conduct training on-site unless otherwise indicated.

B. Owner will provide classroom and seating at no cost to Contractor.

C. Provide training in minimum two hour segments, 8 hours total.

D. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.

E. Review of Facility Policy on Operation and Maintenance Data: During training discuss:
   1. The location of the O&M manuals and procedures for use and preservation; backup copies.
   2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
   3. Typical uses of the O&M manuals.

F. Product- and System-Specific Training:
   1. Review the applicable O&M manuals.
   2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.
   3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.

NOT FOR BIDDING

4. Provide hands-on training on all operational modes possible and preventive maintenance.
5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.
6. Discuss common troubleshooting problems and solutions.
7. Discuss any peculiarities of equipment installation or operation.
8. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.
9. Review recommended tools and spare parts inventory suggestions of manufacturers.
10. Review spare parts and tools required to be furnished by Contractor.
11. Review spare parts suppliers and sources and procurement procedures.

G. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

END OF SECTION

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SECTION 02 41 00
DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Selective demolition of built site elements.

B. Selective demolition of building elements for alteration purposes.

1.02 RELATED REQUIREMENTS

A. Section 01 10 00 - Summary: Limitations on Contractor's use of site and premises.

B. Section 01 70 00 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.

1.03 DEFINITIONS

A. Demolition: Dismantle, raze, destroy or wreck any building or structure or any part thereof.

B. Remove: Detach or dismantle items from existing construction and dispose of them off site, unless items are indicated to be salvaged or reinstalled.

C. Remove and Salvage: Detach or dismantle items from existing construction in a manner to prevent damage. Clean, package, label and deliver salvaged items to Owner in ready-for-reuse condition.

D. Remove and Reinstall: Detach or dismantle items from existing construction in a manner to prevent damage. Clean and prepare for reuse and reinstall where indicated.

E. Existing to Remain: Designation for existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

1.04 REFERENCE STANDARDS

A. 29 CFR 1926 - U.S. Occupational Safety and Health Standards.

B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Site Plan: Indicate:
   1. Areas for temporary construction and field offices.

C. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION

3.01 GENERAL PROCEDURES AND PROJECT CONDITIONS

A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
   1. Obtain required permits.
   2. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
   3. Provide, erect, and maintain temporary barriers and security devices.

NOT FOR BIDDING

4. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
5. Do not close or obstruct roadways or sidewalks without permit.
6. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
7. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.

B. Do not begin removal until receipt of notification to proceed from Owner.

C. Protect existing structures and other elements that are not to be removed.
1. Provide bracing and shoring.
2. Prevent movement or settlement of adjacent structures.
3. Stop work immediately if adjacent structures appear to be in danger.

3.02 EXISTING UTILITIES

A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.

B. Protect existing utilities to remain from damage.

C. Do not disrupt public utilities without permit from authority having jurisdiction.

D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.

E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.

F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.

G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

3.03 SELECTIVE DEMOLITION FOR ALTERATIONS

A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
1. Verify that construction and utility arrangements are as shown.
2. Report discrepancies to Architect before disturbing existing installation.
3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.

B. Separate areas in which demolition is being conducted from areas that remain occupied.
1. Provide, erect, and maintain temporary dustproof partitions of construction as required to prevent contamination outside area of disturbance .

C. Maintain weatherproof exterior building enclosure, except for interruptions required for replacement or modifications; prevent water and humidity damage.

D. Remove existing work as indicated and as required to accomplish new work.
1. Remove items indicated on drawings.

E. Services (Including but not limited to Electrical): Remove existing systems and equipment as indicated.

NOT FOR BIDDING

1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
3. Verify that abandoned services serve only abandoned facilities before removal.
4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.

F. Protect existing work to remain.
1. Prevent movement of structure; provide shoring and bracing if necessary.
2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
3. Repair adjacent construction and finishes damaged during removal work.
4. Patch as specified for patching new work.

3.04 DEBRIS AND WASTE REMOVAL

A. Remove debris, junk, and trash from site.

B. Remove from site all materials not to be reused on site; comply with requirements of 01 74 19 Construction Waste Management and Disposal.

C. Leave site in clean condition, ready for subsequent work.

D. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

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SECTION 13 34 23

FABRICATED STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Prefabricated wood-framed storage buildings.
2. Factory-fabricated structural components.
3. Exterior wall assemblies, roofing, doors, trim, and accessories.
4. Manufacturer-provided delivery and installation.

B. Provide complete prefabricated wood storage building assemblies including all components necessary for a complete, weather-tight, and code-compliant structure.

1.2 REFERENCES

A. Comply with applicable requirements of:
1. International Building Code (IBC).
2. National Design Specification for Wood Construction (NDS).
3. American Wood Protection Association (AWPA) standards.
4. Applicable state and local building codes.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Design:

1. Design building structure for applicable code-required loads.
2. Provide manufacturer-engineered design based on project location.

B. Minimum Design Loads:

1. Roof Live Load:
   a. Minimum 20 psf unless otherwise indicated.
2. Floor Live Load:
   a. Minimum 75 psf for general storage.
   b. Provide increased capacity where heavier storage loads are anticipated.
3. Wind Load:

NOT FOR BIDDING

a. Design for applicable basic wind speed, exposure category, and importance factor.

4. Snow Load:

a. Design for applicable ground snow load requirements.

1.5 SUBMITTALS

A. Product Data:

1. Manufacturer product literature.

2. Standard construction details.

3. Material descriptions and finishes.

B. Shop Drawings:

1. Building dimensions and elevations.

2. Floor plans.

3. Framing layouts.

4. Roof framing details.

5. Door and window locations.

6. Foundation and anchorage requirements.

C. Structural Calculations:

1. Provide engineer-sealed structural calculations where required by authorities having jurisdiction.

2. Include:

a. Gravity loads.

b. Wind loads.

c. Snow loads.

d. Anchorage calculations.

D. Installation Instructions:

1. Manufacturer installation requirements.

2. Foundation preparation requirements.

NOT FOR BIDDING

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Minimum five years documented experience manufacturing prefabricated wood buildings.

2. Capable of providing engineered designs and installation instructions.

B. Installer Qualifications:

1. Manufacturer-approved installer.

2. Experienced in installation of prefabricated wood storage buildings.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer packaging.

B. Protect components from damage, moisture exposure, distortion, and deterioration.

C. Store materials off the ground and protected from weather prior to installation.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:

1. Basis of Design: Tuff Shed – Premier Pro Series (12’ x 10’) with Gable (ranch) style roof 5/12 pitch.
2. Old Hickory Buildings.
3. Derksen Portable Buildings.
4. Approved equal.

B. Substitutions:

1. Comply with Section 01 60 00 Product Requirements.

2.2 PREFABRICATED BUILDING ASSEMBLY

A. Provide factory-fabricated wood storage building consisting of:

1. Wood-framed walls.
2. Wood roof framing.
3. Floor framing system.
4. Exterior siding.
5. Roofing system.
6. Doors and hardware.

NOT FOR BIDDING

7. Trim and accessories.

B. Components shall be factory fabricated for field assembly with minimum field modification.

2.3 WOOD FRAMING

A. Wall Framing:

1. Minimum 2x4 dimensional lumber.

2. Stud spacing:

a. 16 inches on center typical.

B. Lumber:

1. SPF No. 2 or better.
2. Southern Pine No. 2 or better.
3. Pressure-treated lumber at locations exposed to moisture.

C. Roof Framing:

1. Factory fabricated rafters or engineered wood trusses.
2. Designed for applicable roof loads.

2.4 FLOOR SYSTEM

A. Steel Floor System:

1. 2x6 hot-dipped galvanized steel w/ 40-year rating
2. Maximum spacing: 24 inches on center.
3. Minimum 3/4-inch tongue-and-groove plywood or OSB decking.
4. Vinyl sheet flooring with 4” vinyl rubber base.

2.5 WALL ASSEMBLY

A. Exterior Siding:

1. Provide one of the following:

a. Engineered wood siding.

b. Fiber cement siding.

c. Vinyl siding.

B. Insulation:

NOT FOR BIDDING

1. 4” batt insulation, R-12 minimum.

C. Wall Sheathing:

1. Minimum 7/16-inch OSB sheathing.

D. Weather Barrier:

1. Building wrap behind exterior siding.

E. Trim:

1. Manufacturer standard exterior trim components.

2.6 ROOF ASSEMBLY

A. Roof Deck:

1. Minimum 7/16-inch OSB sheathing.

B. Underlayment:

1. Synthetic roofing underlayment or asphalt-saturated felt.

C. Insulation:

1. 6” batt insulation, R-18 minimum.

D. Roofing:

1. Standing seam metal roofing.

E. Accessories:

1. Drip edge.

2. Ridge ventilation where applicable.

3. Flashing components.

2.7 DOORS

A. Provide manufacturer-standard exterior doors.

B. Minimum requirements:

1. Double doors.

2. Weatherstripping.

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3. Lockset hardware.

4. Threshold.

2.8 ACCESSORIES

A. Provide accessories required for complete installation including:

1. Vents.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify:

1. Site conditions are acceptable.

2. Foundation is complete and properly prepared.

3. Access is available for delivery and installation.

B. Do not proceed until unsuitable conditions are corrected.

3.2 INSTALLATION

A. Install building in accordance with:

1. Manufacturer installation instructions.

2. Approved shop drawings.

3. Applicable building codes.

B. Anchor building securely to foundation. Provide 25” ground anchors where anchored to exterior grade.

C. Maintain alignment, level, and weather-tight construction.

3.3 FIELD QUALITY CONTROL

A. Verify:

1. Building is properly anchored.

2. Doors operate correctly.

3. Roof drainage functions properly.

NOT FOR BIDDING

4. Exterior envelope is complete and weather resistant.

3.4 CLEANING

A. Remove construction debris.

B. Clean building surfaces prior to acceptance.

3.5 WARRANTY

A. Provide manufacturer's standard warranty (minimum two years following date of substantial completion) covering:

1. Materials.

2. Workmanship.

3. Roofing and siding systems.

END OF SECTION

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SECTION 23 05 19
METERS AND GAUGES FOR HVAC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pressure gage taps.

B. Thermometers and thermometer wells.

1.02 RELATED REQUIREMENTS

A. Section 23 21 13 - Hydronic Piping.

B. Section 23 09 23 - Direct-Digital Control System for HVAC.

C. Section 23 09 93 - Sequence of Operations for HVAC Controls.

1.03 REFERENCE STANDARDS

A. ASME B40.100 - Pressure Gauges and Gauge Attachments.

B. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers.

C. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers.

D. UL 393 - Indicating Pressure Gauges for Fire-Protection Service.

1.04 SUBMITTALS

A. See Section 01 33 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.

C. Samples: Submit one of each type of instrument specified.

D. Project Record Documents: Record actual locations of components and instrumentation.

E. Operation and Maintenance Data: pressure gages thermometers static pressure gages.

1.05 FIELD CONDITIONS

A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 PRODUCTS

2.01 PRESSURE GAGES

A. Manufacturers:
   1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
   2. Moeller Instrument Co., Inc: www.moellerinstrument.com/#sle.
   3. Omega Engineering, Inc: www.omega.com/#sle.

B. Pressure Gages: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
   1. Case: Steel with brass bourdon tube.
   2. Size: 4-1/2 inch diameter.
   3. Mid-Scale Accuracy: One percent.
   4. Scale: Psi and KPa.

2.02 PRESSURE GAGE TAPPINGS

A. Gage Cock: Tee or lever handle, brass for maximum 150 psi.

NOT FOR BIDDING

B. Needle Valve: Brass or stainless steel 1/4 inch NPT for minimum 150 psi.

C. Pulsation Damper: Pressure snubber, brass with 1/4 inch connections.

D. Syphon: Brass, Stainless Steel or Bronze 1/4 inch angle or straight pattern.

2.03 STEM TYPE THERMOMETERS

A. Manufacturers:
1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
2. Omega Engineering, Inc: www.omega.com/#sle.
3. Weksler Glass Thermometer Corp: www.wekslerglass.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Thermometers - Fixed Mounting: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish.
1. Size: 7 inch scale.
2. Window: Clear Lexan.
3. Stem: 3/4 inch brass.
4. Accuracy: 2 percentper ASTM E77.
5. Calibration: Degrees F and Degrees C.

C. Thermometers - Adjustable Angle: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.
1. Size: 7 inch scale.
2. Window: Clear Lexan.
3. Stem: 3/4 inch NPT brass.
4. Accuracy: 2 percentper ASTM E77.
5. Calibration: Degrees F and Degrees C.

2.04 DIAL THERMOMETERS

A. Manufacturers:
1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
2. Omega Engineering, Inc: www.omega.com/#sle.
3. Weksler Glass Thermometer Corp: www.wekslerglass.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Thermometers - Fixed Mounting: Dial type bimetallic actuated; ASTM E1; stainless steel case, silicone fluid damping, white with black markings and black pointer, hermetically sealed lens, stainless steel stem.
1. Size: 2 inch diameter dial.
2. Lens: Clear Lexan.
3. Accuracy: 1 percent.
4. Calibration: Degrees F and Degrees C.

C. Thermometer: ASTM E1, stainless steel case, adjustable angle with front recalibration, bimetallic helix actuated with silicone fluid damping, white with black markings and black pointer hermetically sealed lens, stainless steel stem.
1. Size: 3 inch diameter dial.
2. Lens: Clear Lexan.
3. Accuracy: 1 percent.
4. Calibration: Degrees F and Degrees C.

NOT FOR BIDDING

D. Thermometers: Dial type vapor or liquid actuated; ASTM E1; stainless steel case, with brass or copper bulb, copper or bronze braided capillary, white with black markings and black pointer, glass lens.
   1. Size: 2-1/2 inch diameter dial.
   2. Lens: Clear Lexan.
   3. Length of Capillary: Minimum 5 feet.
   4. Accuracy: 2 percent.
   5. Calibration: Degrees F and Degrees C.

2.05 THERMOMETER SUPPORTS

A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.

B. Flange: 3 inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.06 TEST PLUGS

A. Test Plug: 1/4 inch or 1/2 inch brass or stainless steel fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with neoprene core for temperatures up to 200 degrees F.

B. Test Plug: 1/4 inch or 1/2 inch brass or stainless steel fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with Nordel core for temperatures up to 350 degrees F.

C. Test Plug: 1/4 inch or 1/2 inch brass or stainless steel fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with Viton core for temperatures up to 400 degrees F.

D. Test Kit: Carrying case, internally padded and fitted containing one 2-1/2 inch diameter pressure gages, one gage adapters with 1/8 inch probes, two 1-1/2 inch dial thermometers.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide one pressure gage per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gage.

C. Install pressure gages with pulsation dampers. Provide gage cock to isolate each gage. Extend nipples to allow clearance from insulation.

D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.

E. Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets. Refer to Section 23 09 23. Where thermometers are provided on local panels, duct or pipe mounted thermometers are provided on local panels, duct or pipe mounted thermometers are not required.

F. Coil and conceal excess capillary on remote element instruments.

G. Provide instruments with scale ranges selected according to service with largest appropriate scale.

H. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

NOT FOR BIDDING

I. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.

J. Locate test plugs adjacent thermometers and thermometer sockets, adjacent to pressure gages and pressure gage taps, adjacent to control device sockets and where indicated.

3.02 SCHEDULE

A. Pressure Gages, Location and Scale Range:
   1. Pumps, 0 to 225 psi.
   2. Expansion tanks, 0 to 225 psi.
   3. Pressure tanks, 0 to 225 psi.

B. Pressure Gage Tappings, Location:
   1. Control valves 3/4 inch & larger - inlets and outlets.
   2. Major coils - inlets and outlets.
   3. Chiller - inlets and outlets.

C. Stem Type Thermometers, Location and Scale Range:
   1. Headers to central equipment, 0 to 220 degrees F.
   2. Coil banks - inlets and outlets, 0 to 220 degrees F.
   3. After major coils, 0 to 220 degrees F.

D. Thermometer Sockets, Location:
   1. Control valves 1 inch & larger - inlets and outlets.

END OF SECTION

NOT FOR BIDDING

SECTION 23 05 33
HEAT TRACING FOR HVAC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Self-regulating parallel resistance electric heating cable.

1.02 RELATED REQUIREMENTS

A. Section 23 05 53 - Identification for HVAC Piping and Equipment.

B. Section 23 07 19 - HVAC Piping Insulation.

C. Section 23 21 13 - Hydronic Piping.

D. Section 23 21 14 - Hydronic Specialties.

E. Section 26 05 19 - Low Voltage Electrical Power Conductors & Cables.

F. Section 26 05 26 - Grounding & Bonding for Electrical Systems.

G. Section 26 05 33.13 - Conduit for Electrical Systems.

H. Section 26 05 33.16 - Boxes for Electrical Systems.

1.03 REFERENCE STANDARDS

A. IEEE 515.1 - IEEE Standard for the Testing, Design, Installation, and Maintenance of Electrical Resistance Trace Heating for Commercial Applications.

B. ITS (DIR) - Directory of Listed Products.

C. NFPA 70 - National Electrical Code.

D. UL (DIR) - Online Certifications Directory.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

B. Coordinate the work with other trades to provide ground fault protection for electric heat tracing circuits as required by NFPA 70.

C. Coordinate the work with other trades to provide circuit breaker ratings suitable for installed circuit lengths.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data for electric heat tracing.

C. Shop Drawings: Indicate electric heat tracing layout, electrical terminations, thermostats, controls, and branch circuit connections.

D. Manufacturer's Installation Instructions: Indicate installation instructions and recommendations.

E. Manufacturer's Qualification Statement.

F. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions of equipment and controls, maintenance and repair data, and parts listings.

G. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

H. Project Record Documents: Record actual locations of electric heat tracing lines and thermostats.

NOT FOR BIDDING

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with at least three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

C. Copies of Documents at Project Site: Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.07 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Provide two year manufacturer warranty for cables, connection kits, accessories, and controls.

PART 2 PRODUCTS

2.01 SELF-REGULATING PARALLEL RESISTANCE ELECTRIC HEATING CABLE

A. Manufacturers:
   1. Chromalox, Inc (Basis of Design): www.chromalox.com.
   2. Pentair: www.pentairthermal.com.
   3. Thermon Manufacturing Company: www.thermon.com.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Provide products listed, classified, and labeled by UL (DIR), ITS (DIR), or testing firm acceptable to authorities having jurisdiction (AHJ).

C. Factory Rating and Testing: Comply with IEEE 515.1.

D. Heating Element:
   1. Provide pair of parallel No. 16 tinned or nickel coated stranded copper bus wires embedded in cross linked conductive polymer core with varying heat output in response to temperature along its length.
   2. Terminations: Waterproof, factory assembled, non-heating leads with connector at one end and water-tight seal at opposite end.
   3. Capable of crossing over itself without overheating.

E. Insulated Jacket: Flame retardant polyolefin.

F. Cable Cover: Provide tinned copper and polyolefin outer jacket with UV inhibitor.

G. Maximum Power-On Operating Temperature: 150 degrees F.

H. Maximum Power-Off Exposure Temperature: 185 degrees F.

I. Electrical Characteristics:
   1. 5 W/lineal ft.
   2. 120 volts, single phase, 60 Hz.

2.02 OUTER JACKET MARKINGS

A. Name of manufacturer, trademark, or other recognized symbol of identification.

B. Catalog number, reference number, or model.

C. Month and year of manufacture, date coding, applicable serial number, or equivalent.

D. Agency listing or approval.

E. Applicable environmental or area use requirements, such as NEMA 4, Type 4, IP ratings, and hazardous (classified) location markings including temperature rating.

NOT FOR BIDDING

F. Any applicable warning/caution statements such as "WARNING: De-energize circuit before removing cover.

2.03 CONNECTION KITS

A. Provide power connection, splice/tee, and end seal kits compatible with the heating cable and without requiring cutting of the cable core to expose bus wires.

B. Furnish with NEMA 4X rating for prevention of corrosion and water ingress.

C. Provide UV stabilized components.

2.04 ACCESSORIES

A. Provide Accessories As Indicated or As Required for Complete Installation, Including but Not Limited To:
   1. High temperature, glass filament tape for attachment of heating cable to metal piping.
   2. Aluminum self-adhesive tape for attachment of heating cable to plastic piping.
   3. Heat-conductive putty.
   4. Cable ties.
   5. Silicone end seals and splice kits.
   6. Installation clips.

2.05 CONTROLS

A. Pipe Mounted Thermostats:
   1. Remote bulb unit with adjustable temperature range from 30 to 50 degrees F.
   2. Snap-action, open-on-rise, single pole switch with minimum current rating adequate for the connected cable.
   3. Remote bulb on capillary, resistance temperature device (RTD) or thermistor for direct sensing of pipe wall temperature.
   4. Control Enclosure: Corrosion resistant and waterproof.

B. Provide minimum 30 ampere contactor to indicate operational status and on/off control.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that piping and equipment are ready to receive work.

B. Verify field measurements are as shown on shop drawings.

C. Verify required power is available, in proper location, and ready for use.

3.02 PREPARATION

A. Clean all surfaces prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer.

3.03 INSTALLATION

A. Install in accordance with manufacturer's recommendations.

B. Comply with installation requirements of IEEE 515.1 and NFPA 70, Article 427.

C. Apply heating cable linearly on pipe with fiberglass tape only after piping has successfully completed any required pressure testing.

D. Comply with all national and local code requirements.

E. Grounding: Refer to Section 26 05 26.

F. Identification:

NOT FOR BIDDING

1. After thermal insulation installation, apply external pipeline decals to indicate presence of the thermal insulation cladding at intervals not to exceed 20 ft including cladding over each valve or other equipment that may require maintenance.

3.04 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Perform start-up by factory technician or factory representative as per Owner's requirements.

C. Field Testing and Inspections:
   1. Commission system in accordance with installation and operation manual.
   2. Inspect for sources of water entry and proper sealing.
   3. Inspect weather barrier to confirm that no sharp edges are contacting the trace heating.
   4. Minimum Acceptable Insulation Resistance: 20 megohms or greater at a test voltage of 2500 VDC for polymer insulated trace heaters.
   5. Test heating cable integrity with megohmmeter at the following intervals:
      a. Before installing the cable.
      b. After cable has been installed onto the piping.
      c. After installing the connection kits.
      d. After the installation of thermal insulation onto the piping.
      e. Prior to initial start-up (commissioning).
   6. Measure voltage and current at each unit.
   7. Controls:
      a. Verify control parameters are set to the application requirements.
      b. Verify factory provided digital temperature controller is correctly configured with the building automation system.

3.05 CLOSEOUT ACTIVITIES

A. See Section 01 78 00 - Closeout Submittals.

B. Demonstrate operation of controls.

3.06 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

NOT FOR BIDDING

SECTION 23 05 53
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Pipe Markers.

1.02 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.03 SUBMITTALS

A. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.

B. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

C. Product Data: Provide manufacturers catalog literature for each product required.

D. Samples: Submit two labels or tags 1/2 x 4 inch in size.

E. Manufacturer's Installation Instructions: Indicate special procedures, and installation.

F. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

A. Cooling Towers: Nameplates.

B. Major Control Components: Nameplates.

C. Piping: Pipe markers.

D. Valves: Tags.

2.02 MANUFACTURERS

A. Brady Corporation: www.bradycorp.com.

B. Champion America, Inc: www.Champion-America.com.

C. Seton Identification Products: www.seton.com/aec.

D. Substitutions: See Setion 01 60 00 - Product Requirements.

2.03 NAMEPLATES

A. Description: Laminated three-layer plastic with engraved letters.
   1. Letter Color: White.
   2. Letter Height: 1/4 inch.
   3. Background Color: Black.

2.04 TAGS

A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.

B. Metal Tags: Aluminum with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

C. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

NOT FOR BIDDING

2.05 PIPE MARKERS

A. Color: Conform to ASME A13.1.

B. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

D. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Verify identification colors and designations with owner prior to application.

C. Install tags with corrosion resistant chain.

D. Install plastic pipe markers in accordance with manufacturer's instructions.

E. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

F. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

G. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.

H. Identify control panels and major control components outside panels with plastic nameplates.

I. Identify thermostats relating to terminal boxes or valves with nameplates.

J. Identify valves in main and branch piping with tags.

K. Identify air terminal units and radiator valves with numbered tags.

L. Tag automatic controls, instruments, and relays. Key to control schematic.

M. Identify piping, concealed or exposed, with plastic pipe markers, plastic tape pipe markers or stencilled painting. Use tags on piping 3/4 inch diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

N. Identify ductwork with plastic nameplates or stencilled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

O. Locate ceiling tacks to locate valves, units, or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

NOT FOR BIDDING

SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Testing, adjustment, and balancing of hydronic systems.

1.02 REFERENCE STANDARDS

A. AABC MN-1 - AABC National Standards for Total System Balance; Associated Air Balance Council; 2002.

B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems.

C. NEBB (TAB) - Procedural Standards for Testing Adjusting Balancing of Environmental Systems.

D. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing.

1.03 SUBMITTALS

A. Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract.

B. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
   1. Submit to Architect.
   2. Submit to the Commissioning Authority, Construction Manager, and HVAC controls contractor.
   3. Submit six weeks prior to starting the testing, adjusting, and balancing work.
   4. Include certification that the plan developer has reviewed the contract documents, the equipment and systems, and the control system with the Architect and other installers to sufficiently understand the design intent for each system.
   5. Include at least the following in the plan:
      a. Preface: An explanation of the intended use of the control system.
      b. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
      c. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
      d. Identification and types of measurement instruments to be used and their most recent calibration date.
      e. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
      f. Final test report forms to be used.
      g. Detailed step-by-step procedures for TAB work for each system and issue, including:
         1) Terminal flow calibration (for each terminal type).
         2) Diffuser proportioning.
         3) Branch/submain proportioning.
         4) Total flow calculations.
         5) Rechecking.
         6) Diversity issues.
      h. Expected problems and solutions, etc.

NOT FOR BIDDING

i. Criteria for using air flow straighteners or relocating flow stations and sensors .
j. Details of how TOTAL flow will be determined; for example:
   1) Air: Sum of terminal flows via control system calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations.
   2) Water: Pump curves, circuit setter, flow station, ultrasonic, etc.
k. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and methods to verify this.
l. Confirmation of understanding of the outside air ventilation criteria under all conditions.
m. Method of verifying and setting minimum outside air flow rate will be verified and set and for what level (total building, zone, etc.).
n. Method of checking building static and exhaust fan and/or relief damper capacity.
o. Proposed selection points for sound measurements and sound measurement methods.
p. Methods for making coil or other system plant capacity measurements, if specified.
q. Time schedule for TAB work to be done in phases (by floor, etc.).
r. Description of TAB work for areas to be built out later, if any.
s. Time schedule for deferred or seasonal TAB work, if specified.
t. False loading of systems to complete TAB work, if specified.
u. Exhaust fan balancing and capacity verifications, including any required room pressure differentials.
v. Interstitial cavity differential pressure measurements and calculations, if specified.
w. Procedures for field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).
x. Procedures for formal progress reports, including scope and frequency.
y. Procedures for formal deficiency reports, including scope, frequency and distribution.

C. Field Logs: Submit at least once a week to Commissioning Authority and Construction Manager.

D. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.

E. Progress Reports.

F. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
   1. Submit to the Commissioning Authority, Construction Manager, and HVAC controls contractor within two weeks after completion of testing, adjusting, and balancing.
   2. Revise TAB plan to reflect actual procedures and submit as part of final report.
   3. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.
   4. Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
   5. Include actual instrument list, with manufacturer name, serial number, and date of calibration.

NOT FOR BIDDING

6. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
7. Units of Measure: Report data in I-P (inch-pound) units only.
8. Include the following on the title page of each report:
    a. Name of Testing, Adjusting, and Balancing Agency.
    b. Address of Testing, Adjusting, and Balancing Agency.
    c. Telephone number of Testing, Adjusting, and Balancing Agency.
    d. Project name.
    e. Project location.
    f. Project Architect.
    g. Project Engineer.
    h. Project Contractor.
    i. Project altitude.
    j. Report date.

G. Project Record Documents: Record actual locations of flow measuring stations and balancing valves and rough setting.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. Perform total system balance in accordance with one of the following:
1. AABC MN-1, AABC National Standards for Total System Balance.
2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
3. NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems.
4. SMACNA HVAC Systems Testing, Adjusting, and Balancing.
5. Maintain at least one copy of the standard to be used at project site at all times.

B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.

C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.

D. TAB Agency Qualifications:
1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
2. Having minimum of three years documented experience.
3. Certified by one of the following:
    a. AABC, Associated Air Balance Council: www.aabchq.com; upon completion submit AABC National Performance Guaranty.
    b. NEBB, National Environmental Balancing Bureau: www.nebb.org/#sle.
    c. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: www.tabbcertified.org/#sle.

E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

F. TAB Supervisor Qualifications: Professional Engineer licensed in the State in which the Project is located.

NOT FOR BIDDING

3.02 EXAMINATION

A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
   1. Systems are started and operating in a safe and normal condition.
   2. Temperature control systems are installed complete and operable.
   3. Proper thermal overload protection is in place for electrical equipment.
   4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
   5. Duct systems are clean of debris.
   6. Fans are rotating correctly.
   7. Fire and volume dampers are in place and open.
   8. Air coil fins are cleaned and combed.
   9. Access doors are closed and duct end caps are in place.
   10. Air outlets are installed and connected.
   11. Duct system leakage is minimized.
   12. Hydronic systems are flushed, filled, and vented.
   13. Pumps are rotating correctly.
   14. Proper strainer baskets are clean and in place.
   15. Service and balance valves are open.

B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.

C. Beginning of work means acceptance of existing conditions.

3.03 PREPARATION

A. Hold a pre-balancing meeting at least one week prior to starting TAB work.
   1. Require attendance by all installers whose work will be tested, adjusted, or balanced.

B. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect to facilitate spot checks during testing.

C. Provide additional balancing devices as required.

3.04 ADJUSTMENT TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 10 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.

B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 10 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.05 RECORDING AND ADJUSTING

A. Field Logs: Maintain written logs including:
   1. Running log of events and issues.
   2. Discrepancies, deficient or uncompleted work by others.
   3. Contract interpretation requests.
   4. Lists of completed tests.

B. Ensure recorded data represents actual measured or observed conditions.

C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

NOT FOR BIDDING

D. Mark on drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.

E. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

G. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.

H. Check and adjust systems approximately six months after final acceptance and submit report.

3.06 WATER SYSTEM PROCEDURE

A. Adjust water systems to provide required or design quantities.

B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.

C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

D. Effect system balance with automatic control valves fully open to heat transfer elements.

E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

F. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

3.07 SCOPE

A. Test, adjust, and balance the following:
   1. Existing HVAC Pumps/Hydronic Systems
   2. Cooling Towers

3.08 MINIMUM DATA TO BE REPORTED

A. Electric Motors:
   1. Manufacturer
   2. Model/Frame
   3. HP/BHP
   4. Phase, voltage, amperage; nameplate, actual, no load
   5. RPM
   6. Service factor
   7. Starter size, rating, heater elements
   8. Sheave Make/Size/Bore

B. V-Belt Drives:
   1. Identification/location
   2. Required driven RPM
   3. Driven sheave, diameter and RPM
   4. Belt, size and quantity
   5. Motor sheave diameter and RPM
   6. Center to center distance, maximum, minimum, and actual

C. Pumps:

NOT FOR BIDDING

1. Identification/number
2. Manufacturer
3. Size/model
4. Impeller
5. Service
6. Design flow rate, pressure drop, BHP
7. Actual flow rate, pressure drop, BHP
8. Discharge pressure
9. Suction pressure
10. Total operating head pressure
11. Shut off, discharge and suction pressures
12. Shut off, total head pressure

D. Cooling Tower:
1. Tower identification/number
2. Manufacturer
3. Model number
4. Serial number
5. Rated capacity
6. Entering air WB temperature, specified and actual
7. Leaving air WB temperature, specified and actual
8. Ambient air DB temperature
9. Condenser water entering temperature
10. Condenser water leaving temperature
11. Condenser water flow rate
12. Fan RPM

END OF SECTION

NOT FOR BIDDING

SECTION 23 07 19
HVAC PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Piping insulation.

B. Jackets and accessories.

1.02 RELATED REQUIREMENTS

A. Section 23 21 13 - Hydronic Piping: Placement of hangers and hanger inserts.

1.03 REFERENCE STANDARDS

A. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

B. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

C. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric].

D. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.

E. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.

F. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.

G. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

H. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.

I. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

J. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.

K. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation.

L. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.

M. ASTM C585 - Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing.

N. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.

O. ASTM C610 - Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation.

P. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

Q. ASTM D1056 - Standard Specification for Flexible Cellular Materials--Sponge or Expanded Rubber.

R. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics.

S. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

T. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.

NOT FOR BIDDING

U. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association; 2006.

V. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

1.04 SUBMITTALS

A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

B. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum three years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.07 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION

A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, NFPA 255, UL 723, ASTM E84, NFPA 255, UL 723, ASTM E84, NFPA 255, or UL 723.

2.02 GLASS FIBER

A. Manufacturers:
1. Knauf Insulation: www.knaufusa.com.
2. Johns Manville Corporation: www.jm.com.
3. Owens Corning Corp: www.owenscorning.com.
4. CertainTeed Corporation: www.certainteed.com.
5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
1. 'K' value: ASTM C177, 0.24 at 75 degrees F.
2. Maximum service temperature: 850 degrees F.
3. Maximum moisture absorption: 0.2 percent by volume.

C. Insulation: ASTM C547 and ASTM C795; semi-rigid, noncombustible, end grain adhered to jacket.
1. 'K' value: ASTM C177, 0.24 at 75 degrees F.
2. Maximum service temperature: 650 degrees F.
3. Maximum moisture absorption: 0.2 percent by volume.

D. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.

NOT FOR BIDDING

E. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

F. Vapor Barrier Lap Adhesive:
   1. Compatible with insulation.

G. Insulating Cement/Mastic:
   1. ASTM C195; hydraulic setting on mineral wool.

H. Fibrous Glass Fabric:
   1. Cloth: Untreated; 9 oz/sq yd weight.
   2. Blanket: 1.0 lb/cu ft density.
   3. Weave: 5x5.

I. Indoor Vapor Barrier Finish:
   1. Cloth: Untreated; 9 oz/sq yd weight.
   2. Vinyl emulsion type acrylic, compatible with insulation, black color.

J. Outdoor Vapor Barrier Mastic:
   1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

K. Outdoor Breather Mastic:
   1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

L. Insulating Cement:
   1. ASTM C449/C449M.

2.03 CELLULAR GLASS

A. Manufacturers:
   1. Owens Corning Corp: www.owenscorning.com.
   2. CertainTeed Corporation: www.certainteed.com.
   3. Pittsburgh Corning Corporation: www.foamglasinsulation.com/#sle.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Insulation: ASTM C552, Grade 1.
   1. 'K' value: 0.37 at 100 degrees F.
   2. Service Temperature: Up to 900 degrees F.
   3. Water Vapor Permeability: 0.005 perm inch.
   4. Water Absorption: 0.2 percent by volume, maximum.

2.04 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturer:
   1. Aeroflex USA, Inc; Aerocel Stay-Seal with Protape (SSPT): www.aeroflexusa.com/#sle.
   2. Armacell International: www.armacell.com/#sle.
   3. K-Flex USA LLC; K-Flex Titan: www.kflexusa.com/#sle.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534 Grade 3; use molded tubular material wherever possible.
   1. Minimum Service Temperature: -40 degrees F.
   2. Maximum Service Temperature: 220 degrees F.
   3. Connection: Waterproof vapor barrier adhesive.

C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.05 JACKETS

A. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.
   1. Thickness: 0.016 inch sheet.

NOT FOR BIDDING

2. Finish: Smooth.
3. Joining: Longitudinal slip joints and 2 inch laps.
4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
5. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Exposed Piping: Locate insulation and cover seams in least visible locations.

D. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

E. Glass fiber insulated pipes conveying fluids below ambient temperature:
1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

F. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

G. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.

H. Glass fiber insulated pipes conveying fluids above ambient temperature:
1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

I. Inserts and Shields:
1. Application: Piping 1-1/2 inches diameter or larger.
2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
3. Insert location: Between support shield and piping and under the finish jacket.
4. Insert configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
5. Insert material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

J. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 07 84 00.

K. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of

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horizontal piping. Provide two coats of UV resistant finish for flexible elastomeric cellular insulation without jacketing.

L. Buried Piping: Provide factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.

M. Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.03 SCHEDULE

A. PIPING INSULATION SCHEDULES
   1. General: Abbreviations used in the following schedules include:
      a. Field Applied Jackets: P - PVC, K-Foil and Paper, A - Aluminum, SS - Stainless Steel.
      b. Piping Sizes: NPS - Nominal Pipe Size.

B. INTERIOR PIPING APPLICATION SCHEDULE
   1. Service: Makeup water piping
      a. Operating Temperature: 35 to 95 deg F.
      b. Insulation Material: Flexible elastomeric.
      c. Insulation Thickness: 0.5 inch.
      d. Jacket: PVC.
      e. Vapor Retarder Required: Yes.
      f. Finish: None.

C. EXTERIOR PIPING INSULATION APPLICATION SCHEDULE

D. Service: Condenser-water supply and return piping.
   1. Operating Temperature: 50 to 95 deg F.
   2. Insulation Material: Cellular glass, with jacket.
   3. Insulation Thickness: Apply the following insulation thicknesses:
      a. Pipe, Up to 4”: 2.0 inch.
      b. Pipe, 5” to 10”: 2.5 inch.
      c. Pipe 10” and up: 3 inch.
   4. Field-Applied Jacket: Aluminum
   5. Vapor Retarder Required: No.
   6. Finish: None.

E. Service: Makeup water piping.
   1. Operating Temperature: 35 to 95 deg. F.
   2. Insulation Material: Mineral fiber or cellular glass, with jacket.
   3. Insulation Thickness: Apply the following insulation thicknesses:
      a. Pipe, Any pipe size: 2.0 inch.
   4. Field-Applied Jacket: Aluminum.
   5. Vapor Retarder Required: No.
   6. Finish: None.

F. Service: Chemical treatment piping.
   1. Operating Temperature: 35 to 95 deg. F.
   2. Insulation Material: Mineral fiber or cellular glass, with jacket.
   3. Insulation Thickness: Apply the following insulation thicknesses:

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a. Pipe, Any pipe size: 2.0 inch.

4. Field-Applied Jacket: Aluminum.
5. Vapor Retarder Required: No.
6. Finish: None.

G. Service: Equipment drains and overflow piping.
1. Operating Temperature: 35 to 95 deg. F.
2. Insulation Material: Mineral fiber or cellular glass, with jacket.
3. Insulation Thickness: Apply the following insulation thicknesses:
a. Pipe, Any pipe size: 2.0 inch.
4. Field-Applied Jacket: Aluminum.
5. Vapor Retarder Required: No.
6. Finish: None.

END OF SECTION

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SECTION 23 09 50
BUILDING AUTOMATION SYSTEM (BAS) GENERAL

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. General Requirements
B. Description of Work
C. Quality Assurance
D. System Architecture
E. Distributed Processing Units/Quantity and Location
F. Demolition and Reuse of Existing Materials and Equipment
G. Sequence of Work

1.02 RELATED DOCUMENTS

A. Section 23 09 51 - Building Automation System (BAS) Basic Materials, Interface Devices, and Sensors
B. Section 23 09 53 - BAS Field Panels
C. Section 23 09 54 - BAS Communication Devices
D. Section 23 09 55 - BAS Software and Programming
E. Section 23 09 58 - Sequence of Operation

1.03 DESCRIPTION OF WORK

A. **Modifications to the existing Building Automation System (BAS) are to be performed by the existing BAS vendor -- Automated Logic by Radius Systems. The existing BAS vendor shall be retained, at contractor's expense, to remove and reinstall existing HVAC controls components and reinstall with modifications required to facilitate the HVAC controls scope described in the documents.**
B. The building automation system (BAS) defined in this specification shall interface with the Owner's Network, and shall utilize the BACnet communication requirements as defined by ASHRAE/ANSI 135 (current version and addendum) for all communication.
C. Contractor shall modify the existing building automation system (BAS). The BAS shall utilize electronic sensing, microprocessor-based digital control, and electronic actuation of dampers and valves to perform control sequences and functions specified. The BAS for this project will generally consist of monitoring and control of systems listed below. Reference also control drawings, sequences of operation, and points lists.

1.04 APPLICATION OF OPEN PROTOCOLS

A. Subject to the detailed requirements provided throughout the specifications, the BAS and digital control and communications components installed, as work of this contract shall be an integrated distributed processing system utilizing BACnet. System components shall communicate using true BacNET in accordance with ASHRAE Standard 135 and current addenda and annexes, including all workstations, all building controllers, and all application specific controllers. Gateways to other communication protocols are not acceptable

1.05 QUALITY ASSURANCE

A. Product Line Demonstrated History: The product line being proposed for the project must have an installed history of demonstrated satisfactory operation for a length of 2 years since date of

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final completion in at least 10 installations of comparative size and complexity. Submittals shall document this requirement with references. The following requirement relates to the actual installing contractor.

B. Installer's Qualifications: Firms specializing and experienced in control system installations for not less than 5 years. Firms with experience in BAS installation projects with point counts equal to this project and systems of the same character as this project. If installer is a Value Added Reseller (VAR) of a manufacturer's product, installer must demonstrate at least three years prior experience with that manufacturer's products. Experience starts with awarded Final Completion of previous projects. Submittals must document this experience with references.

C. Installer's Experience with Proposed Product Line: Firms shall have specialized in and be experienced with the installation of the proposed product line for not less than one year from date of final completion on at least 3 projects of similar size and complexity. Submittals shall document this experience with references.

D. Installer's Field Coordinator and Sequence Programmer Qualifications: Individual(s) shall specialize in and be experienced with control system installation for not less than 5 years. Proposed field coordinator shall have experience with the installation of the proposed product line for not less than 2 projects of similar size and complexity. Installer shall submit the names of the proposed individual and at least one alternate for each duty. Submittals shall document this experience with references. The proposed individuals must show proof of the following training:
   1. Product Line Training: Individuals overseeing the installation and configuration of the proposed product line must provide evidence of the most advanced training offered by the Manufacturer on that product line for installation and configuration
   2. Programming Training: Individuals involved with programming the site-specific sequences shall provide evidence of the most advanced programming training offered by the vendor of the programming application offered by the Manufacturer.

E. Installer's Service Qualifications: The installer must be experienced in control system operation, maintenance and service. Installer must document a minimum 5 year history of servicing installations of similar size and complexity. Installer must also document at least a one year history of servicing the proposed product line.

F. Installer's Response Time and Proximity
   1. Installer must maintain a fully capable service facility within a 45 mile radius of the project site. Service facility shall manage the emergency service dispatches and maintain the inventory of spare parts.
   2. Emergency response times are listed below in this section. Installer must demonstrate the ability to meet the response times.

1.06 CODES AND STANDARDS

A. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
   1. ASHRAE 135: BACnet - A Data Communication Protocol for Building Automation and Control Networks. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. current edition including all related addenda shall apply.

B. Electronics Industries Alliance
   1. EIA-709.1-A-99: Control Network Protocol Specification
   2. EIA-709.3-99: Free-Topology Twisted-Pair Channel Specification
   3. EIA-232: Interface between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange.
   4. EIA-458: Standard Optical Fiber Material Classes and Preferred Sizes

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5. EIA-485: Standard for Electrical Characteristics of Generator and Receivers for use in Balanced Digital Multipoint Systems.
6. EIA-472: General and Sectional Specifications for Fiber Optic Cable
7. EIA-475: Generic and Sectional Specifications for Fiber Optic Connectors and all Sectional Specifications
8. EIA-573: Generic and Sectional Specifications for Field Portable Polishing Device for Preparation Optical Fiber and all Sectional Specifications
9. EIA-590: Standard for Physical Location and Protection of Below-Ground Fiber Optic Cable Plant and all Sectional Specifications

C. Underwriters Laboratories
1. UL 916: Energy Management Systems. The following rating is required only for devices used for smoke control purposes. If these are not intended, delete.
2. UUKL 864: UL Supervised Smoke Control

D. NEMA Compliance
1. NEMA 250: Enclosure for Electrical Equipment
2. NEMA ICS 1: General Standards for Industrial Controls.

E. NFPA Compliance
1. NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.
2. NFPA 70 National Electrical Code (NEC)

F. Institute of Electrical and Electronics Engineers (IEEE)
1. IEEE 142: Recommended Practice for Grounding of Industrial and Commercial Power Systems
2. IEEE 802.3: CSMA/CD (Ethernet - Based) LAN
3. IEEE 802.4: Token Bus Working Group (ARCNET - Based) LAN

1.07 DEFINITIONS

A. Advanced Application Controller (AAC): A device with limited resources relative to the Building Controller (BC). It may support a level of programming and may also be intended for application specific applications.

B. Application Protocol Data Unit (APDU): A unit of data specified in an application protocol and consisting of application protocol control information and possible application user data (ISO 9545).

C. Application Specific Controller (ASC): A device with limited resources relative to the Advanced Application Controller (AAC). It may support a level of programming and may also be intended for application-specific applications..

D. BACnet/BACnet Standard: BACnet communication requirements as defined by ASHRAE/ANSI 135 (Current edition and addendum).

E. BACnet Interoperability Building Blocks (BIBB): A BIBB defines a small portion of BACnet functionality that is needed to perform a particular task. BIBBS are combined to build the BACnet functional requirements for a device in a specification.

F. Binding: In the general sense, binding refers to the associations or mappings of the sources network variable and their intended opr required destinations.

G. Building Automation System (BAS): The entire integrated management and control system

H. Building Controller (BC): A fully programmable device capable of carrying out a number of tasks including control and monitoring via direct digital control (DDC) of specific systems, acting as a

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communications router between the controlled devices / equipment and the CSS, and temporary data storage for trend information, time schedules, and alarm data.

I. Change of Value (COV): An event that occurs when a measured or calculated analog value changes by a predefined amount (ASHRAE/ANSI 135 (current version and addendum)).

J. Client: A device that is the requestor of services from a server. A client device makes requests of and receives responses from a server device.

K. Continuous Monitoring: A sampling and recording of a variable based on time or change of state (e.g. trending an analog value, monitoring a binary change of state).

L. Controller or Control Unit (CU): Intelligent stand-alone control device. Controller is a generic reference and shall include BCs, AACs, and ASCs as appropriate.

M. Control Systems Server (CSS): A server class computer(s) that maintains the systems configuration and programming database. This server is located at the State of Delaware's data center in a virtual environment and serves as an access point to BAS.

N. Controlling LAN: High speed, peer-to-peer controller LAN connecting BCs, AACs and ASCs. Refer to System Architecture below.

O. Direct Digital Control (DDC): Microprocessor-based control including Analog/Digital conversion and program logic

P. Functional Profile: A collection of variables required to define a the key parameters for a standard application. As this applies to the HVAC industry, this would include applications like VAV terminal, fan coil units, and the like.

Q. Gateway (GTWY): A device, which contains two or more dissimilar networks/protocols, permitting information exchange between them.

R. Hand Held Device (HHD): Manufacturer's microprocessor based device for direct connection to a Controller.

S. LAN Interface Device (LANID): Device or function used to facilitate communication and sharing of data throughout the BAS

T. Local Area Network (LAN): General term for a network segment within the architecture. Various types and functions of LANs are defined herein.

U. Local Supervisory LAN: Also known as the State's Network: Ethernet-based network connecting Primary Controlling LANs with each other and OWSs and CSSs. See System Architecture below.

V. Master-Slave/Token Passing (MS/TP): Data link protocol as defined by the BACnet standard.

W. Open Database Connectivity (ODBC): An open standard application-programming interface (API) for accessing a database developed. ODBC compliant systems make it possible to access any data from any application, regardless of which database management system (DBMS) is handling the data.

X. Operator Interface (OI): A device used by the operator to manage the BAS including OWSs, POTs, and HHDs.

Y. Operator Workstation (OWS): The user's interface with the BAS system. As the BAS network devices are stand-alone, dedicated OWS is not required for communications to occur. The OWS can be any computer on the State's Network that has a compatible Web browser.

Z. Point-to-Point (PTP): Serial communication as defined in the BACnet standard.

AA. Portable Operators Terminal (POT): Mobile computer used both for direct connection to a controller as well as network connection.

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BB. Protocol Implementation Conformance Statement (PICS): A written document, created by the manufacturer of a device, which identifies the particular options specified by BACnet that are implemented in the device (ASHRAE/ANSI 135 (current version and addendum).

CC. Router: A device that connects two or more networks at the network layer.

DD. Secondary Controlling LAN: LAN connecting AACs and ASCs, generally lower speed and less reliable than the Controlling LAN. Refer to System Architecture below.

EE. Server: A device that is a provider of services to a client. A client device makes requests of and receives responses from a server device.

FF. Standardized Query Language (SQL): A database computer language designed for managing data in relational database management system (RDBMS). Its scope includes data insert, query, update and delete, schema creation and modification, and data access control.

GG. Smart Device: A control I/O device such as a sensor or actuator that can directly communicate with a controller through the network. This differs from an ASC in that it typically deals only with one variable.

HH. Extensible Markup Language (XML): A specification developed by the World Wide Web Consortium. XML is a pared-down version of SGML, designed especially for Web documents. It is a set of rules for encoding documents in machine-readable form that allows designers to create their own customized tags, enabling the definition, transmission, validation, and interpretation of data between applications and between organizations.

1.08 FUNCTIONAL INTENT

A. Throughout Sections 23 09 50 Building Automation System (BAS) General through 23 09 58 Sequence of Operation detailed requirements are specified, some of which indicate a means, method or configuration acceptable to meet that requirement. Contractor may submit products that utilize alternate means, methods, and configurations that meet the functional intent. However these will only be allowed with prior approval.

1.09 SUBMITTALS

A. Electronic Submittals: While all requirements for hard copy submittal apply, control submittals and O&M information shall also be provided in electronic format as follows.
   1. Drawings and Diagrams: Shop drawings shall be provided on electronic media as an AutoCAD (current version) and/or Adobe Portable Document Format file. All 'X reference' and font files must be provided with AutoCAD files.
   2. Other Submittals: All other submittals shall be provided in Adobe Portable Document Format (PDF).

B. Qualifications: Manufacturer, Installer, and Key personnel qualifications as indicated for the appropriate item above.

C. Product Data: Submit manufacturer's technical product data for each control device, panel, and accessory furnished, indicating dimensions, capacities, performance and electrical characteristics, and material finishes. Also include installation and start-up instructions.

D. Shop Drawings: Submit shop drawings for each control system, including a complete drawing for each air handling unit, system, pump, device, etc. with all point descriptors, addresses and point names indicated. Each shop drawing shall contain the following information:
   1. System Architecture and System Layout:
      a. One-line diagram indicating schematic locations of all control units, workstations, LAN interface devices, gateways, etc. Indicate network number, device ID,, instance number, MAC address, drawing reference number, and controller type for each control unit. Indicate media, protocol, baud rate, and type of each LAN. Indicate

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media, protocol, baud rate, and type of each LAN. All optical isolators, repeaters, end-of-line resistors, junctions, ground locations etc. shall be located on the diagram.

b. Provide electronic floor plans locating all control units, workstations, LAN interface devices, gateways, etc. Include all network communication wiring routing, power wiring, power originating sources, and low voltage power wiring. Indicate network number, device ID, instance number, MAC address, drawing reference number, and controller type for each control unit. Indicate media, protocol, baud rate, and type of each LAN. All optical isolators, repeaters, end-of-line resistors, junctions, ground locations etc. shall be located on the floor plans. Wiring routing as-built conditions shall be maintained accurately throughout the construction period and the drawing shall be updated to accurately reflect accurate, actual installed conditions.

2. Schematic flow diagram of each air and water system showing fans, coils, dampers, valves, pumps, heat exchange equipment and control devices. Include verbal description of sequence of operation.
3. All physical points on the schematic flow diagram shall be indicated with names, descriptors, and point addresses identified as listed in the point summary table.
4. With each schematic, provide a point summary table listing building number and abbreviation, system type, equipment type, full point name, point description, Ethernet backbone network number, network number, device ID, object ID (object type, instance number). See Section 23 09 55 - Part III for additional requirements.
5. Label each control device with setting or adjustable range of control.
6. Label each input and output with the appropriate range.
7. Provide a Bill of Materials with each schematic. Indicate device identification to match schematic and actual field labeling, quantity, actual product ordering number, manufacturer, description, size, voltage range, pressure range, temperature range, etc. as applicable.
8. With each schematic, provide valve and actuator information including size, Cv, design flow, design pressure drop, manufacturer, model number, close off rating, etc. Indicate normal positions of spring return valves and dampers.
9. Indicate all required electrical wiring. Electrical wiring diagrams shall include both ladder logic type diagram for motor starter, control, and safety circuits and detailed digital interface panel point termination diagrams with all wire numbers and terminal block numbers identified. Provide panel termination drawings on separate drawings. Ladder diagrams shall appear on system schematic. Clearly differentiate between portions of wiring, which are existing, factory-installed and portions to be field-installed.
10. Details of control panels, including controls, instruments, and labeling shown in plan or elevation indicating the installed locations.
11. Sheets shall be consecutively numbered.
12. Each sheet shall have a title indicating the type of information included and the HVAC system controlled.
13. Table of Contents listing sheet titles and sheet numbers.
14. Legend and list of abbreviations.
15. Memory allocation projections.
16. Submit along with shop drawings but under separate cover calculated and guaranteed system response times of the most heavily loaded LAN in the system.

E. Open Protocol Information

1. BACnet Systems:
   a. BACnet object description, object ID, and device ID, for each I/O point.

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b. Documentation for any non-standard BACnet objects, properties, or enumerations used detailing their structure, data types, and any associated lists of enumerated values.
c. Submit PICS indicating the BACnet functionality and configuration of each controller.

F. Framed Control Drawings: Laminated control drawings including system control schematics, sequences of operation and panel termination drawings, shall be provided in panels for major pieces of equipment. Terminal unit drawings shall be located in the central plant equipment panel or mechanical room panel.

G. Control Logic Documentation
1. Submit control logic program listings (for graphical programming) and logic flow charts (for line type programs) to document the control software of all control units.
2. Control logic shall be annotated to describe how it accomplishes the sequence of operation. Annotations shall be sufficient to allow an operator to relate each program component (block or line) to corresponding portions of the specified Sequence of Operation.
3. Include written description of each control sequence.
4. Include control response, settings, setpoints, throttling ranges, gains, reset schedules, adjustable parameters and limits.
5. Sheets shall be consecutively numbered.
6. Each sheet shall have a title indicating the controller designations and the HVAC system controlled.
7. Include Table of Contents listing sheet titles and sheet numbers
8. Submit one complete set of programming and operating manuals for all digital controllers concurrently with control logic documentation. This set will count toward the required number of Operation and Maintenance materials specified below and in Section 01 30 00 Administrative Requirements.

H. Operation and Maintenance Materials:
1. Submit documents under provisions of Section 01 03 00 Administrative Requirements. One copy of the materials shall be delivered directly to the State facilities operation staff, in addition to the copies required by other Sections.
2. Submit maintenance instructions and spare parts lists for each type of control device, control unit, and accessory.
3. Submit BAS User's Guides (Operating Manuals) for each controller type.
4. Submit BAS advanced Programming Manuals for each controller type.
5. Include all submittals (product data, shop drawings, control logic documentation, hardware manuals, software manuals, installation guides or manuals, maintenance instructions and spare parts lists) in maintenance manual; in accordance with requirements of Division 1.

I. Controls contractor shall provide the State with all product line technical manuals and technical bulletins, to include new and upgraded products, by the same distribution channel as to dealers or branches. This service will be provided for 5 years as part of the contract price, and will be offered to the State thereafter for the same price as to a dealer or branch.

J. Manufacturers Certificates: For all listed and/or labeled products, provide certificate of conformance.

K. Product Warranty Certificates: submit manufacturers product warranty certificates covering the hardware provided.

1.10 PROJECT RECORD DOCUMENTS

A. Submit documents under provisions of Section 01 30 00 Adminsitrative Requirements.

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B. Record copies of product data and control shop drawings updated to reflect the final installed condition.

C. Record copies of approved control logic programming and database on paper and on CD's. Accurately record actual setpoints and settings of controls, final sequence of operation, including changes to programs made after submission and approval of shop drawings and including changes to programs made during specified testing.

D. Record copies of approved project specific graphic software on CDs.

E. Record copies shall include individual floor plans with controller locations with all interconnecting wiring routing including space sensors, LAN wiring, power wiring, low voltage power wiring. Indicate device instance, MAC address and drawing reference number.

F. Provide record riser diagram showing the location of all controllers.

G. Maintain project record documents throughout the warranty period and submit final documents at the end of the warranty period

1.11 SYSTEM ARCHITECTURE

A. The system provided shall incorporate hardware resources sufficient to meet the functional requirements of these Specifications. The Contractor shall include all items not specifically itemized in these Specifications that are necessary to implement, maintain, and operate the system in compliance with the functional intent of these Specifications.

B. **All data points are to be mapped to the State of Delaware OMB / Division of Facilities Management State-Wide Building Control System (BAS).** The system shall be configured as a distributed processing network(s) capable of expansion as specified below.

C. The system architecture shall consist of the Ethernet-based State Network, and Controlling LANs that support BCs, AACs, ASCs, Smart Devices (SD), and Remote Communication Devices (RCDs) as applicable. The following indicates a functional description of the BAS structure.

1. State Network: Internet-based network connecting multiple facilities with a central data and application server, accessible via standard web-browser. This is an existing infrastructure and contractor is not required to configure any components of this network. Refer to Section 23 09 54 for requirements. This contractor shall integrate the controlling devices and the CCS together.
2. Local Supervisory LAN: The Local Supervisory LAN shall be an Ethernet-based, 100 Mbps LAN connecting Primary Control LANs and OWSs. The LAN serves as the inter-BC gateway and OWS-to-BC gateway and communications path. Contractor shall provide this as a dedicated LAN for the control system. LAN shall be IEEE 802.3 Ethernet over Fiber or Category 5 cable with switches and routers that support 100 Mbps throughput. Power-line carrier communication shall not be acceptable for communications. The physical media will be that installed for the IT infrastructure of the facility and as such network drops will be provided under that scope of work to facilitate work of this scope. This network will be 100 Mbps and therefore all network interface cards shall support that speed. The higher level layers of this network shall be BACnet as described below:
    a. BACnet Supervisory LAN: Shall be BACnet/IP as defined in the BACnet standard, and shall share a common network number for the Ethernet backbone, as defined in the BACnet standard. Point/Object naming conventions are specified in 23 09 55 - Part III.
3. Controlling LAN: High-speed, peer-to-peer communicating LAN used to connect AACs, ASCs and Building Controllers (BCs) and communicate exclusively control information. Acceptable technologies include:
    a. Ethernet (IEEE802.3)

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b. ARCNET (IEEE802.4)
c. Communication to/from building controller (BC) and the control system server (CSS) shall utilize standard TCP/IP, BACnet/IP ports (80and/or 47808)

4. Secondary Controlling LAN: Network used to connect AACs, ASCs or SDs. These can be Master Slave/ Token Passing or polling, in addition to those allowed for Primary Controller LANs. Network speed vs. the number of controllers on the LAN shall be dictated by the response time and trending requirements.

D. Dynamic Data Access: Any data throughout any level of the network shall be available to and accessible by all other devices, Controllers and OWS, whether directly connected or connected remotely.

E. Remote Data Access: The system shall support the following methods of remote access to the building data.
1. Browser-based access: A remote user using a standard browser shall be able to access all control system facilities and graphics with proper authentication. The State shall maintain continuous network connection. The following paradigms are acceptable for browser-based access:
a. Native Internet-based user interface (HTML, Java, XML, etc.) via a standard freely distributed web browser that does not require a Windows client software installation.

F. The communication speed between the controllers, LAN interface devices, and operator interface devices shall be sufficient to ensure fast system response time under any loading condition. Contractor shall submit guaranteed response times with shop drawings including calculations to support the guarantee. In no case shall delay times between an event, request, or command initiation and its completion be greater than those listed herein. Contractor shall recommend reconfiguring the LAN as necessary to accomplish these performance requirements.:
1. 5 seconds between a Level 1 (critical) alarm occurrence and enunciation at operator workstation.
2. 10 seconds between a Level 2 alarm occurrence and enunciation at operator workstation.
3. 20 seconds between and a Level 3-5 alarm occurrence and enunciation at operator workstation.
4. 10 seconds between an operator command via the operator interface to change a setpoint and the subsequent change in the controller.
5. 5 seconds between an operator command via the operator interface to start/stop a device and the subsequent command to be received at the controller.
6. 10 seconds between a change of value or state of an input and it being updated on the operator interface.
7. 10 seconds between an operator selection of a graphic and it completely painting the screen and updating at least 10 points.

G. Control Systems Server (CSS): A server class computer(s) that maintains the systems configuration and programming database. This server is located at the State of Delaware's data center in a virtual environment and serves as an access point to BAS. It shall hold the backup files of the information downloaded into the individual controllers and as such support uploading and downloading that information directly to/from the controllers. It shall also act as a control information server to non-control system based programs. It shall allow secure multiple-access to the control information.

H. The BCs, AACs, ASCs, [and SDs] shall monitor, control, and provide the field interface for all points specified. Each BC, AAC, or ASC shall be capable of performing all specified energy management functions, and all DDC functions, independent of other BCs, AACs, or ASCs and operator interface devices as more fully specified in Section 23 09 53 - BAS Field Panels.

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I. Systems Configuration Database: The system architecture shall support maintaining the systems configuration database on the CSS. User tools provided to the State shall allow configuring, updating, maintaining, etc. current configurations and settings whether they are initiated at the server or the end device.
   1. Database Schema shall be published and provided to the State to facilitate easy access to the data.
   2. Database shall be ODBC compliant.

J. Interruptions or fault at any point on any Primary Controller LAN shall not interrupt communications between other nodes on the network. If a LAN is severed, two separate networks shall be formed and communications within each network shall continue uninterrupted.

K. All line drivers, signal boosters, and signal conditioners etc. shall be provided as necessary for proper data communication.

L. Anytime any controller's database or program is changed in the field, the controller shall be capable of automatically uploading the new data to the CSS.

1.12 WARRANTY MAINTENANCE

A. Contractor shall warrant all products and labor for a period of (2) two years after Substantial Completion.

B. The State reserves the right to make changes to the BAS during the warranty period. Such changes do not constitute a waiver of warranty. The Contractor shall warrant parts and installation work regardless of any such changes made by the State, unless the Contractor provides clear and convincing evidence that a specific problem is the result of such changes to the BAS.

C. At no cost to the State, during the warranty period, the Contractor shall provide maintenance services for software and hardware components as specified below:
   1. Maintenance services shall be provided for all devices and hardware specified in sections 23 09 51 through 23 09 59. Service all equipment per the manufacturer's recommendations. All devices shall be calibrated within the last month of the warranty period.
   2. Emergency Service: Any malfunction, failure, or defect in any hardware component or failure of any control programming that would result in property damage or loss of comfort control shall be corrected and repaired following notification by the State to the Contractor.
      a. Response by telephone to any request for service shall be provided within two (2) hours of the State's initial telephone request for service.
      b. In the event that the malfunction, failure, or defect is not corrected through the telephonic communication, at least one (1) hardware and software technician, trained in the system to be serviced, shall be dispatched to the State's site within eight (8) hours of the State's initial telephone request for such services, as specified.
   3. Normal Service: Any malfunction, failure, or defect in any hardware component or failure of any control programming that would not result in property damage or loss of comfort control shall be corrected and repaired following telephonic notification by the State to the Contractor.
      a. Response by telephone to any request for service shall be provided within eight (8) working hours (contractor specified 40 hr per week normal working period) of the State's initial telephone request for service.
      b. In the event that the malfunction, failure, or defect is not corrected through the telephonic communication, at least one (1) hardware and software technician, trained

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in the system to be serviced, shall be dispatched to the State's site within three (3) working days of the State's initial telephone request for such services, as specified.

4. Telephonic Request for Service: Contractor shall specify a maximum of three telephone numbers for The State to call in the event of a need for service. At least one of the lines shall be attended at any given time at all times. Alternatively, pagers can be used for technicians trained in system to be serviced. One of the three paged technicians shall respond to every call within 15 minutes.
5. Technical Support: Contractor shall provide technical support by telephone throughout the warranty period.
6. Preventive maintenance shall be provided throughout the warranty period in accordance with the hardware component manufacturer's requirements.

1.13 DELIVERY, STORAGE, AND HANDLING

A. Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons during shipping, storage and handling as required to prevent equipment damage, and to eliminate dirt and moisture from equipment. Store equipment and materials inside and protect from weather.

1.14 LISTING AND LABELING

A. The BAS and components shall be listed by Underwriters Laboratories (UL 916) as an Energy Management System.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Materials shall be new, the best of their respective kinds without imperfections or blemishes and shall not be damaged in any way. Used equipment shall not used in any way for the permanent installation except where drawings or specs specifically allow existing materials to remain in place.

2.02 UNIFORMITY

A. To the extent practical, all equipment of the same type serving the same function shall be identical and from the same manufacturer.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION OF CONTROL SYSTEMS

A. General: Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details shown on drawings.

B. Network Connectivity: The BAS contractor shall provide two network connections with Cat-6 cables from the Building Controller to the State's IT network.

1. The BAS contractor shall terminate one end of the two Cat-6 cables at or around the State's patch panel and make connections to the State's switch with green patch cables, following the instruction of the DFM's IT personnel.
2. The BAS contractor shall terminate the other end of the two Cat-6 cables near or within the building controller cabinet with dual RJ-45 terminal box and make connection of one cable to the building controller. Note: the second connection is for on-site operator interface through a mobile computer. Exposed cable shall be protected by conduit or wire mold.

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3. The BAS contractor shall label the two network connections BAC-1 and BAC-2 on both ends.

C. Refer to additional requirements in other sections of this specification.

3.03 SURGE PROTECTION

A. The Contractor shall furnish and install any power supply surge protection, filters, etc. as necessary for proper operation and protection of all BCs, AAC/ASCS operator interfaces, printers, routers, gateways and other hardware and interface devices. All equipment shall be capable of handling voltage variations 10% above or below measured nominal value, with no effect on hardware, software, communications, and data storage.

3.04 DEMOLITION AND REUSE OF EXISTING MATERIALS AND EQUIPMENT

A. Contractor shall assume that existing equipment that specifically is indicated to be reused is in good condition and is operable. Contractor, during the course of work, shall inspect these devices and determine if any devices are in need of replacement or repair. Contractor shall prepare an itemized list of suggested repairs/replacement. This repair/replacement will be at the discretion of the State and will be accomplished by expanding this contract.

B. Existing wire, conduit, and control panel cabinets may be reused at the State Project Engineer's discretion, but only if such materials or equipment comply with the applicable specification for new materials and equipment. Such materials shall not be reused if visibly damaged or otherwise unsuitable for the intended service.

C. Where such materials are reused, the contractor's shop drawings shall reflect the existing wiring designation. If existing labeling is illegible or otherwise does not comply with the applicable specification for labeling, wiring runs shall be relabeled in accordance with the requirements specified elsewhere.

D. Existing pneumatic tubing located between the existing BAS panels and the pneumatic operators shall not be reused; however, conduit for such tubing may be reused. All other pneumatic tubing may be reused, but only if such materials comply with the applicable specification for new materials. Materials shall not be reused if visibly damaged or otherwise unsuitable for the intended service. All pneumatic tubing to be reused shall be pressure tested and all leaks shall be repaired. All reused pneumatic tubing shall be purged with dry air or nitrogen.

E. The existing pneumatic main air supply system shall be modified as required and reused to serve existing pneumatic controls that are to remain, and shall be extended as necessary to serve new pneumatic controls. Where existing pneumatic controls are removed, main air piping shall be removed back to the point of connection to the main air supply which remains in use, and shall be capped or plugged.

F. Existing valves and dampers and their operators may be reused only when preapproved by the State. Contractor shall lubricate all damper linkages of dampers being controlled under this project.

G. Other materials and equipment not specifically mentioned herein may be reused only if specifically allowed by indications on the drawings.

H. For HVAC systems which are indicated to receive a new BAS, all existing materials and equipment associated with the existing pneumatic controls and EMCS shall be removed unless otherwise specified or indicated to remain, or unless reused in accordance with the above requirements, except for the following: 1) conduit and electrical boxes (but not wiring within conduit) may remain in place if not reused (leave a pull line); 2) inaccessible pneumatic tubing may remain in place if not reused. Existing materials and equipment to be removed shall be removed subject to the requirements in paragraph “Sequence of Work”. For HVAC systems,

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which are not to receive a new DDC BAS, the existing pneumatic control system shall remain fully functional.

3.05 CONTROL POWER SOURCE AND SUPPLY

A. Section 23 09 50 Building Automation System (BAS) Contractor shall extend all power source wiring required for operation of all equipment and devices provided under Sections 23 09 50 Building Automation Sytem (BAS) General through 23 09 58 Sequence of Operation. The following item will have to be customized for each system and project. The consideration is where to power controllers from. For distributed controllers that are associated with one unit, it is convenient to power them along with the system so the controller can take action based on the presence of power. However on large centralized panels, it may be best to put these on the most reliable source of power that serves the equipment being controlled and then provide for individual monitoring of the various system's power sources by the controller. The object here is to make a robust system that does not interpret power failures as device failure and therefore in some instances have to take down the unit for manual acknowledged reset. This can compromise reliability.

B. General requirements for obtaining power include the following:
   1. Obtain power from a source that feeds the equipment being controlled such that both the control component and the equipment are powered from the same panel. Where equipment is powered from a 460V source, obtain power from the electrically most proximate 120v source fed from a common origin.
   2. Where control equipment is located inside a new equipment enclosure, coordinate with the equipment manufacturer and feed the control with the same source as the equipment. If the equipment's control transformer is large enough and of the correct voltage to supply the controls it may be used. If the equipment's control transformer is not large enough or of the correct voltage to supply the controls provide separate transformer
   3. Where a controller controls multiple systems on varying levels of power reliability (normal, emergency, and/or interruptible), the controller shall be powered by the highest level of reliability served. Furthermore, the controller in that condition shall monitor each power type served to determine so logic can assess whether a failure is due to a power loss and respond appropriately. A three-phase monitor into a digital input shall suffice as power monitoring.
   4. Standalone Functionality: Refer to Section 23 09 53 BAS Field Panels.

3.06 SEQUENCE OF OPERATION

A. Refer to Section 23 09 58 - Sequence of Operation

END OF SECTION

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SECTION 23 09 51
BAS BASIC MATERIALS, INTERFACE DEVICES, AND SENSORS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Wiring
B. Control Valves and Actuators
C. Control Panels
D. Sensors
E. Flow Meter
F. Electric Control Components (Switches, EP Valves, Thermostats, Relays, Smoke Detectors, etc.)
G. Transducers
H. Current Switches
I. Nameplates
J. Testing Equipment

1.02 RELATED DOCUMENTS

A. Section 23 09 50 - Building Automation System (BAS) General
B. Section 23 09 53 - BAS Field Panels
C. Section 23 09 54 - BAS Communications Devices
D. Section 23 09 55 - BAS Software
E. Section 23 09 58 - Sequences of Operation

1.03 DESCRIPTION OF WORK

A. Refer to Section 23 09 50 Building Automation System (BAS) for general requirements.
B. Refer to other Division 23 sections for installation of instrument wells, valve bodies, and dampers in mechanical systems; not work of this section.
C. Provide the following electrical work of this section, complying with requirements of Division 26 sections:
    1. Control wiring between field-installed controls, indicating devices, and unit control panels.
    2. Interlock wiring between electrically interlocked devices, sensors, and between a hand or auto position of motor starters as indicated for all mechanical and controls.
    3. Wiring associated with indicating and alarm panels (remote alarm panels) and connections to their associated field devices.
    4. All other necessary wiring for fully complete and functional control system as specified.

1.04 WORK BY OTHERS

A. Control Valves furnished under this section shall be installed under the applicable piping section under the direction of Section 23 09 51 Basic Materials, Interfaces and SensorsContractor who will be fully responsible for the proper operation of the valve.
B. Control Dampers furnished under this section shall be installed under the applicable air distribution or air handling equipment section under the direction of Section 23 09 51 BAS

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Basic Materials, Interfaces and Sensors Contractor who will be fully responsible for the proper operation of the damper

C. Water Pressure Taps, Thermal Wells, Flow Switches, Flow Meters, etc. that will have wet surfaces, shall be installed under the applicable piping Section under the direction of Section 23 09 51 BAS Basic Materials, Interfaces and Sensors Contractor who will be fully responsible for the proper installation and application.

D. Controlled Equipment Power Wiring shall be furnished and installed under Division 26. Where control involves 120V control devices controlling 120V equipment, Division 26 Contractor shall extend power wiring to the equipment. Section 23 09 51 Basic Materials, Interfaces and Sensors Contractor shall extend it from the equipment to the control device.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. General: Provide electronic control products in sizes and capacities indicated, consisting of valves, dampers, thermostats, clocks, controllers, sensors, and other components as required for complete installation and reviewed and approved by the State. Except as otherwise indicated, provide manufacturer's standard materials and components as published in their product information; designed and constructed as recommended by manufacturer, and as required for application indicated.

B. Communication Wiring: All wiring shall be in accordance with National Electrical Codes and Division 26 of this specification.
   1. Contractor shall supply all communication wiring between Building Controllers, Routers, Gateways, AAC's, ASC's and local and remote peripherals (e.g., operator workstations, printers, and modems).
   2. Local Supervisory LAN: For any portions of this network required under this section of the specification, contractor shall use Fiber or Category 6 of standard TIA/EIA (100/1000BaseT). Network shall be run with no splices and separate from any wiring over thirty (30) volts.
   3. Primary and Secondary Controller LANs: Communication wiring shall be individually 100% shielded pairs per manufacturers recommendations for distances installed, with overall PVC cover, Class 2, plenum-rated run with no splices and separate from any wiring over thirty (30) volts. Shield shall be terminated and wiring shall be grounded as recommended by BC manufacturer.

C. Signal Wiring: Contractor shall run all signal wiring in accordance with National Electric Codes and Division 26 of this Specification.
   1. Signal wiring to all field devices, including, but not limited to, all sensors, transducers, transmitters, switches, etc. shall be twisted, 100% shielded pair, minimum 18-gauge wire, with PVC cover. Signal wiring shall be run with no splices and separate from any wiring above thirty (30) volts.
   2. Signal wiring shield shall be grounded at controller end only unless otherwise recommended by the controller manufacturer.

D. Low Voltage Analog Output Wiring: Contractor shall run all low voltage control wiring in accordance with National Electric Codes and Division 26 of this Specification.
   1. Low voltage control wiring shall be minimum 16-gauge, twisted pair, 100% shielded, with PVC cover, Class 2 plenum-rated. Low voltage control wiring shall be run with no splices separate from any wiring above thirty (30) volts.

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E. Control Panels: Provide control panels with suitable brackets for wall mounting for each control system. Locate panel adjacent to systems served.
   1. Fabricate panels of 16-gage furniture-grade steel, or 6063-T5 extruded aluminum alloy, totally enclosed on four sides, with hinged door and keyed lock, with manufacturer's standard shop- painted finish and color.
   2. Provide UL-listed cabinets for use with line voltage devices.
   3. Control panel shall be completely factory wired and piped, and all electrical connections made to a terminal strip. Control panel shall have standard manufacturer's color.
   4. All gauges and control components shall be identified by means of nameplates.
   5. All control tubing and wiring shall be run neatly and orderly in open slot wiring duct with cover.
   6. Complete wiring and tubing termination drawings shall be mounted in or adjacent to panel.

2.02 CONTROL VALVES

A. General: Provide factory fabricated 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. Control valves shall be equipped with heavy-duty actuators, and with proper close-off rating for each individual application. Minimum close-off rating shall be as scheduled and adequate for each application, and shall generally be considered at dead head rating of the pump.

B. Plug-Type Globe Pattern for Water Service:
   1. Valve Sizing: Where not specifically indicated on the control drawings, modulating valves shall be sized for maximum full flow pressure drop between 50% and 100% of the branch circuit it is controlling unless scheduled otherwise. Two-position valves shall be same size as connecting piping.
   2. Single Seated (Two-way) Valves: Valves shall have equal-percentage characteristic for typical heat exchanger service and linear characteristic for building loop connections to campus systems unless otherwise scheduled on the drawings. Valves shall have cage-type trim, providing seating and guiding surfaces for plug on 'top-and-bottom' guided plugs.
   3. Double Seated (Three-way) Valves: Valves shall have linear characteristic. Valves shall be balanced-plug type, with cage-type trim providing seating and guiding surfaces on 'top-and-bottom' guided plugs.
   4. Temperature Rating: 25°F minimum, 250°F maximum
   5. Body: Bronze, screwed, 250 psi maximum working pressure for 1/2” to 2”; Cast Iron, flanged, 125 psi maximum working pressure for 2-1/2” and larger.
   6. Valve Trim: Bronze; Stem: Polished stainless steel.
   7. Packing: Spring Loaded Teflon or Synthetic Elastomer U-cups, self-adjusting.
   8. Plug: Brass, bronze or stainless steel, Seat: Brass
   9. Disc: Replaceable Composition or Stainless Steel Filled PTFE.
   10. Ambient Operating Temperature Limits: -10 to 150°F (-12.2 to 66 °C)
   11. Acceptable Manufacturers: Subject to compliance with requirements approved manufacturers are as follows:
      a. Johnson Controls
      b. Invensys
      c. Warren
      d. Delta

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e. Belimo
f. Substitutions: See Section 01 60 00 - Product Requirements.

C. Butterfly Type:
1. Body: Extended neck epoxy coated cast or ductile iron with full lug pattern, ANSI Class 125 or 250 bolt pattern to match specified flanges.
2. Seat: EPDM, except in loop bypass applications where seat shall be metal to metal
3. Disc: Bronze or stainless steel, pinned or mechanically locked to shaft
4. Bearings: Bronze or stainless steel
5. Shaft: 416 stainless steel
6. Cold Service Pressure: 175 psi
7. Close Off: Bubble-tight shutoff to 150 psi
8. Operation: Valve and actuator operation shall be smooth both seating and unseating. Should more that 2 psi deadband be required to seat/unseat the valve, valve shall be replaced at no cost to the State.
9. Acceptable Manufacturers: Subject to compliance with requirements approved manufacturers are as follows:
a. Jamesbury WS815
b. Bray Series 31
c. Keystone AR2
d. Dezurik BGS
e. Belimo
f. Substitutions: See Section 01 60 00 - Product Requirements.

D. Ball Type
1. Body: Brass or bronze; one-, two-, or three-piece design; threaded ends.
2. Seat: Reinforced Teflon
3. Ball: Stainless steel.
4. Port: Standard or 'V' style.
5. Stem: Stainless steel, blow-out proof design, extended to match thickness of insulation.
6. Cold Service Pressure: 600 psi WOG
7. Steam working Pressure: 150 psi
8. Acceptable Manufacturers: Subject to compliance with requirements approved manufacturers are as follows:
a. Conbraco
b. Worcester
c. Nibco
d. Jamesbury
e. PBM
f. Delta
g. Belimo
h. Substitutions: See Section 01 60 00 - Product Requirements

E. Segmented or Characterized Ball Type
1. Body: Carbon Steel (ASTM 216), one-piece design with wafer style ends.
2. Seat: Reinforced Teflon (PTFE).
3. Ball: Stainless steel ASTM A351
4. Port: Segmented design with equal-percentage characteristic.
5. Stem: Stainless steel.
6. Cold Service Pressure: 200 psi WOG

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7. Cavitation Trim: Provide cavitation trim where indicated and/or required, designed to eliminate cavitation and noise while maintaining an equal percentage characteristic. Trim shall be a series of plates with orifices to break the pressure drop into multi-stages.
8. Acceptable Manufacturers: Subject to compliance with requirements approved manufacturers are as follows:
   a. Jamesbury R-Series
   b. Fisher
   c. Belimo
   d. Substitutions: See Section 01 60 00 - Product Requirements

2.03 CONTROL DAMPERS

A. General: Provide factory fabricated automatic control dampers of sizes, velocity and pressure classes as required for smooth, stable, and controllable air flow. Provide parallel or opposed blade dampers as recommended by manufacturers sizing techniques. For dampers located near fan outlets, provide dampers rated for fan outlet velocity and close-off pressure, and recommended by damper manufacturer for fan discharge damper service. Control dampers used for smoke dampers shall comply with UL 555S. Control Dampers used for fire dampers shall comply with UL 555.

B. For general isolation and modulating control service in rectangular ducts at velocities not greater than 1500 fpm (7.62 m/s), differential pressure not greater than 2.5” w.c. (622 Pa):
   1. Performance: Test in accordance with AMCA 500.
   2. Frames: Galvanized steel, 16-gauge minimum thickness, welded or riveted with corner reinforcement.
   3. Blades: Stainless steel in lab exhausts and galvanized steel elsewhere, maximum blade size 8 inches (200 mm) wide by 48 inches (1219 mm) long, attached to minimum 1/2 inch (12.7 mm) shafts with set screws, 16 gauge minimum thickness.
   4. Blade Seals: Synthetic elastomer, mechanically attached, field replaceable.
   5. Jamb Seals: Stainless steel.
   6. Shaft Bearings: Oil impregnated sintered bronze, graphite impregnated nylon sleeve or other molded synthetic sleeve, with thrust washers at bearings.
   7. Linkage: Concealed in frame.
   8. Linkage Bearings: Oil impregnated sintered bronze or graphite impregnated nylon.
   9. Leakage: Less than one percent based on approach velocity of 1500 ft./min. (7.62 m/s) and 1 inches wg. (249Pa).
   10. Maximum Pressure Differential: 2.5 inches wg. (622 Pa)
   11. Temperature Limits: -40 to 200 °F (-40 to 93 °C).
   12. Where opening size is larger than 48 inches (1219 mm) wide, or 72 inches (1829 mm) high, provide dampers in multiple sections, with intermediate frames and jackshafts appropriate for installation.

C. For general isolation and modulating control service in rectangular ducts at velocities not greater than 4000 fpm (20.3 m/s), differential pressure not greater than 6” w.c. (1493 Pa):
   1. Performance: Test in accordance with AMCA 500.
   2. Frames: Galvanized steel, 16-gauge minimum thickness, welded or riveted with corner reinforcement.
   3. Blades: extruded aluminum hollow airfoil shape, maximum blade size 8 inches (200 mm) wide by 48 inches (1219 mm) long, attached to minimum 1/2 inch (12.7 mm) shafts, 14 gauge minimum extrusion thickness.
   4. Blade Seals: Synthetic elastomeric, mechanically attached, field replaceable.

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5. Jamb Seals: Stainless steel.
6. Shaft Bearings: Oil impregnated sintered bronze sleeve, graphite impregnated nylon sleeve, molded synthetic sleeve, or stainless steel sleeve, with thrust washers at bearings.
7. Linkage: Concealed in frame.
8. Linkage Bearings: Oil impregnated sintered bronze or graphite impregnated nylon.
9. Leakage: Less than 0.1 percent based on approach velocity of 4000 ft./min. (20.3 m/s) and 1 inches wg. (249Pa).
10. Maximum Pressure Differential: 6 inches wg. (622 Pa)
11. Temperature Limits: -40 to 200 °F (-40 to 93 °C).
12. Where opening size is larger than 48 inches (1219 mm) wide, or 72 inches (1829 mm) high, provide dampers in multiple sections, with appropriately intermediate frames, and jackshafts.

D. For general isolation and modulating control service in rectangular ducts at velocities not greater than 4000 fpm, differential pressure not greater than 12” w.c.:
1. Performance: Test in accordance with AMCA 500.
2. Frames: Galvanized steel, 12-gauge minimum thickness, welded or riveted with corner reinforcement.
3. Blades: Extruded aluminum hollow airfoil shape, maximum blade size 8 inches (200 mm) wide by 48 inches (1219 mm) long, attached to minimum 3/4 inch (19 mm) shafts with set screws
4. Shaft Bearings: Oil impregnated sintered bronze or stainless steel, pressed into frame, with thrust washers at bearings.
5. Linkage: 10-gauge minimum thickness galvanized steel clevis type crank arms, 3/16” x3/4” (4.76 mm x 19 mm) minimum thickness tie rods.
6. Linkage Bearings: Oil impregnated sintered bronze or graphite impregnated nylon.
7. Leakage: Less than 0.2 percent based on approach velocity of 4000 ft./min. (20.3 m/s) and 1 inches wg. (249Pa) differential pressure.
8. Maximum Pressure Differential: 12 inches wg. (2984 Pa)
9. Temperature Limits: -40 to 300 °F (-40 to 149 °C).
10. Where opening size is larger than 48 inches (1219 mm) wide, or 72 inches (1829 mm) high, provide dampers in multiple sections, with appropriately intermediate frames, and jackshafts.

E. For general isolation and modulating control service in round ducts up to 40 inches in size at velocities not greater than 2500 fpm (12.7 m/s), differential pressure not greater than 4” w.c. (994 Pa):
1. Performance: Test in accordance with AMCA 500.
2. Frames: rolled 12 gauge steel strip for sizes 6 inch and smaller, rolled 14 gauge steel channel for larger sizes, galvanized or aluminum finish.
3. Blades: Steel construction, 12 gauge minimum thickness for dampers less than 18 inches (457 mm) in size, 10 gauge minimum thickness for larger dampers.
4. Blade Seals: Full circumference neoprene.
5. Shaft: ½ inch (12.7 mm) diameter zinc or cadmium plated steel.
6. Shaft Bearings: Oil impregnated sintered bronze or stainless steel, pressed into frame, with thrust washers at bearings.
7. Leakage: Less than 0.2 percent based on approach velocity of 4000 ft./min. (20.3 m/s) and 1 inches wg. (249Pa) differential pressure.
8. Maximum Pressure Differential: 4 inches wg. (994 Pa)
9. Temperature Limits: -40 to 300 °F (-40 to 149 °C).

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F. For general isolation and modulating control service in round ducts up to 60 inches in size at velocities not greater than 4000 fpm (20.3 m/s), differential pressure not greater than 6" w.c. (1492 Pa):
   1. Performance: Test in accordance with AMCA 500.
   2. Frames: rolled 10-gauge steel channel for sizes 48 inch and smaller, rolled 3/16 inch (4.76 mm) thick steel channel for larger sizes, galvanized or aluminum finish.
   3. Blades: Steel construction, 10-gauge minimum thickness for dampers not greater than 48 inches in size, ¼ inch (6.35 mm) minimum thickness for larger dampers.
   4. Blade stops: ½ inch x ¼ inch (12.7 mm x 6.35 mm) full circumference steel bar.
   5. Blade Seals: Full circumference neoprene.
   6. Shaft: zinc or cadmium plated steel, angle reinforcing as necessary.
   7. Shaft Bearings: Oil impregnated sintered bronze or stainless steel, pressed into frame, with thrust washers at bearings.
   8. Leakage: Less than 0.4 percent based on approach velocity of 4000 ft./min. (20.3 m/s) and 1 inches wg. (249Pa) differential pressure.
   9. Maximum Pressure Differential: 6 inches wg. (1492 Pa)
   10. Temperature Limits: -40 to 250 °F (-40 to 121 °C).

2.04 ACTUATORS

A. General: Size actuators and linkages to operate their appropriate dampers or valves with sufficient reserve torque or force to provide smooth modulating action or 2-position action as specified. Select spring-return actuators with manual override to provide positive shut-off of devices as they are applied.

B. Damper Actuators
   1. Ambient Operating Temperature Limits: -10 to 150°F (-12.2 to 66 °C)
   2. Two Position Electric Actuators: Line voltage with spring return
   3. Electronic Actuators: Provide actuators with spring return for two-position (24v), 0-5 Vdc, 0-10 Vdc, 2-10Vdc, 4-20 mA, or PWM input (subject to restrictions) as required. Actuators shall travel full stroke in less than [90] seconds. Actuators shall be designed for a minimum of 60,000 full cycles at full torque and be UL 873 listed. Provide stroke indicator. Actuators shall have positive positioning circuit. Where two actuators are required in parallel or in sequence provide an auxiliary actuator driver. Actuators shall have current limiting motor protection. Actuators shall have manual override where indicated. Modulating actuators for valves shall have minimum rangeability of 40 to 1.
      a. Close-Off Pressure: Provide the minimum torque required, and spring return for fail positioning (unless otherwise specifically indicated) sized for required close-off pressure. Required close-off pressure for two-way water valve applications shall be the shutoff head of associated pump. Required close-off rating of steam valve applications shall be design inlet steam pressure plus 50 percent for low pressure steam, and 10 percent for high pressure steam. Required close-off rating of air damper applications shall be shutoff pressure of associated fan, plus 10 percent.
      b. Acceptable Manufacturers: Subject to compliance with requirements approved manufacturers are as follows:
         1) Belimo
         2) Johnson Controls
         3) Delta
         4) Invensys
         5) Substitutions: See Section 01 60 00 - Product Requirements

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C. Quarter-Turn Actuators (for ball and butterfly valves):
   1. Electric
      a. Motor: Suitable for 120 or 240 Volt single-phase power supply. Insulation shall be NEMA Class F or better. Motor shall be rated for 100 percent duty cycle. Motors shall have inherent overload protection.
      b. Gear Train. Motor output shall be directed to a self locking gear drive mechanism. Gears shall be rated for torque input exceeding motor locked rotor torque.
      c. Wiring: Power and control wiring shall be wired to a terminal strip in the actuator enclosure
      d. Failsafe Positioning: Actuators shall be spring return type for failsafe positioning.
      e. Enclosure: Actuator enclosure shall be NEMA-4 rated, and shall have a minimum of two threaded conduit entries. Provide an enclosure heater for actuators located outside of buildings.
      f. Limit Switches: Travel limit switches shall be UL and CSA approved. Switches shall limit actuator in both open and closed positions.
      g. Mechanical Travel Stops: The actuator shall include mechanical travel stops of stainless steel construction to limit actuator to specific degrees of rotation.
      h. Manual Override: Actuators shall have manual actuator override to allow operation of the valve when power is off. For valves 4 inches and smaller the override may be a removable wrench or lever or geared handwheel type. For larger valves, the override shall be a fixed geared handwheel type. An automatic power cut-off switch shall be provided to disconnect power from the motor when the handwheel is engaged for manual operation.
      i. Valve Position Indicator: A valve position indicator with arrow and open and closed position marks shall be provided to indicate valve position.
      j. Torque Limit Switches: Provide torque limit switches to interrupt motor power when torque limit is exceeded in either direction of rotation.
      k. Position Controller: For valves used for modulating control, provide an electronic positioner capable of accepting 4-20 mA, 0-10 Vdc, 2-10 Vdc, and 135 Ohm potentiometer.
      l. Ambient Conditions: Actuator shall be designed for operation from -140 to 150 °F ambient temperature with 0 to 100 percent relative humidity.

2.05 GENERAL FIELD DEVICES

A. Provide field devices for input and output of digital (binary) and analog signals into controllers (BCs, AACs, ASCs). Provide signal conditioning for all field devices as recommended by field device manufacturers, and as required for proper operation in the system.

B. It shall be the Contractor's responsibility to assure that all field devices are compatible with controller hardware and software.

C. Field devices specified herein are generally 'two-wire' type transmitters, with power for the device to be supplied from the respective controller. If the controller provided is not equipped to provide this power, or is not designed to work with 'two-wire' type transmitters, or if field device is to serve as input to more than one controller, or where the length of wire to the controller will unacceptably affect the accuracy, the Contractor shall provide 'four-wire' type equal transmitter and necessary regulated DC power supply or 120 VAC power supply, as required.

D. For field devices specified hereinafter that require signal conditioners, signal boosters, signal repeaters, or other devices for proper interface to controllers, Contractor shall furnish and install

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proper device, including 120V power as required. Such devices shall have accuracy equal to, or better than, the accuracy listed for respective field devices.

E. Accuracy: As stated in this Section, accuracy shall include combined effects of nonlinearity, nonrepeatability and hysteresis.

2.06 TEMPERATURE SENSORS (TS)

A. Sensor range: When matched with A/D converter of BC, AAC/ASC, or SD, sensor range shall provide a resolution of no worse than 0.3°F (0.16 °C) (unless noted otherwise). Where thermistors are used, the stability shall be better than 0.25°F over 5 years.

B. Matched Sensors: The following applications shall require matched sensors:
   1. Building Loop Connections: Provide matched loop and building supply sensors where control sequence requires controlling to a temperature rise (differential).
   2. Hydronic Temperature Difference Calculations: Provide matched supply and return temperature sensors where the pair is used for calculating temperature difference for use in load calculations or sequencing such as across chillers and plants.
   3. Air Handling Unit Sequencing: Provide matched pair for the cooling and heating coil leaving sensors where the sequence includes calculating an offset from the supply air setpoint to maintain a leaving heating coil temperature.

C. Liquid immersion temperature sensor shall include [brass] thermowell, sensor and connection head for wiring connections. Temperature range shall be as required for resolution of 0.15°F.
   1. Sensing element (chilled water/glycol systems) shall be platinum RTD +/- 0.2°F accuracy at calibration point. Temperature range shall be as required for resolution of 0.15°F.
   2. Sensing element (other systems) shall be platinum RTD, thermistor, or integrated circuit, +/- 0.4°F accuracy at calibration point. Temperature range shall be as required for resolution of 0.3°F.

D. Pipe Surface-Mount Temperature Sensor: Shall include metal junction box and clamps and shall be suitable for sensing pipe surface temperature and installation under insulation. Provide thermally conductive paste at pipe contact point. Temperature range shall be as require for resolution indicated in paragraph A.
   1. Sensing element shall be platinum RTD, thermistor, or integrated circuit, +/- 0.4°F accuracy at calibration point.

E. Outside air sensors shall consist of a sensor, sun shield, utility box, and watertight gasket to prevent water seepage. Temperature range shall be as require for resolution indicated in Paragraph A
   1. Sensing element shall be platinum RTD, thermistor, or integrated circuit, +/- 0.4°F accuracy at calibration point.

2.07 TEMPERATURE TRANSMITTERS

A. Where required by Controller, or where wiring runs are over 50 feet, sensors as specified above may be matched with transmitters outputting 4-20 mA linearly across the specified temperature range. Transmitters shall have zero and span adjustments, an accuracy of 0.1°F when applied to the sensor range.

2.08 PRESSURE SWITCHES (PS)

A. Diaphragm or bourdon tube with adjustable setpoint and differential and snap-acting Form C contacts rated for the application. Pressure switches shall be capable of withstanding 150% of rated pressure.

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B. Acceptable Manufacturers: Square D, ITT Neo-Dyn, ASCO, Penn, Honeywell, and Johnson Controls. Substitutions shall be allowed per Division 1.

2.09 TRANSDUCERS

A. Standard Capacity Electronic-to-Pneumatic (E-P) Transducers: E-P transducers shall be Voltage-to-Pneumatic (V-P) type, Current-to-Pneumatic (I-P) type, [and Pulse Width Modulated-to-Pneumatic (PWM-P) type]:
   1. Electrical Power Supply: 24 Vac or 24 Vdc.
   2. Pneumatic Air Supply: 30 psig (2.07 bar) maximum.
   3. Air Capacity: 1100 scim @ 20 psig (300 cm3/sec @ 1.4 bar).
   4. Air Consumption: Zero at steady state.
   5. Output Span: 0-20 psig (0-1.4 bar).
   6. Input: 4-20 mA, 0-5 Vdc, 1-5 Vdc, 0-10 Vdc, 2-10 Vdc, 0-15 Vdc, or 3-15 Vdc input. [Pulse width modulated or tri-state input shall be allowed].
   7. Pulse Width Modulated and Tri-state Input Time Base: Dip switch selectable
   8. Enclosure: Polymer designed for surface or panel mount.
   9. Air Connections: ¼" (6.35 mm) barbed.
   10. Failure Mode on Power Loss: Non-failsafe transducers shall have no output air loss. Failsafe transducers shall exhaust output upon power loss.
   11. Acceptable Manufacturers: RE Technologies Model UCP-522. Substitutions shall be allowed per Division 1.

B. Binary to Analog Transducers ([Pulse Width Modulating] or Tri-State-to-Voltage or -Current):
   1. Adjustable zero and span.
   2. Failure Mode on Power Loss: Shall be provided with memory feature to allow the transducer to return to last value on power failure.
   3. Accuracy: ± 1% of span
   4. Output Span: 4-20 mA, 0-5 Vdc, 1-5 Vdc, 0-10Vdc, 2-10Vdc, 0-15Vdc, 3-15Vdc
   5. Input: 4-20 mA, pulse width modulated or tri-state input.
   6. Pulse Width Modulated] and Tri-state Input Time Base: Dip switch selectable.
   7. Enclosure: Polymer designed for surface or panel mount.
   8. Failure Mode on Power Loss: Non-failsafe transducers shall have no output air loss. Failsafe transducers shall exhaust output upon power loss.
   9. Acceptable Manufacturers: RE Technologies Model PWA Series. Substitutions shall be allowed per Division 1.

C. Electronic-to Electronic (Voltage or Current to Current or Voltage):
   1. Adjustable zero and span.
   2. Failure Mode on Power Loss: Memory feature to allow the transducer to return to last value on power failure.
   3. Accuracy: ± 1% of span.
   4. Output Span: 4-20 mA, 0-5 Vdc, 1-5 Vdc, 0-10 Vdc, 2-10 Vdc, 0-15 Vdc, 3-15 Vdc.
   5. Input: 0-20 Vdc, 0-20 ma, 0-10 kOhm.
   6. Pulse Width Modulated] and Tri-state Input Time Base: Dip switch selectable
   7. Enclosure: Polymer enclosure designed for surface or panel mount.
   8. Acceptable Manufacturers: RE Technologies Model PWA Series. Substitutions shall be allowed per Division 1.

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2.10 CURRENT SWITCHES (CS)

A. Clamp-On or Solid-Core Design Current Operated Switch (for Constant Speed Motor Status Indication)
   1. Range: 1.5 to 150 amps.
   2. Trip Point: Adjustable.
   3. Switch: Solid state, normally open, 1 to 135 Vac or Vdc, 0.3 Amps. Zero off state leakage.
   4. Lower Frequency Limit: 6 Hz.
   5. Trip Indication: LED
   6. Approvals: UL, CSA
   7. Max. Cable Size: 350 MCM
   8. Acceptable Manufacturers: Veris Industries H-708/908; Inc., RE Technologies SCS1150A-LED. Substitutions shall be allowed per Division 1.

B. Clamp-on or Solid-Core Wire Through Current Switch (CS/CR) (for Constant Speed Motors): Same as CS with 24v command relay rated at 5A @ 240 Vac resistive, 3A @ 240 Vac inductive, load control contact power shall be induced from monitored conductor (minimum conductor current required to energize relay 5A, max. rating of 135A). Acceptable Manufacturers shall be Veris Industries, Inc., Model # H938/735; or RE Technologies RCS 1150. Substitutions shall be allowed per Division 1.
   1. Where used for single-phase devices, provide the CS/CR in a self-contained unit in a housing similar with override switch to Kele RIBX. Substitutions shall be allowed per Division 1.

C. Clamp-On Design Current Operated Switch for Variable Speed Motor Status Indication
   1. Range: 1.5 to 135 Amps.
   2. Trip Point: Self-calibrating based on VA memory associated with frequency to detect loss of belt with subsequent increase of control output to 60 Hz.
   3. Switch: Solid state, normally open, 1 to 135 Vac or Vdc, 0.3 Amps. Zero off state leakage.
   4. Frequency Range: 5-75 Hz
   5. Trip Indication: LED
   6. Approvals: UL, CSA
   7. Max. Cable Size: 350 MCM
   8. Acceptable Manufacturers: Veris Industries, Inc. H-904. Substitutions shall be allowed per Division 1.

D. Clamp-On Wire Through Current Switch (CS/CR) (for Variable Speed Motors): Same as CS with 24v command relay rated at 5A @ 240 Vac resistive, 3A @ 240 Vac inductive, load control contact power shall be induced from monitored conductor (minimum conductor current required to energize relay 5A, max. rating of 135A). Acceptable manufacturer shall be Veris Industries, Inc., Model # H934. Substitutions shall be allowed per Division 1.

E. Variable Speed Status: Where current switches are used to sense the status for variable speed devices, the CT shall include on-board VA/Hz memory to allow distinction between a belt break and subsequent ramp up to 60 Hz, versus operation at low speed. The belt break scenario shall be indicated as a loss of status and the operation at low speed shall indicate normal status.

2.11 CURRENT TRANSFORMERS (CT)

A. Clamp-On Design Current Transformer (for Motor Current Sensing)
   1. Range: 1-10 amps minimum, 20-200 amps maximum
   2. Trip Point: Adjustable
   3. Output: 0-5 VDC.

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4. Accuracy: ±0.2% from 20 to 100 Hz.
5. Acceptable Manufacturers: KELE SA100. Substitutions shall be allowed per Division 1.

2.12 ELECTRIC CONTROL COMPONENTS

A. Limit Switches (LS): Limit switches shall be UL listed, SPDT or DPDT type, with adjustable trim arm. Limit switches shall be as manufactured by Square D, Allen Bradley. Substitutions shall be allowed per Division 1.

B. Electric Solenoid-Operated Pneumatic Valves (EP): EP valves shall be rated for a minimum of 1.5 times their maximum operating static and differential pressure.. Valves shall be ported 2-way, 3-way, or 4-way and shall be normally closed or open as required by the application. EPs shall be sized for minimum pressure drop, and shall be UL and CSA listed. Furnish and install gauges on all inputs of EPs. Furnish an adjustable air pressure regulator on input side of solenoid valves serving actuators operating at greater than 30 psig.
   1. Coil Enclosure: Indoors shall be NEMA-1, Outdoors and NEMA-3, 4, 7, 9.
   2. Fluid Temperature Rating: Valves for compressed air and cold water service shall have 150 °F (66 °C) minimum rating. Valves for hot water or steam service shall have fluid temperature rating higher than the maximum expected fluid temperature.
   3. Acceptable Manufacturers: EP valves shall be as manufactured by ASCO or Parker. Substitutions shall be allowed per Division 1.
   4. Coil Rating: EP valves shall have appropriate voltage coil rated for the application (i.e., 24 VAC, 120 VAC, 24 VDC, etc.).

C. Low Temperature Detector ('Freezestat') (FZ): Low temperature detector shall consist of a 'cold spot' element which responds only to the lowest temperature along any one foot of entire element, minimum bulb size of 1/8" x 20' (3.2mm x 6.1m), junction box for wiring connections and gasket to prevent air leakage or vibration noise, DPST (4 wire, 2 circuit) with manual reset. Temperature range 15 to 55°F (-9.4 to 12.8°C), factory set at 38°F.

D. High Temperature Detectors ('Firestat') (FS): High temperature detector shall consist of 3-pole contacts, a single point sensor, junction box for wiring connections and gasket to prevent air leakage of vibration noise, triple-pole, with manual reset. Temperature range 25 to 215°F (-4 to 102°C).

E. Surface-Mounted Thermostat: Surface-mounted thermostat shall consist of SPDT contacts, operating temperature range of 50 to 150° F (10 to 65°C), and a minimum 10°F fixed setpoint differential.

F. Low Voltage Wall Thermostat: Wall-mounted thermostat shall consist of SPDT sealed mercury contacts, operating temperature range of 50 to 90°F (10 to 32°C), switch rating of 24 Vac (30 Vac max.), and both manual and automatic fan operation in both the heat and cool modes.

G. Control Relays: All control relays shall be UL listed, with contacts rated for the application, and mounted in minimum NEMA-1 enclosure for indoor locations, NEMA-4 for outdoor locations.
   1. Control relays for use on electrical systems of 120 volts or less shall have, as a minimum, the following:
      a. AC coil pull-in voltage range of +10%, -15% or nominal voltage.
      b. Coil sealed volt-amperes (VA) not greater than four (4) VA.
      c. Silver cadmium Form C (SPDT) contacts in a dustproof enclosure, with 8 or 11 pin type plug.
      d. Pilot light indication of power-to-coil and coil retainer clips.
      e. Coil rated for 50 and 60 Hz service.

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f. Acceptable Manufacturers: Relays shall be Potter Brumfield, Model KRPA. Substitutions shall be allowed per Division 1.
g. Relays used for across-the-line control (start/stop) of 120V motors, 1/4 HP, and 1/3 HP, shall be rated to break minimum 10 Amps inductive load. Relays shall be IDEC. Substitutions shall be allowed per Division 1.
h. Relays used for stop/start control shall have low voltage coils (30 VAC or less), and shall be provided with transient and surge suppression devices at the controller interface.

H. General Purpose Power Contactors: NEMA ICS 2, AC general-purpose magnetic contactor. ANSI/NEMA ICS 6, NEMA type 1enclosure. Manufacturer shall be Square 'D', Cutler-Hammer or Westinghouse.

I. Control Transformers: Furnish and install control transformers as required. Control transformers shall be machine tool type, and shall be US and CSA listed. Primary and secondary sides shall be fused in accordance with the NEC. Transformer shall be proper size for application, and mounted in minimum NEMA-1 enclosure.
1. Transformers shall be manufactured by Westinghouse, Square 'D', or Jefferson. Substitutions shall be allowed per Division 1.

J. Time Delay Relays (TDR): TDRs shall be capable of on or off delayed functions, with adjustable timing periods, and cycle timing light. Contacts shall be rated for the application with a minimum of two (2) sets of Form C contacts, enclosed in a dustproof enclosure.
1. TDRs shall have silver cadmium contacts with a minimum life span rating of one million operations. TDRs shall have solid state, plug-in type coils with transient suppression devices.
2. TDRs shall be UL and CSA listed, Crouzet type. Substitutions shall be allowed per Division 1.

K. Electric Push Button Switch: Switch shall be momentary contact, oil tight, push button, with number of N.O. and/or N.C. contacts as required. Contacts shall be snap-action type, and rated for minimum 120 Vac operation. Switch shall be 800T type, as manufactured by Allen Bradley. Substitutions shall be allowed per Division 1.

L. Pilot Light: Panel-mounted pilot light shall be NEMA ICS 2 oil tight, transformer type, with screw terminals, push-to-test unit, LED type, rated for 120 VAC. Unit shall be 800T type, as manufactured by Allen-Bradley. Substitutions shall be allowed per Division 1.

M. Alarm Horn: Panel-mounted audible alarm horn shall be continuous tone, 120 Vac Sonalert solid-state electronic signal, as manufactured by Mallory. Substitutions shall be allowed per Division 1.

N. Electric Selector Switch (SS): Switch shall be maintained contact, NEMA ICS 2, oil-tight selector switch with contact arrangement, as required. Contacts shall be rated for minimum 120 Vac operation. Switch shall be 800T type, as manufactured by Allen-Bradley. Substitutions shall be allowed per Division 1.

2.13 NAMEPLATES

A. Provide engraved phenolic or micarta nameplates for all equipment, components, and field devices furnished. Nameplates shall be 1/8 thick, black, with white center core, and shall be minimum 1" x 3", with minimum 1/4" high block lettering. Nameplates for devices smaller than 1" x 3" shall be attached to adjacent surface.

B. Each nameplate shall identify the function for each device.

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2.14 TESTING EQUIPMENT

A. Contractor shall test and calibrate all signaling circuits of all field devices to ascertain that required digital and accurate analog signals are transmitted, received, and displayed at system operator terminals, and make all repairs and recalibrations required to complete test. Contractor shall be responsible for test equipment required to perform these tests and calibrations. Test equipment used for testing and calibration of field devices shall be at least twice as accurate as respective field device (e.g., if field device is +/-0.5% accurate, test equipment shall be +/-0.25% accurate over same range).

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION OF CONTROL SYSTEMS

A. General: Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details shown on drawings. Install electrical components and use electrical products complying with requirements of National Electric Code and all local codes.

B. Control Wiring: The term "control wiring" is defined to include providing of wire, conduit and miscellaneous materials as required for mounting and connection of electric control devices.

1. Wiring System: Install complete wiring system for electric control systems. Conceal wiring except in mechanical rooms and areas where other conduit and piping are exposed. Installation of wiring shall generally follow building lines. Install in accordance with National Electrical Code and Division 16 of this Specification. Fasten flexible conductors bridging cabinets and doors, neatly along hinge side, and protect against abrasion. Tie and support conductors neatly.
2. Control Wiring Conductors: Install control wiring conductors, without splices between terminal points, color-coded. Install in neat workmanlike manner, securely fastened. Install in accordance with National Electrical Code and Division 16 of this Specification.
3. Communication wiring, signal wiring and low voltage control wiring shall be installed separate from any wiring over thirty (30) volts. Signal wiring shield shall be grounded at controller end only, unless otherwise recommended by the controller manufacturer.
4. All WAN and LAN Communication wiring shield shall be terminated as recommended by controller manufacturer. All WAN and LAN Communication wiring shall be labeled with a network number, device ID at each termination and shall correspond with the WAN and LAN system architecture and floor plan submittals.
5. Install all control wiring external to panels in electric metallic tubing or raceway. However, communication wiring, signal wiring and low voltage control wiring may be run without conduit in concealed, accessible locations if noise immunity is ensured. Contractor will be fully responsible for noise immunity and rewire in conduit if electrical or RF noise affects performance. Accessible locations are defined as areas inside mechanical equipment enclosures, such as heating and cooling units, instrument panels etc.; in accessible pipe chases with easy access, or suspended ceilings with easy access. Installation of wiring shall generally follow building lines. Run in a neat and orderly fashion, bundled where applicable, and completely suspended (strapped to rigid elements or routed through wiring rings) away from areas of normal access. Tie and support conductors neatly with suitable nylon ties. Conductors shall not be supported by the ceiling system or ceiling support system. Conductors shall be pulled tight and be installed as high as practically possible in ceiling cavities. Wiring shall not be laid on the ceiling or duct. Conductors shall not be

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installed between the top cord of a joist or beam and the bottom of roof decking. Contractor shall be fully responsible for noise immunity and rewire in conduit if electrical or RF noise affects performance.

6. Number-code or color-code conductors appropriately for future identification and servicing of control system. Code shall be as indicated on approved installation drawings.

C. Control Valves: Install so that actuators, wiring, and tubing connections are accessible for maintenance. Where possible, install with valve stem axis vertical, with operator side up. Where vertical stem position is not possible, or would result in poor access, valves may be installed with stem horizontal. Do not install valves with stem below horizontal, or down.

D. Fluid Flow Sensors: Install per manufacturer's recommendations in an unobstructed straight length of pipe.

E. Flow Switches: Where possible, install in a straight run of pipe at least 15 diameters in length to minimize false indications.

F. Current Switches for Motor Status Monitoring: Adjust so that setpoint is below minimum operating current and above motor no load current.

G. Cutting and Patching Insulation: Repair insulation to maintain integrity of insulation and vapor barrier jacket. Use hydraulic insulating cement to fill voids and finish with material matching or compatible with adjacent jacket material.

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SECTION 23 09 53
BAS FIELD PANELS

PART 1 - GENERAL

1.01 SECTION INCLUDES:

A. Building Controller (BC)

B. Advance Application Specific Controller (AAC)

C. Application Specific Controller (ASC)

1.02 RELATED DOCUMENTS:

A. Section 23 09 50 - Building Automation System (BAS) General - Refer to this section for definitions of terminology

B. Section 23 09 51 - BAS Basic Materials, Interface Devices, and Sensors

C. Section 23 09 54 - BAS Communications Devices

D. Section 23 09 55 - BAS Software

E. Section 23 09 58 - Sequence of Operation

1.03 DESCRIPTION OF WORK:

A. Furnish and install DDC Control units and/or Smart Devices required to support specified building automation system functions.

B. Refer to Section 23 09 50 for general requirements.

PART 2 - PRODUCTS

2.01 STAND-ALONE FUNCTIONALITY

A. General: These requirements clarify the requirement for stand-alone functionality relative to packaging I/O devices with a controller. Stand-alone functionality is specified with the controller and for each Application Category specified in Part 3. This item refers to acceptable paradigms for associating the points with the processor.

B. Functional Boundary: Provide controllers so that all points associated with and common to one unit or other complete system/equipment shall reside within a single control unit. The boundaries of a standalone system shall be as dictated in the contract documents. Generally systems specified for the Application Category will dictate the boundary of the standalone control functionality. See related restrictions below. When referring to the controller as pertains to the standalone functionality, reference is specifically made to the processor. One processor shall execute all the related I/O control logic via one operating system that uses a common programming and configuration tool.

C. The following configurations are considered acceptable with reference to a controller's standalone functionality:

1. Points packaged as integral to the controller such that the point configuration is listed as an essential piece of information for ordering the controller (having a unique ordering number).
2. Controllers with processors and modular back planes that allow plug in point modules as an integral part of the controller.
3. I/O point expander boards, plugged directly into the main controller board to expand the point capacity of the controller.
4. I/O point expansion devices connected to the main controller board via wiring and as such may be remote from the controller and that communicate via a sub LAN protocol. These arrangements to be considered standalone shall have a sub LAN that is dedicated to that

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controller and include no other controller devices (AACs or ASCs). All wiring to interconnect the I/O expander board shall be:
   a. Contained in the control panel enclosure;
   b. Or run in conduit. Wiring shall only be accessible at the terminations.

D. The following configurations are considered unacceptable with reference to a controller's standalone functionality:
   1. Multiple controllers enclosed in the same control panel to accomplish the point requirement.

2.02 BUILDING CONTROLLER (BC)

A. General Requirements:
   1. The BC(s) shall provide fully distributed control independent of the operational status of the OWSs and CSS. All necessary calculations required to achieve control shall be executed within the BC independent of any other device. All control strategies performed by the BC(s) shall be both operator definable and modifiable through the Operator Interfaces.
   2. BCs shall perform overall system coordination, accept control programs, perform automated HVAC functions, control peripheral devices and perform all necessary mathematical and logical functions. BCs shall share information with the entire network of BCs and AACs/ASCs for full global control. Each controller shall be accessed through the CSS in normal operations. In the event that the CSS is not available, the controller shall permit multi-user operation from multiple OWS and mobile computers connected either locally or over the network. Each unit shall have its own internal RAM, non-volatile memory, microprocessor, battery backup, regulated power supply, power conditioning equipment, ports for connection of operating interface devices, and control enclosure. BCs shall be programmable from the CSS, OWS, mobile computer, or hand held device. BC shall contain sufficient memory for all specified global control strategies, user defined reports and trending, communication programs, and central alarming.
   3. BCs shall be connected to a controller network that qualifies as a controlling LAN.
   4. All BCs shall be provided with a UPS to protect against memory loss and allow for continuous communication with the CSS in the event of a loss of power.
      a. The UPS shall be a 500 VA UPS equal to APC Back-UPS CS, 300 Watts / 500 VA, Input 120V / Output 120V, Interface Port DB-9 RS-232, USB
   5. In addition BCs may provide intelligent, standalone control of BAS functions. Each BC may be capable of standalone direct digital operation utilizing its own processor, non-volatile memory, input/output, wiring terminal strips, A/D converters, real-time clock/calendar and voltage transient and lightning protection devices. Refer to standalone functionality specified above.
   6. The BC may provide for point mix flexibility and expandability. This requirement may be met via either a family of expander boards, modular input/output configuration, or a combination thereof. Refer to stand alone functionality specified above.
   7. All BC point data, algorithms and application software shall be modifiable from the CSS and OWS.
   8. Each BC shall execute application programs, calculations, and commands via a microprocessor resident in the BC. The database and all application programs for each BC shall be stored in non-volatile or battery backed volatile memory within the BC and will be able to upload/download to/from the CSS.
   9. BC shall provide buffer for holding alarms, messages, trends etc.

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10. Each BC shall include self-test diagnostics, which allow the BC to automatically alarm any malfunctions, or alarm conditions that exceed desired parameters as determined by programming input.
11. Each BC shall contain software to perform full DDC/PID control loops.
12. For systems requiring end-of-line resistors those resistors shall be located in the BC.
13. Input-Output Processing
    a. Digital Outputs (DO): Outputs shall be rated for a minimum 24 Vac or Vdc, 1 amp maximum current. Each shall be configurable as normally open or normally closed. Each output shall have an LED to indicate the operating mode of the output and a manual hand off or auto switch to allow for override. Each DO shall be discrete outputs from the BC's board (multiplexing to a separate manufacturer's board is unacceptable). Provide suppression to limit transients to acceptable levels.
    b. Analog Inputs (AI): AI shall be 0-5 Vdc, 0-10 Vdc, 0-20 Vdc, and 0-20 mA. Provide signal conditioning, and zero and span calibration for each input. Each input shall be a discrete input to the BC's board (multiplexing to a separate manufacturers board is unacceptable unless specifically indicated otherwise). A/D converters shall have a minimum resolution of 12 bits.
    c. Digital Inputs (DI): Monitor dry contact closures. Accept pulsed inputs of at least one per second. Source voltage for sensing shall be supplied by the BC and shall be isolated from the main board. Software multiplexing of an AI and resistors may only be done in non-critical applications and only with prior approval of Architect/Engineer.
    d. Universal Inputs (UI-AI or DI): To serve as either AI or DI as specified above.
    e. Electronic Analog Outputs (AO): Voltage mode: 0-5 Vdc and 0-10 Vdc; Current mode: 4-20 mA. Provide zero and span calibration and circuit protection. Pulse Width Modulated (PWM) analog via a DO [and transducer] is acceptable only with State approval (Generally these will not be allowed on loops with a short time constant such as discharge temperature loops, economizer loops, pressure control loops and the like. They are generally acceptable for standard room temperature control loops.). Where these are allowed, transducer/actuator shall be programmable for normally open, normally closed, or hold last position and shall allow adjustable timing. Each DO shall be discrete outputs from the BC's board (multiplexing to a separate manufacturers board is unacceptable). D/A converters shall have a minimum resolution of 10 bits.
    f. Pulsed Inputs: Capable of counting up to 8 pulses per second with buffer to accumulate pulse count. Pulses shall be counted at all times.
14. A communication port for operator interface through a mobile computer shall be provided in each BC. It shall be possible to perform all program and database back-up, system monitoring, control functions, and BC diagnostics through this port. Standalone BC panels shall allow temporary use of portable devices without interrupting its normal operation.
15. Each BC shall be equipped with loop tuning algorithm for precise proportional, integral, derivative (PID) control. Loop tuning tools provided with the CSS software is acceptable. In any case, tools to support loop tuning must be provided such that P, I, and D gains are automatically calculated.
16. All analog output points shall have a selectable failure setpoint. The BC shall be capable of maintaining this failure setpoint in the event of a system malfunction, which causes loss of BC control, or loss of output signal, as long as power is available at the BC. The failure setpoint shall be selectable on a per point basis.
17. Slope intercepts and gain adjustments shall be available on a per-point basis.
18. BC Power Loss:

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a. Upon a loss of power to any BC, the other units on the controlling LAN shall not in any way be affected.
b. Upon a loss of power to any BC, the battery backup shall ensure that the energy management control software, the Direct Digital Control software, the database parameters, and all other programs and data stored in the RAM are retained for a minimum of fifty (50) hours. An alarm diagnostic message shall indicate that the BC is under battery power.
c. Upon restoration of power within the specified battery backup period, the BC shall resume full operation without operator intervention. The BC shall automatically reset its clock such that proper operation of any time dependent function is possible without manual reset of the clock. All monitored functions shall be updated.
d. Should the duration of a loss of power exceed the specified battery back-up period or BC panel memory be lost for any reason, the panel shall automatically report the condition (upon resumption of power) and be capable of receiving a download via the network from the CSS or a mobile computer. In addition, the State shall be able to upload the most current versions of all energy management control programs, Direct Digital Control programs, database parameters, and all other data and programs in the memory of each BC to the CSS or a mobile computer via the network or the local USB or RS-232C port.

19. BC Failure:
    a. Building Controller LAN Data Transmission Failure: BC shall continue to operate in stand-alone mode. BC shall store loss of communication alarm along with the time of the event. All control functions shall continue with the global values programmable to either the last value or a specified value. Peer BCs shall recognize the loss and report alarm.
    b. BC Hardware Failure: BC shall cease operation and terminate communication with other devices. All outputs shall go to their specified fail position.
20. Each BC shall be equipped with firmware resident self-diagnostics for sensors and be capable of assessing an open or shorted sensor circuit and taking an appropriate control action (close valve, damper, etc.).
21. BCs may include network communications interface functions for controlling secondary controlling LANs Refer to Section 23 09 54 - BAS System Communications Devices for requirements if this function is packaged with the BC.
22. A minimum of four levels of privileges shall be provided at each BC.
23. All local user accounts shall be password protected. Strong password shall be used and complies with the State security standard.
24. BCs shall be mounted on equipment, in packaged equipment enclosures, or locking wall mounted in a NEMA 1 enclosure, as specified elsewhere.

B. BACnet Building Controller Requirements:
1. The BC(s) shall support all BIBBs defined in the BACnet-IP (B-BC) device profile as defined in the BACnet standard.
2. BCs shall communicate over the BACnet-IP LAN.
3. Each BC shall be connected to the BACnet-IP LAN communicating to/from other BCs.

2.03 ADVANCED APPLICATION SPECIFIC CONTROLLER (AAC) AND APPLICATION SPECIFIC CONTROLLER (ASC)

A. General Requirements:
1. AACs and ASCs shall provide intelligent, standalone control of HVAC equipment. Each unit shall have its own internal RAM, non-volatile memory and will continue to operate all local control functions in the event of a loss of communications on the ASC LAN or sub-

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LAN. Refer to standalone requirements by application specified in Part 3 of this section. In addition, it shall be able to share information with every other BC and AAC /ASC on the entire network.

2. Each AAC and ASC shall include self-test diagnostics that allow the AAC /ASC to automatically relay to the BC, or LAN Interface Device, any malfunctions or abnormal conditions within the AAC /ASC or alarm conditions of inputs that exceed desired parameters as determined by programming input.
3. AACs and ASCs shall include sufficient memory to perform the specific control functions required for its application and to communicate with other devices.
4. Each AAC and ASC must be capable of stand-alone direct digital operation utilizing its own processor, non-volatile memory, input/output, minimum 8 bit A to D conversion, voltage transient and lightning protection devices. All volatile memory shall have a battery backup of at least fifty- (50) hrs with a battery life of (5) five years.
5. All point data; algorithms and application software within an AAC /ASC shall be modifiable from the OWS.
6. AAC and ASC Input-Output Processing
    a. Digital Outputs (DO): Outputs shall be rated for a minimum 24 VAC or VDC, 1 amp maximum current. Each shall be configurable as normally open or normally closed. Each output shall have an LED to indicate the operating mode of the output and a manual hand off or auto switch to allow for override (Only AAC requires HOA). Each DO shall be discrete outputs from the AAC/ASC's board (multiplexing to a separate manufacturer's board is unacceptable). Provide suppression to limit transients to acceptable levels.
    b. Analog Inputs (AI): AI shall be O-5 Vdc, 0-10Vdc, 0-20Vdc, and 0-20 mA. Provide signal conditioning, and zero and span calibration for each input. Each input shall be a discrete input to the BC's board (multiplexing to a separate manufacturers board is unacceptable unless specifically indicated otherwise). A/D converters shall have a minimum resolution of 8-10 bits depending on application.
    c. Digital Inputs (DI): Monitor dry contact closures. Accept pulsed inputs of at least one per second. Source voltage for sensing shall be supplied by the BC and shall be isolated from the main board. Software multiplexing of an AI and resistors may only be done in non-critical applications and only with prior approval of Architect/Engineer
    d. Universal Inputs (UI-AI or DI): To serve as either AI or DI as specified above.
    e. Electronic Analog Outputs (AO) as required by application: voltage mode, 0-5VDC and 0-10VDC; current mode (4-20 mA). Provide zero and span calibration and circuit protection. Pulse Width Modulated (PWM) analog via a DO [and transducer] is acceptable only with State approval (Generally, PWM will not be allowed on loops with a short time constant such as discharge temperature loops, economizer loops, pressure control loops and the like. They are generally acceptable for standard room temperature control loops.). Where PWM is allowed, transducer/actuator shall be programmable for normally open, normally closed, or hold last position and shall allow adjustable timing. Each DO shall be discrete outputs from the BC's board (multiplexing to a separate manufacturers board is unacceptable). D/A converters shall have a minimum resolution of 8 bits.

B. BACnet AAC(s) and ASC(s) Requirements:
    1. The AAC(s) and ASC(s) shall support all BIBBs defined in the BACnet Building Controller (B-AAC and B-ASC) device profile as defined in the BACnet standard.
    2. AAC(s) and ASC(s) shall communicate over the BACnet Building Controller LAN or the ASC LAN or sub-LAN.

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3. Each BC shall be connected to the BACnet Building Controller LAN communicating to/from other BCs.

C. Terminal Box Controllers:
1. Terminal box controllers controlling damper positions to maintain a quantity of supply or exhaust air serving a space shall have an automatically initiated function that resets the volume regulator damper to the fully closed position on a scheduled basis. The controllers shall initially be set up to perform this function once every 24 hours. The purpose of this required function is to reset and synchronize the actual damper position with the calculated damper position and to assure the damper will completely close when commanded. The software shall select scheduled boxes randomly and shall not allow more than 5% of the total quantity of controllers in a building to perform this function at the same time. This reset shall be performed while the AHU is operating. The BAS shall send an alarm for any terminal box that has been reset and does not indicate 0 cfm flow with the damper commanded closed.

PART 3 - EXECUTION

3.01 INSPECTION:

A. Examine areas and conditions under which control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION OF CONTROL SYSTEMS:

A. General: Install systems and materials in accordance with manufacturer's instructions, specifications roughing-in drawings and details shown on drawings. Contractor shall install all controllers in accordance with manufacturer's installation procedures and practices.

3.03 HARDWARE APPLICATION REQUIREMENTS

A. General: The functional intent of this specification is to allow cost effective application of manufacturers standard products while maintain the integrity and reliability of the control functions. A BC as specified above is generally fully featured and customizable whereas the AAC/ASC refers to a more cost-effective unit designed for lower-end applications. Specific requirements indicated below are required for the respective application. Manufacturer may apply the most cost-effective unit that meets the requirement of that application.

B. Standalone Capability: Each Control Unit shall be capable of performing the required sequence of operation for the associated equipment. All physical point data and calculated values required to accomplish the sequence of operation shall originate within the associated CU with only the exceptions enumerated below. Refer to Item 2.01 above for physical limitations of standalone functionality. Listed below are functional point data and calculated values that shall be allowed to be obtained from or stored by other CUs or SDs via LAN.

C. Where associated control functions involve functions from different categories identified below, the requirements for the most restrictive category shall be met.

D. Application Category 0 (Distributed monitoring)
1. Applications in this category include the following:
a. Monitoring of variables that are not used in a control loop, sequence logic, or safety.
2. Points on BCs, AACs, and ASCs may be used in these applications as well as SDs and/or general-purpose I/O modules.
3. Where these points are trended, contractor shall verify and document that the network bandwidth is acceptable for such trends and is still capable of acceptable and timely control function.

E. Application Category 1 (Application Specific Controller):

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1. Applications in this category include the following:
   a. Fan Coil Units
   b. Airflow Control Boxes (VAV and Constant Volume Terminal Units)
   c. Misc. Heaters
   d. Unitary equipment <15 tons (Package Terminal AC Units, Package Terminal Heat Pumps, Split-System AC Units, Split-System Heat Pumps, Water-Source Heat Pumps)
   e. Induction Units
   f. Variable Speed Drive (VSD) controllers not requiring safety shutdowns of the controlled device.
2. ASCs may be used in these applications.
3. Standalone Capability: Provide capability to execute control functions for the application for a given setpoint or mode, which shall generally be occupied mode control. Only the following data (as applicable) may be acquired from other controllers via LANs. In the event of a loss of communications with any other controller, or any fault in any system hardware that interrupts the acquisition of any of these values, the ASC shall use the last value obtained before the fault occurred. If such fault has not been corrected after the specified default delay time, specified default value(s) shall then be substituted until such fault has been corrected.
   a. Physical/Virtual PointDefault Value
   b. Scheduling PeriodNormal
   c. Morning Warm-UpOff (cold discharge air)
   d. Load ShedOff (no shedding)
   e. Summer/WinterWinter
   f. [Trend DataN/A]
   g. [Smoke Pressurization ModeNormal Mode]
4. Mounting:
   a. ASCs that control equipment located above accessible ceilings shall be mounted on the equipment in an accessible enclosure that does not hinder maintenance of mechanical equipment and shall be rated for plenum use.
   b. ASCs that control equipment mounted in a mechanical room may either be mounted in, on the equipment, or on the wall of the mechanical room at an adjacent, accessible location.
   c. ASCs that control equipment located in occupied spaces or outside shall either be mounted within the equipment enclosure (responsibility for physical fit remains with the contractor) or in a nearby mechanical/utility room in which case it shall be enclosed in a NEMA 1, locking enclosure.
   d. Section 23 09 53 contractor may furnish ASCs to the terminal unit manufacturer for factory mounting.
5. Programmability: Operator shall be able to modify all setpoints (temperature and airflow), scheduling parameters associated with the unit, tuning and set up parameters, interstage timing parameters, and mode settings. Application-specific block control algorithms may be used to meet the sequence of operations. The ability to customize the control algorithm is not required unless specifically indicated otherwise.
6. LAN Restrictions: Limit the number of nodes on the network to the maximum recommended by the manufacturer.

F. Application Category 2 (General Purpose Terminal Controller)
   1. Applications in this category include the following:

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a. Unitary Equipment >= 15 tons (Air Conditioners, Heat Pumps, Packaged Heating/Cooling Units, and the like)
b. Small, Constant Volume Single Zone Air Handling Units
c. Constant Volume Pump Start/Stop
d. Misc. Equipment (Exhaust Fan) Start/Stop
e. Misc. Monitoring (not directly associated with a control sequence and where trending is not critical)
f. Steam Converter Control

2. BCs may be used in these applications.
3. ASC's may be used in these applications provided the ASC meets all requirements specified below. This category requires a general-purpose ASC to which application-specific control algorithms can be attached.
4. Standalone Capability: Only the following data (as applicable) may be acquired from other ASCs via LANs. In the event of a loss of communications with any other ASCs, or any fault in any system hardware that interrupts the acquisition of any of these values, the AAC/ASC shall use the last value obtained before the fault occurred. If such fault has not been corrected after the specified default delay time, specified default value(s) shall then be substituted until such fault has been corrected.
   a. Physical/Virtual PointDefault Delay TimeDefault Value
   b. Outside Air Temperature3 minutes80°F
   c. Outside Air Humidity3 minutes60%RH
   d. Outside Air Enthalpy3 minutes30 Btu/lb
   e. Trend DataN/A
   f. Cooling/Heating Requests3 minutesNone
   g. Smoke Pressurization Mode3 minutesNormal Mode
   h. Smoke Exhaust Command3 minutesNormal Mode
5. Mounting:
   a. ASCs that control equipment located above accessible ceilings shall be mounted on the equipment so as not to hinder mechanical maintenance and shall be rated for plenum use.
   b. ASCs that control equipment located in occupied spaces or outside shall either be mounted within the equipment enclosure (responsibility for physical fit remains with the contractor) or in a nearby mechanical/utility room in which case it shall be enclosed in a NEMA 1, locking enclosure.
6. Programmability: Operator shall be able to modify all setpoints (temperature and airflow), scheduling parameters associated with the unit, tuning and set up parameters, interstage timing parameters, and mode settings. Operator shall be able to address and configure spare inputs for monitoring. [Operator shall be able to address and configure spare outputs for simple single loop control actions or event initiated actions.] Application-specific block control algorithms shall used to meet the sequence of operations. The ability to customize the control algorithm is not required unless specifically indicated otherwise.
7. LAN Restrictions: Limit the number of nodes servicing any one of these applications on the AAC/ASC LAN to 32.

G. Application Category 3 (Advanced Application Controller)
1. Applications in this category include the following:
   a. Large Constant Volume Air Handlers
   b. VAV Air Handlers generally >5,000 and <10,000cfm
   c. Dual Duct Air Handlers generally >5000 and < 10,000 cfm
   d. Multizone Air Handlers

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e. Self-Contained VAV Units

2. BCs may be used in these applications.
3. AAC's may be used in these applications provided:
   a. The AAC's meets all requirements specified below.
   b. All control functions and physical I/O associated with a given unit resides in one AAC.
   c. Input A/D is 10-bit. Exception: 8-bit input A/D can be used when matched with high accuracy sensors, the range of which meets the resolution requirements specified for the applicable sensor in Section 23 09 51.
   d. Pulsed inputs required for the application can be monitored and accumulated effectively.
4. Standalone Capability: Only the following data (as applicable) may be acquired from other AACs via LANs. In the event of a loss of communications with any other AACs, or any fault in any system hardware that interrupts the acquisition of any of these values, the AAC shall use the last value obtained before the fault occurred. If such fault has not been corrected after the specified default delay time, specified default value(s) shall then be substituted until such fault has been corrected.
   a. Physical/virtual point - default delay - time default value
   b. Outside Air Temperature - 3 minutes - 80°F
   c. Outside Air Humidity - 3 minutes - 60%RH
   d. Outside Air Enthalpy - 3 minutes - 30 Btu/lb
   e. Enable Local Operation - Last Value
   f. Cooling/Heating Requests - 3 minutes - None
   g. Smoke Pressurization Mode - 3 minutes - Normal Mode
   h. Smoke Exhaust Command - 3 minutes - Normal Mode
5. Mounting:
   a. AACs that control equipment located above accessible ceilings shall be mounted on the equipment so as not to hinder mechanical maintenance and shall be rated for plenum use.
   b. AACs that control equipment located in occupied spaces or outside shall either be mounted within the equipment enclosure (responsibility for physical fit remains with the contractor) or in a near by mechanical/utility room in which case it shall be enclosed in a NEMA 1, locking enclosure.
6. Programmability: Operator shall be able to modify all setpoints (temperature and airflow), scheduling parameters associated with the unit, tuning and set up parameters, interstage timing parameters, and mode settings. Operator shall be able to address and configure spare inputs for monitoring. Operator shall be able to program custom DDC control algorithms and specify trending parameters, which will be retained in memory in the event of a loss of communications. Application-specific block control algorithms may be used provided they meet the sequence of operations. The control algorithms shall be completely customizable.
7. LAN Restrictions: Each LAN which participates in the transfer of data between the CU and the local operator workstation shall be subject to the following criteria:
   a. Limit the number of nodes servicing any one of these applications on the AAC/ASC LAN to 16.
   b. The Building Controller LAN shall be subject only to manufacturer's published LAN limitations.

H. Application Category 4
   1. Applications in this category include the following:
      a. Central Cooling Plant

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b. Central Heating Plant
c. Cooling Towers
d. Sequenced or Variable Speed Pump Control
e. Local Chiller Control (unit specific)
f. Local Free Cooling Heat Exchanger Control
g. Air Handlers over 10,000 cfm or serving critical areas

2. BCs shall be used in these applications.

3.04 CONTROL UNIT REQUIREMENTS

A. Refer to Section 23 09 50 Building Automation System (BAS) General for requirements pertaining to control unit quantity and location.

END OF SECTION

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SECTION 23 09 54
BAS COMMUNICATION DEVICES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Network Integration Devices

1.02 RELATED DOCUMENTS:

A. Section 23 09 50 - Building Automation System (BAS) General

B. Section 23 09 51 - BAS Basic Materials, Interface Devices, and Sensors

C. Section 23 09 53 - BAS Field Panels

D. Section 23 09 55 - BAS Software

E. Section 23 09 58 - Sequences of Operation

1.03 DESCRIPTION OF WORK

A. Contractor shall provide all interface devices and software to provide an integrated system connecting BCs, AACs, ASCs and Gateways to the State network.

PART 2 - PRODUCTS

2.01 NETWORK CONNECTION

A. State WAN: Refer Section 23 09 50 Building Automation System (BAS) General Part 1.11.C.1 - Building Automation System (BAS) General for description of System Architecture.

B. The following BIBBs must be supported on the Local Supervisory LAN using Ethernet either directly or through a gateway:

1. BACnet Data Sharing Objects (DS-):
    a. Read Property (RP-A) Initiate
    b. Read Property (RP-B) Execute
    c. Read Property Multiple (RPM-A) Initiate
    d. Read Property Multiple (RPM-B) Execute
    e. Write Property (WP-A) Initiate
    f. Write Property (WP-B) Execute
    g. Write Property Multiple (WPM-A) Initiate
    h. Write Property Multiple (WPM-B) Execute
    i. COV Unsubscribed (COVU-A) Initiate
    j. COV Unsubscribed (COVU-B) Execute
2. BACnet Alarm and Event Object (AE-)
    a. Confirmed Event Notification (N-B) Initiate
    b. Unconfirmed Event Notification (N-B) Initiate
    c. Refer to Section 23 09 55 BAS Software and Pogramming Part III for the BACnet Object naming convention.

2.02 BACNET GATEWAYS

A. Gateways shall be provided to link non-BACnet control products to the BACnet inter-network. All of the functionality described in this section is to be provided by using the BACnet capabilities. Each Gateway shall have the ability to expand the number of BACnet objects of each type supported by 20% to accommodate future system changes.

B. Each Gateway shall provide values for all points on the non-BACnet side of the Gateway to BACnet devices as if the values were originating from BACnet objects. The Gateway shall also

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provide a way for BACnet devices to modify (write) all points specified by the AOC using standard BACnet services. All points are required to be writable for each site.

C. The Gateway shall implement BACnet schedule objects and permit both read and write access to the schedules from the BC.

D. Each Gateway shall provide a way to collect and archive or trend (time, value) data pairs.

E. Each Gateway and any devices that the Gateway represents which have time-of-day information shall respond to workstation requests to synchronize the date and time. Each Gateway and any devices that the Gateway represents shall support dynamic device binding and dynamic object binding.

F. All points in the system shall be made network visible through the use of standard BACnet objects or through proprietary BACnet extensions that the workstation also supports. All points shall be writable using standard BACnet services.

G. All devices have a Device Object instance number that is unique throughout the entire inter-network. All BACnet devices shall be configured with a Device Object instance number that is based on the format specified (shown in decimal notation). This includes all physical devices as well as any logical BACnet devices that are physically represented by Gateways.

H. All BACnet Interoperability Building Blocks (BIBBs) are required to be supported for each native BACnet device or Gateway. The Gateway shall support all BIBBs defined in the BACnet Gateway's device profile as defined in the BACnet standard.

2.03 2.03 CONTROLLER LOCAL AREA NETWORK INTERFACE DEVICES (LANID)

A. The LANID shall be a microprocessor-based communications device which acts as a gateway/router between the Primary Controlling LAN and the Secondary Controlling LAN. It provides an operator interface. These may be provided within a BC or as a separate device.

B. The LANID shall perform information translation between the Primary Controlling LAN and the Secondary Controlling LAN, supervise communications on a polling Secondary Controlling LAN, and be applicable to systems in which the same functionality is not provided in the BC. In systems where the LANID is a separate device, it shall contain its own microprocessor, RAM, battery, real-time clock, communication ports, and power supply as specified for a BC in Section 23 09 53. Each LANID shall be mounted in a lockable enclosure.

C. Each LANID shall support interrogation, full control, and all utilities associated with all BCs on the Primary Controlling LAN, all AACs and ASCs connected to all Secondary Controlling LANs under the Primary Controlling LAN, and all points connected to those PCUs and SCUs.

D. Upon loss of power to a LANID, the battery shall provide for minimum 100-hour backup of all programs and data in RAM. The battery shall be sealed and self-charging.

E. The LANID shall be transparent to control functions and shall not be required to control information routing on the Primary Controlling LANControlling LANControlling LANControlling LANControlling LAN

F. All BACnet Interoperability Building Blocks (BIBBs) are required to be supported for each native BACnet device or Gateway. The Gateway shall support all BIBBs defined in the BACnet Gateway's device profile as defined in the BACnet standard.

2.04 LOCAL SUPERVISORY LAN GATEWAYS/ROUTERS

A. The gateway/router shall be a microprocessor-based communications device that acts as a gateway/router between the Supervisory LAN CSSs or OWS and the Controlling LAN.

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B. The gateway/router shall perform information translation between the Controlling LAN and the Local Supervisory LAN, and shall use BACnet over IP. When BACnet is used, refer to the requirements of the BACnet Gateways specified herein.

C. The gateway/router shall contain its own microprocessor, RAM, battery, real-time clock, communication ports, and power supply as specified for a BC in Section 23 09 53 BAS Field Panels. Each gateway/router shall be mounted in a lockable enclosure.

D. The gateway/router shall allow centralized overall system supervision, operator interface, management report generation, alarm annunciation, acquisition of trend data, and communication with control units. It shall allow system operators to perform the following functions from the CSS, and OWSs:
   1. Configure systems.
   2. Monitor and supervise control of all points.
   3. Change control setpoints.
   4. Override input values.
   5. Override output values
   6. Enter programmed start/stop time schedules.
   7. View and acknowledge alarms and messages.
   8. Receive, store and display trend logs and management reports.
   9. Upload/Download programs, databases, etc. as specified.

E. Upon loss of power to the gateway/router, the battery shall provide for minimum 100 hour backup of all programs and data in RAM. The battery shall be sealed and self-charging.

F. The gateway/router shall be transparent to control functions and shall not be required to control information routing on the Controlling LAN

2.05 CHILLER CONTROLS INTERFACE DEVICE (CID)

A. The CID shall be a microprocessor-based communications device that acts as a gateway between the control protocol and the applicable chiller controller.

B. The CID shall contain its own microprocessor, RAM, battery, communication ports and, power supply.

C. Each CID shall support full bi-directional communications translation as more fully specified in Section 23 09 55 BAS Software and Programming.

D. See drawings for required list of mapped points.

PART 3 - EXECUTION

3.01 INSPECTION:

A. Examine areas and conditions under which control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 3.02 INSTALLATION OF CONTROL SYSTEMS:

A. General: Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details shown on drawings.

B. Contractor shall provide all interface devices and software to provide an integrated system.

C. Contractor shall closely coordinate with the State, or designated representative, to establish IP addresses and communications to assure proper operation of the building control system on the State (DE) network.

END OF SECTION 23 09 54

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SECTION 23 09 55
BAS SOFTWARE AND PROGRAMMING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. System Software
B. Programming Description
C. Control Algorithms
D. Energy Management Applications
E. Password Protection
F. Alarm Reporting
G. Trending
H. Data Acquisition and Storage
I. Point Structuring
J. Dynamic Color Graphics

1.02 RELATED DOCUMENTS:

A. Section 23 09 50 - Building Automation System (BAS) General
B. Section 23 09 51 - BAS Basic Materials, Interface Devices, and Sensors
C. Section 23 09 53 - BAS Field Panels
D. Section 23 09 54 - BAS Communications Devices
E. Section 23 09 58 - Sequences of Operation

1.03 DESCRIPTION OF WORK:

A. Fully configure systems and furnish and install all software, programming and dynamic color graphics for a complete and fully functioning system as specified.
B. Refer to Section 23 09 50 - Building Automation System (BAS) for general requirements
C. Refer to 23 09 58 - Sequence of Operation for specific sequences of operation for controlled equipment.

1.04 LICENSING

A. Include licensing for all software packages at all required workstations.
B. All operator interface, programming environment, networking, database management and any other software used by the Contractor to install the system or needed to operate the system to its full capabilities shall be licensed and provided to the State.
C. All BAS software should be available on CSS(s) provided, and on all Portable Operator Terminals. All software keys to provide all rights shall be installed on CSS. At least 2 sets of media (CD or DVD) shall be provided with backup software and configurations for all software provided, so that the State may reinstall any software as necessary
D. Provide licensing and original software media for each device. Include all BAS software licenses and all required third party software licenses.
E. Upgrade all software packages to the release (version) in effect at the end of the Warranty Period.

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F. Refer to Section 23 09 50 - Building Automation System (BAS) General for further requirements.

PART 2 - PRODUCTS

2.01 SYSTEM SOFTWARE-GENERAL

A. Functionality and Completeness: The Contractor shall furnish and install all software and programming necessary to provide a complete and functioning system as specified. The Contractor shall include all software and programming not specifically itemized in these Specifications, which is necessary to implement, maintain, operate, and diagnose the system in compliance with these Specifications.

B. Configuration: The software shall support the system as a distributed processing network configuration.

2.02 CONTROLLER SOFTWARE

A. BC Software Residency: Each BC as defined below shall be capable of controlling and monitoring of all points physically connected to it. All software including the following shall reside and execute at the BC:
   1. Real-Time Operating System software
   2. Real-Time Clock/Calendar and network time synchronization
   3. BC diagnostic software
   4. LAN Communication software/firmware
   5. Direct Digital Control software
   6. Alarm Processing and Buffering software
   7. Energy Management software
   8. Data Trending, Reporting, and Buffering software
   9. I/O (physical and virtual) database
   10. Remote Communications software

B. AAC/ASC Software Residency: Each AAC/ASC as defined below shall be capable of controlling and monitoring of all points physically connected to it. As a minimum, software including the following shall reside and execute at the AAC/ASC. Other software to support other required functions of the AAC/ASC may reside at the BC or LAN interface device (specified in Section 23 09 54) with the restrictions/exceptions per application provided in Section 23 09 53:
   1. Real-Time Operating System software
   2. AAC/ASC diagnostic software
   3. LAN Communications software
   4. Control software applicable to the unit it serves that will support a single mode of operation
   5. I/O (physical and virtual) database to support one mode of operation

C. Standalone Capability: BC shall continue to perform all functions independent of a failure in other BC/AAC/ASC, CSS, or other communication links to other BCs/AACs/ASCs or CSSs. Trends and runtime totalization shall be retained in memory. Runtime totalization shall be available on all digital input points that monitor electric motor status. Refer also to Section 23 09 53 for other aspects of standalone functionality.

D. Operating System: Controllers shall include a real-time operating system resident in ROM. This software shall execute independently from any other devices in the system. It shall support all specified functions. It shall provide a command prioritization scheme to allow functional override of control functions. Refer also to Section 23 09 53 for other aspects of the controller's operating system.

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E. Network Communications: Each controller shall include software/firmware that supports the networking of CUs on a common communications trunk that forms the respective LAN. Network support shall include the following:
   1. Controller communication software shall include error detection, correction, and re-transmission to ensure data integrity.
   2. Operator/System communication software shall facilitate communications between other BCs, all subordinate AACs/ASCs, Gateways and LAN Interface Devices or CSS. Software shall allow point interrogation, adjustment, addition/deletion, and programming while the controller is online and functioning without disruption to unaffected points. The software architecture shall allow networked controllers to share selected physical and virtual point information throughout the entire system.

F. Diagnostic Software: Controller software shall include diagnostic software that checks memory and communications and reports any malfunctions.

G. Alarm/Messaging Software: Controller software shall support alarm/message processing and buffering software as more fully specified below.

H. Application Programs: CUs shall support and execute application programs as more fully specified below:
   1. All Direct Digital Control software, Energy Management Control software, and functional block application programming software templates shall be provided in a 'ready-to-use' state, and shall not require (but shall allow) user programming.

I. Security: Controller software shall support multiple level privileges access restriction as more fully specified below.

J. Direct Digital Control: Controller shall support application of Direct Digital Control Logic. All logic modules shall be provided pre-programmed with written documentation to support their application. Provide the following logic modules as a minimum:
   1. Proportional-Integral-Derivative (PID) control with analog, PWM and floating output
   2. Two Position control (Hi or Low crossing with deadband)
   3. Single-Pole Double-Throw relay
   4. Delay Timer (delay-on-make, delay-on-break, and interval)
   5. Hi/Low Selection
   6. Reset or Scaling Module
   7. Logical Operators (AND, OR, NOT, XOR)

K. Psychrometric Parameters: Controller software shall provide preprogrammed functions to calculated and present psychrometric parameters (given temperature and relative humidity) including the following as a minimum: Enthalpy, Wet Bulb Temperature.

L. Updating/Storing Application Data: Site-specific programming residing in volatile memory shall be uploadable/downloadable from an OWS or CSS using BACnet services connected locally or through the network. Initiation of an upload or download shall include all of the following methods: Manual, Scheduled, and Automatic upon detection of a loss or change.

M. Restart: System software shall provide for orderly shutdown upon loss of power and automatic restart upon power restoration. Volatile memory shall be retained; outputs shall go to programmed fail-safe (open, closed, or last) position. Equipment restart shall include a user definable time delay on each piece of equipment to stagger the restart. Loss of power shall be alarmed at operator interface indicating date and time.

N. Time Synchronization: Automatic time synchronization shall be provided using BACnet services. Operators shall be able to set the time and date in any device on the network that

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supports time-of-day functionality. The operator shall be able to select to set the time and date for an individual device, devices on a single network, or all devices simultaneously.

O. Misc. Calculations: System software shall automate calculation of psychometric functions, calendar functions, kWh/kW, and flow determination and totalization from pulsed or analog inputs, curve-fitting, look-up table, input/output scaling, time averaging of inputs and A/D conversion coefficients.

2.03 APPLICATION PROGRAMMING DESCRIPTION

A. The application software shall be user programmable.

B. This specification generally requires a programming convention that is logical, easy to learn, use, and diagnose. General approaches to application programming shall be provided by one, or a combination, of the following conventions:
   1. Point Definition: Provide templates customized for point type, to support input of individual point information. Use standard BACnet Objects as applicable.
   2. Graphical Block Programming: Manipulation of graphic icon 'blocks', each of which represents a subroutine, in a functional/logical manner forming a control logic diagram. Blocks shall allow entry of adjustable settings and parameters via pop-up windows. Provide a utility that shall allow the graphic logic diagrams to be directly compiled into application programs. Logic diagrams shall be viewable either off-line, or on-line with real-time block output values.
   3. Functional Application Programming: Pre-programmed application specific programs that allow/require limited customization via 'fill-in-the-blanks' edit fields. Typical values would be setpoints gains, associated point names, alarm limits, etc.

C. Provide a means for testing and/or debugging the control programs both off-line and on-line.

2.04 ENERGY MANAGEMENT APPLICATIONS

A. System shall have the ability to perform all of the following energy management routines via preprogrammed function blocks or template programs. As a minimum provide the following whether or not required in the software:
   1. Time-of-Day Scheduling
   2. Calendar-Based Scheduling
   3. Holiday Scheduling
   4. Temporary Schedule Overrides
   5. Optimal Start / Optimal Stop based on space temperature offset, outdoor air temperature, and building heating and cooling capacitance factors as a minimum
   6. Night Setback and Morning Recovery Control, with ventilation only during occupancy
   7. Economizer Control (enthalpy or dry-bulb)
   8. Peak Demand Limiting / Load Shedding
   9. Dead Band Control

B. All programs shall be executed automatically without the need for operator intervention, and shall be flexible enough to allow operator customization. Programs shall be applied to building equipment as described in Section 23 09 58 - Sequence of Operation.

2.05 ACCESS PRIVILEGES

A. Multiple-level access privileges shall be provided. A minimum of four (4) levels of access shall be supported.

B. The highest level of access, Administrator Level access, shall allow the BAS administrator to perform application, database, and user management functions.

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C. Each login credentials shall be assigned to a pre-defined level of access. Alternately, a comprehensive list of accessibility/functionality items shall be provided, to be enabled or disabled for each user according to the level of access granted.

D. Operators shall be able to perform only those commands available for the access level assigned to their login credentials.

E. Login credentials are stored in the BC's local database. A minimum of 20 user names shall be supported and programmed per the State's direction.

F. Login credentials can be looked up using the Lightweight Directory Access (LDAP) through the BAS server.

G. Strong password shall be used on all login credentials.

H. User-definable, automatic log-off timers from 1 to 60 minutes shall be provided to prevent users from inadvertently leaving interface device unattended.

I. At system handover, all default and Contractor created login credentials for the system shall be provided to the State and all temporary login credentials shall be removed.

2.06 ALARM AND EVENT MANAGEMENT REPORTING

A. Alarm management shall be provided to monitor, buffer, and direct alarms and messages to operator devices and memory files. Each BC shall perform distributed, independent alarm analysis and filtering to minimize operator interruptions due to non-critical alarms, minimize network traffic, and prevent alarms from being lost. At no time shall a BCs ability to report alarms be affected by either operator activity at an OWS or local handheld device, or by communications with other panels on the network.

1. Alarm Descriptor: Each alarm or point change shall include that point's English language description, and the time and date of occurrence. In addition to the alarm's descriptor and the time and date, the user shall be able to print, display and store an alarm message to more fully describe the alarm condition or direct operator response.
2. Alarm Prioritization: The software shall allow users to define the handling and routing of each alarm by their assignment to discrete priority levels. A minimum of five (5) priority levels shall be provided - Level 1 Life Safety (i.e. smoke detector), Level 2 Critical (i.e. controller failure), Level 3 Abnormal (i.e. out-of-range temperature), Level 4 Energy Waste(i.e. fighting valves), Level 5 Maintenance Message (i.e. runtime monitor, filter status). For each priority level, users shall have the ability to enable or disable an audible tone whenever an alarm is reported and whenever an alarm returns to normal condition. Users shall have the ability to manually inhibit alarm reporting for each individual alarm and for each priority level. Contractor shall coordinate with the State on establishing alarm priority definitions.
3. Alarm Report Routing: Each alarm priority level shall be associated with a unique user-defined list of operator devices including any combination of local or remote workstations, printers and workstation disk files. All alarms associated with a given priority level shall be routed to all operator devices on the user-defined list and/or email to designated State email address (mailbox resource) associated with that priority level. For each priority level, alarms shall be automatically routed to a default operator device in the event that alarms are unable to be routed to any operator device assigned to the priority level.
4. Auto-Dial Alarm Routing: For alarm priority levels that include a mobile device as one of the listed reporting destinations, the BC shall initiate a call to report the alarm, and shall terminate the call after alarm reporting is complete. System shall be capable of multiple retries and buffer alarms until a connection is made. If no connection is made, system shall attempt connection to an alternate mobile device. System shall also be able to dial multiple mobile devices upon alarm activation.

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5. Alarm Acknowledgment: For alarm priority levels that are directed to a OWS, an indication of alarm receipt shall be displayed immediately regardless of the application is in use at the OWS, and shall remain on the screen until acknowledged by a user having a privilege that allows alarm acknowledgment. Upon acknowledgment, the complete alarm message string (including date, time, and user name of acknowledging operator) shall be stored in a selected file on the BC or CSS.

B. It shall be possible for any operator to receive a summary of all alarms regardless of acknowledgement status; for which a particular recipient is enrolled for notification; based on current event state; based on the particular BACnet event algorithm (e.g., change of value, change of state, out of range, and so on); alarm priority; and notification class.

C. BACnet Alarming Services: All alarms and events shall be implemented using standard BACnet event detection and notification mechanisms. The workstation shall receive BACnet alarm and event notifications from any gateway or BACnet controller in the system and display them to an operator. Either intrinsic reporting or algorithmic change reporting may be used but the intrinsic reporting method is preferred. The workstation shall also log alarms and events, provide a way for an operator with sufficient privilege to acknowledge alarms, and log acknowledgements of alarms. It shall be possible for an operator to receive, at any time, a summary of all alarms that are currently in effect at any site whether or not they have been acknowledged. Operators shall also be able to view and change alarm limits for any alarm at the appropriate access level.

D. Alarm Historical Database: The database shall store all alarms and events object occurrences in an ODBC or an OLE database-compliant relational database. Provide a commercially available ODBC driver or OLE database data provider, which would allow applications to access the data using standard Microsoft Windows data access services.

2.07 TRENDING

A. The software shall display historical data in both a tabular and graphical format. The requirements of this trending shall include the following:
   1. Provide trends for all physical points, virtual points and calculated variables.
   2. BACnet Trend Objects are preferred but where not possible trend data shall be stored in relational database format as specified in herein under Data Acquisition and Storage.
   3. In the graphical format, the trend shall plot at least 4 different values for a given time period superimposed on the same graph. The 4 values shall be distinguishable by using unique colors. In printed form the 4 lines shall be distinguishable by different line symbology. Displayed trend graphs shall indicate the engineering units for each trended value.
   4. The sample rate and data selection shall be selectable by the operator.
   5. The trended value range shall be selectable by the operator.
   6. Where trended values on one table/graph are COV, software shall automatically fill the trend samples between COV entries.

B. Control Loop Performance Trends: Controllers incorporating PID control loops shall also provide high resolution sampling in less than six second increments for verification of control loop performance.

C. Data Buffering and Archiving: Trend data shall be buffered at the BC, and uploaded to hard disk storage when archival is desired. All archived trends shall be transmitted to the CSS. Uploads shall occur based upon a user-defined interval, manual command, or automatically when the trend buffers become full.

D. Time Synchronization: Provide a time master that is installed and configured to synchronize the clocks of all BACnet devices supporting time synchronization. Synchronization shall be done using Coordinated Universal Time (UTC). All trend sample times shall be able to be

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synchronized. The frequency of time synchronization message transmission shall be selectable by the operator.

2.08 DYNAMIC PLOTTING

A. Provide a utility to dynamically plot in real-time at least four (4) values on a given 2-dimensional dynamic plot/graph with at least two Y-axes. At least five (5) dynamic plots shall be allowed simultaneously.

2.09 DATA ACQUISITION AND STORAGE

A. All points included in the typical equipment point list must be represented in a common, open or accessible format. All points should be provided as BACnet standard analog, binary, schedule, or trend objects when possible. Naming conventions for these points and network addressing are discussed in the 'Point Naming Conventions' paragraph below.

B. Non-BACnet data from the BAS shall be stored in relational database format. The format and the naming convention used for storing the database files shall remain consistent across the database and across time. The relational structure shall allow for storage of any additional data points, which are added to the BAS in future. The metadata/schema or formal descriptions of the tables, columns, domains, and constraints shall be provided for each database.

C. The database shall allow applications to access the data while the database is running. The database shall not require shutting down in order to provide read-write access to the data. Data shall be able to be read from the database without interrupting the continuous storage of trend data being carried by the BAS.

D. The database shall be ODBC or OLE database compliant. Provide a commercially-available ODBC driver or OLE database data provider, which would allow applications to access the data using standard Microsoft Windows data access services.

2.10 TOTALIZATION

A. The software shall support totalizing analog, digital, and pulsed inputs and be capable of accumulating, storing, and converting these totals to engineering units used in the documents. These values shall generally be accessible to the Operator Interfaces to support management-reporting functions.

B. Totalization of electricity use/demand shall allow application of totals to different rate periods, which shall be user definable.

C. When specified to provide electrical or utility Use/Demand, the Contractor shall obtain from the local utility all information required to obtain meter data, including k factors, conversion constants, and the like.

2.11 EQUIPMENT SCHEDULING

A. Provide a graphic utility for user-friendly operator interface to adjust equipment-operating schedules.

B. All schedules shall be implemented using BACnet objects and messages. All building systems with date and time scheduling requirements shall have schedules represented by the BACnet Schedule object. All operators shall be able to view the entries for a schedule. Operators with sufficient privilege shall be able to modify schedule entries from any BACnet workstation.

C. Scheduling feature shall include multiple seven-day master schedules, plus holiday schedule, each with start time and stop time. Master schedules shall be individually editable for each day and holiday.

D. Scheduling feature shall allow for each individual equipment unit to be assigned to one of the master schedules.

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E. Timed override feature shall allow an operator to temporarily change the state of scheduled equipment. An override command shall be selectable to apply to an individual unit, all units assigned to a given master schedule, or to all units in a building. Timed override shall terminate at the end of an operator selectable time, or at the end of the scheduled occupied/unoccupied period, whichever comes first. A privilege level that does not allow assignment of master schedules shall allow a timed override feature.

F. A yearly calendar feature shall allow assignment of holidays, and automatic reset of system real time clocks for transitions between daylight savings time and standard time.

2.12 POINT STRUCTURING AND NAMING

A. General: The intent of this section is to require a consistent means of naming points across all State facilities. Contractor shall configure the systems from the perspective of the Enterprise, not solely the local project. The following requirement establishes a standard for naming points and addressing Buildings, Networks, Devices, Instances, and the like. The convention is tailored towards the BACnet-based format and as such, the interface shall always use this naming convention. Native BACnet systems shall also use this naming convention. For non-BACnet systems, the naming convention shall be implemented as much as practical, and any deviations from this naming convention shall be approved by the State. The Contractor shall contact the State to determine the Building number and abbreviation.

B. Point Summary Table
   1. The term 'Point' is a generic description for the class of object represented by analog and binary inputs, outputs, and values in accordance with ASHARE 135 standard.
   2. With each schematic, Contractor shall provide a Point Summary Table listing:
      a. Building number and abbreviation
      b. System type
      c. Equipment type
      d. Point suffix
      e. Full point name (see Point Naming Convention paragraph)
      f. Point description
      g. Ethernet backbone network number
      h. Network number
      i. Device ID
      j. Device MAC address
      k. Object ID (object type, instance number)
      l. Engineering units.
   3. Additional fields for non-BACnet systems shall be appended to each row. Point Summary Table shall be provided in both hard copy and in electronic format (ODBC-compliant).
   4. Point Summary Table shall also illustrate Network Variables/BACnet Data Links Bindings.
   5. The Contractor shall coordinate with the State's representative and compile and submit a proposed Point Summary Table for review prior to any object programming or project startup.
   6. The Point Summary Table shall be kept current throughout the duration of the project by the Contractor as the Master List of all points for the project. Project closeout documents shall include an up-to-date accurate Point Summary Table. The Contractor shall deliver to the State the final Point Summary Table prior to Substantial Completion of the system. The Point Summary Table shall be used as a reference and guide during the commissioning process.
   7. The Point Summary Table shall contain all data fields on a single row per point. The Point Summary Table is to have a single master source for all point information in the building that is easily sorted and kept up-to-date. Although a relational database of Device ID-to-

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point information would be more efficient, the single line format is required as a single master table that will reflect all point information for the building. The point description shall be an easily understandable English-language description of the point.

a. Point Summary Table Example Row Headers and Examples (Transpose for a single point per row format)
    1) Campus RK Building Number 006 Building Association ZZ = no association (default to ZZ) System Type Cooling Equipment Type Chiller Point Suffix CHLR1KW *Point Name (Object Name) CA0006ZZ.COOLING.CHILLER.CHLR1KW *Point Description (Object Description) Chiller 1 kW Ethernet Network Number 600 Network Number 610 Device ID 1024006 Device MAC address 24 Object Type AI Instance Number 4 Engineering Units KW Network Variable? True Server Device 1024006 Client Devices 1028006 Included with Functional
    2) *Represents information that shall reside in the relevant BACnet property for the object

C. Point Naming Convention
1. All point names shall adhere to the format as established below. Said objects shall include all physical I/O points, calculated points used for standard reports, and all application program parameters. For each BAS object, a specific and unique BACnet object name shall be required.
2. For each point, four (4) distinct descriptors shall be linked to form each unique object name: Building, System, Equipment, and Point. Use alphanumeric characters. Space and special characters are not allowed. Each of the four descriptors must be bound by a period to form the entire object name. Reference the paragraphs below for an example of these descriptors.
3. The State shall designate the Building descriptor. The System descriptor shall further define the object in terms of air handling, cooling, heating, or other system. The Equipment descriptor shall define the equipment category; e.g., Chiller, Air Handler, or other equipment. The Point descriptor shall define the hardware or software type or function associated with the equipment; e.g., supply temperature, water pressure, alarm, mixed air temperature setpoint, etc. and shall contain any numbering conventions for multiples of equipment; e.g., CHLR1KW, CHLR2KW, BLR2AL (Boiler 2 Alarm), HWP1ST (Hot Water Pump 1 Status).
4. A consistent object (point) naming convention shall be utilized to facilitate familiarity and operational ease across the BAS network. Inter-facility consistency shall be maintained to ensure transparent operability to the greatest degree possible. The table below details the object naming convention and general format of the descriptor string. BACnet Object Name Requirements Descriptors Comment Campus, Building Number & RK0006ZZ AZ0134ZZ The Master Building List also Building Association has the correct abbreviations for each building. System AIRHANDLING - EXHAUST - Boilers and ancillary HEATING - COOLING - equipment Chillers and UTILITY - ENDUSE - MISC ancillary equipment Main electrical and gas meters Specific building loads by type Equipment BOILERS - CHILLERS - Non-specific boiler system FACILITY - TOWERS - points - Non-specific chiller WEATHER system points Point Suffix See Input/Output point summary table for conventions
5. Examples: Within each object name, the descriptors shall be bound by a period. Within each descriptor, words shall not be separated by dashes, spaces, or other separators as follows:
    a. RK0006ZZ.COOLING.CHILLERS.CHWP1ST
    b. RK0006ZZ.HEATING.BOILERS.BLR1CFH

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D. Device Addressing Convention:
   1. BACnet network numbers and Device Object IDs shall be unique throughout the network.
   2. All assignment of network numbers and Device Object IDs shall be coordinated with the State.
   3. Each Network number shall be unique throughout all facilities and shall be assigned in the following manner unless specified otherwise:
      a. BBBFF, where: BBB = 1-655 assigned to each building, FF = 00 for building backbone network, 1-35 indicating floors or separate systems in the building.
   4. Each Device Object Identifier property shall be unique throughout the system and shall be assigned in the following manner unless specified otherwise:
      a. XXFFBBB, where: XX = number 0 to 40, FF = 00 for building backbone network, 1-35 indicating floors or separate systems in the building. BBB = 1-655 assigned to each building.
   5. The BAS Contractor shall coordinate with designated State representative to ensure that no duplicate Device Object IDs occur.
   6. Alternative Device ID schemes or cross project Device ID duplication if allowed shall be approved before project commencement by the State.

2.13 OPERATOR INTERFACE GRAPHIC SOFTWARE

A. Graphic software shall facilitate user-friendly interface to all aspects of the System Software specified above. The intent of this specification is to require a graphic package that provides for intuitive operation of the systems without extensive training and experience. It shall facilitate logical and simple system interrogation, modification, configuration, and diagnosis.

B. Graphic software shall support multiple simultaneous screens to be displayed and resizable in a web-based environment. All functions excepting text entry functions shall be executable with a mouse.

C. Graphic software shall display current operating mode (i.e. warm-up, dehumidification, et al) for equipment with multiple modes of operation.

D. Graphic software shall provide for multitasking such that other application can be used while the operator is accessing the BAS. Software shall provide the ability to alarm graphically even when operator is in another software package.

E. The software shall be compatible to the current and current minus one versions of Microsoft Windows operating system. The software shall allow for the State's creation of user-defined, color graphic displays of geographic maps, building plans, floor plans, and mechanical and electrical system schematics. These graphics shall be capable of displaying all point information from the database including any attributes associated with each point (i.e., engineering units, etc.). In addition, operators shall be able to command equipment or change setpoints from a graphic through the use of a pointing device; e.g. mouse and touch screen.

F. Screen Penetration: The operator interface shall allow users to access the various system graphic screens via a graphical penetration scheme by using the pointing device to select from menus or 'button' icons. Each graphic screen shall be capable of having a unique list of other graphic screens that are directly linked through the selection of a menu item or button icon.

G. DYNAMIC DATA DISPLAYS: DYNAMIC PHYSICAL POINT VALUES SHALL AUTOMATICALLY UPDATED AT A MINIMUM FREQUENCY OF 6 UPDATES PER MINUTE WITHOUT OPERATOR INTERVENTION. POINT VALUE FIELDS SHALL BE DISPLAYED WITH A COLOR CODE DEPICTING NORMAL, ABNORMAL, OVERRIDE AND ALARM CONDITIONS.

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H. Point Override Feature: Each displayed point shall be individually enabled/disabled to allow pointing device driven override of digital points or changing of analog points. Such overrides or changes shall occur in the control unit, not just in the BAS software. The graphic point override feature shall be subject to privilege level protection. Points that are overridden shall be reported as an alarm, and shall be displayed in a coded color. The alarm message shall include the operator's login name. A list of points that are currently in an override state shall be available through menu selection and include the time/date of the override along with the operator's login name that initiated that override.

I. Dynamic Symbols: Provide a selection of standard symbols that change in appearance based on the value of an associated point.
   1. Analog symbol: Provide a symbol that represents the value of an analog point as the length of a line or linear bar.
   2. Digital symbol: Provide symbols such as switches, pilot lights, rotating fan wheels, etc. to represent the value of digital input and output points.
   3. Point Status Color: Graphic presentations shall indicate different colors for different point statuses. (For instance, green = normal, red = alarm, gray (or '???') for non-response.

J. Graphics Development Package: Graphic development and generation software shall be provided to allow the user to add, modify, or delete system graphic displays.
   1. The Contractor shall provide libraries of pre-engineered screens and symbols depicting standard air handling unit components (e.g. fans, cooling coils, filters, dampers, etc.), mechanical system components (e.g., pumps, chillers, cooling towers, boilers, etc.), complete mechanical systems (e.g. constant volume-terminal reheat, VAV, etc.) and electrical symbols.
   2. The Graphic Development Package shall use a pointing device to allow the user to perform the following:
      a. Define symbols
      b. Position items on graphic screens
      c. Attach physical or virtual points to a graphic
      d. Define background screens
      e. Define connecting lines and curves
      f. Locate, orient and size descriptive text
      g. Define and display colors for all elements
      h. Establish correlation between symbols or text and associated system points or other displays
      i. Create hot spots or link triggers to other graphic displays or other functions in the software

K. Graphic images shall reside on the CSS.

L. The software shall be capable of initiating communication between the BC and the CSS:
   1. Upon user command, to perform all specified functions.
   2. In accordance with user-programmed time schedules to report alarms and upload trend and report data to the CSS.

M. The software shall automatically terminate the communication when all specified functions are completed.

PART 3 - EXECUTION

3.01 SYSTEM CONFIGURATION

A. Contractor shall thoroughly and completely configure BAS system software, supplemental software, network communications, BC and CSS, if necessary .

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3.02 SITE-SPECIFIC APPLICATION PROGRAMMING

A. Provide all database creation and site-specific application control programming as required by these Specifications, national and local standards and for a fully functioning system. Contractor shall provide all initial site-specific application programming and thoroughly document programming. Generally meet the intent of the written sequences of operation. It is the Contractor's responsibility to request clarification on sequence issues that require such clarification.

B. All site-specific programming shall be fully documented and submitted for review and approval, both prior to downloading into the panel, at the completion of functional performance testing, and at the end of the warranty period.

C. All programming, graphics and data files must be maintained in a logical system of directories with self-explanatory file names. All files developed for the project will be the property of the State and shall remain on the BC and CSS at the completion of the project.

3.03 PRIVILEGE LEVELS SETUP

A. Set up the following privilege levels to include the specified capabilities:
   1. Level 1: (State's BAS Administrator)
      a. Level 1 capabilities
         1) Configure system software
         2) Modify graphic software
         3) View, add, change and delete user login credentials and privilege levels
         4) All unrestricted system capabilities including all network management functions.
   2. Level 1a (Contractor Technician)
      a. Level 1a capabilities
      b. Configure system software
      c. cModify graphic software
   3. Level 2: (Maintenance Manager)
      a. Level 2 capabilities
      b. Modify control unit programs
   4. Level 3: (Senior BAS Technician)
      a. Level 3 capabilities
      b. Override output points
      c. Change setpoints
      d. Change equipment schedules
   5. Level 4: (Junior BAS Technician and Trainee)
      a. Level 4 capabilities
      b. Acknowledge alarms
      c. Temporarily override equipment schedules
   6. Level 5: (Read Only)
      a. a. Display all graphic data
      b. b. Trend point data

B. Contractor shall assist:
   1. State's BAS Administrator with assigning user login credentials and privilege levels, configure system software and modify graphic software.
   2. Maintenance Manger with modifying control unit programs.

3.04 POINT PARAMETERS

A. Provide the following minimum programming for each analog input:

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1. Name
2. Address
3. Scanning frequency or COV threshold
4. Engineering units
5. Offset calibration and scaling factor for engineering units
6. High and low alarm values and alarm differentials for return to normal condition
7. High and low value reporting limits (reasonableness values), which shall prevent control logic from using shorted or open circuit values.
8. Default value to be used when the actual measured value is not reporting. This is required only for points that are transferred across the primary and/or secondary controlling networks and used in control programs residing in control units other than the one in which the point resides. Events causing the default value to be used shall include failure of the control unit in which the point resides, or failure of any network over which the point value is transferred.
9. Selectable averaging function that shall average the measured value over a user selected number of scans for reporting.

B. Provide the following minimum programming for each analog output:
1. Name
2. Address
3. Output updating frequency
4. Engineering units
5. Offset calibration and scaling factor for engineering units
6. Output Range
7. Default value to be used when the normal controlling value is not reporting.

C. Provide the following minimum programming for each digital input:
1. Name
2. Address
3. Engineering units (on/off, open/closed, freeze/normal, etc.)
4. Debounce time delay
5. Message and alarm reporting as specified
6. Reporting of each change of state, and memory storage of the time of the last change of state
7. Totalization of on-time (for all motorized equipment status points), and accumulated number of off-to-on transitions.

D. Provide the following minimum programming for each digital output:
1. Name
2. Address
3. Output updating frequency
4. Engineering units (on/off, open/closed, freeze/normal, etc.)
5. Direct or Reverse action selection
6. Minimum on-time
7. Minimum off-time
8. Status association with a DI and failure alarming (as applicable)
9. Reporting of each change of state, and memory storage of the time of the last change of state.
10. Totalization of on-time (for all motorized equipment status points), and accumulated number of off-to-on transitions.
11. Default value to be used when the normal controlling value is not reporting.

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3.05 TRENDS

A. Contractor shall establish and store trend logs. Trend logs shall be prepared for each physical input and output point, and all dynamic virtual points such as setpoints subject to a reset schedule, intermediate setpoint values for cascaded control loops, and the like as directed by the State.

B. The State will analyze trend logs of the system operating parameters to evaluate normal system functionality. Contractor shall establish these trends and ensure they are being stored properly.
   1. Data shall include a single row of field headings and the data thereafter shall be contiguous. Each record shall include a date and time field or single date stamp. Recorded parameters for a given piece of equipment or component shall be trended at the same intervals and be presented in a maximum of two separate 2-dimensional formats with time being the row heading and field name being the column heading.

C. Sample times indicated as COV (±) or change-of-value mean that the changed parameter only needs to be recorded after the value changes by the amount listed. When output to the trending file, the latest recorded value shall be listed with any given time increment record. The samples shall be filled with the latest values also if the points include different time intervals. If the BAS does not have the capability to record based on COV, the parameter shall be recorded based on the interval common to the unit.

D. Trending intervals or COV thresholds shall be dictated by the State upon system start-up.

E. The Contractor shall demonstrate functional trends as specified for a period of 30 days after successful system demonstration before Substantial Completion of the system.

3.06 TREND GRAPHS

A. Prepare controller and graphic software to display graphical format trends. Trended values and intervals shall be the same as those specified.

B. Lines shall be labeled and shall be distinguishable from each other by using either different line types, or different line colors.

C. Indicate engineering units of the y-axis values; e.g. degrees F., inches w.g., Btu/lb, percent open, etc.

D. The y-axis scale shall be chosen so that all trended values are in a readable range. Do not mix trended values on one graph if their unit ranges are incompatible.

E. Trend outside air temperature, humidity, and enthalpy during each period in which any other points are trended.

F. All points trended for one subsystem (e.g. air handling unit, chilled water system, etc.) shall be trended during the same trend period.

G. Each graph shall be clearly labeled with the subsystem title, date, and times.

3.07 ALARMS

A. Override Alarms: Any point that is overridden through the override feature of the graphic software shall be reported as a Level 3 alarm.

B. Analog Input Alarms: For each analog input, program an alarm message for reporting whenever the analog value is outside of the programmed alarm limits. Report a 'Return-to-Normal' message after the analog value returns to the normal range, using a programmed alarm differential. The alarm limits shall be individually selected by the Contractor based on the following criteria:
   1. Space temperature, except as otherwise stated in sequence of operation: Level 3

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a. Low alarm: 64°F
b. Low return-to-normal: 68°F
c. High alarm: 85°F
d. High return-to-normal: 80°F

2. Controlled media temperature other than space temperature (e.g. AHU discharge air temperature, steam converter leaving water temperature, condenser water supply, chilled water supply, etc.): Level 3 (If controlled media temperature setpoint is reset, alarm setpoints shall be programmed to follow setpoint)
   a. Low alarm: 3°F below setpoint
   b. Low return-to-normal: 2°F below setpoint
   c. High alarm: 3°F above setpoint
   d. High return-to-normal: 2°F above setpoint.
3. AHU mixed air temperature: Level 4
   a. Low alarm: 45°F
   b. Low return-to-normal: 46°F
   c. High alarm: 90°F
   d. High return-to-normal: 89°F
4. Duct Pressure:
   a. Low alarm: 0.5”w.g. below setpoint
   b. Low return-to-normal: 0.25”w.g. below setpoint
   c. High alarm: 0.5”w.g. above setpoint
   d. High return-to-normal: 0.25”w.g. above setpoint
5. Space humidity:
   a. Low alarm: 35%
   b. Low return-to-normal: 40%
   c. High alarm: 75%
   d. High return-to-normal: 70%

C. HOA Switch Tampering Alarms: The Sequences of Operation are based on the presumption that motor starter Hand-Off-Auto (HOA) switches are in the 'Auto' position. [If a motorized equipment unit starts without a prior start command from the FMS, (as sensed by status sensing device), then FMS shall perform the remaining sequence as specified.] BAS shall also enunciate the following Level 5 alarm message if status indicates a unit is operational when the run command is not present:
   1. DEVICE XXXX FAILURE: Status is indicated on the device even though it has been commanded to stop. Check the HOA switch, control relay, status sensing device, contactors, and other components involved in starting the unit. Acknowledge this alarm when the problem has been corrected.
   2. Maintenance Alarms: Enunciate Level 5 alarms when runtime accumulation exceeds a value specified by the operator
      a. DEVICE XXXX REQUIRES MAINTENANCE. Runtime has exceeded specified value since last reset.

D. See requirements for additional equipment-specific alarms specified in Section 23 09 59 - Sequences of Operation.

3.08 GRAPHIC SCREENS

A. Floor Plan Screens: The contract document drawings will be made available to the Contractor in AutoCAD (current version) format upon request. These drawings may be used only for developing backgrounds for specified graphic screens; however the State does not guarantee the suitability of these drawings for the Contractor's purpose.

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1. Provide graphic floor plan screens for each [floor] [wing] [tower] [other] of the building. Indicate the location of all equipment that is not located on the equipment room screens. Indicate the location of temperature sensors associated with each temperature-controlled zone (i.e., VAV terminals, fan-coils, single-zone AHUs, etc.) on the floor plan screens. [Zone background color shall change based on the temperature offset from setpoint]. Display the space temperature point adjacent to each temperature sensor symbol. Use a distinct line symbol to demarcate each terminal unit zone boundary. Use distinct colors to demarcate each air handling unit zone. [Mechanical floor plan drawings will be made available to the contractor upon request for the purpose of determining zone boundaries.] Indicate room numbers as provided by the State. Provide a drawing link from each space temperature sensor symbol and equipment symbol shown on the graphic floor plan screens to each corresponding equipment schematic graphic screen.
2. Provide graphic floor plan screens for each mechanical equipment room and a plan screen of the roof. Indicate the location of each item of mechanical equipment. Provide a drawing link from each equipment symbol shown on the graphic plan view screen to each corresponding mechanical system schematic graphic screen.
3. IF MULTIPLE FLOOR PLANS ARE NECESSARY TO SHOW ALL AREAS, PROVIDE A GRAPHIC BUILDING KEY PLAN. USE ELEVATION VIEWS AND/OR PLAN VIEWS AS NECESSARY TO GRAPHICALLY INDICATE THE LOCATION OF ALL OF THE LARGER SCALE FLOOR PLANS. LINK GRAPHIC BUILDING KEY PLAN TO LARGER SCALE PARTIAL FLOOR PLANS. PROVIDE LINKS FROM EACH LARGER SCALE GRAPHIC FLOOR PLAN SCREEN TO THE BUILDING KEY PLAN AND TO EACH OF THE OTHER GRAPHIC FLOOR PLAN SCREENS.
4. Provide a graphic site plan with links to and from each building plan.

B. System Schematic Screens: Provide graphic system schematic screen for each subsystem controlled with each I/O point in the project appearing on at least one graphic screen. System graphics shall include flow diagrams with status, setpoints, current analog input and output values, operator commands, etc. as applicable. General layout of the system shall be schematically correct. Input/output devices shall be shown in their schematically correct locations. Include appropriate engineering units for each displayed point value. Verbose names (English language descriptors) shall be included for each point on all graphics; this may be accomplished by the use of a hover box when the operator moves the cursor over the displayed point. Indicate all adjustable setpoints on the applicable system schematic graphic screen or, if space does not allow, on a supplemental linked-setpoint screen.
   1. Provide graphic screens for each air handling system. Indicate outside air temperature and enthalpy, and mode of operation as applicable (i.e., occupied, unoccupied, warm-up, cool-down). Link screens for air handlers to the heating system and cooling system graphics. Link screens for supply and exhaust systems if they are not combined onto one screen.
   2. Provide a graphic screen for each zone. Provide links to graphic system schematic screens of air handling units that serve the corresponding zone.
   3. Provide a cooling system graphic screen showing all points associated with the chillers, cooling towers and pumps. Indicate outside air dry-bulb temperature and calculated wet-bulb temperature. Link screens for chilled water and condenser water systems if they cannot fit onto one cooling plant graphic screen.
   4. Link screens for heating and cooling system graphics to utility history reports showingcurrent and monthly electric uses, demands, peak values, and other pertinent values.

C. Bar Chart Screens: On each graphic Bar Chart Screen, provide drawing links to the graphic air handling unit schematic screens.

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1. Provide a graphic chilled water valve screen showing the analog output signal of all chilled water valves in a bar chart format, with signals expressed as percentage of fully open valve (percentage of full cooling). Indicate the discharge air temperature and setpoint of each air handling unit, cooling system chilled water supply and return temperatures and the outside air temperature and humidity on this graphic. Provide drawing links between the graphic cooling plant screen and this graphic screen.
2. Provide a graphic heating water valve screen showing the analog output signal of all air handling unit heating water valves in a bar chart format, with signals expressed as percentage of fully open valve (percentage of full heating). Indicate the temperature of the controlled medium (such as AHU discharge air temperature or zone hot water supply temperature) and the associated setpoint and the outside air temperature and humidity.

D. Alarms: Each programmed alarm shall appear on at least one graphic screen. In general, alarms shall be displayed on the graphic system schematic screen for the system that the alarm is associated with (for example, chiller alarm shall be shown on graphic cooling system schematic screen). For all graphic screens, display analog values that are in a 'high alarm' condition in a red color, 'low alarm' condition in a blue color. Indicate digital values that are in alarm condition in a red color.

END OF SECTION 23 09 55

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SECTION 23 09 58
SEQUENCE OF OPERATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Chilled Water System

1.02 RELATED DOCUMENTS:

A. Section 23 09 50 - Building Automation System (BAS) General

B. Section 23 09 51 - BAS Basic Materials, Interface Devices, and Sensors

C. Section 23 09 53 - BAS Field Panels

D. Section 23 09 54 - BAS Communications Devices

E. Section 23 09 55 - BAS Software and Programming

1.03 SYSTEM DESCRIPTION

A. The systems to be controlled under work of this section basically comprise the replacement of existing water-cooled chillers.

B. This Section defines the manner and method by which controls function.

1.04 SUBMITTALS

A. Refer to Section 23 09 50 Buliding Automatoin System (BAS) General and Division 01 for requirements for control shop drawings, product data, User Manual, etc.

B. Programming Manual: Provide BAS system programming manual as well as documentation of site-specific programming prior to the start of Acceptance Phase.

1.05 PROJECT RECORD DOCUMENTS

A. Within two weeks of the completion of commissioning, provide record documents to represent the final control configuration with actual setpoints and tuning parameters as existed at acceptance.

B. Record documents shall be modified control drawings with the actual installed information. Drawings shall be delivered in both reproducible hard copy and electronic format in AutoCAD (current version) drawing files. Provide all supporting files, blocks, fonts, etc. required by the drawings.

C. Provide final points list as described above.

D. Provide final detailed wiring diagrams with all wire numbers and termination points indicated.

E. Accurately record final sequences and control logic made after submission of shop drawings.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 GENERAL

A. Sequences specified herein indicate the functional intent of the systems operation and may not fully detail every aspect of the programming that may be required to obtain the indicated operation. Contractor shall provide all programming necessary to obtain the sequences/system operation indicated.

B. Except as specified otherwise, throttling ranges, proportional bands, and cycle differentials shall be centered on the associated setpoint. All modulating feedback control loops shall include the capability of having proportional, integral, and derivative action. Unless the loop is specified

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"proportional only" or "P+I", Contractor shall apply appropriate elements of integral and derivative gain to each control loop which shall result in stable operation, minimum settling time, and shall maintain the primary variable within the specified maximum allowable variance.

C. Scheduling Terminology: When air handlers are scheduled throughout the day, the following defines the terminology used (Designer coordinate with The State regarding actual occupancy schedules and initial setpoints):
   1. OCCUPIED PERIOD: PERIOD OF TIME WHEN THE BUILDING IS IN USE AND OCCUPIED. UNLESS INDICATED OTHERWISE, THIS PERIOD IS DEFINED AS 7:30 AM - 5:00 PM, USER ADJUSTABLE, WEEKDAYS AND 7:30 AM TO 12:00PM (NOON) SATURDAYS. EXCLUDE ALL NATIONAL HOLIDAYS. GENERALLY SYSTEMS WILL BE FULLY OPERATIONAL THROUGHOUT THIS PERIOD AND VENTILATION AIR SHALL BE CONTINUOUSLY INTRODUCED. SPACE TEMPERATURE SETPOINTS WILL GENERALLY BE IN THE "NORMAL" RANGE OF 69-77°F.
   2. Unoccupied period: Period of time when the building or zone is not in use and unoccupied. Ventilation air shall not be introduced.
   3. Preoccupancy Period: Time prior to the Occupied period when the systems are returning the space temperatures from setback to "normal" or occupied setpoints (warm-up and cool-down). Ventilation air shall not be introduced unless outside air conditions permit free-cooling. Time period shall be determined by an optimum start strategy unless otherwise specified.
   4. Setback Period: Setback will typically coincide start with the end of the occupied period and end with the start of the preoccupancy period, however it shall be provided with its own schedule. Generally systems will be off except to maintain a "setback" temperature.
      a. Where any sequence or occupancy schedule calls for more than one motorized unit to start simultaneously, the BAS start commands shall be staggered by 5 second (adj.) intervals to minimize inrush current.

D. Alarm messages specified throughout the sequences are assigned to discrete priority levels. Priority levels dictate the handling and destination of alarm reports, and are defined in Section 23 09 55 - ATC System Software and Programming.

E. Wherever a value is indicated as adjustable (adj.), it shall be modifiable, with the proper privilege level, from the operator interface or via a function block menu. For these points, it is unacceptable to have to modify programming statements to change the setpoint.

F. When a power failure is detected in any phase, the BAS start commands shall be retracted immediately from all electrically powered units served by the failed power source. If the associated primary control unit (PCU) is powered by normal or emergency power, it may monitor its own power source as an indication of power status. If the PCU is powered by uninterruptable power supply (UPS), or if PCU is not capable of monitoring its own power for use in sequences, Contractor shall provide at least one voltage monitor (three phase when applicable) per building. When the BAS detects that power has been restored, all equipment for which the BAS start command had been retracted shall be automatically restarted on staggered 5 second intervals to minimize inrush current. When loss of equipment status coincides with a power failure, system shall not alarm individual equipment failures. Instead, only a single Level 2 alarm shall be enunciated as follows:
   1. BUILDING XXXX POWER FAILURE: Notify electric shop. Acknowledge alarm when power is restored.

G. Where reset action is specified in a sequence of operation, but a reset schedule is not indicated on the drawings, one of the following methods shall be employed:
   1. Contractor shall determine a fixed reset schedule which shall result in stable operation and shall maintain the primary variable within the specified maximum allowable variance.

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2. A floating reset algorithm shall be used which increments the secondary variable setpoint (setpoint of control loop being reset) on a periodic basis to maintain primary variable setpoint. The recalculation time and reset increment shall be chosen to maintain the primary variable within the specified maximum allowable variance.
3. Primary variable shall control the devices directly using a PID feedback control loop without resetting the secondary variable. However, the control devices shall still modulate as necessary to maintain upper and lower limits on the secondary variable. Proportional band, integral gain, and derivative term shall be selected to maintain the primary variable within the specified maximum allowable tolerance while minimizing overshoot and settling time. Contractor shall gain prior approval for implementing this method of reset.

H. Where “prove operation” of a device (generally controlled by a digital output) is indicated in the sequence, it shall require that the BAS shall, after an adjustable time delay after the device is commanded to operate (feedback delay) , confirm that the device is operational via the status input. If the status point does not confirm operation after the time delay or anytime thereafter for an adjustable time delay (debounce delay) while the device is commanded to run, an alarm shall be enunciated audibly and via an alarm message at the operator interface and print at the alarm printers. A descriptive message shall be attached to the alarm message indicating the nature of the alarm and actions to be taken. Contractor shall provide messages to meet this intent. [Upon failure of equipment with redundant backup, run command shall be removed from equipment and the device shall be locked out until the alarm is manually acknowledged. Upon failure of equipment without redundant backup, run command shall remain energized and the alarm shall be latched until reset by an operator. BAS shall provide for adjustable maximum rates of change for increasing and decreasing output from the following analog output points:
   1. Speed control of variable speed drives

I. Wherever a value is indicated to be dependent on another value (i.e.: setpoint plus 5°F) BAS shall use that equation to determine the value. Simply providing a virtual point that the operator must set is unacceptable. In this case three virtual points shall be provided. One to store the parameter (5°F), one to store the setpoint, and one to store the value which is the result of the equation.

3.02 CHILLED WATER SYSTEM

A. See drawings for project-specific central plant sequence of operations.

B. Chilled Water System Monitoring - The following points shall be monitored and displayed at the operator's terminal:
   1. In addition to the interface points listed above, the following points shall be monitored and displayed at the BAS terminal via sensors, which are provided by the BAS contractor:
   2. Chiller Status
   3. Tower Status, Each Cell
   4. Pump Status
   5. Chilled Water Supply and Return Temperature
   6. Condenser Water Supply and Return Temperature
   7. Bypass (Control) Valve Status
   8. Alarm Failure of Pumps, Chiller, and Tower Fan
   9. Tower Basin Water Temperature, Low Temperature Alarm
   10. Tower Basin Heater Status, Failure Alarm
   11. High and Low Chilled Temperature Alarms
   12. Primary (Chiller) Loop Supply Temperature
   13. Primary (Chiller) Loop Return Temperature
   14. Secondary (Building) Loop Supply Temperature

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15. Secondary (Building) Loop Return Temperature
16. Primary and secondary pumping flow status via current sensors
17. Secondary pump differential pressure reading
18. Secondary pump differential pressure setpoint
19. Make-up water system status
20. Water-cooled chiller status, errors, and alarm status as provided by factory BAS interface
21. Cooling tower pump flow status via differential pressure switch
22. Cooling tower loop supply temperature
23. Cooling tower loop return temperature
24. Cooling tower fan status
25. Diagram showing the layout of the central plant, chilled water loop, and building loop with major components and dynamic temperatures and pressures shown where temperature sensors exist in the system.

END OF SECTION

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SECTION 23 09 69
VARIABLE FREQUENCY CONTROLLERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes solid-state, PWM, VFCs for speed control of three-phase motors.

1.03 DEFINITIONS

A. BMS: Building management system.

B. IGBT: Integrated gate bipolar transistor.

C. LAN: Local area network.

D. PID: Control action, proportional plus integral plus derivative.

E. PWM: Pulse-width modulated.

F. VFC: Variable frequency controller.

1.04 SUBMITTALS

A. Product Data: For each type of VFC, provide dimensions; mounting arrangements; location for conduit entries; shipping and operating weights; and manufacturer's technical data on features, performance, electrical ratings, characteristics, and finishes.

B. Shop Drawings (for each VFC):
   1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
      a. Each installed unit's type and details.
      b. Nameplate legends.
      c. Short-circuit current ratings of integrated unit.
      d. UL listing for series rating of overcurrent protective devices in combination controllers.
   2. Wiring Diagrams: Power, signal, and control wiring for VFC. Provide schematic wiring diagram for each type of VFC.

C. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around VFCs where pipe and ducts are prohibited. Show VFC layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

D. Qualification Data: For testing agency and manufacturer.

E. Field Test Reports: Written reports specified in Part 3.

F. Manufacturer's field service report.

G. Operation and Maintenance Data: For VFCs, all installed devices, and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section " Operation and Maintenance Data," include the following:
   1. Routine maintenance requirements for VFCs and all installed components.
   2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

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H. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

I. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that dip switch settings for motor running overload protection suit actual motor to be protected.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.

B. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.

C. Source Limitations: Obtain VFCs of a single type through one source from a single manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NFPA 70.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store VFCs indoors in clean, dry space with uniform temperature to prevent condensation. Protect VFCs from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.07 COORDINATION

A. Coordinate layout and installation of VFCs with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate features of VFCs, installed units, and accessory devices with pilot devices and control circuits to which they connect.

C. Coordinate features, accessories, and functions of each VFC and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

1.08 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents:
   1. Spare Fuses: Furnish one spare for every five installed, but not less than one set of three of each type and rating
   2. Indicating Lights: Two of each type installed.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ABB Power Distribution, Inc.; ABB Control, Inc. Subsidiary.
   2. Yaskawa, Inc.

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3. Danfoss

2.02 VARIABLE FREQUENCY CONTROLLERS

A. Microprocessor based Bypass Controller - Manual or automatic (selectable) transfer to line power via contactors. A keypad to control the bypass controller is to be mounted on the enclosure door. The bypass keypad shall include a one line diagram and status LEDs to indicate the mode of operation and “External Fault” conditions. When in the “Normal” mode, the bypass contactor is open and the drive output contactor is closed. In the “Test” position, both contactors are open, in the “Bypass” position, the drive output contactor is open, and the bypass contactor is closed. Start/stop via customer supplied maintained contact shall be 24V or 115V compatible and shall function in both the “Normal” and “Bypass” modes. The voltage tolerance of the bypass power supply shall be ± 35% to eliminate the problem of contactor coil burnout. The design shall include single-phase protection in both the AFD and bypass modes.

B. Customer Interlock Terminal Strip - provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. Include fireman’s override and damper control circuit as standard. All external safety interlocks shall remain fully functional whether the system is in Hand, Auto, or Bypass modes.

C. Automatic bypass operation shall be selectable in the standard microprocessor based bypass design.

D. Door / cover interlocked circuit breaker disconnect switch which will disconnect all input power from the drive and all internally mounted options. The disconnect handle shall be through the door, and be padlockable in the “Off” position.

E. Fast acting semi-conductor fuses exclusive to the AFD - fast acting semi-conductor fuses allow the AFD to disconnect from the line prior to clearing upstream branch circuit protection, maintaining bypass capability. Bypass designs which have no such fuses, or that incorporate fuses common to both the AFD and the bypass will not be accepted. In such designs, a fuse clearing failure would render the bypass unusable.

F. Class 10 or 20 (selectable) electronic motor overload protection shall be included in the microprocessor bypass to protect the motor in bypass mode.

G. 3% DC line reactor

H. Input AC Line Reactor

I. The following operating information displays shall be standard on the AFD digital display. All applicable operating values shall be capable of being displayed in engineering (user) units. A minimum of two operating values from the list below shall be capable of being displayed at all times. The display shall be in complete English words (alpha-numeric codes are not acceptable):
   1. Output Frequency
   2. Motor Speed (RPM, %, or Engineering units)
   3. Motor Current
   4. Calculated Motor Torque
   5. Calculated Motor Power (kW)
   6. DC Bus Voltag
   7. Output Voltage
   8. Heatsink Temperature (0F)
   9. Analog Input Values
   10. Analog Output Value
   11. Keypad Reference Values
   12. Elapsed Time Meter (resettable)

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13. kWh meter (resettable)
14. mWh meter
15. Digital input status
16. Digital output status

J. Communications: Provide an ethernet interface allowing VFC to be used with an external system within a multidrop LAN configuration. Interface shall allow all parameter settings of VFC to be programmed via a BACNet IP BMS. Provide capability for VFC to retain these settings within the nonvolatile memory.

2.03 ENCLOSURES

A. Enclosure: NEMA 250 Type I, with hinged full front access for indoor applications.

B. Enclosure: NEMA 250 Type 3R with hinged full front access and integral locking handle for outdoor applications.

2.04 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested VFCs before shipping.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas, surfaces, and substrates to receive VFCs for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Anchor each VFC assembly to steel-channel sills arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and grout sills flush with VFC mounting surface.

B. Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Division 26 Section "Fuses."

3.03 IDENTIFICATION

A. Identify VFCs, components, and control wiring according to Division 15 Section "Mechanical identification."

B. Operating Instructions: Frame printed operating instructions for VFCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFC units.

3.04 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including pretesting and adjusting VFCs.

B. Test Reports: Prepare a written report to record the following:
1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

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3.05 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions.

3.06 CLEANING

A. Clean VFCs internally, on completion of installation, according to manufacturer's written instructions. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

3.07 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain VFCs.

END OF SECTION

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SECTION 23 21 13
HYDRONIC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General hydronic system requirements.

B. Domestic water / makeup water piping, above grade.

C. Condenser water piping, above grade.

D. Equipment drains and overflows.

E. Chemical treatment piping for cooling towers.

F. Pipe hangers and supports.

G. Unions, flanges, mechanical couplings, and dielectric connections.

H. Valves:
   1. Gate valves.
   2. Globe or angle valves.
   3. Ball valves.
   4. Plug valves.
   5. Butterfly valves.
   6. Check valves.

1.02 RELATED REQUIREMENTS

A. Section 23 05 48 - Vibration and Seismic Con. for HVAC and Plumb, Piping and Equip..

B. Section 23 05 53 - Identification for HVAC Piping and Equipment.

C. Section 23 07 19 - HVAC Piping Insulation.

D. Section 23 21 14 - Hydronic Specialties.

E. Section 26 05 83 - Wiring Connections: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

A. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300.

B. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Qualifications.

C. ASME B16.3 - Malleable Iron Threaded Fittings; The American Society of Mechanical Engineers; 1998 (R2006).

D. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.

E. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.

F. ASME B31.9 - Building Services Piping.

G. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers; 2001 (R2005).

H. ASME B31.5 - Refrigeration Piping and Heat Transfer Components; The American Society of Mechanical Engineers; 2006.

I. ASME B31.9 - Building Services Piping; The American Society of Mechanical Engineers; 2008 (ANSI/ASME B31.9).

J. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

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K. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

L. ASTM B32 - Standard Specification for Solder Metal.

M. ASTM B88 - Standard Specification for Seamless Copper Water Tube.

N. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric).

O. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

P. ASTM D2235 - Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.

Q. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).

R. ASTM D2310 - Standard Classification for Machine-Made "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.

S. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

T. ASTM D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

U. ASTM D2680 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping.

V. ASTM D2751 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings; 2005.

W. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.

X. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers; 1992 (Reapproved 2008).

Y. ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing.

Z. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications.

AA. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding.

BB. AWS D10.12M/D10.12 - Guide for Welding Mild Steel Pipe.

CC. ASTM F877 - Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems; 2007.

DD. AWS A5.8/A5.8M - Specification for Filler Metals for Brazing and Braze Welding; American Welding Society; 2004 and errata.

EE. AWS D1.1/D1.1M - Structural Welding Code - Steel.

FF. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; American Water Works Association; 2005 (ANSI/AWWA C105/A21.5).

GG. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings.

HH. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

II. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast.

JJ. AWWA C606 - Grooved and Shouldered Joints.

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KK. AWWA C606 - Standard Specification for Grooved and Shouldered Joints; American Water Works Association; 2006.

LL. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.

1.04 SYSTEM DESCRIPTION

A. Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

B. Grooved mechanical couplings and fasteners may be used in accessible locations only.

C. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.

D. Use non-conducting dielectric connections whenever jointing dissimilar metals.

E. Provide pipe hangers and supports in accordance with ASME B31.9 unless indicated otherwise.

F. Use gate or ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

G. Use globe or ball valves for throttling, bypass, or manual flow control services.

H. Use plug cocks for throttling service. Use non-lubricated plug cocks only when shut-off or isolating valves are also provided.

I. Use lug end butterfly valves to isolate equipment.

J. Use 3/4 inch gate or ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. Pipe to nearest floor drain.

1.05 SUBMITTALS

A. Product Data: Include data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalogue information. Indicate valve data and ratings.

B. Welders Certificate: Include welders certification of compliance with ASME (BPV IX).

C. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

D. Project Record Documents: Record actual locations of valves.

E. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified in this sectionwith minimum three years of experience.

C. Provide all grooved joint couplings, fittings, valves, specialties, and grooving tools from a single manufacturer.

D. Welder Qualifications: Certify in accordance with ASME (BPV IX).

1.07 REGULATORY REQUIREMENTS

A. Conform to ASME B31.9 code for installation of piping system.

NOT FOR BIDDING

B. Welding Materials and Procedures: Conform to ASME (BPV IX) and applicable state labor regulations.

C. Provide certificate of compliance from authority having jurisdiction, indicating approval of welders.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.09 FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.01 HYDRONIC SYSTEM REQUIREMENTS

A. Comply with ASME B31.9 and applicable federal, state, and local regulations.

B. Piping: Provide piping, fittings, hangers and supports as required, as indicated, and as follows:
   1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
   2. Use non-conducting dielectric connections whenever jointing dissimilar metals.
   3. Grooved mechanical joints may be used in accessible locations only.
      a. Accessible locations include those exposed to interior of building, in accessible pipe chases, above acoustical ceilings, in mechanical rooms, aboveground outdoors, and as approved by Architect.
      b. Grooved mechanical connections and joints comply with AWWA C606.
      c. Use rigid joints unless otherwise indicated.
   4. Provide pipe hangers and supports in accordance with ASME B31.9 or MSS SP-58 unless indicated otherwise.
   5. Provide pipe hangers and supports in accordance with ASME B31.9 unless indicated otherwise.

C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges, unions, or grooved couplings to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.
   1. Where grooved joints are used in piping, provide grooved valve/equipment connections if available; if not available, provide flanged ends and grooved flange adapters.

D. Valves: Provide valves where indicated:
   1. Provide drain valves where indicated, and if not indicated provide at least at main shut-off, low points of piping, bases of vertical risers, and at equipment. Use 3/4 inch gate valves with cap.
   2. Isolate equipment using butterfly valves with lug end flanges or grooved mechanical couplings.
   3. For throttling, bypass, or manual flow control services, use globe, ball, or butterfly valves.

E. Welding Materials and Procedures: Conform to ASME (BPV IX).

NOT FOR BIDDING

2.02 DOMESTIC WATER / MAKEUP WATER PIPING, ABOVE GROUND

A. Steel Pipe: ASTM A53/A53M, Schedule 40, black, using one of the following joint types:
   1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D10.12M/D10.12 welded.
   2. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.
   3. Fittings: ASTM B 16.3, malleable iron or ASTM A 234/A 234M, wrought steel welding type fittings.
   4. Joints: Grooved, or AWS D1.1 welded.

B. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), drawn, using one of the following joint types:
   1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings.
      a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
      b. Braze: AWS A5.8M/A5.8 BCuP copper/silver alloy.
   2. Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.
   3. Mechanical Press Sealed Fittings: Double pressed type complying with ASME B16.22, utilizing EPDM, nontoxic synthetic rubber sealing elements.
      a. Manufacturers:
         1) Apollo Valves: www.apollovalves.com/#sle.
         2) Grinnell Products: www.grinnell.com/#sle.
         3) Viega LLC: www.viega.us/#sle.
         4) Substitutions: See Section 01 60 00 - Product Requirements.
   4. Joints: Solder, lead free, 95-5 tin-antimony, or tin and silver.

2.03 CHEMICAL TREATMENT PIPING FOR COOLING TOWERS

A. PVC Pipe Sizes 6 inches and Smaller: ASTM D1785, Schedule 40, or ASTM D2241, SDR 21 or 26.
   1. Fittings: ASTM D2466, or ASTM D2467, PVC.
   2. Joints: Solvent welded in accordance with ASTM D2855.

B. PVC Pipe: ASTM D1785, Schedule 40, or ASTM DD224.1, SDR 21 or 26 -- to be coordinated and approved by chemical treatment vendor prior to procurement.

2.04 CONDENSER WATER PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A 53/A 53M, Schedule 40, black.
   1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings with finish matching piping; AWS D1.1/D1.1M welded.
   2. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.
   3. Fittings: ASME B16.3, galvanized malleable iron or ASTM A 234/A 234M, wrought steel welding type.
   4. Joints: Grooved, or AWS D1.1 welded.

B. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), drawn; using one of the following joint types:
   1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings.
   2. Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.
   3. Mechanical Press Sealed Fittings: Double pressed type complying with ASME B16.22, utilizing EPDM, nontoxic synthetic rubber sealing elements.

NOT FOR BIDDING

a. Manufacturers:
   1) FNW; Copper Press: www.fnw.com/#sle.
   2) Grinnell Products, a Tyco Business: www.grinnell.com.
   3) Viega LLC: www.viega.com.
   4) Substitutions: See Section 01 60 00 - Product Requirements.

2.05 EQUIPMENT DRAINS AND OVERFLOWS

A. Steel Pipe: ASTM A53/A53M, Schedule 40 galvanized; using one of the following joint types:
   1. Threaded Joints: Galvanized cast iron, or ASME B16.3 malleable iron fittings.
   2. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.
   3. Joints: Threaded, or grooved mechanical couplings.

B. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), drawn; using one of the following joint types:
   1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings; ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
   2. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.
   3. Joints: Solder, lead free, ASTM B 32, HB alloy (95-5 tin-antimony), or tin and silver.

2.06 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.
   1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.

B. Conform to ASME B31.9.

C. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron, adjustable swivel, split ring.

D. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.

E. Hangers for Hot Pipe Sizes 2 to 4 Inches: Carbon steel, adjustable, clevis.

F. Hangers for Hot Pipe Sizes 6 Inches and Over: Adjustable steel yoke, cast iron roll, double hanger.

G. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

H. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches and Over: Steel channels with welded spacers and hanger rods, cast iron roll.

I. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.

J. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.

K. Wall Support for Hot Pipe Sizes 6 Inches and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.

L. Vertical Support: Steel riser clamp.

M. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

N. Floor Support for Hot Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

O. Floor Support for Hot Pipe Sizes 6 Inches and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.

P. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

NOT FOR BIDDING

Q. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

R. Inserts: Malleable iron case of 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.

S. In grooved installations, use rigid couplings with offsetting angle-pattern bolt pads or with wedge shaped grooves in header piping to permit support and hanging in accordance with ASME B31.9.

2.07 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

A. Unions for Pipe 2 Inches and Under:
   1. Ferrous Piping: 150 psig malleable iron, threaded.
   2. Copper Pipe: Bronze, soldered joints.

B. Flanges for Pipe Over 2 Inches:
   1. Ferrous Piping: 150 psig forged steel, slip-on.
   2. Copper Piping: Bronze.
   3. Gaskets: 1/16 inch thick preformed neoprene.

C. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.
   1. Dimensions and Testing: In accordance with AWWA C606.
   2. Mechanical Couplings: Comply with ASTM F1476.
   3. Housing Material: Malleable iron or ductile iron, galvanized.
   4. Housing Clamps: Malleable iron galvanized to engage and lock, designed to permit some angular deflection, contraction, and expansion.
   5. Gasket Material: EPDM suitable for operating temperature range from -30 degrees F to 230 degrees F.
   6. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
   7. When pipe is field grooved, provide coupling manufacturer's grooving tools.

D. Dielectric Connections: Union or waterway fitting with water impervious isolation barrier and one galvanized or plated steel end and one copper tube end, end types to match pipe joint types used.

2.08 GATE VALVES

A. Manufacturers:
   1. Conbraco Industries: www.conbraco.com.
   2. Nibco, Inc: www.nibco.com.
   3. Milwaukee Valve Company: www.milwaukeevalve.com.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Up To and Including 2 Inches:
   1. Bronze body, bronze trim, screwed or union bonnet, non-rising stem, lockshield stem or handwheel, inside screw with backseating stem, solid wedge disc, alloy seat rings, solder ends.

C. Over 2 Inches:
   1. Iron body, bronze trim, bolted bonnet, rising stem, handwheel, outside screw and yoke, solid wedge disc with bronze seat rings, flanged or grooved ends.

2.09 GLOBE OR ANGLE VALVES

A. Manufacturers:

NOT FOR BIDDING

1. Conbraco Industries: www.conbraco.com.
2. Nibco, Inc: www.nibco.com.
3. Milwaukee Valve Company: www.milwaukeevalve.com.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Up To and Including 2 Inches:
1. Bronze body, bronze trim, screwed or union bonnet, rising stem and handwheel, inside screw with backseating stem, renewable composition disc and bronze seat, solder ends.

C. Over 2 Inches:
1. Iron body, bronze trim, bolted bonnet, rising stem, handwheel, outside screw and yoke, rotating plug-type disc with renewable seat ring and disc, flanged ends.

2.10 BALL VALVES

A. Manufacturers:
1. Conbraco Industries: www.conbraco.com.
2. Nibco, Inc: www.nibco.com.
3. Milwaukee Valve Company: www.milwaukeevalve.com.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Up To and Including 2 Inches:
1. Bronze one piece body, chrome plated brass ball, teflon seats and stuffing box ring, lever handle with balancing stops, solder ends with union.

C. Over 2 Inches:
1. Ductile iron body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle, grooved ends or flanged, rated to 800 psi.
2. Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle, flanged.

2.11 PLUG VALVES

A. Manufacturers:
1. Conbraco Industries: www.conbraco.com.
2. Nibco, Inc: www.nibco.com.
3. Milwaukee Valve Company: www.milwaukeevalve.com.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Up To and Including 2 Inches:
1. Bronze body, bronze tapered plug, full port opening, non-lubricated, teflon packing, threaded ends.
2. Operator: One plug valve wrench for every ten plug valves minimum of one.

C. Over 2 Inches:
1. Cast iron body and plug, full port opening, pressure lubricated, teflon packing, flanged ends.
2. Operator: Each plug valve with a wrench with set screw.

2.12 BUTTERFLY VALVES

A. Manufacturers:
1. Hammond Valve: www.hammondvalve.com.
2. Crane Co.: www.cranevalve.com.
3. Milwaukee Valve Company: www.milwaukeevalve.com.
4. Victaulic Company: www.victaulic.com/#sle.
5. Substitutions: See Section 01 60 00 - Product Requirements.

NOT FOR BIDDING

B. Body: Cast or ductile iron with resilient replaceable EPDM seat, wafer, lug, or grooved ends, extended neck.

C. Disc: Construct of aluminum bronze, chrome plated ductile iron, stainless steel, ductile iron with EPDM enscapsulation, or Buna-N enscapsulation.

D. Body: Cast or ductile iron with resilient replaceable EPDM seat, wafer or lug ends, extended neck.

E. Disc: Aluminum bronze.

F. Operator: 10 position lever handle.

2.13 SWING CHECK VALVES

A. Manufacturers:
1. Hammond Valve: www.hammondvalve.com.
2. Nibco, Inc: www.nibco.com.
3. Victaulic Company: www.victaulic.com/#sle.
4. Milwaukee Valve Company: www.milwaukeevalve.com.
5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Up To and Including 2 Inches:
1. Bronze body, bronze trim, bronze rotating swing disc, with composition disc, solder ends.

C. Over 2 Inches:
1. Iron body, bronze trim, stainless steel, bronze, or bronze faced rotating swing disc, renewable disc and seat, flanged or grooved ends.
2. Iron body, bronze trim, bronze or bronze faced rotating swing disc, renewable disc and seat, flanged ends.

2.14 SPRING LOADED CHECK VALVES

A. Manufacturers:
1. Hammond Valve: www.hammondvalve.com.
2. Crane Co.: www.cranevalve.com.
3. Milwaukee Valve Company: www.milwaukeevalve.com.
4. Victaulic Company: www.victaulic.com/#sle.
5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Iron body, bronze trim, split plate, hinged with stainless steel spring, resilient seal bonded to body, wafer or threaded lug ends.

PART 3 EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Prepare pipe for grooved mechanical joints as required by coupling manufacturer.

C. Remove scale and dirt on inside and outside before assembly.

D. Prepare piping connections to equipment using jointing system specified.

E. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

F. After completion, fill, clean, and treat systems. Refer to Section 23 25 00 for additional requirements.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

NOT FOR BIDDING

B. Install heating water, chilled water, dual-temperature, and condenser water piping to ASME B31.9 requirements.

C. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.

D. Route piping in orderly manner, parallel to building structure, and maintain gradient.

E. Install piping to conserve building space and to avoid interfere with use of space.

F. Group piping whenever practical at common elevations.

G. Sleeve pipe passing through partitions, walls and floors.

H. Slope piping and arrange to drain at low points.

I. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 22 05 16.

J. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 23 05 16.

K. Inserts:
   1. Provide inserts for placement in concrete formwork.
   2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
   3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
   4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
   5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of slab.

L. Pipe Hangers and Supports:
   1. Install in accordance with ASME B31.9.
   2. Support horizontal piping as scheduled.
   3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
   4. Place hangers within 12 inches of each horizontal elbow.
   5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
   6. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
   7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
   8. Provide copper plated hangers and supports for copper piping.
   9. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

M. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 07 19.

N. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 23 07 19.

O. Provide access where valves and fittings are not exposed.

P. Use eccentric reducers to maintain top of pipe level.

Q. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

NOT FOR BIDDING

R. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting. Refer to Section 09 90 00.

S. Install valves with stems upright or horizontal, not inverted.

3.03 SCHEDULES

A. Hanger Spacing for Copper Tubing.
1. 1/2 inch and 3/4 inch: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. 1 inch: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. 1-1/2 inch and 2 inch: Maximum span, 8 feet; minimum rod size, 3/8 inch.
4. 2-1/2 inch: Maximum span, 9 feet; minimum rod size, 3/8 inch.
5. 3 inch: Maximum span, 10 feet; minimum rod size, 3/8 inch.
6. 4 inch: Maximum span, 12 feet; minimum rod size, 1/2 inch.
7. 6 inch: Maximum span, 14 feet; minimum rod size, 1/2 inch.
8. 8 inch: Maximum span, 16 feet; minimum rod size, 5/8 inch.
9. 10 inch: Maximum span, 18 feet; minimum rod size, 3/4 inch.
10. 12 inch: Maximum span, 19 feet; minimum rod size, 7/8 inch.

B. Hanger Spacing for Steel Piping.
1. 1/2 inch, 3/4 inch, and 1 inch: Maximum span, 7 feet; minimum rod size, 1/4 inch.
2. 1-1/4 inches: Maximum span, 8 feet; minimum rod size, 3/8 inch.
3. 1-1/2 inches: Maximum span, 9 feet; minimum rod size, 3/8 inch.
4. 2 inches: Maximum span, 10 feet; minimum rod size, 3/8 inch.
5. 2-1/2 inches: Maximum span, 11 feet; minimum rod size, 3/8 inch.
6. 3 inches: Maximum span, 12 feet; minimum rod size, 3/8 inch.
7. 4 inches: Maximum span, 14 feet; minimum rod size, 1/2 inch.
8. 6 inches: Maximum span, 17 feet; minimum rod size, 1/2 inch.
9. 8 inches: Maximum span, 19 feet; minimum rod size, 5/8 inch.
10. 10 inches: Maximum span, 20 feet; minimum rod size, 3/4 inch.
11. 12 inches: Maximum span, 23 feet; minimum rod size, 7/8 inch.
12. 14 inches: Maximum span, 25 feet; minimum rod size, 1 inch.
13. 16 inches: Maximum span, 27 feet; minimum rod size, 1 inch.
14. 18 inches: Maximum span, 28 feet; minimum rod size, 1-1/4 inch.
15. 20 inches: Maximum span, 30 feet; minimum rod size, 1-1/4 inch.

C. Hanger Spacing for Plastic Piping.
1. 1/2 inch: Maximum span, 42 inches; minimum rod size, 1/4 inch.
2. 3/4 inch: Maximum span, 45 inches; minimum rod size, 1/4 inch.
3. 1 inch: Maximum span, 51 inches; minimum rod size, 1/4 inch.
4. 1-1/4 inches: Maximum span, 57 inches; minimum rod size, 3/8 inch.
5. 1-1/2 inches: Maximum span, 63 inches; minimum rod size, 3/8 inch.
6. 2 inches: Maximum span, 69 inches; minimum rod size, 3/8 inch.
7. 3 inches: Maximum span, 7 feet; minimum rod size, 3/8 inch.
8. 4 inches: Maximum span, 8 feet; minimum rod size, 1/2 inch.
9. 6 inches: Maximum span, 10 feet; minimum rod size, 1/2 inch.
10. 8 inches: Maximum span, 11 feet; minimum rod size, 5/8 inch.
11. 10 inches: Maximum span, 13 feet; minimum rod size, 3/4 inch.
12. 12 inches: Maximum span, 14 feet; minimum rod size, 7/8 inch.
13. 14 inches: Maximum span, 15 feet; minimum rod size, 1 inch.
14. 16 inches: Maximum span, 16 feet; minimum rod size, 1 inch.

NOT FOR BIDDING

15. 18 inches: Maximum span, 18 feet; minimum rod size, 1-1/4 inch.

END OF SECTION

NOT FOR BIDDING

SECTION 23 21 14
HYDRONIC SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Air vents.

B. Strainers.

C. Flexible equipment connectors.

D. Balancing valves.

E. Flow meters.

F. Flow indicators, controls, meters.

G. Relief valves.

1.02 RELATED REQUIREMENTS

A. Section 23 21 13 - Hydronic Piping.

1.03 REFERENCE STANDARDS

A. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description, model.

C. Certificates: Inspection certificates for pressure vessels from authority having jurisdiction.

D. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

E. Project Record Documents: Record actual locations of flow controls and flow meters.

F. Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.07 EXTRA MATERIALS

A. See Section 01 6000 - Project Requirements, for additional provisions.

NOT FOR BIDDING

PART 2 PRODUCTS

2.01 AIR VENTS

A. Manufacturers:
   1. Armstrong International, Inc: www.armstronginternational.com/#sle.
   2. ITT Bell & Gossett: www.bellgossett.com/#sle.
   3. Taco, Inc: www.taco-hvac.com/#sle.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Manual Type: Short vertical sections of 2 inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber.

C. Float Type:
   1. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.

D. Washer Type:
   1. Brass with hygroscopic fiber discs, vent ports, adjustable cap for manual shut-off, and integral spring loaded ball check valve.

E. Maximum Fluid Pressure: 150 psi.

F. Maximum Fluid Temperature: 250 degrees F.

2.02 STRAINERS

A. Manufacturers:
   1. Armstrong International, Inc: www.armstronginternational.com/#sle.
   2. Victaulic Company of America: www.victaulic.com.
   3. Green Country Filtration: greencountryfiltration.com.
   4. WEAMCO: www.weamco.com.
   5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Size 2 inch and Under:
   1. Screwed brass or iron body for 175 psi working pressure, Y pattern with 1/32 inch stainless steel perforated screen.
   2. Body Material by Fluid Service:
      a. Stainless Steel:
         1) Liquids: Up to 1,440 psi at 100 degrees F.

C. Size 2-1/2 inch to 4 inch:
   1. Provide flanged or grooved iron body for up to 175 psi working pressure, up to 250 degrees F working temperature, Y-pattern strainer with 1/16 inch or 3/64 inch stainless steel perforated screen.
   2. Body Material by Fluid Service:
      a. Stainless Steel:
         1) Liquids: Up to 285 psi at 100 degrees F.
   3. Flanged iron body for 175 psi working pressure, Y pattern with 3/64 inch stainless steel perforated screen.

D. Accessories: Provide air vent, hanging tag, outlet ball valve, and PT test plug extension.

2.03 FLEXIBLE EQUIPMENT CONNECTORS

A. Manufacturers:
   1. American Wheatley, a company of Global Flow Products, LLC: www.wheatleyhvac.com/#sle.

NOT FOR BIDDING

2. Anvil International; AnviFlex: www.anvilintl.com/#sle.
3. The Metraflex Company; Vane Flex: www.metraflex.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Flexible Connectors: Flanged, braided type with wetted components of stainless steel, sized to match piping.
1. Maximum Allowable Working Pressure: 150 psig at 120 degrees F.
2. Accommodate the Following:
   a. Angular Rotation: 15 degrees.
   b. Force developed by 1.5 times specified maximum allowable operating pressure.
3. End Connections: Flanged ductile iron; complying with ASME B16.1 Class 125.
4. Provide pump connector with integral vanes to reduce turbulent flow.
5. Provide necessary accessories including, but not limited to, swivel joints, limit stops, and internal flow liners.

2.04 BALANCING VALVES

A. Manufacturers:
1. Armstrong International, Inc: www.armstronginternational.com/#sle.
2. ITT Bell & Gossett: www.bellgossett.com/#sle.
3. Taco, Inc: www.taco-hvac.com/#sle.
4. Tour and Andersson: www.tahydronics.com
5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Size 2 inch and Smaller:
1. Provide ball or globe style with flow balancing, flow measurement, 3/4" NPT hose end drain connection, and full shut-off capabilities, memory stops, minimum of two metering ports and NPT threaded or soldered connections.
2. Metal construction materials consist of bronze or brass.
3. Non-metal construction materials consist of EPDM.

C. Size 2.5 inch and Larger:
1. Provide globe or butterfly style with flow balancing, memory stops, flow measurement, 3/4" NPT hose end drain connection, and full shut-off capabilities and flanged, grooved, or weld end connections.
2. Valve body construction materials consist of ductile iron.
3. Internal components construction materials consist of Ametal, Ametal, Ametal, or Ametal.

2.05 FLOW METERS

A. Manufacturers:
1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
2. EMCO Flow Systems: www.emcoflow.com/#sle.
3. GE Infrastructure Sensing/GE Panametrics: www.gesensing.com.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Orifice principle by-pass circuit with direct reading gage, soldered or flanged piping connections for 125 psi working pressure, with shut off valves, and drain and vent connections.

C. Direct reading with insert pitot tube, threaded coupling, for 150 psi working pressure, maximum 240 degrees F, 5 percent accuracy.

D. Cast iron, wafer type, orifice insert flow meter for 250 psi working pressure, with read-out valves equipped with integral check valves with gasketed caps.

E. Calibrated, plug type balance valve with precision machined orifice, readout valves equipped with integral check valves and gasketed caps, calibrated nameplate and indicating pointer.

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F. Cast iron or bronze, globe style, balance valve with handwheel with vernier type ring setting and memory stop, drain connection, readout valves equipped with integral check valves and gasketed caps.

G. Portable meter consisting of case containing one, 3 percent accuracy pressure gage with 0-60 feet pressure range for 500 psi maximum working pressure, color coded hoses for low and high pressure connections, and connectors suitable for connection to read-out valves.

H. Portable meter consisting of case containing two, 3 percent accuracy pressure gages with 0-135 inches and 0-60 feet pressure ranges for 500 psi maximum working pressure, color coded hoses for low and high pressure connections, and connectors suitable for connection to read-out valves.

2.06 RELIEF VALVES

A. Manufacturers:
   1. Armstrong International, Inc: www.armstronginternational.com/#sle.
   2. ITT Bell & Gossett: www.bellgossett.com/#sle.
   3. Conbraco Industries, Inc: www.conbraco.com/#sle.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labelled.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install specialties in accordance with manufacturer's instructions.

B. Where large air quantities can accumulate, provide enlarged air collection standpipes.

C. Provide manual air vents at system high points and as indicated.

D. Provide valved drain and hose connection on strainer blow down connection.

E. Provide relief valves on pressure tanks, low pressure side of reducing valves, heat exchangers, and expansion tanks.

F. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.

G. Pipe relief valve outlet to nearest floor drain.

H. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.

END OF SECTION

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SECTION 23 25 00
HVAC WATER TREATMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Materials.
   1. Condenser water system treatment (cooling towers).
B. Cleaning of piping systems.
C. Chemical treatment.

1.02 RELATED REQUIREMENTS

A. Section 23 21 13 - Hydronic Piping.
B. Section 23 21 14 - Hydronic Specialties.
C. Section 23 09 13 - Instrumentation and Control Devices for HVAC.
D. Section 26 05 83 - Wiring Connections: Electrical characteristics and wiring connections.

1.03 SUBMITTALS

A. See Section 01 33 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide chemical treatment materials, chemicals, and equipment including electrical characteristics and connection requirements.
C. Shop Drawings: Indicate system schematic, equipment locations, and controls schematics, electrical characteristics and connection requirements.
D. Manufacturer's Installation Instructions: Indicate placement of equipment in systems, piping configuration, and connection requirements.
E. Manufacturer's Field Reports: Indicate start-up of treatment systems when completed and operating properly. Indicate analysis of system water after cleaning and after treatment.
F. Certificate: Submit certificate of compliance from authority having jurisdiction indicating approval of chemicals and their proposed disposal.
G. Project Record Documents: Record actual locations of equipment and piping, including sampling points and location of chemical injectors.
H. Operation and Maintenance Data: Include data on chemical feed pumps, agitators, and other equipment including spare parts lists, procedures, and treatment programs. Include step by step instructions on test procedures including target concentrations.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum ten years of documented experience. Company shall have local representatives with water analysis laboratories and full time service personnel.
B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum five years of documented experience and approved by manufacturer.

1.05 REGULATORY REQUIREMENTS

A. Conform to applicable code for addition of non-potable chemicals to building mechanical systems and to public sewage systems.
B. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.

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1.06 MAINTENANCE MATERIALS

A. See Section 01 6000 - Product Requirements, for additional provisions.

B. Supply sufficient chemicals for startup treatment.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. General Requirements (at Contractor's expense):
   1. Contractor is to work with existing water treatment vendor (Tustin).
   2. Prior to beginning the work, the water treatment vendor shall shut down the existing water treatment system, store and protect on site to facilitate the work.
   3. During the work, the water treatment vendor shall provide assistance to the Contractor to field-locate required injection points in new piping and any other required appurtenances to facilitate water treatment system reinstallation.
   4. At conclusion of the work, the Contractor shall flush and clean the existing condenser water system to the satisfaction of the water treatment vendor. The water treatment vendor shall reinstall water treatment system and provide startup services in coordination with cooling tower startup.
   5. Upon project conclusion, the water treatment vendor shall resume existing term maintenance service agreement.

2.02 MATERIALS

A. Condenser Water System Treatment (Cooling Towers):
   1. Manufacturers:
      a. AmSolv/Division of Amrep, Inc: www.amsolv.com/#sle.
      b. GE Water Technologies: www.gewater.com/#sle.
      c. Nalco Company: www.nalco.com/#sle.
      d. Substitutions: See Section 01 60 00 - Product Requirements.
   2. Sequestering agent to inhibit scaling; phosphonates, sodium polyphosphates, lignin derivatives, synthetic polymer polyelectrolytes, or organic phosphates.
   3. Acid to reduce alkalinity and pH; sulphuric acid.
   4. Corrosion inhibitor; zinc-phosphate, phosphonate-phosphate, phosphonate-molybdate and phosphonate-silicate, sodium tolyltriazole, or low molecular weight polymers.
   5. Biocide chlorine release agents such as sodium hypochlorite or calcium hypochlorite or microbiocides such as quaternary ammonia compounds, tributyl tin oxide, methylene bis (thiocyanate).

PART 3 EXECUTION

3.01 PREPARATION

A. Systems shall be operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system.

B. Place terminal control valves in open position during cleaning.

C. Verify that electric power is available and of the correct characteristics.

3.02 CLEANING SEQUENCE

A. Concentration:
   1. As recommended by manufacturer.

B. Chilled Water and Condenser Water Systems:
   1. Circulate for 48 hours, then drain systems as quickly as possible.
   2. Refill with clean water, circulate for 24 hours, then drain.

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3. Refill with clean water and repeat until system cleaner is removed.

C. Use neutralizer agents on recommendation of system cleaner supplier and approval of Contruction Manager, Architect or Engineer of Record.

D. Flush open systems and glycol filled closed systems with clean water for one hour minimum. Drain completely and refill.

E. Remove, clean, and replace strainer screens.

F. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.04 CLOSEOUT ACTIVITIES

A. Training: Train Owner's personnel on operation and maintenance of chemical treatment system.
   1. Provide minimum of two hours of instruction for two people.
   2. Have operation and maintenance data prepared and available for review during training.
   3. Conduct training using actual equipment after treated system has been put into full operation.

END OF SECTION

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SECTION 23 65 14
INDUCED DRAFT COOLING TOWERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cooling tower.

B. Safety railings and ladder.

C. Accessories including field-installed control panel with fan VFD, recirculation pump, and basin heater.

1.02 RELATED REQUIREMENTS

A. Section 23 21 13 - Hydronic Piping.

B. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.

1.03 REFERENCE STANDARDS

A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings.

B. ABMA STD 11 - Load Ratings and Fatigue Life for Roller Bearings.

C. ASME PTC 23 - Atmospheric Water Cooling Equipment.

D. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

E. CTI ATC-105 - Acceptance Test Code.

F. CTI STD-201 OM - Operations Manual for Thermal Performance Certification of Evaporative Heat Rejection Equipment.

G. CTI STD-201 RS - Performance Rating of Evaporative Heat Rejection Equipment.

H. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

I. NEMA MG 1 - Motors and Generators.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide rated capacities, dimensions, weights and point loadings, accessories, required clearances, electrical requirements and wiring diagrams, and location and size of field connections. Submit schematic indicating capacity controls.
   1. Test and certify closed circuit cooler thermal performance according to CTI Standard 201.
   2. Test and certify closed circuit cooler sound performance according to CTI ATC-128.
   3. Meet or Exceed energy efficiency per ASHRAE 90.1.

C. Shop Drawings: Indicate suggested structural steel supports including dimensions, sizes, and locations for mounting bolt holes.

D. Manufacturer's Instructions: Submit manufacturer's complete installation instructions.

E. Operation and Maintenance Data: Include start-up instructions, maintenance data, parts lists, controls, and accessories.

F. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Extra Fan Belts: One set, matched, for each unit.

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1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years of experience and approved by manufacturer.

C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

F. ASME Compliance: Fabricate and label heat-exchanger coils to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

G. CTI Certification: Cooling tower thermal performance according to CTI STD 201, "Certification Standard for Commercial Water-Cooling Towers Thermal Performance."

1.06 DELIVERY, STORAGE, AND HANDLING

A. Factory assemble entire unit. For shipping, disassemble into large sub-assemblies to minimize field work required for re-assembly.

B. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

1.07 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace the following components of cooling towers that fail in materials or workmanship within specified warranty period:
   1. Fan assembly including fan, sheaves, bearings, and motor assembly: 5 years
   2. Motor with space heater wired and operating at start-up: 7 years
   3. Cold water basin: 5 years leak proof warranty
   4. All components of cooling tower: two years from date of substantial completion

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design - Baltimore Aircoil Company: www.baltimoreaircoil.com (See Drawing M-500 - Mechanical Equipment Schedules & Details)

B. EVAPCO, Inc; www.evapco.com.

C. SPX Cooling Technologies, Inc. / Marley; www.spxcooling.com.

D. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 CLOSED-CIRCUIT, INDUCED-DRAFT, COMBINED-FLOW COOLING TOWERS

A. Induced draft counter flow type cooling towers are not acceptable

B. If an alternate cooling tower shall be utilized it must match basis of design dimensions and weight requirements as specified on contract documents.

C. If a cooling tower other than the basis of design is proposed, it is the responsibility of the installing contractor to provide structural analysis and professional engineer stamped drawings to match existing site requirements at no additional cost to the owner.

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D. Fabricate cooling tower mounting base with reinforcement strong enough to resist cooling tower movement during a seismic event when cooling tower is anchored to field support structure.

E. Cooling tower designed to resist wind load of 30 lbf/sq. ft.

F. Casing and Frame:
   1. Casing and Frame: Galvanized steel, ASTM A 653/A 653M, G235 coating
   2. Fasteners: match materials of construction
   3. Joints and Seams: Sealed watertight.
   4. Welded Connections: Continuous and watertight.

G. Collection Basin:
   1. Material: Type 316 stainless steel.
   2. Strainer: Removable stainless steel strainer with openings smaller than nozzle orifices.
   3. Overflow and drain connections.
   4. Makeup water connection.
   5. Basin Sweeper Distribution Piping and Nozzles:
      a. Pipe Material: PVC
      b. Nozzle Material: Plastic
      c. Configure piping and nozzles to minimize sediment from collecting in the collection basin.

H. Mechanically Operated, Collection Basin Water-Level Control: Manufacturer's standard adjustable, mechanical float assembly and valve.

I. Electric/Electronic, Collection Basin Water-Level Controller with Solenoid Valve:
   1. Enclosure: NEMA 250, Type 3RX or 4 X
   2. Sensor: Solid-state controls with multiple electrode probes and relays factory wired to a terminal strip to provide control of makeup water valve and high / low level alarms.
   3. Electrode Probes: Stainless steel.
   4. Water Stilling Chamber: PVC Pipe
   5. Solenoid Valve: Slow closing controlled and powered through level controller in response to water-level set point.
   6. Electrical Connection Requirements: 120 V, single phase, 60 Hz.

J. Electric Basin Heater:
   1. Electric Immersion Heaters: Installed in a threaded coupling on the side of the collection basin.
   2. Heater Control Panel: Mounted on the side of each cooling tower cell.
   3. Enclosure: NEMA 250, Type 3R
   4. Magnetic contactors controlled by a temperature sensor/controller to maintain collection basin water-temperature set point. Water-level probe shall monitor cooling tower water level and de-energize the heater when the water reaches low-level set point.
   5. Control-circuit transformer with primary and secondary side fuses.
   6. Terminal blocks with numbered and color-coded wiring to match wiring diagram.

K. Pressurized Water Distribution Piping: Main header and lateral branch piping designed for even distribution over heat-exchanger coil or fill throughout the flow range without the need for balancing valves and for connecting individual, removable, nonclogging spray nozzles.
   1. Pipe Material: PVC
   2. Spray Nozzle Material: Plastic
   3. Piping Supports: Corrosion-resistant hangers and supports to resist movement during operation and shipment.

L. Recirculating Piping: PVC

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M. Spray Pump: Close-coupled, end-suction, single-stage, bronze-fitted centrifugal pump; with suction strainer and flow balancing valve, and mechanical seal suitable for outdoor service.
   1. General Requirements for Spray Pump Motor: Comply with NEMA designation and temperature-rating requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment" and not indicated below.
   2. Motor Enclosure: Totally enclosed fan cooled (TEFC)
   3. Energy Efficiency: [omply with ASHRAE/IESNA 90.1]
   4. Service Factor: 1.15

N. Fill:
   1. Materials: PVC with maximum flame-spread index of 5 according to ASTM E 84.
   2. Fabrication: Fill-type sheets fabricated, formed, and bonded together after forming into removable assemblies that are factory installed by manufacturer.
   3. Fill Material Operating Temperature: Suitable for entering-water temperatures up through 120 deg F

O. Heat-Exchanger Coils:
   1. Galvanized Steel: The coil will be constructed of continuous serpentine all prime surface steel, be pneumatically tested at 375 psig (2,685 kPa), and be hot-dip galvanized after fabrication. The coil will be designed for free drainage of fluid and will be ASME B31.5 compliant. Maximum allowable working pressure will be 300 psig (280 psig for coils supplied with a CRN).
   2. Field Piping Connections: Vent, supply, and return

P. Drift Eliminator:
   1. Material: FRP or PVC; with maximum flame-spread index of 5 according to ASTM E 84.
   2. UV Treatment: Inhibitors to protect against damage caused by UV radiation.
   3. Configuration: Multipass, designed and tested to reduce water carryover to achieve performance indicated.
   4. Fill Drift Eliminators: Integral to fill.
   5. Heat-Exchanger Coil Drift Eliminators: Located on discharge side and removable.

Q. Air-Intake Louvers:
   1. PVC Inlet Shields, The combined inlet shields shall be UV resistant PVC, installed on the air inlet face to minimize air resistance, prevent water splash out, minimized sunlight exposure to reduce the potential for algae growth in the cold water basin. Axial

R. Fan: Balanced at the factory after assembly.
   1. Blade Material: Aluminum
   2. Hub Material: Aluminum
   3. Blade Pitch: Field adjustable.
   4. Protective Enclosure: Removable, galvanized-steel, wire-mesh screens complying with OSHA regulations.
   5. Fan Shaft Bearings: Self-aligning ball or roller bearings with moisture-proof seals and premium, moisture-resistant grease suitable for temperatures between minus 20 and plus 300 deg F. Bearings designed for an L-10 life of 40,000 hours.
   6. Bearings Grease Fittings: Extended lubrication lines to an easily accessible location.

S. Belt Drive:
   1. Service Factor: 1.5 based on motor nameplate horsepower.
   2. Sheaves: Fan and motor shafts shall have taper-lock sheaves fabricated from corrosion-resistant materials.
   3. Belt: Multiple V-belt design with a matched set of belts.

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4. Belt: One-piece, multigrooved, solid-back belt.
5. Belt Material: Oil resistant, nonstatic conducting, and constructed of neoprene polyester cord.
6. Belt-Drive Guard: Comply with OSHA regulations.

T. Fan Motor:
1. General Requirements for Fan Motors: Comply with NEMA designation and temperature-rating requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment" and not indicated below.
2. Motor Enclosure Totally enclosed air over (TEAO) with epoxy or polyurethane finish
3. Energy Efficiency: Comply with ASHRAE/IESNA 90.1 / NEMA Premium Efficient.
4. Service Factor: 1.15
5. Variable-Speed Motors: Inverter-duty rated per NEMA MG-1, Section IV, "Performance Standard Applying to All Machines," Part 31, "Definite-Purpose, Inverter-Fed, Polyphase Motors."
6. Motor Location: Mounted inside of cooling tower casing and cooling tower discharge airstream.
7. Motor Base: Adjustable, or other suitable provision for adjusting belt tension.
8. Motors will include an internal space heater whcih are to be field-wired to remove condensation when motor is not in use.
9. Motors to be provided with factory installed shaft grounding rings.

U. Motor Removal Davit:
1. The unit will be equipped with a motor removal davit. The motor will lower from the mechanical equipment supports down to grade. Davit will attach to the unit without the need for tools. If tools are required for davit installation or removal, provide (1) davit for each motor provided.

V. Vibration Switch: For each fan drive.
1. Enclosure: NEMA 250, Type 4
2. Vibration Detection: Sensor with a field-adjustable, acceleration-sensitivity set point in a range of 0 to 1 g and frequency range of 0 to 3000 cycles per minute. Cooling tower manufacturer shall recommend switch set point for proper operation and protection.
3. Provide switch with manual-reset button hardwired connection to fan motor electrical circuit.
4. Switch shall, on sensing excessive vibration and shut down the fan.

W. Controls: Single Point Power Cooling Tower Control Panel
1. The cooling tower package shall include a single point power control panel provided by the cooling manufacturer.
2. Enclosure Type: NEMA 3R
3. The cooling tower control panel shall include complete Variable Frequency Drive (VFD) fan controls to accommodate all fan motor requirements, spray pump starter and control, and incorporate control basin heaters when applicable.
4. A single point power connection for all controlled motors will be included. UL 489 breaker shall include thermal and magnetic trip mechanisms.
5. The VFD(s) shall be capable of controlling the cooling tower fan motor over a range of 10% to 100% of the motor’s base frequency.
6. The control panel shall include manual bypass functionality which isolates the VFD.
7. VFD operator controls shall include a VFD/Off/Bypass switch and HOA switch mounted on the enclosure door.’

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8. Minimum 3% Line Reactors shall be provided on the input side of the drive for harmonic suppression and input rectifier protection. DC Link Reactors or Bus Chokes are not acceptable substitute.
9. The control panel shall include all necessary terminal inputs to control the sequence of operations from a Building Management System including at a minimum: VFD start command, VFD reference speed, spray pump operation, basin heater operation.
10. In the absence of a Building Management System, the control panel shall include a solid state 3-Stage PID temperature controller to operate positive closure damper actuators, spray pump starter and adjust the VFD frequency to maintain water temperature. The cold-water temperature shall be displayed on the PID controller.
11. Voltage terminal for fan motor space heater to be included.
12. Panel shall also include a basin heater contactor with Off/Auto switch installed and mounted on the enclosure door. Interlock between VFD and basin heater to be included.
13. Terminal inputs shall be provided for Vibration Cut Out Switch.
14. All internal power and control wiring to be installed and tested in the factory.
15. A Five (5) year parts only warranty shall be provided as a standard option by the panel manufacturer.
16. VFD Start-up assistance and training shall be provided by factory and/or VFD provider. Start-up services shall be provided by a trained manufacturer's certified technician. A factory supplied start-up form shall be filled out for each drive with a copy provided to the owner, and a copy sent to be kept on file at the manufacturer.
17. Factory trained application engineering and service personnel that are thoroughly trained with the supplied VFD and optional packages shall be available via factory remote technical assistance at both the specifying and installation locations. Additional local support to be available through VFD supplier or referred technician for hire or pre-negotiated service terms. Servicing technician does not need to be factory certified to preserve warranty.

X. Personnel Access Components:
1. Doors: Large enough for personnel to access cooling tower internal components from both cooling tower end walls. Doors shall be operable from both sides of the door.
2. External Platforms with Handrails: Aluminum, FRP, or galvanized-steel bar grating at cooling tower louver face for access to spray distribution and/or at cooling tower access door
3. Handrail: Aluminum, galvanized steel, or stainless steel complete with kneerail and toeboard, Comply with 29 CFR 1910.23.
4. Internal Walkway: to match cooling tower materials of construction
   a. Spanning the collection basin from one end of cooling tower to the other and positioned to form a path between the access doors. Platform shall be elevated so that all parts are above the high water level of the collection basin

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide the services of the manufacturer's field representative to supervise rigging, hoisting, and installation, allowing for minimum of one eight hour day per tower.

C. Connect condenser water piping with flanged connections to tower. Pitch condenser water supply to tower and condenser water suction away from tower. Refer to Section 23 21 13.

D. Connect make-up water piping with flanged or union connections to tower. Pitch to tower.

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E. Connect overflow, bleed, and drain, to grade within 20' of cooler as directed by owner.

3.02 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Provide the services of the manufacturer's field representative to inspect tower after installation and submit report prior to start-up, verifying installation is in accordance with specifications and manufacturer's recommendations.

C. Test for capacity under actual operating conditions in accordance with CTI ATC-105 and verify specified performance. Perform testing during peak summer design condition and submit report to engineer.

3.03 SYSTEM STARTUP

A. Engage a factory-authorized service representative to perform startup service.

B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assemblies, installations, and connections.

C. Obtain performance data from manufacturer.
   1. Complete installation and startup checks according to manufacturer's written instructions and perform the following:
      a. Clean entire unit including basins.
      b. Verify that accessories are properly installed.
      c. Verify clearances for airflow and for cooling tower servicing.
      d. Check for vibration isolation and structural support.
      e. Lubricate bearings.
      f. Verify fan rotation for correct direction and for vibration or binding and correct problems.
      g. Adjust belts to proper alignment and tension.
      h. Operate variable-speed fans through entire operating range and check for harmonic vibration imbalance. Set motor controller to skip speeds resulting in abnormal vibration.
      i. Check vibration switch setting. Verify operation.
      j. Verify water level in tower basin. Fill to proper startup level. Check makeup water-level control and valve.
      k. Verify operation of basin heater and control.
      l. Verify that cooling tower air discharge is not recirculating air into tower or HVAC air intakes. Recommend corrective action.
      m. Replace defective and malfunctioning units.

D. Start cooling tower and associated water pumps. Follow manufacturer's written starting procedures.

E. Prepare a written startup report that records the results of tests and inspections.

END OF SECTION

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SECTION 26 05 05
SELECTIVE DEMOLITION FOR ELECTRICAL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical demolition.

1.02 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify field measurements and circuiting arrangements are as shown on Drawings.

B. Verify that abandoned wiring and equipment serve only abandoned facilities.

C. Demolition drawings are based on casual field observation .

D. Report discrepancies to Owner before disturbing existing installation.

E. Report discrepancies to Architect before disturbing existing installation.

F. Beginning of demolition means installer accepts existing conditions.

3.02 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings to be removed.

B. Coordinate utility service outages with utility company.

C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Remove, relocate, and extend existing installations to accommodate new construction.

B. Remove abandoned wiring to source of supply.

C. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

D. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.

E. Disconnect and remove abandoned panelboards and distribution equipment.

F. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

G. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.

H. Repair adjacent construction and finishes damaged during demolition and extension work.

I. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.

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J. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

3.04 CLEANING AND REPAIR

A. See Section 01 74 19 - Construction Waste Management and Disposal for additional requirements.

B. Clean and repair existing materials and equipment that remain or that are to be reused.

C. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

D. Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps , ballasts and broken electrical parts.

E. Any lighting or ceiling-mounted devices removed during construction must be reinstalled.

END OF SECTION

NOT FOR BIDDING

SECTION 26 05 19
LOW VOLTAGE ELECTRICAL POWER CONDUCTORS & CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Single conductor building wire.
B. Wire and cable for 600 volts and less.
C. Wiring connectors.
D. Electrical tape.
E. Wire pulling lubricant.

1.02 REFERENCE STANDARDS

A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire.
B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes.
D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation.
E. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape.
F. NECA 1 - Standard for Good Workmanship in Electrical Construction.
G. NEMA WC 70 - Nonshielded Power Cable 2000 V or Less for the Distribution of Electrical Energy.
H. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.
I. NFPA 70 - National Electrical Code.
J. UL 44 - Thermoset-Insulated Wires and Cables.
K. UL 83 - Thermoplastic-Insulated Wires and Cables.
L. UL 486A-486B - Wire Connectors.
M. UL 486C - Splicing Wire Connectors.
N. UL 486D - Sealed Wire Connector Systems.
O. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
   2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
   3. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

NOT FOR BIDDING

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.

C. Product Data: Provide for each cable assembly type.

D. Samples of Actual Product Delivered: Submit one 18 inch length of cable assembly from each reel.
   1. Select each length to include complete set of manufacturer markings.
   2. Attach tag indicating cable size and application information.

E. Test Reports: Indicate procedures and values obtained.

F. Design Data: Indicate voltage drop and ampacity calculations for aluminum conductors substituted for copper conductors. Include proposed modifications to raceways, boxes, wiring gutters, enclosures, etc. to accommodate substituted conductors.

G. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

H. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing for underground circuits.

I. Project Record Documents: Record actual locations of components and circuits.

1.05 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.07 FIELD CONDITIONS

A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect and obtain direction before proceeding with work.

PART 2 PRODUCTS

2.01 CONDUCTOR AND CABLE APPLICATIONS

A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.

B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.

C. Metal-clad cable is not permitted.

D. Concealed Dry Interior Locations: Use only building wire in raceway type THHN/THHW.

E. Exposed Dry Interior Locations: Use only building wire in raceway type THHN/THHW.

F. Above Accessible Ceilings: Use only building wire in raceway type THHN.

NOT FOR BIDDING

G. Wet or Damp Interior Locations: Use only building wire in raceway type THW.
H. Exterior Locations: Use only building wire in raceway type THHW.
I. Use solid conductor for feeders and branch circuits 10 AWG and smaller.
J. Use solid conductors for control circuits.
K. Use conductor not smaller than 12 AWG for power and lighting circuits.
L. Use conductor not smaller than 16 AWG for control circuits.
M. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet.
N. Use 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet.

2.02 CONDUCTOR AND CABLE MANUFACTURERS

A. Cerro Wire LLC: www.cerrowire.com.
B. Southwire Company: www.southwire.com.
C. Houston Wire and Cable Co: www.houwire.com.
D. Substitutions:

2.03 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

A. Provide products that comply with requirements of NFPA 70.
B. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose indicated.
C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
D. Comply with NEMA WC 70.
E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.
F. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.
G. Conductors for Grounding and Bonding: Also comply with Section 26 05 26 - Grounding and Bonding for Electrical Systems.
H. Conductor Material:
    1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.
    2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B 787M unless otherwise indicated.
    3. Tinned Copper Conductors: Comply with ASTM B33.
I. Minimum Conductor Size:12 AWG.
    1. Branch Circuits: 12 AWG.
        a. Exceptions:
            1) 20 A, 120 V circuits longer than 75 feet: 10 AWG, for voltage drop.
            2) 20 A, 120 V circuits longer than 150 feet: 8 AWG, for voltage drop.
            3) 20 A, 277 V circuits longer than 150 feet: 10 AWG, for voltage drop.
    2. Control Circuits: 14 AWG.
J. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
K. Conductor Color Coding:

NOT FOR BIDDING

1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
2. Color Coding Method: Integrally colored insulation.
   a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
3. Color Code:
   a. 480Y/277 V, 3 Phase, 4 Wire System:
      1) Phase A: Brown.
      2) Phase B: Orange.
      3) Phase C: Yellow.
      4) Neutral/Grounded: Gray.
   b. 208Y/120 V, 3 Phase, 4 Wire System:
      1) Phase A: Black.
      2) Phase B: Red.
      3) Phase C: Blue.
      4) Neutral/Grounded: White.
   c. Equipment Ground, All Systems: Green.
   d. For modifications or additions to existing wiring systems, comply with existing color code when existing code complies with NFPA 70 and is approved by the authority having jurisdiction.
   e. For control circuits, comply with manufacturer's recommended color code.

2.04 SINGLE CONDUCTOR BUILDING WIRE

A. Manufacturers:
   1. Copper Building Wire:
      a. Cerro Wire LLC: www.cerrowire.com/#sle.
      b. Encore Wire Corporation: www.encorewire.com/#sle.
      c. Southwire Company: www.southwire.com/#sle.
      d. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: Single conductor insulated wire.

C. Conductor Stranding:
   1. Feeders and Branch Circuits:
      a. Size 10 AWG and Smaller: Solid.
      b. Size 8 AWG and Larger: Stranded.
   2. Control Circuits: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation:
   1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.
      a. Size 4 AWG and Larger: Type XHHW-2.

F. Conductor: Copper.
   1. For Sizes Smaller Than 4 AWG: Copper.
   2. For Sizes 4 AWG and Larger: Copper.

G. Insulation Voltage Rating: 600 volts.

H. Insulation: NFPA 70, Type THHW/THWN/THHN/THW.

I. Insulation: Thermoplastic material rated 75/90 degrees C.

NOT FOR BIDDING

2.05 WIRING CONNECTORS

A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.

B. Connectors for Grounding and Bonding: Comply with Section 26 05 26 - Grounding and Bonding For Electrical Systems.

C. Wiring Connectors for Splices and Taps:
   1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
   2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.

D. Wiring Connectors for Terminations:
   1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
   2. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
   3. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
   4. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.
   5. Conductors for Control Circuits: Use crimped terminals for all connections.

E. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
   1. Manufacturers:
      a. 3M: www.3m.com/#sle.
      b. Ideal Industries, Inc: www.idealindustries.com/#sle.
      c. NSI Industries LLC: www.nsiindustries.com/#sle.
      d. Substitutions: See Section 01 60 00 - Product Requirements.

F. Mechanical Connectors: Provide bolted type or set-screw type.
   1. Manufacturers:
      a. Burndy LLC: www.burndy.com/#sle.
      b. Ilsco: www.ilsco.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.
      d. Substitutions: See Section 01 60 00 - Product Requirements.

G. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.
   1. Manufacturers:
      a. Burndy LLC: www.burndy.com/#sle.
      b. Ilsco: www.ilsco.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.
      d. Substitutions: See Section 01 60 00 - Product Requirements.

2.06 WIRING ACCESSORIES

A. Electrical Tape:
   1. Manufacturers:
      a. 3M: www.3m.com/#sle.

NOT FOR BIDDING

b. Plymouth Rubber Europa: www.plymouthrubber.com/#sle.
c. Thomas & Betts Corporation[<>]: www.tnb.com/#sle.
d. Substitutions: See Section 01 60 00 - Product Requirements.

2. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.
3. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.

B. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.
1. Manufacturers:
a. 3M: www.3m.com/#sle.
b. American Polywater Corporation: www.polywater.com/#sle.
c. Ideal Industries, Inc: www.idealindustries.com/#sle.

C. Split Bolt Connectors: Description: Connector suitable for copper to copper connection tested and listed to UL 486A requirements. Black burn type-H or equal.
1. Product: Thomas R Betts or equal
2. Substitutions: See Section 01 6000 - Product Requirements.

D. Spring Wire Connectors: Description: Flame retardant thermoplastic shell with plated steel square wire spring gated for 105 degrees C, 600 volts, Thomas and Betts fixed spring wire connectors or equal.
1. Product: Ideal or equal

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that work likely to damage wire and cable has been completed.

C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.

D. Verify that raceway installation is complete and supported.

E. Verify that field measurements are as shown on the drawings.

F. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.03 INSTALLATION

A. Circuiting Requirements:
1. Unless dimensioned, circuit routing indicated is diagrammatic.
2. When circuit destination is indicated and routing is not shown, determine exact routing required.
3. Arrange circuiting to minimize splices.

B. Install products in accordance with manufacturer's instructions.

C. Install conductors and cable in a neat and workmanlike manner in accordance with NECA 1.

NOT FOR BIDDING

D. Installation in Raceway:
   1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
   2. Pull all conductors and cables together into raceway at same time.
   3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
   4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.

E. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.

F. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.

G. Install conductors with a minimum of 12 inches of slack at each outlet.

H. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.

I. Make wiring connections using specified wiring connectors.
   1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
   2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
   3. Do not remove conductor strands to facilitate insertion into connector.
   4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
   5. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.

J. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.

K. Insulate ends of spare conductors using vinyl insulating electrical tape.

L. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.

M. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00 - Firestopping.

N. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

O. Install wire and cable securely, in a neat and workmanlike manner, as specified in NECA 1.

P. Route wire and cable as required to meet project conditions.
   1. Wire and cable routing indicated is approximate unless dimensioned.
   2. Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.
   3. Include wire and cable of lengths required to install connected devices within 10 ft of location shown.

Q. Use wiring methods indicated.

NOT FOR BIDDING

R. Pull all conductors into raceway at same time.

S. Use suitable wire pulling lubricant for building wire 4 AWG and larger.

T. Protect exposed cable from damage.

U. Support cables above accessible ceiling, using spring metal clips or metal cable ties to support cables from structure or ceiling suspension system. Do not rest cable on ceiling panels.

V. Use suitable cable fittings and connectors.

W. Neatly train and lace wiring inside boxes, equipment, and panelboards.

X. Clean conductor surfaces before installing lugs and connectors.

Y. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

Z. Use suitable reducing connectors or mechanical connector adaptors for connecting aluminum conductors to copper conductors.

AA. Use split bolt connectors for copper conductor splices and taps, 6 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.

BB. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.

CC. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

DD. Identify and color code wire and cable under provisions of Section 26 05 53 Identification for Electrical Systems. Identify each conductor with its circuit number or other designation indicated.

3.04 FIELD QUALITY CONTROL

A. Perform inspection, testing, and adjusting in accordance with Section 01 40 00 Quality Requirements.

B. Perform field inspection and testing in accordance with Section 01 40 00 Quality Requirements.

C. Inspect and test in accordance with NETA STD ATS, except Section 4.

D. Perform inspections and tests listed in NETA STD ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.

E. Correct deficiencies and replace damaged or defective conductors and cables.

F. Perform inspections and tests listed in NETA STD ATS, Section 7.3.2.

END OF SECTION

NOT FOR BIDDING

SECTION 26 05 26
GROUNDING & BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Grounding and bonding requirements.

B. Conductors for grounding and bonding.

C. Connectors for grounding and bonding.

D. Ground rod electrodes.

E. Grounding and bonding components.

F. Provide all components necessary to complete the grounding system(s) consisting of:
   1. Existing metal underground water pipe.
   2. Metal frame of the building.
   3. Existing metal underground gas piping system.
   4. Metal underground gas piping system.

1.02 REFERENCE STANDARDS

A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction.

C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings.

D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.

E. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association; 2007.

F. NFPA 70 - National Electrical Code.

G. UL 467 - Grounding and Bonding Equipment.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Verify exact locations of underground metal water service pipe entrances to building.
   2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
   3. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.04 PERFORMANCE REQUIREMENTS

A. Grounding System Resistance: 25 ohms.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittals procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.

C. Shop Drawings:

NOT FOR BIDDING

1. Indicate proposed arrangement for signal reference grids. Include locations of items to be bonded and methods of connection.

D. Product Data: Provide for grounding electrodes and connections.

E. Test Reports: Indicate overall resistance to ground and resistance of each electrode.

F. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

G. Project Record Documents: Record actual locations of components and grounding electrodes.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Installer Qualifications for Signal Reference Grids: Company with minimum five years documented experience with high frequency grounding systems.

E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience with service facilities within 100 miles of Project.

C. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 GROUNDING AND BONDING REQUIREMENTS

A. Existing Work: Where existing grounding and bonding system components are indicated to be reused, they may be reused only where they are free from corrosion, integrity and continuity are verified, and where acceptable to the authority having jurisdiction.

B. Do not use products for applications other than as permitted by NFPA 70 and product listing.

C. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.

D. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

E. Grounding System Resistance:
1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Architect. Precipitation within the previous 48 hours does not constitute normally dry conditions.
2. Grounding Electrode System: Not greater than 5 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.

NOT FOR BIDDING

3. Between Grounding Electrode System and Major Electrical Equipment Frames, System Neutral, and Derived Neutral Points: Not greater than 0.5 ohms, when tested using "point-to-point" methods.

F. Bonding and Equipment Grounding:
1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
   a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.
   b. Metal gas piping.
   c. Metal process piping.
8. Provide bonding for interior metal air ducts.
9. Provide bonding for metal building frame.

2.02 GROUNDING AND BONDING COMPONENTS

A. General Requirements:
1. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) or testing firm acceptable to authority having jurisdiction as suitable for the purpose indicated.
2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in addition to requirements of Section 26 05 19:
1. Use insulated copper conductors unless otherwise indicated.
   a. Exceptions:
      1) Use bare copper conductors where installed underground in direct contact with earth.
      2) Use bare copper conductors where directly encased in concrete (not in raceway).

C. Connectors for Grounding and Bonding:
1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.
4. Manufacturers - Mechanical and Compression Connectors:

NOT FOR BIDDING

a. Advanced Lightning Technology (ALT): www.altfab.com/#sle.
b. Burndy LLC: www.burndy.com/#sle.
c. Harger Lightning & Grounding: www.harger.com/#sle.
d. Thomas & Betts Corporation: www.tnb.com/#sle.
e. Substitutions: See Section 01 60 00 - Product Requirements.

D. Ground Rod Electrodes:
1. Comply with NEMA GR 1.
2. Material: Copper-bonded (copper-clad) steel.
3. Size: 3/4 inch diameter by 10 feet length, unless otherwise indicated.
4. Manufacturers:
a. Advanced Lightning Technology (ALT): www.altfab.com/#sle.
b. Erico International Corporation: www.erico.com/#sle.
c. Harger Lightning & Grounding: www.harger.com/#sle.
d. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 MANUFACTURERS

A. Cooper Power Systems: www.cooperpower.com.

B. Framatome Connectors International: www.fciconnect.com.

C. Lightning Master Corporation: www.lightningmaster.com.

D. Substitutions: See Section 01 6000 - Product Requirements.

2.04 CONNECTORS AND ACCESSORIES

A. Mechanical Connectors: Bronze.
1. Product: Type H manufactured by Thomas and Betts or equal.
2. Substitutions: See Section 01 6000 - Product Requirements.

B. Wire: Stranded copper.

C. Grounding Electrode Conductor: Size to meet NFPA 70 requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that work likely to damage grounding and bonding system components has been completed.

B. Verify that field measurements are as shown on the drawings.

C. Verify that conditions are satisfactory for installation prior to starting work.

D. Verify existing conditions prior to beginning work.

E. Verify that final backfill and compaction has been completed before driving rod electrodes.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install grounding and bonding system components in a neat and workmanlike manner in accordance with NECA 1.

C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70.

NOT FOR BIDDING

D. Make grounding and bonding connections using specified connectors.
   1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
   2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
   3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
   4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
   5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

E. Identify grounding and bonding system components in accordance with Section 26 05 53 - Identification For Electrical Systems.

F. Provide bonding to meet requirements described in Quality Assurance.

G. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing. Each of branch circuits and feeder circuits shall have dedicated equipment grounding conductor, sharing this conductor with other grounding conductors is not permitted.

3.03 FIELD QUALITY CONTROL

A. Perform inspection in accordance with Section 01 40 00 - Quality Requirements.

B. Inspect and test in accordance with NETA STD ATS except Section 4.

C. Perform inspections and tests listed in NETA STD ATS, Section 7.13.

D. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.

E. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

END OF SECTION

NOT FOR BIDDING

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NOT FOR BIDDING

SECTION 26 05 29
HANGERS & SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Support and attachment components for equipment, conduit, cable, boxes, and other electrical work.

1.02 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.

D. MFMA-4 - Metal Framing Standards Publication.

E. NECA 1 - Standard for Good Workmanship in Electrical Construction.

F. NFPA 70 - National Electrical Code.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
   2. Coordinate the work with other trades to provide additional framing and materials required for installation.
   3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
   4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
   5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 30 00 Cast-in-Place Concrete.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel (strut) framing systems, non-penetrating rooftop supports, and post-installed concrete and masonry anchors.

C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.

D. Product Data: Provide manufacturer’s catalog data for fastening systems.

E. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.05 QUALITY ASSURANCE

A. Comply with NFPA 70.

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B. Comply with applicable building code.

C. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
   1. Comply with the following. Where requirements differ, comply with most stringent.
      a. NFPA 70.
      b. Requirements of authorities having jurisdiction.
   2. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
   3. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) or testing firm acceptable to authority having jurisdiction as suitable for the purpose indicated, where applicable.
   4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
   5. Do not use products for applications other than as permitted by NFPA 70 and product listing.
   6. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
      a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
      b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
      c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
      d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.
   1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
   2. Conduit Clamps: Bolted type unless otherwise indicated.
   3. Manufacturers:
      a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
      b. Erico International Corporation: www.erico.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.
      d. Substitutions: See Section 01 60 00 - Product Requirements.

C. Outlet Box Supports: Hangers, brackets, etc. suitable for the boxes to be supported.
   1. Manufacturers:
      a. ABB: www.electrification.us.abb.com/#sle.
      b. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.

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d. Substitutions: See Section 01 60 00 - Product Requirements.

D. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
1. Manufacturers:
a. ABB: www.electrification.us.abb.com/#sle.
b. Eaton Corporation: www.eaton.com/#sle.
c. Elgen Manufacturing Company, Inc: www.elgenmfg.com/#sle.
d. Substitutions: See Section 01 60 00 - Product Requirements.
2. Comply with MFMA-4.
3. Channel Material:
a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
4. Minimum Channel Thickness: Steel sheet, 12 gage, 0.1046 inch.
5. Minimum Channel Dimensions: 1-5/8 inch width by 1-5/8 inch height.
6. Manufacturers:
a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
b. Thomas & Betts Corporation: www.tnb.com/#sle.
c. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
d. Substitutions: See Section 01 60 00 - Product Requirements.
e. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.

E. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
1. Minimum Size, Unless Otherwise Indicated or Required:
a. Equipment Supports: 1/2 inch diameter.
b. Single Conduit up to 1 inch (27 mm) trade size: 1/4 inch diameter.
c. Single Conduit larger than 1 inch (27 mm) trade size: 3/8 inch diameter.
d. Trapeze Support for Multiple Conduits: 3/8 inch diameter.
e. Outlet Boxes: 1/4 inch diameter.

F. Anchors and Fasteners:
1. Manufacturers - Mechanical Anchors:
a. Dewalt: anchors.dewalt.com/#sle.
b. Hilti, Inc: www.hilti.com/#sle.
c. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
d. Substitutions: See Section 01 60 00 - Product Requirements.
2. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
3. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
4. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
5. Hollow Masonry: Use toggle bolts.
6. Hollow Stud Walls: Use toggle bolts.
7. Steel: Use beam clamps, machine bolts, or welded threaded studs.
8. Sheet Metal: Use sheet metal screws.
9. Wood: Use wood screws.
10. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
a. Comply with MFMA-4.
b. Channel Material: Use galvanized steel.

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c. Manufacturer: Same as manufacturer of metal channel (strut) framing system.

2.02 MANUFACTURERS

A. Thomas & Betts Corporation: www.tnb.com.

B. Threaded Rod Company: www.threadedrod.com.

C. Substitutions: See Section 01 6000 - Product Requirements.

2.03 MATERIALS

A. Hangers, Supports, Anchors, and Fasteners - General: Corrosion-resistant materials of size and type adequate to carry the loads of equipment and conduit, including weight of wire in conduit.

B. Supports: Fabricated of structural steel or formed steel members; galvanized.

C. Anchors and Fasteners:
1. Do not use powder-actuated anchors.
2. Concrete Structural Elements: Use precast inserts.
3. Steel Structural Elements: Use beam clamps.
4. Concrete Surfaces: Use self-drilling anchors or expansion anchors.
5. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use hollow wall fasteners.
6. Solid Masonry Walls: Use expansion anchors.
7. Sheet Metal: Use sheet metal screws.
8. Wood Elements: Use wood screws.

D. Formed Steel Channel:
1. Product: manufactured by [B-Line] or approved equal.
2. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install support and attachment components in a neat and workmanlike manner in accordance with NECA 1.

C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

G. Equipment Support and Attachment:
1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.

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2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

H. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.

I. Secure fasteners according to manufacturer's recommended torque settings.

J. Remove temporary supports.

K. Identify independent electrical component support wires above accessible ceilings (only where specifically indicated or permitted) with color distinguishable from ceiling support wires in accordance with NFPA 70.

3.03 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Inspect support and attachment components for damage and defects.

C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

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SECTION 26 05 33.13
CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Galvanized steel rigid metal conduit (RMC).
B. Liquidtight flexible metal conduit (LFMC).
C. Electrical metallic tubing (EMT).
D. Rigid polyvinyl chloride (PVC) conduit.
E. Liquidtight flexible nonmetallic conduit (LFNC).
F. Conduit fittings.
G. Accessories.
H. Conduit, fittings and conduit bodies.

1.02 REFERENCE STANDARDS

A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC).
B. ANSI C80.3 - American National Standard for Steel Electrical Metallic Tubing (EMT).
C. ANSI C80.5 - American National Standard for Electrical Rigid Aluminum Conduit (ERAC).
D. NECA 1 - Standard for Good Workmanship in Electrical Construction.
E. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT).
F. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC).
G. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.
H. NFPA 70 - National Electrical Code.
I. UL 6 - Electrical Rigid Metal Conduit-Steel.
J. UL 360 - Liquid-Tight Flexible Steel Conduit.
K. UL 514B - Conduit, Tubing, and Cable Fittings.
L. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings.
M. UL 797 - Electrical Metallic Tubing-Steel.
N. UL 1660 - Liquid-Tight Flexible Nonmetallic Conduit.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate minimum sizes of conduits with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
   2. Coordinate the arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
   3. Verify exact conduit termination locations required for boxes, enclosures, and equipment installed under other sections or by others.
   4. Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
   5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

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B. Sequencing:
   1. Do not begin installation of conductors and cables until installation of conduit is complete between outlet, junction and splicing points.

1.04 SUBMITTALS

A. See Section 01 33 00 - Administrative Requirements for submittals procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.

C. Shop Drawings:
   1. Indicate proposed arrangement for conduits to be installed within structural concrete slabs, where permitted.
   2. Include proposed locations of roof penetrations and proposed methods for sealing.

D. Project Record Documents: Record actual routing for conduits installed underground, conduits embedded within concrete slabs, and conduits 2 inch (53 mm) trade size and larger.

E. Product Data: Provide for metallic conduit and flexible metal conduit.

F. Samples of Materials Actually Delivered to Site:
   1. Two pieces each of conduit, 2 feet long.

G. Project Record Documents: Accurately record actual routing of conduits larger than 2 inches.

1.05 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

D. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for purpose specified and shown.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

B. Accept conduit on site. Inspect for damage.

C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

D. Protect PVC conduit from sunlight.

PART 2 PRODUCTS

2.01 CONDUIT APPLICATIONS

A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.

B. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.

C. Underground:

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1. Under Slab on Grade: Use rigid PVC conduit.
2. Exterior, Direct-Buried: Use rigid PVC conduit.
3. Exterior, Embedded Within Concrete: Use rigid PVC conduit.
4. Where rigid polyvinyl (PVC) conduit larger than 2 inch (53 mm) trade size is provided, use galvanized steel rigid metal conduit elbows for bends.

D. Concealed Within Masonry Walls: Use galvanized steel rigid metal conduit or electrical metallic tubing (EMT).

E. Concealed Within Hollow Stud Walls: Use galvanized steel rigid metal conduit or electrical metallic tubing (EMT).

F. Concealed Above Accessible Ceilings: Use electrical metallic tubing (EMT).

G. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit.

H. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit or electrical metallic tubing (EMT).

I. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit.
1. Locations subject to physical damage include, but are not limited to:
   a. Mechanical Rooms.
   b. Boiler Rooms.
   c. Electrical Rooms.
   d. Chiller Rooms.
   e. Mechanical Equipment Rooms.

J. Exposed, Exterior: Use galvanized steel rigid metal conduit.

K. Connections to Vibrating Equipment:
1. Dry Locations: Use liquidtight flexible nonmetal conduit.
2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible nonmetal conduit.
3. Maximum Length: 6 feet unless otherwise indicated.
4. Vibrating equipment includes, but is not limited to:
   a. Transformers.
   b. Motors.
   c. HVAC equipment.

2.02 CONDUIT REQUIREMENTS

A. Comply with NFPA 70.

B. Fittings for Grounding and Bonding: Also comply with Section 26 05 26 - Grounding and Bonding For Electrical Systems.

C. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.

D. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) or testing firm acceptable to authority having jurisdiction as suitable for the purpose indicated.

E. Minimum Conduit Size, Unless Otherwise Indicated:
1. Branch Circuits: 1/2 inch (16 mm) trade size.
2. Branch Circuit Homeruns: 3/4 inch (21 mm) trade size.
3. Control Circuits: 1/2 inch (16 mm) trade size.
4. Underground, Interior: 3/4 inch (21 mm) trade size.
5. Underground, Exterior: 1 inch (27 mm) trade size.

F. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

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2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Manufacturers:
   1. Allied Tube & Conduit: www.alliedeg.com/#sle.
   2. Republic Conduit: www.republic-conduit.com/#sle.
   3. Wheatland Tube Company: www.wheatland.com/#sle.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.

C. Fittings:
   1. Manufacturers:
      a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
      b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.
      d. Substitutions: See Section 01 60 00 - Product Requirements.
   2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   3. Material: Use steel or malleable iron.
   4. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.04 RIGID METAL CONDUIT (RMC)

A. Manufacturers:
   1. Allied Tube & Conduit: www.alliedtube.com.
   2. Beck Manufacturing, Inc: www.beckmfg.com.
   3. Wheatland Tube Company: www.wheatland.com.
   4. Substitutions: See Section 01 6000 - Product Requirements.

B. Rigid Steel Conduit: ANSI C80.1.

C. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit.

2.05 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. Manufacturers:
   1. AFC Cable Systems, Inc: www.afcweb.com/#sle.
   2. Electri-Flex Company: www.electriflex.com/#sle.
   3. International Metal Hose: www.metalhose.com/#sle.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.

C. Fittings:
   1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   2. Material: Use steel or malleable iron.

D. Description: Interlocked steel construction with PVC jacket.

E. Fittings: NEMA FB 1.

2.06 ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers:

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1. Allied Tube & Conduit: www.alliedeg.com/#sle.
2. Beck Manufacturing, Inc: www.beckmfg.com.
3. Wheatland Tube Company: www.wheatland.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: NFPA 70, Type EMT steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.

C. Fittings:
1. Manufacturers:
a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com/#sle.
c. Thomas & Betts Corporation: www.tnb.com/#sle.
d. Substitutions: See Section 01 60 00 - Product Requirements.
2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use steel or malleable iron.
4. Connectors and Couplings: Use compression (gland) or set-screw type.
a. Do not use indenter type connectors and couplings.

D. Fittings and Conduit Bodies: NEMA FB 1; steel set screw type.

2.07 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

A. Manufacturers:
1. Cantex Inc: www.cantexinc.com/#sle.
2. Carlon, a brand of Thomas & Betts Corporation: www.carlon.com/#sle.
3. AFC Cable Systems, Inc: www.afcweb.com.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.

C. Fittings:
1. Manufacturer: Same as manufacturer of conduit to be connected.
2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

D. Description: NEMA TC 2; Schedule 40 PVC.

E. Fittings and Conduit Bodies: NEMA TC 3.

2.08 LIQUIDTIGHT FLEXIBLE NONMETALLIC CONDUIT (LFNC)

A. Manufacturers:
1. AFC Cable Systems, a division of Atkore International: www.afcweb.com/#sle.
2. Electri-Flex Company: www.electriflex.com/#sle.
3. IPEX, a division of Aliaxis: www.ipexna.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: NFPA 70, Type LFNC liquidtight flexible nonmetallic conduit listed and labeled as complying with UL 1660.

C. Fittings:
1. Manufacturer: Same as manufacturer of conduit to be connected.

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2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B; suitable for type of conduit to be connected.

2.09 ACCESSORIES

A. Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil.

B. Conduit Joint Compound: Corrosion-resistant, electrically conductive; suitable for use with the conduit to be installed.

C. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.

D. Pull Strings: Use nylon cord with average breaking strength of not less than 200 pound-force.

E. Sealing Compound for Sealing Fittings: Listed for use with the particular fittings to be installed.

F. Description: NEMA TC 2.

G. Fittings and Conduit Bodies: NEMA TC 3.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on drawings.

B. Verify that mounting surfaces are ready to receive conduits.

C. Verify that conditions are satisfactory for installation prior to starting work.

D. Verify routing and termination locations of conduit prior to rough-in.

E. Conduit routing is shown on drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install conduit in a neat and workmanlike manner in accordance with NECA 1.

C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.

D. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.

E. Install liquidtight flexible nonmetallic conduit (LFNC) in accordance with NECA 111.

F. Conduit Routing:
   1. Unless dimensioned, conduit routing indicated is diagrammatic.
   2. When conduit destination is indicated and routing is not shown, determine exact routing required.
   3. Conceal all conduits unless specifically indicated to be exposed.
   4. Conduits in the following areas may be exposed, unless otherwise indicated:
      a. Electrical rooms.
      b. Mechanical equipment rooms.
      c. Within joists in areas with no ceiling.
   5. Conduits installed underground or embedded in concrete may be routed in the shortest possible manner unless otherwise indicated. Route all other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
   6. Arrange conduit to maintain adequate headroom, clearances, and access.
   7. Arrange conduit to provide no more than 150 feet between pull points.
   8. Route conduits above water and drain piping where possible.

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9. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
10. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
11. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to:
    a. Heaters.
    b. Hot water piping.
    c. Flues.
12. Group parallel conduits in the same area together on a common rack.

G. Conduit Support:
1. Secure and support conduits in accordance with NFPA 70 and Section 26 05 29 using suitable supports and methods approved by the authority having jurisdiction.
2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
4. Use conduit strap to support single surface-mounted conduit.
    a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
5. Use of wire for support of conduits is not permitted.

H. Connections and Terminations:
1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
3. Use suitable adapters where required to transition from one type of conduit to another.
4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
6. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
7. Secure joints and connections to provide maximum mechanical strength and electrical continuity.

I. Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
2. Make penetrations perpendicular to surfaces unless otherwise indicated.
3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
4. Conceal bends for conduit risers emerging above ground.
5. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.
6. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
7. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and

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maintain roof warranty. Include proposed locations of penetrations and methods for sealing with submittals.

8. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00 - Firestopping.

J. Underground Installation:
   1. Provide trenching and backfilling in accordance with Section 31 23 16.13 - Trenching.
   2. Minimum Cover, Unless Otherwise Indicated or Required:
      a. Underground, Exterior: 24 inches.
   3. Provide underground warning tape in accordance with Section 26 05 53 - Identification For Electrical Systems along entire conduit length.

K. Concrete Encasement: Where conduits not otherwise embedded within concrete are indicated to be concrete-encased, provide concrete in accordance with Section 03 30 00 with minimum concrete cover of 3 inches on all sides unless otherwise indicated.

L. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
   1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
   2. Where conduits are subject to earth movement by settlement or frost.

M. Conduit Sealing:
   1. Use foam conduit sealant to prevent entry of moisture and gases. This includes, but is not limited to:
      a. Where conduits enter building from outside.
      b. Where service conduits enter building from underground distribution system.
      c. Where conduits enter building from underground.
      d. Where conduits may transport moisture to contact live parts.
   2. Where conduits cross barriers between areas of potential substantial temperature differential, use foam conduit sealant at accessible point near penetration to prevent condensation. This includes, but is not limited to:
      a. Where conduits pass from outdoors into conditioned interior spaces.
      b. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.

N. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
   1. Where conduits pass from outdoors into conditioned interior spaces.
   2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.

O. Provide pull string in all empty conduits and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.

P. Provide grounding and bonding in accordance with Section 26 05 26 - Grounding and Bonding For Electrical Systems.

Q. Identify conduits in accordance with Section 26 05 53 - Identification For Electrical Systems.

3.03 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

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C. Correct deficiencies and replace damaged or defective conduits.

3.04 CLEANING

A. Clean interior of conduits to remove moisture and foreign matter.

3.05 PROTECTION

A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

B. Install conduit securely, in a neat and workmanlike manner, as specified in NECA 1.

C. Install steel conduit as specified in NECA 101.

D. Install nonmetallic conduit in accordance with manufacturer's instructions.

E. Arrange supports to prevent misalignment during wiring installation.

F. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

G. Group related conduits; support using conduit rack. Construct rack using steel channel ; provide space on each for 25 percent additional conduits.

H. Fasten conduit supports to building structure and surfaces under provisions of Section 26 05 29.

I. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.

J. Do not attach conduit to ceiling support wires.

K. Arrange conduit to maintain headroom and present neat appearance.

L. Route exposed conduit parallel and perpendicular to walls.

M. Route conduit installed above accessible ceilings parallel and perpendicular to walls.

N. Route conduit in and under slab from point-to-point.

O. Do not cross conduits in slab.

P. Maintain adequate clearance between conduit and piping.

Q. Maintain 12 inch clearance between conduit and surfaces with temperatures exceeding 104 degrees F.

R. Cut conduit square using saw or pipecutter; de-burr cut ends.

S. Bring conduit to shoulder of fittings; fasten securely.

T. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.

U. Use conduit hubs to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.

V. Install no more than equivalent of three 90 degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use hydraulic one shot bender to fabricate bends in metal conduit larger than 2 inch size.

W. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.

X. Provide suitable fittings to accommodate expansion and deflection where conduit crosses seismic, control, and expansion joints.

NOT FOR BIDDING

Y. Provide suitable pull string in each empty conduit except sleeves and nipples.

Z. Use suitable caps to protect installed conduit against entrance of dirt and moisture.

AA. Ground and bond conduit under provisions of Section 26 05 26 - Grounding and Bonding For Electrical Systems.

BB. Identify conduit under provisions of Section 26 05 53 - Identification For Electrical Systems.

3.06 INTERFACE WITH OTHER PRODUCTS

A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00 - Firestopping.

END OF SECTION

NOT FOR BIDDING

SECTION 26 05 33.16
BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.

B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.

C. Wall and ceiling outlet boxes.

D. Pull and junction boxes.

1.02 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction.

B. NECA 130 - Standard for Installing and Maintaining Wiring Devices.

C. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

D. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.

E. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.

F. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports.

G. NFPA 70 - National Electrical Code.

H. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.

I. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations.

J. UL 508A - Industrial Control Panels.

K. UL 514A - Metallic Outlet Boxes.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
6. Coordinate the work with other trades to preserve insulation integrity.
7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
8. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

NOT FOR BIDDING

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for underground handhole enclosures, underground handhole enclosures, underground handhole enclosures, and underground handhole enclosures.

C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

D. Project Record Documents: Record actual locations for underground handhole enclosures, underground handhole enclosures, underground handhole enclosures, underground handhole enclosures, and underground handhole enclosures.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Keys for Lockable Enclosures: Two of each different key.

F. Project Record Documents: Record actual locations and mounting heights of outlet, pull, and junction boxes on project record documents.

1.05 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 BOXES

A. General Requirements:
   1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
   2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
   3. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) or testing firm acceptable to authority having jurisdiction as suitable for the purpose indicated.
   4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
   5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:
   1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
   2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
   3. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.

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4. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
5. Minimum Box Size, Unless Otherwise Indicated:
   a. Wiring Devices (Other Than Communications Systems Outlets): 4 inch square by 2-1/8 inch deep (100 by 54 mm) trade size.
6. Wall Plates: Comply with Section 26 27 26 - Wiring Devices.
7. Manufacturers:
   a. Cooper Crouse-Hinds, a division of Cooper Industries: www.cooperindustries.com/#sle.
   b. Hubbell Incorporated; Bell Products: www.hubbell-bell.com/#sle.
   c. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com/#sle.
   d. Thomas & Betts Corporation: www.tnb.com/#sle.
   e. Substitutions: See Section 01 60 00 - Product Requirements.

C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:
1. Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
2. NEMA EN 10250 Environment Type, Unless Otherwise Indicated:
   a. Indoor Clean, Dry Locations: Type 1, painted steel.
   b. Outdoor Locations: Type 3R, painted steel.
3. Junction and Pull Boxes Larger Than 100 cubic inches:
   a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
4. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes:
   a. Provide lockable hinged covers, all locks keyed alike unless otherwise indicated.
   b. Back Panels: Painted steel, removable.
   c. Terminal Blocks: Provide voltage/current ratings and terminal quantity suitable for purpose indicated, with 25 percent spare terminal capacity.
5. Finish for Painted Steel Enclosures: Manufacturer's standard grey unless otherwise indicated.
6. Manufacturers:
   a. Cooper B-Line, a division of Cooper Industries: www.cooperindustries.com/#sle.
   b. Hoffman, a brand of Pentair Technical Products: www.hoffmanonline.com/#sle.
   c. Hubbell Incorporated; Wiegmann Products: www.hubbell-wiegmann.com/#sle.
   d. Substitutions: See Section 01 60 00 - Product Requirements.
7. Free Standing Outdoor Portable Generator Connection Box.
   a. Manufacturers:
      1) Penn Panel
      2) East Coast Power Systems
      3) Trystar
   b. Construction: Free standing, self supporting ,NEMA 3R , bolted construction of # 10 gauge sheet steel, ANSI # 61 gray colour.
   c. Doors: Hinged doors with filtered louvers and hinged bottom cover with pad lock provisions.
   d. Bus Bars: Tin plated copper with 2000 amp ampacity, phase,neutral and ground bars braced for 65000 amp available interrupting capacity.
   e. Lugs and terminations:(5) 500 kcmil crimp lugs for phase,neutral and ground wires, and (5) Leviton 16 series female angle termial receptacle with 400 amp rating for phase, neutrral and ground wires.
   f. Manufacturer: Penn Panel or equal

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g. Unit to meet and labeled per UL 891 specifications

2.02 MANUFACTURERS

A. Appleton Electric: www.appletonelec.com.

B. Unity Manufacturing: www.unitymfg.com.

C. Thomas and Betts

D. Substitutions: Reco, Inc. See Section 01 6000 - Product Requirements.

2.03 OUTLET BOXES

A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
   1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 1/2 inch male fixture studs where required.
   2. Concrete Ceiling Boxes: Concrete type.

B. Nonmetallic Outlet Boxes: NEMA OS 2.

C. Cast Boxes: NEMA FB 1, Type FD, aluminum. Provide gasketed cover by box manufacturer. Provide threaded hubs.

D. Wall Plates for Finished Areas: As specified in Section 26 27 26 Wiring Devices.

2.04 PULL AND JUNCTION BOXES

A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.

B. Surface Mounted Cast Metal Box: NEMA 250, Type 4; flat-flanged, surface mounted junction box:
   1. Material: Galvanized cast iron; Cast Aluminum.
   2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on drawings.

B. Verify that mounting surfaces are ready to receive boxes.

C. Verify that conditions are satisfactory for installation prior to starting work.

D. Verify locations of floor boxes and outlets in offices and work areas prior to rough-in.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide separate boxes for emergency power and normal power systems.

E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.

F. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.

G. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.

H. Box Locations:

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1. Locate boxes to be accessible. Provide access panels in accordance with Section 08 31 00 as required where approved by the Architect.
2. Unless dimensioned, box locations indicated are approximate.
3. Locate boxes so that wall plates do not span different building finishes.
4. Locate boxes so that wall plates do not cross masonry joints.
5. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
6. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.
7. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
    a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.
    b. Do not install flush-mounted boxes with area larger than 16 square inches or such that the total aggregate area of openings exceeds 100 square inches for any 100 square feet of wall area.
8. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 26 05 33.13.
9. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:
    a. Concealed above accessible suspended ceilings.
    b. Within joists in areas with no ceiling.
    c. Mechanical equipment rooms.

I. Box Supports:
1. Secure and support boxes in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction.
2. Provide independent support from building structureexcept for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.

J. Install boxes plumb and level.

K. Flush-Mounted Boxes:
1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
2. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.

L. Install boxes as required to preserve insulation integrity.

M. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified by the NFPA or authority having jurisdiction.

N. Close unused box openings.

O. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.

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P. Provide grounding and bonding in accordance with Section 26 05 26 - Grounding and Bonding For Electrical Systems.

Q. Identify boxes in accordance with Section 26 05 53.

R. Install boxes securely, in a neat and workmanlike manner, as specified in NECA 1.

S. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and as required by NFPA 70.

T. Electrical boxes are shown on Drawings in approximate locations unless dimensioned.
   1. Adjust box locations up to 10 feet if required to accommodate intended purpose.

U. Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26 - Wiring Devices.

V. Maintain headroom and present neat mechanical appearance.

W. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

X. Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400 - Firestopping.

Y. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.

Z. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.

AA. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

BB. Use stamped steel bridges to fasten flush mounting outlet box between studs.

CC. Install flush mounting box without damaging wall insulation or reducing its effectiveness.

DD. Support boxes independently of conduit, except cast box that is connected to two rigid metal conduits both supported within 12 inches of box.

EE. Use gang box where more than one device is mounted together. Do not use sectional box.

FF. Use cast outlet box in exterior locations exposed to the weather and wet locations.

GG. Large Pull Boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.

3.03 ADJUSTING

A. Adjust floor boxes flush with finish flooring material.

B. Adjust flush-mounting outlets to make front flush with finished wall material.

C. Install knockout closures in unused box openings.

3.04 CLEANING

A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.05 PROTECTION

A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION

NOT FOR BIDDING

SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical identification requirements.
B. Identification nameplates and labels.
C. Wire and cable markers.
D. Voltage markers.
E. Underground warning tape.
F. Warning signs and labels.
G. Field-painted identification of conduit.

1.02 REFERENCE STANDARDS

A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs.
B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels.
C. NFPA 70 - National Electrical Code.
D. NFPA 70E - Standard for Electrical Safety in the Workplace.
E. UL 969 - Marking and Labeling Systems.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.
B. Sequencing:
   1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
   2. Do not install identification products until final surface finishes and painting are complete.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittals procedures.
B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.
C. Shop Drawings: Provide schedule of items to be identified indicating proposed designations, materials, legends, and formats.
D. Product Data: Provide catalog data for nameplates, labels, and markers.
E. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation and installation of product.

1.05 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

1.06 FIELD CONDITIONS

A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

NOT FOR BIDDING

1.07 EXTRA MATERIALS

A. See Section 01 60 00 - Product Requirements for additional requirements.

PART 2 PRODUCTS

2.01 IDENTIFICATION REQUIREMENTS

A. Existing Work: Unless specifically excluded, identify existing elements to remain that are not already identified in accordance with specified requirements.

B. Identification for Equipment:
   1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
      a. Switchgear:
         1) Identify ampere rating.
         2) Identify voltage and phase.
         3) Identify power source and circuit number. Include location when not within sight of equipment.
         4) Use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
      b. Switchboards:
         1) Identify ampere rating.
         2) Identify voltage and phase.
         3) Identify power source and circuit number. Include location when not within sight of equipment.
         4) Use identification nameplate to identify main overcurrent protective device.
         5) Use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
      c. Motor Control Centers:
         1) Identify ampere rating.
         2) Identify voltage and phase.
         3) Identify power source and circuit number. Include location when not within sight of equipment.
         4) Use identification nameplate to identify main overcurrent protective device.
         5) Use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
      d. Panelboards:
         1) Identify ampere rating.
         2) Identify voltage and phase.
         3) Identify power source and circuit number. Include location when not within sight of equipment.
         4) Identify main overcurrent protective device. Use identification label for panelboards with a door. For power distribution panelboards without a door, use identification nameplate.
         5) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.
         6) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
      e. Transformers:
         1) Identify kVA rating.
         2) Identify voltage and phase for primary and secondary.

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3) Identify power source and circuit number. Include location when not within sight of equipment.

f. Enclosed switches, circuit breakers, and motor controllers:
1) Identify voltage and phase.
2) Identify power source and circuit number. Include location when not within sight of equipment.
3) Identify load(s) served. Include location when not within sight of equipment.

g. Enclosed Contactors:
1) Identify ampere rating.
2) Identify voltage and phase.
3) Identify configuration, e.g., E.O.E.H. (electrically operated, electrically held) or E.O.M.H. (electrically operated, mechanically held).
4) Identify coil voltage.
5) Identify load(s) and associated circuits controlled. Include location.

h. Transfer Switches:
1) Identify voltage and phase.
2) Identify power source and circuit number for both normal power source and standby power source. Include location when not within sight of equipment.

2. Service Equipment:
a. Use identification nameplate to identify each service disconnecting means.
b. For buildings or structures supplied by more than one service, or any combination of branch circuits, feeders, and services, use identification nameplate or means of identification acceptable to authority having jurisdiction at each service disconnecting means to identify all other services, feeders, and branch circuits supplying that building or structure. Verify format and descriptions with authority having jurisdiction.
c. Use identification nameplate at each piece of service equipment to identify the available fault current and the date calculations were performed.

3. Emergency System Equipment:
a. Use identification nameplate or voltage marker to identify emergency system equipment in accordance with NFPA 70.
b. Use identification nameplate at each piece of service equipment to identify type and location of on-site emergency power sources.

4. Use voltage marker to identify highest voltage present for each piece of electrical equipment.
5. Use identification nameplate to identify equipment utilizing series ratings, where permitted, in accordance with NFPA 70.
6. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.
7. Use identification label or handwritten text using indelible marker on inside of door at each fused switch to identify required NEMA fuse class and size.
8. Use identification label to identify overcurrent protective devices for branch circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".
9. Arc Flash Hazard Warning Labels: Use warning labels to identify arc flash hazards for electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized.
a. Minimum Size: 3.5 by 5 inches.
b. Legend: Include orange header that reads "WARNING", followed by the word message "Arc Flash and Shock Hazard; Appropriate PPE Required; Do not operate

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controls or open covers without appropriate personal protection equipment; Failure to comply may result in injury or death; Refer to NFPA 70E for minimum PPE requirements" or approved equivalent.

C. Identification for Conductors and Cables:
   1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 05 19 Low-Voltage Electrical Power Conductors and Cables.
   2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
   3. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:
      a. At each source and load connection.
      b. Within boxes when more than one circuit is present.
      c. Within equipment enclosures when conductors and cables enter or leave the enclosure.

D. Identification for Raceways:
   1. Use voltage markers to identify highest voltage present for accessible conduits at maximum intervals of 20 feet.
   2. Use voltage markers or color-coded bands to identify systems other than normal power system for accessible conduits at maximum intervals of 20 feet.
      a. Color-Coded Bands: Use field-painting or vinyl color coding electrical tape to mark bands 3 inches wide.
         1) Color Code:
            (a) Emergency Power System: Red.
               (1) Life Safety Branch: Red.
               (2) Critical Branch: Red.
               (3) Equipment Branch: Grey.
            (b) Fire Alarm System: Red.
         2) Field-Painting: Comply with Section 09 90 00 - Painting and Coating.
         3) Vinyl Color Coding Electrical Tape: Comply with Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
   3. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify circuits enclosed for accessible conduits at wall penetrations, at floor penetrations, at roof penetrations, and at equipment terminations when source is not within sight.

E. Identification for Boxes:
   1. Use voltage markers to identify highest voltage present.
   2. Use voltage markers or color coded boxes to identify systems other than normal power system.
      a. Color-Coded Boxes: Field-painted in accordance with Section 09 90 00 Painting and Coating per the same color code used for raceways.
         1) Emergency Power System: Red.
   3. Use identification labels or handwritten text using indelible marker to identify circuits enclosed.
      a. For exposed boxes in public areas, use only identification labels.

F. Identification for Devices:
   1. Factory Pre-Marked Wallplates: Comply with Section 26 27 26 - Wiring Devices.
   2. Use identification label to identify fire alarm system devices.

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a. For devices concealed above suspended ceilings, provide additional identification on ceiling tile below device location.

3. Use identification label or engraved wallplate to identify serving branch circuit for all receptacles.
   a. For receptacles in public areas or in areas as directed by Architect, provide identification on inside surface of wallplate.
4. Use identification label or engraved wallplate to identify load controlled for wall-mounted control devices controlling loads that are not visible from the control location and for multiple wall-mounted control devices installed at one location.

2.02 MANUFACTURERS

A. Brady Corporation: www.bradycorp.com.

B. Seton Identification Products: www.seton.com/aec.

C. HellermannTyton: www.hellermanntyton.com.

D. Substitutions: See Section 01 6000 - Product Requirements.

2.03 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:
1. Manufacturers:
   a. Brimar Industries, Inc: www.brimar.com/#sle.
   b. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
   c. Seton Identification Products: www.seton.com/#sle.
   d. Substitutions: See Section 01 60 00 - Product Requirements.
2. Materials:
   a. Indoor Clean, Dry Locations: Use plastic nameplates.
   b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
3. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
   a. Exception: Provide minimum thickness of 1/8 inch when any dimension is greater than 4 inches.
4. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.
5. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text.
6. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.

B. Identification Labels:
1. Manufacturers:
   a. Brady Corporation: www.bradyid.com/#sle.
   b. Brother International Corporation: www.brother-usa.com/#sle.
   c. Panduit Corp: www.panduit.com/#sle.
   d. Substitutions: See Section 01 60 00 - Product Requirements.
2. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
   a. Use only for indoor locations.
3. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

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C. Format for Equipment Identification:
   1. Minimum Size: 1 inch by 2.5 inches.
   2. Legend:
      a. System designation where applicable:
         1) Emergency Power System: Identify with text "EMERGENCY".
      b. Equipment designation or other approved description.
   3. Text: All capitalized unless otherwise indicated.
   4. Minimum Text Height:
      a. System Designation: 1 inch.
      b. Equipment Designation: 1/2 inch.
      c. Other Information: 1/4 inch.
      d. Exception: Provide minimum text height of 1 inch for equipment located more than 10 feet above floor or working platform.
   5. Color:
      a. Normal Power System: White text on black background.
         1) 480Y/277 V, 3 Phase Equipment: White text on Black background.
         2) 208Y/120 V, 3 Phase Equipment: White text on Black background.
      b. Emergency Power System: White text on red background.
         1) Equipment Branch: White text on Black background.

D. Format for General Information and Operating Instructions:
   1. Minimum Size: 1 inch by 2.5 inches.
   2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
   3. Text: All capitalized unless otherwise indicated.
   4. Minimum Text Height: 1/4 inch.
   5. Color: Black text on white background unless otherwise indicated.

E. Format for Control Device Identification:
   1. Minimum Size: 3/8 inch by 1.5 inches.
   2. Legend: Load controlled or other designation indicated.
   3. Text: All capitalized unless otherwise indicated.
   4. Minimum Text Height: 3/16 inch.
   5. Color: Black text on clear background.

F. Nameplates: Engraved three-layer laminated plastic, black letters on white background.

G. Locations:
   1. Each electrical distribution and control equipment enclosure.
   2. Communication cabinets.
   3. Disconnect switches, and starters.

H. Letter Size:
   1. Use 1/8 inch letters for identifying individual equipment and loads.
   2. Use 1/4 inch letters for identifying grouped equipment and loads.

2.04 WIRE AND CABLE MARKERS

A. Manufacturers:
   1. Brady Corporation: www.bradyid.com/#sle.
   2. HellermannTyton: www.hellermanntyton.com/#sle.
   3. Panduit Corp: www.panduit.com/#sle.
   4. Panduit Corp.

NOT FOR BIDDING

5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.

C. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.

D. Legend: Power source and circuit number or other designation indicated.

E. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.

F. Minimum Text Height: 1/8 inch.

G. Color: Black text on white background unless otherwise indicated.

H. Description: split sleeve type wire markers.

I. Locations: Each conductor at panelboard gutters, pull boxes, outlet boxes, and junction boxes each load connection.

J. Legend:
1. Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.
2. Control Circuits: Control wire number indicated on shop drawings.

2.05 VOLTAGE MARKERS

A. Manufacturers: Panduit Corp
1. Brady Corporation: www.bradyid.com/#sle.
2. Brimar Industries, Inc: www.brimar.com/#sle.
3. Panduit Corp.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Markers for Conduits: Use factory pre-printed self-adhesive vinyl, self-adhesive vinyl cloth, or vinyl snap-around type markers.

C. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.

D. Minimum Size:
1. Markers for Equipment: 1 1/8 by 4 1/2 inches.
2. Markers for Conduits: As recommended by manufacturer for conduit size to be identified.
3. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches.
4. Markers for Junction Boxes: 1/2 by 2 1/4 inches.

E. Legend:
1. Markers for Voltage Identification: Highest voltage present.
2. Markers for System Identification:
a. Emergency Power System: Text "EMERGENCY".

F. Color: Black text on orange background unless otherwise indicated.

G. Location: Furnish markers for each conduit longer than 6 feet.

H. Spacing: 20 feet on center.

I. Color:
1. 480 Volt System: Brown.
2. 208 Volt System: Yellow.
3. Fire Alarm System: Red.

J. Legend:

NOT FOR BIDDING

1. 480 Volt System: brown.
2. 208 Volt System: yellow.
3. Fire Alarm System: red.

2.06 UNDERGROUND WARNING TAPE

A. Materials: Use non-detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.

B. Non-detectable Type Tape: 6 inches wide, with minimum thickness of 4 mil.

C. Legend: Type of service, continuously repeated over full length of tape.

D. Color:
1. Tape for Buried Power Lines: Black text on red background.
2. Tape for Buried Communication, Alarm, and Signal Lines: Black text on orange background.

2.07 WARNING SIGNS AND LABELS

A. Manufacturers:
1. Brimar Industries, Inc: www.brimar.com/#sle.
2. Clarion Safety Systems, LLC: www.clarionsafety.com/#sle.
3. Seton Identification Products: www.seton.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.

C. Warning Signs:
1. Materials:
a. Indoor Dry, Clean Locations: Use factory pre-printed rigid plastic or self-adhesive vinyl signs.
b. Outdoor Locations: Use factory pre-printed rigid aluminum signs.
2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.
3. Minimum Size: 7 by 10 inches unless otherwise indicated.

D. Warning Labels:
1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
a. Do not use labels designed to be completed using handwritten text.
b. Provide polyester overlaminate to protect handwritten text.
2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
3. Minimum Size: 2 by 4 inches unless otherwise indicated.

PART 3 EXECUTION

3.01 PREPARATION

A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

B. Degrease and clean surfaces to receive nameplates and labels.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
1. Surface-Mounted Equipment: Enclosure front.

NOT FOR BIDDING

2. Flush-Mounted Equipment: Inside of equipment door.
3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
4. Elevated Equipment: Legible from the floor or working platform.
5. Branch Devices: Adjacent to device.
6. Interior Components: Legible from the point of access.
7. Conduits: Legible from the floor.
8. Boxes: Outside face of cover.
9. Conductors and Cables: Legible from the point of access.
10. Devices: Outside face of cover.

C. Install identification products centered, level, and parallel with lines of item being identified.

D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.

E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.

F. Install underground warning tape above buried lines with one tape per trench at 3 inches below finished grade.

G. Secure rigid signs using stainless steel screws.

H. Mark all handwritten text, where permitted, to be neat and legible.

3.03 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

END OF SECTION

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SECTION 26 05 73
POWER SYSTEM STUDIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Short-circuit study.

B. Protective device coordination study.

C. Arc flash and shock risk assessment.
   1. Includes arc flash hazard warning labels.

D. Short circuit study.

E. Coordination study and analysis.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Existing Installations: Coordinate with equipment manufacturer(s) to obtain data necessary for completion of studies.
   2. Coordinate the work to provide equipment and associated protective devices complying with criteria for selection and adjustment, as determined by studies to be performed.
   3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Submit study reports prior to or concurrent with product submittals.
   2. Do not order equipment until matching study reports and product submittals have both been evaluated by Architect.
   3. Verify naming convention for equipment identification prior to creation of final drawings, reports, and arc flash hazard warning labels (where applicable).

C. Scheduling:
   1. Arrange access to existing facility for data collection with Owner.
   2. Where work of this section involves interruption of existing electrical service, arrange service interruption with Owner.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Study preparer's qualifications.

C. Field testing agency's qualifications.

D. Study reports, stamped or sealed and signed by study preparer.

E. Site-specific arc flash hazard warning labels.

F. Study Report: Submit protective device studies as specified, prior to submission of product data submittals or ordering or fabrication of protective devices.
   1. Include stamp or seal and signature of preparing engineer.

G. Field quality control reports.

H. Certification that field adjustable protective devices have been set in accordance with requirements of studies.

1.04 POWER SYSTEM STUDIES

A. Scope of Studies:

NOT FOR BIDDING

1. Perform analysis of new electrical distribution system as indicated on drawings.
   a. Include portions of electrical distribution system designated as "future."
2. Except where study descriptions below indicate exclusions, analyze system at each bus from primary protective devices of utility source down to each piece of equipment involved, including parts of system affecting calculations being performed (e.g. fault current contribution from motors).
3. Include in analysis alternate sources and operating modes (including known future configurations) to determine worst case conditions.
   a. Known Operating Modes:
      1) Utility as source.
      2) Generator as source.

B. General Study Requirements:
1. Comply with NFPA 70.
2. Perform studies utilizing computer software complying with specified requirements; manual calculations are not permitted.

C. Data Collection:
1. Compile information on project-specific characteristics of actual installed equipment, protective devices, feeders, etc. as necessary to develop single-line diagram of electrical distribution system and associated input data for use in system modeling.
   a. Utility Source Data: Include primary voltage, maximum and minimum three-phase and line-to-ground fault currents, impedance, X/R ratio, and primary protective device information.
      1) Obtain up-to-date information from Utility Company.
   b. Generators: Include manufacturer/model, kW and voltage ratings, and impedance.
   c. Motors: Include manufacturer/model, type (e.g. induction, synchronous), horsepower rating, voltage rating, full load amps, and locked rotor current or NEMA MG 00001 code letter designation.
   d. Transformers: Include primary and secondary voltage ratings, kVA rating, winding configuration, percent impedance, and X/R ratio.
   e. Protective Devices:
      1) Circuit Breakers: Include manufacturer/model, type (e.g. thermal magnetic, electronic trip), frame size, trip rating, voltage rating, interrupting rating, available field-adjustable trip response settings, and features (e.g. zone selective interlocking).
      2) Fuses: Include manufacturer/model, type/class (e.g. Class J), size/rating, and speed (e.g. time delay, fast acting).
   f. Protective Relays: Include manufacturer/model, type, settings, current/potential transformer ratio, and associated protective device.
   g. Conductors: Include feeder size, material (e.g. copper, aluminum), insulation type, voltage rating, number per phase, raceway type, and actual length.
2. Existing Installations:
   a. Provide the services of field testing agency or equipment manufacturer's representative to perform field data collection.
   b. Collect data on existing electrical distribution system necessary for completion of studies, including field verification of available existing data (e.g. construction documents, previous studies). Include actual settings for field-adjustable devices.

D. Short-Circuit Study:
1. Comply with IEEE 551 and applicable portions of IEEE 141, IEEE 242, and IEEE 399.

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2. For purposes of determining equipment short circuit current ratings, consider conditions that may result in maximum available fault current, including but not limited to:
   a. Maximum utility fault currents.
   b. Maximum motor contribution.
   c. Known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).
3. For each bus location, calculate the maximum available three-phase bolted symmetrical and asymmetrical fault currents. For grounded systems, also calculate the maximum available line-to-ground bolted fault currents.

E. Protective Device Coordination Study:
1. Comply with applicable portions of IEEE 242 and IEEE 399.
2. Analyze alternate scenarios considering known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).
3. Analyze protective devices and associated settings for suitable margins between time-current curves to provide adequate protection for equipment and conductors while achieving full selective coordination.

F. Arc Flash and Shock Risk Assessment:
1. Comply with NFPA 70E.
2. Perform incident energy and arc flash boundary calculations in accordance with IEEE 1584 (as referenced in NFPA 70E Annex D), where applicable.
3. Analyze alternate scenarios considering conditions that may result in maximum incident energy, including but not limited to:
   a. Maximum and minimum utility fault currents.
   b. Maximum and minimum motor contribution.
   c. Known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).

G. Study Reports:
1. General Requirements:
   a. Identify date of study and study preparer.
   b. Identify study methodology and software product(s) used.
   c. Identify scope of studies, assumptions made, implications of possible alternate scenarios, and any exclusions from studies.
   d. Identify base used for per unit values.
   e. Include single-line diagram and associated input data used for studies; identify buses on single-line diagram as referenced in reports, and indicate bus voltage.
   f. Include conclusions and recommendations.
2. Short-Circuit Study:
   a. For each scenario, identify at each bus location:
      1) Calculated maximum available symmetrical and asymmetrical fault currents (both three-phase and line-to-ground where applicable).
      2) Fault point X/R ratio.
      3) Associated equipment short circuit current ratings.
   b. Identify locations where the available fault current exceeds the equipment short circuit current rating, along with recommendations.
3. Protective Device Coordination Study:
   a. For each scenario, include time-current coordination curves plotted on log-log scale graphs.
   b. For each graph include (where applicable):

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1) Partial single-line diagram identifying the portion of the system illustrated.
2) Protective Devices: Time-current curves with applicable tolerance bands for each protective device in series back to the source, plotted up to the maximum available fault current at the associated bus.
3) Conductors: Damage curves.
4) Transformers: Inrush points and damage curves.
5) Generators: Full load current, overload curves, decrement curves, and short circuit withstand points.
6) Motors: Full load current, starting curves, and damage curves.
7) Capacitors: Full load current and damage curves.

c. For each protective device, identify fixed and adjustable characteristics with available ranges and recommended settings.
1) Circuit Breakers: Include long time pickup and delay, short time pickup and delay, and instantaneous pickup.
2) Include ground fault pickup and delay.
3) Include fuse ratings.
4) Protective Relays: Include current/potential transformer ratios, tap, time dial, and instantaneous pickup.

d. Identify cases where either full selective coordination or adequate protection is not achieved, along with recommendations.

4. Arc Flash and Shock Risk Assessment:
a. For the worst case for each scenario, identify at each bus location:
1) Calculated incident energy and associated working distance.
2) Calculated arc flash boundary.
3) Bolted fault current.
4) Arcing fault current.
5) Clearing time.
6) Arc gap distance.

b. For purposes of producing arc flash hazard warning labels, summarize the maximum incident energy and associated data reflecting the worst case condition of all scenarios at each bus location.

1.05 PROTECTIVE DEVICE STUDY

A. Analyze the specific electrical and utilization equipment (according to NEC definition), the actual protective devices to be used, and the actual feeder lengths to be installed.
1. Study Methodology: Comply with requirements and recommendations of NFPA 70, IEEE 399, and IEEE 242.
2. Report: State the methodology and rationale employed in making each type of calculation; identify computer software package(s) used.

B. One-Line Diagrams: Prepare schematic drawing of electrical distribution system, with all electrical equipment and wiring to be protected by the protective devices; identify nodes on the diagrams for reference on report that includes:
1. Calculated fault impedance, X/R ratios, utility contribution, and short circuit values (asymmetric and symmetric) at the main switchboard bus and all downstream devices containing protective devices.
2. Breaker and fuse ratings.
3. Transformer kVA and voltage ratings, percent impedance, X/R ratios, and wiring connections.
4. Identification of each bus, with voltage.

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5. Conduit materials, feeder sizes, actual lengths, and X/R ratios.

C. Short Circuit Study: Calculate the fault impedance to determine available 3-phase short circuit and ground fault currents at each bus and piece of equipment during normal conditions, alternate operations, emergency power conditions, and other operations that could result in maximum fault conditions.
   1. Show fault currents available at key points in the system down to a fault current of 7,000 A at 480 V and 208 V.
   2. Include motor contributions in determining the momentary and interrupting ratings of the protective devices.
   3. Report: Include all pertinent data used in calculations and for each device include:
      a. Device identification.
      b. Protective device.
      c. Device rating.
      d. Calculated short circuit current, asymmetrical and symmetrical, and ground fault current.

D. Coordination Study: Perform an organized time-current analysis of each protective device in series from the individual device back to the primary source, under normal conditions, alternate operations, and emergency power conditions.
   1. Graphically illustrate that adequate time separation exists between series devices, including upstream primary device.
   2. Plot the specific time-current characteristics of each protective device on log-log paper.
   3. Organize plots so that all upstream devices are clearly depicted on one sheet.
   4. Also show the following on curve plot sheets:
      a. Device identification.
      b. Voltage and current transformer ratios for curves.
      c. 3-phase and 1-phase ANSI damage curves for each transformer.
      d. No-damage, melting, and clearing curves for fuses.
      e. Cable damage curves.
      f. Transformer inrush points.
      g. Maximum short circuit cutoff point.
      h. Simple one-line diagram for the portion of the system that each curve plot illustrates.
      i. Software report for each curve plot, labeled for identification.

E. Analysis: Determine ratings and settings of protective devices to minimize damage caused by a fault and so that the protective device closest to the fault will open first.
   1. Required Ratings and Settings: Derive required ratings and settings of protective devices in consideration of upstream protective device settings and optimize system to ensure selective coordination.
   2. Identify any equipment that is underrated as specified.
   3. Identify specified protective devices that will not achieve required protection or coordination and cannot be field adjusted to do so, and for which adequate devices would involve a change to the contract sum.
   4. In all cases where adequate protection or coordination cannot be achieved at no extra cost to Owner, provide a discussion of alternatives and logical compromises for best achievable coordination.

F. Protective Device Rating and Setting Chart: Summarize in tabular format the required characteristics for each protective device based on the analysis; include:
   1. Device identification.
   2. Relay CT ratios, tap, time dial, and instantaneous pickup.

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3. Circuit breaker sensor rating, long-time, short-time, and instantaneous settings, and time bands.
4. Fuse rating and type.
5. Ground fault pickup and time delay.
6. Input level and expected response time at two test points that are compatible with commonly available test equipment and the ratings of the protective device.
7. Highlight all devices that as furnished by Contractor will not achieve required protection.

1.06 QUALITY ASSURANCE

A. Computer Software for Study Preparation: Use the latest edition of commercially available software utilizing specified methodologies.

B. Contractor Responsibility: Provide all project-related data needed by study preparer, including equipment, wire sizes, insulation types, conduit types, and actual circuit lengths.

C. Owner's Responsibility: Provide data on relevant Owner power distribution equipment.

PART 2 PRODUCTS

2.01 ARC FLASH HAZARD WARNING LABELS

A. Provide warning labels complying with ANSI Z535.4 to identify arc flash hazards for each work location analyzed by the arc flash and shock risk assessment.
   1. Materials: Comply with Section 26 05 53.
   2. Legend: Provide custom legend in accordance with NFPA 70E based on equipment-specific data as determined by arc flash and shock risk assessment.
      a. Include the following information:
         1) Arc flash boundary.
         2) Available incident energy and corresponding working distance.
         3) Site-specific PPE (personnel protective equipment) requirements.
         4) Nominal system voltage.
         5) Limited approach boundary.
         6) Restricted approach boundary.
         7) Equipment identification.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install arc flash warning labels in accordance with Section 26 05 53.

3.02 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Adjust equipment and protective devices for compliance with studies and recommended settings.

D. Notify Architect of any conflicts with or deviations from studies. Obtain direction before proceeding.

E. Submit detailed reports indicating inspection and testing results, and final adjusted settings.

3.03 CLOSEOUT ACTIVITIES

A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.

END OF SECTION

NOT FOR BIDDING

SECTION 26 05 83
WIRING CONNECTIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical connections to equipment.

1.02 REFERENCE STANDARDS

A. NEMA WD 1 - General Color Requirements for Wiring Devices.

B. NEMA WD 6 - Wiring Devices - Dimensional Specifications.

C. NFPA 70 - National Electrical Code.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
   2. Determine connection locations and requirements.

B. Sequencing:
   1. Install rough-in of electrical connections before installation of equipment is required.
   2. Make electrical connections before required start-up of equipment.

1.04 SUBMITTALS

A. See Section 01 33 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide wiring device manufacturer's catalog information showing dimensions, configurations, and construction.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.05 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Products: Listed, classified, and labeled as suitable for the purpose intended.

1.06 COORDINATION

A. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.

B. Determine connection locations and requirements.

C. Sequence rough-in of electrical connections to coordinate with installation of equipment.

D. Sequence electrical connections to coordinate with start-up of equipment.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
   1. Colors: Conform to NEMA WD 1.
   2. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.

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3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.
4. Product:
5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Disconnect Switches: As specified in Section and in individual equipment sections.

C. Flexible Conduit: As specified in Section 26 05 33.13 Conduit.

D. Wire and Cable: As specified in Section 26 05 19 Low Voltage Electrical Power Conductors and Cables.

E. Boxes: As specified in Section 26 05 33.16 Boxes.

2.02 EQUIPMENT CONNECTIONS

A. As required by equipment manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.02 ELECTRICAL CONNECTIONS

A. Make electrical connections in accordance with equipment manufacturer's instructions.

B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors at all locations.

C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.

D. Provide receptacle outlet to accommodate connection with attachment plug.

E. Provide cord and cap where field-supplied attachment plug is required.

F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.

H. Install terminal block jumpers to complete equipment wiring requirements.

I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

J. Coolers and Freezers: Cut and seal conduit openings in freezer and cooler walls, floor, and ceilings.

END OF SECTION

NOT FOR BIDDING

SECTION 26 24 13
SWITCHBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Low-voltage (600 V and less) switchboards and associated accessories for service and distribution applications.

B. Overcurrent protective devices for switchboards.

C. Switchboard accessories.

1.02 REFERENCE STANDARDS

A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; Federal Specification.

B. ANSI C12.1 - American National Standard Code for Electricity Metering; 2008.

C. ANSI C39.1 - American National Standard Requirements for Electrical Analog Indicating Instruments; 1981 (R1992).

D. IEC 60051-1 - Direct Acting Indicating Analogue Electrical Measuring Instruments and Their Accessories - Part 1: Definitions and General Requirements Common To All Parts;; 1997.

E. IEC 60051-2 - Direct Acting Indicating Analogue Electrical Measuring Instruments and Their Accessories - Part 2: Special Requirements for Ammeters and Voltmeters; 1984.

F. IEEE C12.1 - American National Standard Code for Electricity Metering; Institute of Electrical and Electronic Engineers; 1988.

G. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers.

H. NECA 400 - Standard for Installing and Maintaining Switchboards.

I. NEMA BS 31047 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum).

J. NEMA PB 2 - Deadfront Distribution Switchboards.

K. NEMA PB 2.1 - General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less.

L. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.

M. NFPA 70 - National Electrical Code.

N. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.

1.03 SUBMITTALS

A. See Section 01 33 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide electrical characteristics including voltage, frame size and trip ratings, fault current withstand ratings, and time-current curves of all equipment and components.

C. Shop Drawings: Indicate front and side views of enclosures with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; size and number of bus bars per phase, neutral, and ground; and switchboard instrument details.

D. Test Reports: Indicate results of factory production tests.

E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

NOT FOR BIDDING

F. Project Record Documents: Record actual installed locations of switchboards and final equipment settings.

G. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Enclosure Keys: Two of each different key.

1.04 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store switchboards in accordance with manufacturer's instructions, NECA 400, and NEMA PB 2.1.

B. Store in a clean, dry space having a uniform temperature to prevent condensation (including outdoor switchboards, which are not weatherproof until completely and properly installed). Where necessary, provide temporary enclosure space heaters or temporary power for permanent factory-installed space heaters.

C. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

D. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

E. Deliver in 48 inch maximum width shipping splits, individually wrapped for protection and mounted on shipping skids.

F. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

G. Handle in accordance with NEMA PB 2.1 and manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Eaton Corporation; Cutler-Hammer Products: www.eaton.com.

B. General Electric Company: www.geindustrial.com.

C. Schneider Electric; Square D Products: www.schneider-electric.us.

D. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 OVERCURRENT PROTECTIVE DEVICES

A. Circuit Breakers:
   1. Interrupting Capacity:
      a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than specified minimum requirements.

NOT FOR BIDDING

b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.

2. Molded Case Circuit Breakers:
   a. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers; listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
      1) Provide thermal magnetic circuit breakers unless otherwise indicated.
      2) Provide electronic trip circuit breakers where indicated.
   b. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
   c. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
      1) Provide the following field-adjustable trip response settings:
         (a) Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
         (b) Long time delay.
         (c) Short time pickup and delay.
         (d) Instantaneous pickup.
         (e) Ground fault pickup and delay where ground fault protection is indicated.

2.03 SOURCE QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Factory test switchboards according to NEMA PB 2, including the following production (routine) tests on each switchboard assembly or component:
   1. Dielectric tests.
   2. Mechanical operation tests.
   3. Grounding of instrument transformer cases test.
   4. Electrical operation and control wiring tests, including polarity and sequence tests.
   5. Ground-fault sensing equipment test.

C. Shop inspect and test switchboard according to NEMA PB 2.

D. Make completed switchboard available for inspection at manufacturer's factory prior to packaging for shipment. Notify Owner at least 7 days before inspection is allowed.

PART 3 EXECUTION

3.01 PREPARATION

A. Provide concrete housekeeping pad under the provisions of Section .

B. Verify that field measurements are as instructed by manufacturer.

3.02 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Before energizing switchboard, perform insulation resistance testing in accordance with NECA 400 and NEMA PB 2.1.

C. Perform field inspection and testing in accordance with Section 01 45 00.

D. Inspect and test in accordance with NETA ATS, except Section 4.

E. Perform inspections and tests listed in NETA ATS, Section 7.1.

NOT FOR BIDDING

F. Molded Case and Insulated Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers. Tests listed as optional are not required.

G. Correct deficiencies and replace damaged or defective switchboards or associated components.

3.03 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

B. Adjust alignment of switchboard covers and doors.

C. Adjust all operating mechanisms for free mechanical movement.

D. Tighten bolted bus connections in accordance with manufacturer's instructions.

E. Adjust circuit breaker trip and time delay settings to values indicated.

F. Adjust circuit breaker trip and time delay settings to values as instructed by Architect.

3.04 CLEANING

A. Clean dirt and debris from switchboard enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred surfaces to match original factory finish.

END OF SECTION

NOT FOR BIDDING

SECTION 26 24 16
PANELBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Overcurrent protective devices for panelboards.

1.02 REFERENCE STANDARDS

A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; Federal Specification.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction.

C. NECA 407 - Standard for Installing and Maintaining Panelboards.

D. NEMA BS 31047 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum).

E. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts.

F. NEMA PB 1 - Panelboards.

G. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

H. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.

I. NFPA 70 - National Electrical Code.

J. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
   2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
   4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
   5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.

C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
   1. Include dimensioned plan and elevation views of panelboards and adjacent equipment with all required clearances indicated.

NOT FOR BIDDING

2. Include wiring diagrams showing all factory and field connections.
3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.

D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.

F. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

1.05 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

1.07 FIELD CONDITIONS

A. Maintain ambient temperature within the following limits during and after installation of panelboards:
1. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.
2. For re-building existing panelboards, backboxes to remain:
a. Measure all existing conditions prior to ordering of new faces and internal compoents.
b. Verify existing wiring for installation of new components.
c. Verify all existing breaker quantities and sizes. Match existing unless otherwise noted.

1.08 MAINTENANCE MATERIALS

A. See Section 01 6000 - Product Requirements, for additional provisions.

B. Furnish two of each panelboard key.

PART 2 PRODUCTS

2.01 OVERCURRENT PROTECTIVE DEVICES

A. Molded Case Circuit Breakers:
1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
2. Interrupting Capacity:
a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:

NOT FOR BIDDING

1) 14000 rms symmetrical amperes at 240 VAC or 208 VAC.
2) 21000_ rms symmetrical amperes at 480 VAC.

b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.

3. Conductor Terminations:
   a. Provide mechanical lugs unless otherwise indicated.
   b. Lug Material: Copper suitable for terminating copper conductors only.
4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
   a. Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 225 amperes and larger.
   b. Provide interchangeable trip units where indicated.
5. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
6. Provide the following circuit breaker types where indicated:
   a. Current Limiting Circuit Breakers: Without using fusible elements, designed to limit the let-through energy to a value less than the energy of a one-half cycle wave of the symmetrical prospective current when operating within its current limiting range.
7. Do not use tandem circuit breakers.
8. Do not use handle ties in lieu of multi-pole circuit breakers.
9. Provide multi-pole circuit breakers for multi-wire branch circuits as required by NFPA 70.

2.02 SOURCE QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

C. Provide required supports in accordance with Section 26 05 29 - Hangers and Supports For Electrical Systems.

D. Install panelboards plumb.

E. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor or working platform.

F. Provide minimum of six spare 1 inch trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.

G. Provide grounding and bonding in accordance with Section 26 05 26 - Grounding and Hanging For Electrical Systems.
   1. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on isolated/insulated ground bus.

NOT FOR BIDDING

H. Install all field-installed branch devices, components, and accessories.

I. Multi-Wire Branch Circuits: Group grounded and ungrounded conductors together in the panelboard as required by NFPA 70.

J. Set field-adjustable circuit breaker tripping function settings as indicated.

K. Provide filler plates to cover unused spaces in panelboards.

L. Identify panelboards in accordance with Section 26 05 53 - Identification For Electrical Systems.

M. Provide typed or neatly handwritten circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.

N. Provide arc flash warning labels in accordance with NFPA 70.

O. Tighten all terminations in panelboard with manufacturer's suggested torque with torque wrench.

3.03 FIELD QUALITY CONTROL

A. Perform inspection, testing, and adjusting in accordance with Section 01 40 00 - Quality Requirements.

B. Perform field inspection and testing in accordance with Section 01 4000 - Quality Requirements.

C. Inspect and test in accordance with NETA STD ATS, except Section 4.

D. Correct deficiencies and replace damaged or defective panelboards or associated components.

E. Perform inspections and tests listed in NETA STD ATS, Section 7.5 for switches, Section 7.6 for circuit breakers.

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

B. Adjust alignment of panelboard fronts.

C. Load Balancing: For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 20 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

3.05 CLEANING

A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

NOT FOR BIDDING

SECTION 26 27 26
WIRING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Receptacles.

B. Wall plates.

1.02 REFERENCE STANDARDS

A. FS W-C-596 - Connector, Electrical, Power, General Specification for; Federal Specification.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction.

C. NECA 130 - Standard for Installing and Maintaining Wiring Devices.

D. NEMA WD 1 - General Color Requirements for Wiring Devices.

E. NEMA WD 6 - Wiring Devices - Dimensional Specifications.

F. NFPA 70 - National Electrical Code.

G. UL 498 - Attachment Plugs and Receptacles.

H. UL 514D - Cover Plates for Flush-Mounted Wiring Devices.

1.03 SUBMITTALS

A. See Section 01 33 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.

C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.04 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Products: Listed, classified, and labeled as suitable for the purpose intended.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Cooper Wiring Devices: www.cooperwiringdevices.com.

B. Leviton Manufacturing, Inc: www.leviton.com.

C. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 ALL WIRING DEVICES

A. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

2.03 RECEPTACLES

A. All Receptacles: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498and where applicable FS W-C-596; types as indicated on the drawings.
   1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.

NOT FOR BIDDING

2. NEMA configurations specified are according to NEMA WD 6.

B. Receptacles: Heavy duty, complying with NEMA WD 6 and WD 1.
1. Device Body: White plastic.
2. Configuration: NEMA WD 6, type as specified and indicated.

C. Convenience Receptacles: Type 5 - 20.

D. Single Convenience Receptacles.

E. Duplex Convenience Receptacles.

F. GFCI Receptacles: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.

2.04 TELEPHONE JACKS

A. Product: AMP manufacturing

B. Substitutions: See Section 01 6000 - Product Requirements.

2.05 WALL PLATES

A. All Wall Plates: Comply with UL 514D.
1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
2. Size: Standard.
3. Screws: Metal with slotted heads finished to match wall plate finish.

B. Decorative Cover Plates: stainless steel.

C. Jumbo Cover Plates: stainless steel.

D. Weatherproof Cover Plates: Gasketed cast metal with hinged cover.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that wall openings are neatly cut and will be completely covered by wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that floor boxes are adjusted properly.

F. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

G. Verify that openings in access floor are in proper locations.

H. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

NOT FOR BIDDING

B. Perform work in a neat and workmanlike manner in accordance with NECA 1, including mounting heights specified in that standard unless otherwise indicated.

C. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of wiring devices provided under this section.

D. Install wiring devices in accordance with manufacturer's instructions.

E. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

F. Where required, connect wiring devices using pigtails not less than 6 inches long. Do not connect more than one conductor to wiring device terminals.

G. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.

H. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

I. Install securely, in a neat and workmanlike manner, as specified in NECA 1.

J. Install wiring devices plumb and level with mounting yoke held rigidly in place.

K. Install wall switches with OFF position down.

L. Do not share neutral conductor on branch circuits utilizing wall dimmers.

M. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.

N. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

O. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.

P. Install receptacles with grounding pole on top.

Q. Connect wiring device grounding terminal to outlet box with bonding jumper.

R. Install decorative plates on switch, receptacle, and blank outlets in finished areas.

S. Connect wiring devices by wrapping conductor around screw terminal.

T. Use jumbo size plates for outlets installed in masonry walls.

U. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

3.04 INTERFACE WITH OTHER PRODUCTS

A. Coordinate locations of outlet boxes provided under Section 26 05 37 to obtain mounting heights.

B. Install wall switch 48 inches above finished floor.

C. Install convenience receptacle 18 inches above finished floor.

D. Install convenience receptacle 6 inches above backsplash of counter.

E. Install telephone jack 18 inches above finished floor.

NOT FOR BIDDING

F. Install telephone jack for side-reach wall telephone to position top of telephone at 54 inches above finished floor.

G. Install telephone jack for forward-reach wall telephone to position top of telephone at 48 inches above finished floor.

3.05 FIELD QUALITY CONTROL

A. Perform field inspection, testing, adjusting, and balancing in accordance with Section 01 45 00.

B. Inspect each wiring device for damage and defects.

C. Operate each wall switch, wall dimmer, and fan speed controller with circuit energized to verify proper operation.

D. Operate each wall switch with circuit energized and verify proper operation.

E. Verify that each receptacle device is energized.

F. Test each receptacle to verify operation and proper polarity.

G. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.

H. Correct wiring deficiencies and replace damaged or defective wiring devices.

I. Verify that each telephone jack is properly connected and circuit is operational.

3.06 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

3.07 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION

NOT FOR BIDDING

SECTION 26 28 13
FUSES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fuses.

1.02 REFERENCE STANDARDS

A. NEMA FU 1 - Low Voltage Cartridge Fuses.

B. NFPA 70 - National Electrical Code.

C. UL 248-1 - Low-Voltage Fuses - Part 1: General Requirements.

D. UL 248-12 - Low-Voltage Fuses - Part 12: Class R Fuses.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate fuse clips furnished in equipment provided under other sections for compatibility with indicated fuses.
   2. Coordinate fuse requirements according to manufacturer's recommendations and nameplate data for actual equipment to be installed.
   3. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard data sheets including voltage and current ratings, interrupting ratings, time-current curves, and current limitation curves.

1.05 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Cooper Bussmann, a division of Cooper Industries: www.cooperindustries.com/#sle.

B. Mersen (formerly Ferraz Shawmut): ferrazshawmut.mersen.com.

C. Littelfuse, Inc: www.littelfuse.com/#sle.

D. Mersen: ep-us.mersen.com/#sle.

E. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 APPLICATIONS

A. Feeders:
   1. Fusible Switches up to 600 Amperes: Class RK1, time-delay.

2.03 FUSES

A. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose indicated.

NOT FOR BIDDING

B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.

C. Provide fuses of the same type, rating, and manufacturer within the same switch.

D. Comply with UL 248-1.

E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.

F. Voltage Rating: Suitable for circuit voltage.

G. Class R Fuses: Comply with UL 248-12.
   1. Class RK1, Time-Delay Fuses:
      a. Products:
         1) Cooper Bussmann: Model # LPN-RK-100SP.
         2) Ferraz Shawmut: Model # A2D100R.
         3) Or approved equal.
         4) Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that fuse ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.

B. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Do not install fuses until circuits are ready to be energized.

B. Install fuses with label oriented such that manufacturer, type, and size are easily read.

END OF SECTION

NOT FOR BIDDING

SECTION 26 28 16.16
ENCLOSED SWITCHES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Enclosed safety switches.

1.02 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction.

B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

C. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.

D. NFPA 70 - National Electrical Code.

E. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.

F. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations.

G. UL 98 - Enclosed and Dead-Front Switches.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
   2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
   4. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.

C. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
   1. Include dimensioned plan and elevation views of enclosed switches and adjacent equipment with all required clearances indicated.
   2. Include wiring diagrams showing all factory and field connections.

D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

E. Project Record Documents: Record actual locations of enclosed switches.

F. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

1.05 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

NOT FOR BIDDING

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

1.07 FIELD CONDITIONS

A. Maintain ambient temperature between -22 degrees F and 104 degrees F during and after installation of enclosed switches.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Siemens Industry, Inc: www.usa.siemens.com.

B. Eaton Corporation; Cutler-Hammer Products: www.eaton.com/#sle.

C. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.

D. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 ENCLOSED SAFETY SWITCHES

A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.

B. Provide products listed and labeled by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
   1. Altitude: Less than 6,600 feet.
   2. Ambient Temperature: Between -22 degrees F and 104 degrees F.

D. Horsepower Rating: Suitable for connected load.

E. Voltage Rating: Suitable for circuit voltage.

F. Short Circuit Current Rating:
   1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
   2. Minimum Ratings:
      a. Heavy Duty Single Throw Switches Protected by Class R, Class J, Class L, or Class T Fuses: 200,000 rms symmetrical amperes.

G. Provide with switch blade contact position that is visible when the cover is open.

H. Fuse Clips for Fusible Switches: As required to accept fuses indicated.

NOT FOR BIDDING

1. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.

I. Conductor Terminations: Suitable for use with the conductors to be installed.

J. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.

K. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
a. Outdoor Locations: Type 3R.

L. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive enclosed safety switches.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install enclosed switches in accordance with manufacturer's instructions.

B. Install enclosed switches securely, in a neat and workmanlike manner in accordance with NECA 1.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required supports in accordance with Section 26 05 29 - Hangers And Supports For Electrical Systems.

E. Install enclosed switches plumb.

F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.

G. Provide grounding and bonding in accordance with Section 26 05 26 - Grounding and Bonding For Electrical Systems.

H. Provide fuses complying with Section 26 28 13 Fuses for fusible switches as indicated or as required by equipment manufacturer's recommendations.

3.03 FIELD QUALITY CONTROL

A. Perform field inspection, testing, and adjusting in accordance with Section 01 40 00 - Quality Requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.

D. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

NOT FOR BIDDING

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

NOT FOR BIDDING