

City of San Diego

CONTRACTOR'S NAME: HPS Mechanical, Inc.

ADDRESS: 3100 E. Belle Terrace, Bakersfield, CA 93307

TELEPHONE NO.: 661-397-2121 ext. 8209 **FAX NO.:**

CITY CONTACT: Rosa Riego, Senior Contract Specialist, Email: RRiego@sandiego.gov

Phone No. (619) 533-3426

J. Rivera / J. Limon / L. I. Russell

BIDDING DOCUMENTS



FOR

NORTH CITY RECLAMATION PLANT CHILLER REPLACEMENT

BID NO.: K-26-2330-DBB-3

SAP NO. (WBS/IO/CC): B-20148

CLIENT DEPARTMENT: 2000

COUNCIL DISTRICT: 1

PROJECT TYPE: HB

THIS CONTRACT WILL BE SUBJECT TO THE FOLLOWING:

- THE CITY'S SUBCONTRACTING PARTICIPATION REQUIREMENTS FOR SLBE PROGRAM
- PREVAILING WAGE RATES: STATE ☒ FEDERAL ☐
- APPRENTICESHIP

BID DUE DATE:

2:00 PM

AUGUST 12, 2025

CITY OF SAN DIEGO'S ELECTRONIC BIDDING SITE, PLANETBIDS

<http://www.sandiego.gov/cip/bidopps/>

ENGINEER OF WORK

The engineering Specifications and Special Provisions contained herein have been prepared by or under the direction of the following Registered Engineer

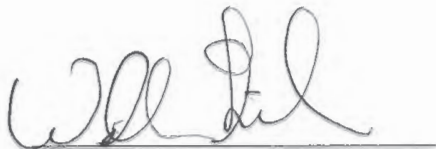
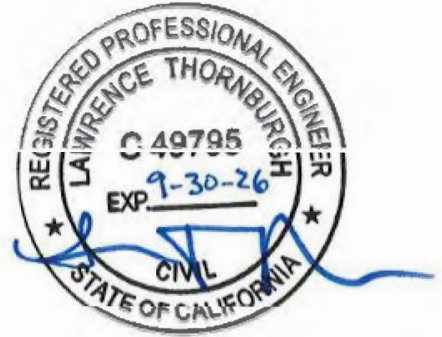


1) Registered Engineer

5/27/25

Date

Seal:



2) For City Engineer

07/28/2025

Date

Seal:



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REQUIRED DOCUMENTS SCHEDULE DURING BIDDING AND AWARDING

The Bidder's attention is directed to the City's Municipal Code §22.0807(d)(2) for important information regarding grounds for debarment for failure to submit required documentation.

The specified Equal Opportunity Contracting Program (EOCP) forms are available for download from the City's web site at:

<http://www.sandiego.gov/eoc/forms/index.shtml>

ITEM	DOCUMENT TO BE SUBMITTED	WHEN DUE	FROM
1.	Bid Bond (PDF via PlanetBids)	At Time of Bid	ALL BIDDERS
2.	Contractor's Certification of Pending Actions	At Time of Bid	ALL BIDDERS
3.	Mandatory Disclosure of Business Interests	At Time of Bid	ALL BIDDERS
4.	Debarment and Suspension Certification for Prime Contractors	At Time of Bid	ALL BIDDERS
5.	Debarment and Suspension Certification for Subcontractors, Suppliers & Mfgs	At Time of Bid	ALL BIDDERS
6.	Bid Bond (Original)	By 5PM 1 working day after bid opening	ALL BIDDERS
7.	SLBE Good Faith Effort Documentation	By 5PM 3 working days after bid opening	ALL BIDDERS
8.	Form AA60 – List of Work Made Available	By 5PM 3 working days after bid opening with Good Faith Effort (GFE) documentation	ALL BIDDERS
9.	If the Contractor is a Joint Venture: - Joint Venture Agreement - Joint Venture License	Within 10 working days of receipt by bidder of contract forms	AWARDED BIDDER
10.	Payment & Performance Bond; Certificates of Insurance & Endorsements; and Signed Contract Agreement Page	Within 10 working days of receipt by bidder of contract forms and NOI	AWARDED BIDDER
11.	In-Use Off-Road Diesel Fueled Fleet Regulation (OFF-ROAD REGULATION) Compliance	Within 10 working days of receipt by bidder of contract forms and NOI	AWARDED BIDDER

ITEM	DOCUMENT TO BE SUBMITTED	WHEN DUE	FROM
12.	Listing of "Other Than First Tier" Subcontractors	Within 10 working days of receipt by bidder of contract forms	AWARDED BIDDER

NOTICE INVITING BIDS

1. **SUMMARY OF WORK:** This is the City of San Diego's (City) solicitation process to acquire Construction services for **North City Reclamation Plant Chiller Replacement**. For additional information refer to Attachment A.
2. **FULL AND OPEN COMPETITION:** This solicitation is subject to full and open competition and may be bid by Contractors on the City's approved Prequalified Contractors List. For information regarding the Contractors Prequalified list visit the City's web site: <http://www.sandiego.gov>.
3. **ESTIMATED CONSTRUCTION COST:** The City's estimated construction cost for this project is **\$1,600,000.00**.
4. **BID DUE DATE AND TIME ARE:** **August 12, 2025 at 2:00 PM.**
5. **PREVAILING WAGE RATES APPLY TO THIS CONTRACT:** Refer to Attachment D.
6. **LICENSE REQUIREMENT:** To be eligible for award of this contract, Prime contractor must possess the following licensing classification: **B**
7. **SUBCONTRACTING PARTICIPATION PERCENTAGES:** Subcontracting participation percentages apply to this contract.
 - 7.1. The City has incorporated **mandatory** SLBE-ELBE subcontractor participation percentages to enhance competition and maximize subcontracting opportunities. For the purpose of achieving the mandatory subcontractor participation percentages, a recommended breakdown of the SLBE and ELBE subcontractor participation percentages based upon certified SLBE and ELBE firms has also been provided to achieve the mandatory subcontractor participation percentages:

1. SLBE participation	1.8%
2. ELBE participation	3.3%
3. Total mandatory participation	5.1%
 - 7.2. The current list of Certified SLBE/ELBE Firms to be used for outreach for this project is posted to the Documents tab on PlanetBids.
 - 7.3. The Bid may be declared non-responsive if the Bidder fails to meet the following requirements:
 - 7.3.1. Include SLBE-ELBE certified subcontractors at the overall mandatory participation percentage identified in this document; OR
 - 7.3.2. Submit Good Faith Effort (GFE) documentation, saved in searchable Portable Document Format (PDF), demonstrating the Bidder made a good faith effort to conduct outreach to and include SLBE-ELBE Subcontractors as required in this solicitation by 5PM 3 Working Days after the Bid opening if the overall mandatory participation percentage is not met.

All submittals in searchable PDF shall be submitted electronically within the prescribed time identified in the contract documents via PlanetBids by invitation to the point of contact named in the bid provided by the Contract Specialist to all bidders.

8. PRE-BID MEETING:

8.1. ONLINE PRE-BID MEETING:

Prospective Bidders are **Encouraged** to attend the Pre-Bid Meeting.

The Pre-Bid Meeting will be held on **Thursday, July 17, 2025, at 10:00 AM (PDT)** at:

Microsoft Teams [Need help?](#)

[Join the meeting now](#)

Meeting ID: 285 557 053 068 1

Passcode: nz34yr7R

Dial in by phone

[+1 945-468-5511,,766937748#](#) United States, Los Angeles

[Find a local number](#)

Phone Conference ID: # 766 937 748#

For organizers: [Meeting options](#) | [Reset dial-in PIN](#)

The purpose of the meeting is to discuss the scope of the Project, submittal requirements, and any Equal Opportunity Contracting Program requirements and reporting procedures.

8.2 PRE-BID SITE VISIT: All those wishing to submit a bid are **Encouraged** to visit the Work Site with the Engineer. The purpose of the Site visit is to acquaint Bidders with the Site conditions. To request a sign language or oral interpreter for this visit, call the Purchasing & Contracting Department, Public Works Division at (619) 533-3450 at least 5 Working Days prior to the meeting to ensure availability. The Pre-Bid Site Visit is scheduled as follows:

Time: 1:00pm – 2:00pm

Date: July 22, 2025

Location: 4940 Eastgate Mall, San Diego, CA 92121

9. AWARD PROCESS:

9.1. The Award of this contract is contingent upon the Contractor's compliance with all conditions of Award as stated within these documents and within the Notice of Intent to Award.

9.2. Upon acceptance of bids and determination of the apparent low bidder, the City will prepare the contract documents for execution within approximately 21 days of the date of the bid opening. The City will then award the contract upon receipt of properly signed Contract, bonds, and insurance documents.

- 9.3.** This contract will be deemed executed and effective only upon the signing of the Contract by the Mayor or his designee and approval as to form by the City Attorney's Office.
- 9.4.** The low Bid will be determined by the Base Bid.
- 9.5.** Once the low Bid has been determined, the City may, at its sole discretion, award the contract for the Base Bid alone.

10. SUBMISSION OF QUESTIONS:

- 10.1.** The Director (or Designee) of the Purchasing & Contracting Department is the officer responsible for opening, examining, and evaluating the competitive Bids submitted to the City for the acquisition, construction and completion of any public improvement except when otherwise set forth in these documents. Any questions related to this solicitation shall be submitted to:

Rosa Riego, Senior Contract Specialist at RRiego@sandiego.gov

- 10.2.** Questions received less than 14 days prior to the date for opening of Bids may not be considered.
- 10.3.** Questions or clarifications deemed by the City to be material shall be answered via issuance of an addendum and posted to the City's online bidding service.
- 10.4.** Only questions answered by formal written addenda shall be binding. Oral and other interpretations or clarifications shall be without legal effect. It is the Bidder's responsibility to be informed of any addenda that have been issued and to include all such information in its Bid.

INSTRUCTIONS TO BIDDERS

1. PREQUALIFICATION OF CONTRACTORS:

- 1.1. Contractors submitting a Bid must be pre-qualified for the total amount proposed, including all alternate items, prior to the date of submittal. Bids from contractors who have not been pre-qualified as applicable and Bids that exceed the maximum dollar amount at which contractors are pre-qualified may be deemed **non-responsive** and ineligible for award.
- 1.2. The completed application must be submitted online no later than 2 weeks prior to the bid opening.
- 1.3. **Joint Venture Bidders Cumulative Maximum Bidding Capacity:** For projects with an engineer's estimate of \$30,000,000 or greater, Joint Ventures submitting bids may be deemed responsive and eligible for award if the cumulative maximum bidding capacity of the individual Joint Venture entities is equal to or greater than the total amount proposed.
 - 1.3.1. Each of the entities of the Joint Venture must have been previously prequalified at a minimum of \$15,000,000.
 - 1.3.2. Bids submitted with a total amount proposed of less than \$30,000,000 are not eligible for Cumulative Maximum Bidding Capacity prequalification. To be eligible for award in this scenario, the Joint Venture itself or at least one of the Joint Venture entities must have been prequalified for the total amount proposed.
 - 1.3.3. Bids submitted by Joint Ventures with a total amount proposed of \$30,000,000 or greater on a project with an engineer's estimate of less than \$30,000,000 are not eligible for Cumulative Maximum Bidding Capacity prequalification.
 - 1.3.4. The Joint Venture designated as the Apparent Low Bidder shall provide evidence of its corporate existence and furnish good and approved bonds in the name of the Joint Venture within 14 Calendar Days of receipt by the Bidder of a form of contract for execution.
- 1.4. Complete information and links to the on-line prequalification application are available at:

<http://www.sandiego.gov/cip/bidopps/prequalification>
- 1.5. Due to the City's responsibility to protect the confidentiality of the contractors' information, City staff will not be able to provide information regarding contractors' prequalification status over the telephone. Contractors may access real-time information about their prequalification status via their vendor profile on [PlanetBids,™](#)

2. **ELECTRONIC FORMAT RECEIPT AND OPENING OF BIDS:** Bids will be received in electronic format (eBids) EXCLUSIVELY at the City of San Diego's electronic bidding (eBidding) site, at: <http://www.sandiego.gov/cip/bidopps/> and are due by the date, and time shown on the cover of this solicitation.
- 2.1. **BIDDERS MUST BE PRE-REGISTERED** with the City's bidding system and possess a system-assigned Digital ID in order to submit an electronic bid.
- 2.2. The City's bidding system will automatically track information submitted to the site including IP addresses, browsers being used and the URLs from which information was submitted. In addition, the City's bidding system will keep a history of every login instance including the time of login, and other information about the user's computer configuration such as the operating system, browser type, version, and more. Because of these security features, Contractors who disable their browsers' cookies will not be able to log in and use the City's bidding system.
- 2.3. The City's electronic bidding system is responsible for bid tabulations. Upon the bidder's or proposer's entry of their bid, the system will ensure that all required fields are entered. **The system will not accept a bid for which any required information is missing.** This includes all necessary pricing, subcontractor listing(s) and any other essential documentation and supporting materials and forms requested or contained in these solicitation documents.
- 2.4. **BIDS REMAIN SEALED UNTIL BID DEADLINE.** eBids are transmitted into the City's bidding system via hypertext transfer protocol secure (https) mechanism using SSL 128-256 bit security certificates issued from Verisign/Thawte which encrypts data being transferred from client to server. Bids submitted prior to the "Bid Due Date and Time" are not available for review by anyone other than the submitter who has until the "Bid Due Date and Time" to change, rescind or retrieve its proposal should it desire to do so.
- 2.5. **BIDS MUST BE SUBMITTED BY BID DUE DATE AND TIME.** Once the bid deadline is reached, no further submissions are accepted into the system. Once the Bid Due Date and Time has lapsed, bidders, proposers, the general public, and City staff are able to immediately see the results on line. City staff may then begin reviewing the submissions for responsiveness, EOCP compliance and other issues. The City may require any Bidder to furnish statement of experience, financial responsibility, technical ability, equipment, and references.
- 2.6. **RECAPITULATION OF THE WORK.** Bids shall not contain any recapitulation of the Work. Conditional Bids may be rejected as being non-responsive. Alternative proposals will not be considered unless called for.
- 2.7. **BIDS MAY BE WITHDRAWN** by the Bidder only up to the bid due date and time.
- 2.7.1. Important Note: Submission of the electronic bid into the system may not be instantaneous. Due to the speed and capabilities of the user's internet service provider (ISP), bandwidth, computer hardware and other variables, it may take

time for the bidder's submission to upload and be received by the City's eBidding system. It is the bidder's sole responsibility to ensure their bids are received on time by the City's eBidding system. The City of San Diego is not responsible for bids that do not arrive by the required date and time.

- 2.8. ACCESSIBILITY AND AMERICANS WITH DISABILITIES ACT (ADA) COMPLIANCE:** To request a copy of this solicitation in an alternative format, contact the Purchasing & Contracting Department, Public Works Division Contract Specialist listed on the cover of this solicitation at least five (5) working days prior to the Bid/Proposal due date to ensure availability.

3. ELECTRONIC BID SUBMISSIONS CARRY FULL FORCE AND EFFECT:

- 3.1.** The bidder, by submitting its electronic bid, acknowledges that doing so carries the same force and full legal effect as a paper submission with a longhand (wet) signature.
- 3.2.** By submitting an electronic bid, the bidder certifies that the bidder has thoroughly examined and understands the entire Contract Documents (which consist of the plans and specifications, drawings, forms, affidavits and the solicitation documents), and that by submitting the eBid as its bid proposal, the bidder acknowledges, agrees to and is bound by the entire Contract Documents, including any addenda issued thereto, and incorporated by reference in the Contract Documents.
- 3.3.** The Bidder, by submitting its electronic bid, agrees to and certifies under penalty of perjury under the laws of the State of California, that the certification, forms and affidavits submitted as part of this bid are true and correct.
- 3.4.** The Bidder agrees to the construction of the project as described in Attachment "A-Scope of Work" for the City of San Diego, in accordance with the requirements set forth herein for the electronically submitted prices. The Bidder guarantees the Contract Price for a period of 120 days from the date of Bid opening. The duration of the Contract Price guarantee shall be extended by the number of days required for the City to obtain all items necessary to fulfill all conditions precedent.

- 4. BIDS ARE PUBLIC RECORDS:** Upon receipt by the City, Bids shall become public records subject to public disclosure. It is the responsibility of the respondent to clearly identify any confidential, proprietary, trade secret or otherwise legally privileged information contained within the Bid. General references to sections of the California Public Records Act (PRA) will not suffice. If the Contractor does not provide applicable case law that clearly establishes that the requested information is exempt from the disclosure requirements of the PRA, the City shall be free to release the information when required in accordance with the PRA, pursuant to any other applicable law, or by order of any court or government agency, and the Contractor will hold the City harmless for release of this information.

5. CONTRACTOR REGISTRATION AND ELECTRONIC REPORTING SYSTEM:

5.1. **Prior** to the Award of the Contract or Task Order, you and your Subcontractors and Suppliers must register with the City's web-based vendor registration and bid management system. For additional information go to:

<http://www.sandiego.gov/purchasing/bids-contracts/vendorreg>

5.2. The City may not award the contract until registration of all subcontractors and suppliers is complete. In the event this requirement is not met within the time frame specified in the Notice of Intent to Award letter, the City reserves the right to rescind the Notice of Award / Intent to Award and to make the award to the next responsive and responsible bidder / proposer

6. JOINT VENTURE CONTRACTORS: Provide a copy of the Joint Venture agreement and the Joint Venture license to the City within 14 Calendar Days after receiving the Contract forms.

7. INSURANCE REQUIREMENTS:

7.1. All certificates of insurance and endorsements required by the contract are to be provided upon issuance of the City's Notice of Intent to Award letter.

7.2. Refer to sections 5-4, "INSURANCE" of the Supplementary Special Provisions (SSP) for the insurance requirements which must be met.

8. REFERENCE STANDARDS: Except as otherwise noted or specified, the Work shall be completed in accordance with the following standards:

Title	Edition	Document Number
Standard Specifications for Public Works Construction ("The GREENBOOK") http://www.greenbookspecs.org/	2021	ECPI010122-01
City of San Diego Standard Specifications for Public Works Construction ("The WHITEBOOK")* https://www.sandiego.gov/ecp/edocref/greenbook	2021	ECPI010122-02
City of San Diego Standard Drawings* https://www.sandiego.gov/ecp/edocref/standarddraw	2021	ECPI010122-03
Citywide Computer Aided Design and Drafting (CADD) Standards https://www.sandiego.gov/ecp/edocref/drawings	2018	PWPI010119-04
California Department of Transportation (CALTRANS) Standard Specifications https://dot.ca.gov/programs/design/july-2023-ccs-standard-plans-and-standard-specifications	2023	ECPD092023-05
CALTRANS Standard Plans https://dot.ca.gov/programs/design/july-2023-ccs-standard-plans-and-standard-specifications	2023	ECPD092023-06

Title	Edition	Document Number
California Manual on Uniform Traffic Control Devices Revision 8 (CA MUTCD Rev 8) https://dot.ca.gov/programs/safety-programs/camutcd	2014	ECPD032324-07
NOTE: *Available online under Engineering Documents and References at: https://www.sandiego.gov/ecp/edocref/ *Electronic updates to the Standard Drawings may also be found in the link above		

9. **CITY'S RESPONSES AND ADDENDA:** The City, at its discretion, may respond to any or all questions submitted in writing via the City's eBidding web site in the **form of an addendum**. No other responses to questions, oral or written shall be of any force or effect with respect to this solicitation. The changes to the Contract Documents through addenda are made effective as though originally issued with the Bid. The Bidders shall acknowledge the receipt of Addenda at the time of bid submission.

10. **CITY'S RIGHTS RESERVED:** The City reserves the right to cancel the Notice Inviting Bids at any time, and further reserves the right to reject submitted Bids, without giving any reason for such action, at its sole discretion and without liability. Costs incurred by the Bidder(s) as a result of preparing Bids under the Notice Inviting Bids shall be the sole responsibility of each bidder. The Notice Inviting Bids creates or imposes no obligation upon the City to enter a contract.

11. **CONTRACT PRICING:** This solicitation is for a Lump Sum contract with Unit Price provisions as set forth herein. The Bidder agrees to perform construction services for the City of San Diego in accordance with these contract documents for the prices listed below. The Bidder further agrees to guarantee the Contract Price for a period of 120 days from the date of Bid opening. The duration of the Contract Price guarantee may be extended, by mutual consent of the parties, by the number of days required for the City to obtain all items necessary to fulfill all contractual conditions.

12. **SUBCONTRACTOR INFORMATION:**
 - 12.1. **LISTING OF SUBCONTRACTORS.** In accordance with the requirements provided in the "Subletting and Subcontracting Fair Practices Act" of the California Public Contract Code, the Bidder shall provide the **NAME** and **ADDRESS** of each Subcontractor who will perform work, labor, render services or who specially fabricates and installs a portion [type] of the work or improvement, in an amount in excess of 0.5% of the Contractor's total Bid. The Bidder shall also state within the description, whether the subcontractor is a **CONSTRUCTOR, CONSULTANT** or **SUPPLIER**. The Bidder shall state the **DIR REGISTRATION NUMBER** for all subcontractors and shall further state within the description, the **PORTION** of the work which will be performed by each subcontractor under this Contract. The Contractor shall list only one Subcontractor for each portion of the Work. The **DOLLAR VALUE** of the total Bid to be performed shall be stated for all subcontractors listed. Failure to comply with this requirement may result in the Bid being rejected as **non-responsive** and ineligible for award. The Bidder's attention is directed to the Special Provisions – Section 3-2, "Self-Performance",

which stipulates the percent of the Work to be performed with the Bidders' own forces. The Bidder shall list all SLBE, ELBE, DBE, DVBE, MBE, WBE, OBE, SDB, WoSB, HUBZone, and SDVOSB Subcontractors for which Bidders are seeking recognition towards achieving any mandatory, voluntary (or both) subcontracting participation goals.

Additionally, pursuant to California Senate Bill 96 and in accordance with the requirements of Labor Code sections 1771.1 and 1725.5, by submitting a bid or proposal to the City, Contractor is certifying that he or she has verified that all subcontractors used on this public work project are registered with the California Department of Industrial Relations (DIR). **The Bidder shall provide the name, address, license number, DIR registration number of any Subcontractor – regardless of tier** - who will perform work, labor, render services or specially fabricate and install a portion [type] of the work or improvement pursuant to the contract.

- 12.2. LISTING OF SUPPLIERS.** Any Bidder seeking the recognition of Suppliers of equipment, materials, or supplies obtained from third party Suppliers towards achieving any mandatory or voluntary (or both) subcontracting participation goals shall provide, at a minimum, the **NAME, LOCATION (CITY), DIR REGISTRATION NUMBER** and the **DOLLAR VALUE** of each supplier. The Bidder will be credited up to 60% of the amount to be paid to the Suppliers for materials and supplies unless vendor manufactures or substantially alters materials and supplies, in which case, 100% will be credited. The Bidder is to indicate within the description whether the listed firm is a supplier or manufacturer. If no indication is provided, the listed firm will be credited at 60% of the listed dollar value for purposes of calculating the Subcontractor Participation Percentage.
- 12.3. LISTING OF SUBCONTRACTORS OR SUPPLIERS FOR ALTERNATES.** For subcontractors or suppliers to be used on alternate items, bidder shall use the provided **“Subcontractors For Alternates”** form and shall indicate for each alternate subcontract whether it is an additive or deductive alternate; the subcontractor’s name, location, phone number, email address, CA license number, and DIR registration number; whether the subcontractor is a designer, constructor or supplier; the type of work the subcontractor will be performing; and the dollar value of the subcontract for that alternate item. Failure to comply with this requirement may result in the bid being rejected as nonresponsive and ineligible for award.
- 13. SUBMITTAL OF “OR EQUAL” ITEMS:** See Section 4-6, “Trade Names” in The WHITEBOOK and as amended in the SSP.
- 14. AWARD:**
- 14.1.** The Award of this contract is contingent upon the Contractor’s compliance with all conditions precedent to Award.
- 14.2.** Upon acceptance of a Bid, the City will prepare contract documents for execution within approximately 21 days of the date of the Bid opening and award the Contract approximately within 7 days of receipt of properly executed Contract, bonds, and insurance documents.

- 14.3.** This contract will be deemed executed and effective only upon the signing of the Contract by the Mayor or his designee and approval as to form the City Attorney's Office.
- 15. SUBCONTRACT LIMITATIONS:** The Bidder's attention is directed to Standard Specifications for Public Works Construction, Section 3-2, "SELF-PERFORMANCE" in The GREENBOOK and as amended in the SSP which requires the Contractor to self-perform not less than the specified amount. Failure to comply with this requirement shall render the bid **non-responsive** and ineligible for award.
- 16. AVAILABILITY OF PLANS AND SPECIFICATIONS:** Contract Documents may be obtained by visiting the City's website: <http://www.sandiego.gov/cip/>. Plans and Specifications for this contract are also available for review in the office of the City Clerk or Purchasing & Contracting Department, Public Works Division.
- 17. ONLY ONE BID PER CONTRACTOR SHALL BE ACCEPTED:** No person, firm, or corporation shall be allowed to make, file, or be interested in more than one (1) Bid for the same work unless alternate Bids are called for. A person, firm or corporation who has submitted a sub-proposal to a Bidder, or who has quoted prices on materials to a Bidder, is not hereby disqualified from submitting a sub-proposal or quoting prices to other Bidders or from submitting a Bid in its own behalf. Any Bidder who submits more than one bid will result in the rejection of all bids submitted.
- 18. SAN DIEGO BUSINESS TAX CERTIFICATE:** The Contractor and Subcontractors, not already having a City of San Diego Business Tax Certificate for the work contemplated shall secure the appropriate certificate from the City Treasurer, Civic Center Plaza, First floor and submit to the Contract Specialist upon request or as specified in the Contract Documents. Tax Identification numbers for both the Bidder and the listed Subcontractors must be submitted on the City provided forms within these documents.
- 19. BIDDER'S GUARANTEE OF GOOD FAITH (BID SECURITY) FOR DESIGN-BID-BUILD CONTRACTS:**
- 19.1.** For bids \$250,000 and above, bidders shall submit Bid Security at bid time. Bid Security shall be in one of the following forms: a cashier's check, or a properly certified check upon some responsible bank; or an approved corporate surety bond payable to the City of San Diego for an amount of not less than 10% of the total bid amount.
- 19.2.** This check or bond, and the monies represented thereby, will be held by the City as a guarantee that the Bidder, if awarded the contract, will in good faith enter into the contract and furnish the required final performance and payment bonds.
- 19.3.** The Bidder agrees that in the event of the Bidder's failure to execute this contract and provide the required final bonds, the money represented by the cashier's or certified check will remain the property of the City; and the Surety agrees that it will pay to the City the damages, not exceeding the sum of 10% of the amount of the Bid, that the City may suffer as a result of such failure.
- 19.4.** At the time of bid submission, bidders must upload and submit an electronic PDF copy of the aforementioned bid security. Whether in the form of a cashier's check, a properly certified check or an approved corporate surety bond payable to the City of San Diego, the bid security must be uploaded to the City's eBidding system. By 5PM,

1 working day after the bid opening date, all bidders must provide the City with the original bid security.

- 19.5.** Failure to submit the electronic version of the bid security at the time of bid submission AND failure to provide the original by 5PM, 1 working day after the bid opening date shall cause the bid to be rejected and deemed **non-responsive**.

Original Bid Bond shall be submitted to:

Purchasing & Contracting Department, Public Works Division

1200 3rd Ave., Suite 200, MS 56P

San Diego, California, 92101

To the Attention of the Contract Specialist on the Front Page of this solicitation.

20. AWARD OF CONTRACT OR REJECTION OF BIDS:

- 20.1.** This contract may be awarded to the lowest responsible and reliable Bidder.
- 20.2.** Bidders shall complete ALL eBid forms as required by this solicitation. Incomplete eBids will not be accepted.
- 20.3.** The City reserves the right to reject any or all Bids, to waive any informality or technicality in Bids received, and to waive any requirements of these specifications as to bidding procedure.
- 20.4.** Bidders will not be released on account of their errors of judgment. Bidders may be released only upon receipt by the City within 3 Working Days of the bid opening, written notice from the Bidder which shows proof of honest, credible, clerical error of a material nature, free from fraud or fraudulent intent; and of evidence that reasonable care was observed in the preparation of the Bid.
- 20.5.** A bidder who is not selected for contract award may protest the award of a contract to another bidder by submitting a written protest in accordance with the San Diego Municipal Code.
- 20.6.** The City of San Diego will not discriminate in the award of contracts with regard to race, religion creed, color, national origin, ancestry, physical handicap, marital status, sex or age.
- 20.7.** Each Bid package properly signed as required by these specifications shall constitute a firm offer which may be accepted by the City within the time specified herein.
- 20.8.** The City reserves the right to evaluate all Bids and determine the lowest Bidder on the basis of the base bid and any proposed alternates or options as detailed herein.

21. BID RESULTS:

- 21.1.** The availability of the bids on the City's eBidding system shall constitute the public announcement of the apparent low bidder. In the event that the apparent low bidder is subsequently deemed non-responsive or non-responsible, a notation of such will be made on the eBidding system. The new ranking and apparent low bidder will be adjusted accordingly.
- 21.2.** To obtain the bid results, view the results on the City's web site, or request the results by U.S. mail and provide a self-addressed, stamped envelope. If requesting by mail,

be sure to reference the bid name and number. The bid tabulations will be mailed to you upon their completion. The results will not be given over the telephone.

22. THE CONTRACT:

- 22.1.** The Bidder to whom award is made shall execute a written contract with the City of San Diego and furnish good and approved bonds and insurance certificates specified by the City within 14 days after receipt by Bidder of a form of contract for execution unless an extension of time is granted to the Bidder in writing.
- 22.2.** If the Bidder takes longer than 14 days to fulfill these requirements, then the additional time taken shall be added to the Bid guarantee. The Contract shall be made in the form adopted by the City, which includes the provision that no claim or suit whatsoever shall be made or brought by Contractor against any officer, agent, or employee of the City for or on account of anything done or omitted to be done in connection with this contract, nor shall any such officer, agent, or employee be liable hereunder.
- 22.3.** If the Bidder to whom the award is made fails to enter into the contract as herein provided, the award may be annulled and the Bidder's Guarantee of Good Faith will be subject to forfeiture. An award may be made to the next lowest responsible and reliable Bidder who shall fulfill every stipulation embraced herein as if it were the party to whom the first award was made.
- 22.4.** Pursuant to the San Diego City Charter section 94, the City may only award a public works contract to the lowest responsible and reliable Bidder. The City will require the Apparent Low Bidder to (i) submit information to determine the Bidder's responsibility and reliability, (ii) execute the Contract in form provided by the City, and (iii) furnish good and approved bonds and insurance certificates specified by the City within 14 Days, unless otherwise approved by the City, in writing after the Bidder receives notification from the City, designating the Bidder as the Apparent Low Bidder and formally requesting the above mentioned items.
- 22.5.** The award of the Contract is contingent upon the satisfactory completion of the above-mentioned items and becomes effective upon the signing of the Contract by the Mayor or designee and approval as to form by the City Attorney's Office. If the Apparent Low Bidder does not execute the Contract or submit required documents and information, the City may award the Contract to the next lowest responsible and reliable Bidder who shall fulfill every condition precedent to award. A corporation designated as the Apparent Low Bidder shall furnish evidence of its corporate existence and evidence that the officer signing the Contract and bond for the corporation is duly authorized to do so.

- 23. EXAMINATION OF PLANS, SPECIFICATIONS, AND SITE OF WORK:** The Bidder shall examine carefully the Project Site, the Plans and Specifications, other materials as described in the Special Provisions, Section 3-9, "TECHNICAL STUDIES AND SUBSURFACE DATA", and the proposal forms (e.g., Bidding Documents). The submission of a Bid shall be conclusive evidence that the Bidder has investigated and is satisfied as to the conditions to be encountered, as to the character, quality, and scope of work, the quantities of materials to be furnished, and as to the requirements of the Bidding Documents Proposal, Plans, and Specifications.

- 24. CITY STANDARD PROVISIONS:** This contract is subject to the following standard provisions. See The WHITEBOOK for details.
- 24.1.** The City of San Diego Resolution No. R-277952 adopted on May 20, 1991 for a Drug-Free Workplace.
 - 24.2.** The City of San Diego Resolution No. R-282153 adopted on June 14, 1993 related to the Americans with Disabilities Act.
 - 24.3.** The City of San Diego Municipal Code §22.3004 for Contractor Standards.
 - 24.4.** The City of San Diego's Labor Compliance Program and the State of California Labor Code §§1771.5(b) and 1776.
 - 24.5.** Sections 1777.5, 1777.6, and 1777.7 of the State of California Labor Code concerning the employment of apprentices by contractors and subcontractors performing public works contracts.
 - 24.6.** The City's Equal Benefits Ordinance (EBO), Chapter 2, Article 2, Division 43 of The San Diego Municipal Code (SDMC).
 - 24.7.** The City's Information Security Policy (ISP) as defined in the City's Administrative Regulation 90.63.
- 25. PRE-AWARD ACTIVITIES:**
- 25.1.** The contractor selected by the City to execute a contract for this Work shall submit the required documentation as specified herein and in the Notice of Intent to Award. Failure to provide the information as specified may result in the Bid being rejected as **non-responsive**.
 - 25.2.** The decision that bid is non-responsive for failure to provide the information required within the time specified shall be at the sole discretion of the City.

PERFORMANCE BOND, LABOR AND MATERIALMEN'S BOND**FAITHFUL PERFORMANCE BOND AND LABOR AND MATERIALMEN'S BOND:**

HPS Mechanical, Inc., a corporation, as principal, and **FIDELITY AND DEPOSIT COMPANY OF MARYLAND**, a corporation authorized to do business in the State of California, as Surety, hereby obligate themselves, their successors and assigns, jointly and severally, to The City of San Diego a municipal corporation in the sum of **Two Million Five Hundred Seventy Five Thousand Dollars and Zero Cents (\$2,575,000.00)** for the faithful performance of the annexed contract, and in the sum of **Two Million Five Hundred Seventy Five Thousand Dollars and Zero Cents (\$2,575,000.00)** for the benefit of laborers and materialmen designated below.

Conditions:

If the Principal shall faithfully perform the annexed contract with the City of San Diego, California, then the obligation herein with respect to a faithful performance shall be void; otherwise it shall remain in full force.

If the Principal shall promptly pay all persons, firms and corporations furnishing materials for or performing labor in the execution of this contract, and shall pay all amounts due under the California Unemployment Insurance Act then the obligation herein with respect to laborers and materialmen shall be void; otherwise it shall remain in full force.

The obligation herein with respect to laborers and materialmen shall inure to the benefit of all persons, firms and corporations entitled to file claims under the provisions of Article 2. Claimants, (iii) public works of improvement commencing with Civil Code Section 9100 of the Civil Code of the State of California.

Changes in the terms of the annexed contract or specifications accompanying same or referred to therein shall not affect the Surety's obligation on this bond, and the Surety hereby waives notice of same.

The Surety shall pay reasonable attorney's fees should suit be brought to enforce the provisions of this bond.

The Surety expressly agrees that the City of San Diego may reject any contractor or subcontractor which may be proposed by Surety in fulfillment of its obligations in the event of default by the Principal.

The Surety shall not utilize the Principal in completing the improvements and work specified in the Agreement in the event the City terminates the Principal for default.

PERFORMANCE BOND, LABOR AND MATERIALMEN'S BOND (continued)

CONTRACTOR
HPS MECHANICAL INC.

By: Jaime T. Ramos

Print Name: JAIME RAMOS, CHIEF ADMINISTRATIVE OFFICER

Date: January 16, 2026

THE CITY OF SAN DIEGO

By: Stephen Samara

Print Name: Stephen Samara
Principal Contract Specialist
Purchasing & Contracting Department

Date: 3/18/2026

SURETY
FIDELITY AND DEPOSIT COMPANY OF MARYLAND

By: Julie Sanders

Print Name: JULIE SANDERS, ATTORNEY-IN-FACT
Attorney-In-Fact

Date: 1/14/2026

APPROVED AS TO FORM
Heather Ferbert, City Attorney

By: Elizabeth Cason

Print Name: Elizabeth Cason
Deputy City Attorney

Date: 3/26/2026

600 RED BROOK BOULEVARD OWINGS MILLS, MD 21117

Local Address of Surety

410-559-8712

Local Phone Number of Surety

\$21,364

Premium

9477439

Bond Number

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

State of California

County of KERN

On 01/14/2026

Date

before me,

Bailey Inez Gather, Notary Public

Name and Title of Officer (e.g., "Jane Doe, Notary Public")

personally appeared

Julie Sanders

Name(s) of Signer(s)

who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.



Place Notary Seal Above

I certify under the PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Bailey Inez Gather
Signature of Notary

OPTIONAL

Though the data below is not required by law, it may prove valuable to persons relying on the document and could prevent fraudulent reattachment of this form.

Description of Attached Document

Title or Type of Document: Performance/Payment Bond

Document Date: 01/14/2026

Number of Pages: _____

Signer(s) Other Than Named Above: _____

Capacity(ies) Claimed by Signer

Signer's Name: _____

- ☐ Corporate Officer – Titles(s) _____
☐ Partner(s) ☐ Limited ☐ General
☐ Individual ☒ Attorney in Fact
☐ Trustee(s) ☐ Guardian/Conservator
☐ Other: _____

Signer is Representing: Fidelity and Deposit Company of Maryland

Name of Person(s) or Entity(ies) _____

RIGHT THUMBPRINT

OF SIGNER

CALIFORNIA ACKNOWLEDGMENT

CIVIL CODE § 1189

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

State of California }

County of KernOn 01/16/2026

Date

before me,

Alma L. Martinez, Notary Public

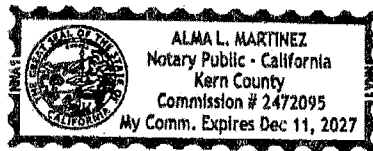
Here Insert Name and Title of the Officer

personally appeared

Jamie Ramos

Name(x) of Signer(x)

who proved to me on the basis of satisfactory evidence to be the person(x) whose name(s) is/~~are~~ subscribed to the within instrument and acknowledged to me that ~~he~~/she/~~they~~ executed the same in ~~his~~/her/~~their~~ authorized capacity(ies), and that by ~~his~~/her/~~their~~ signature(s) on the instrument the person(x), or the entity upon behalf of which the person(x) acted, executed the instrument.



I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Place Notary Seal and/or Stamp Above

Signature

Signature of Notary Public

OPTIONAL

Completing this information can deter alteration of the document or fraudulent reattachment of this form to an unintended document.

Description of Attached DocumentTitle or Type of Document: Payment/Performance Bonds

Document Date: _____ Number of Pages: _____

Signer(s) Other Than Named Above: _____

Capacity(ies) Claimed by Signer(s)

Signer's Name: _____

☐ Corporate Officer – Title(s): _____☐ Partner – ☐ Limited ☐ General☐ Individual ☐ Attorney in Fact☐ Trustee ☐ Guardian or Conservator☐ Other: _____

Signer is Representing: _____

Signer's Name: _____

☐ Corporate Officer – Title(s): _____☐ Partner – ☐ Limited ☐ General☐ Individual ☐ Attorney in Fact☐ Trustee ☐ Guardian or Conservator☐ Other: _____

Signer is Representing: _____

**ZURICH AMERICAN INSURANCE COMPANY
COLONIAL AMERICAN CASUALTY AND SURETY COMPANY
FIDELITY AND DEPOSIT COMPANY OF MARYLAND
POWER OF ATTORNEY**

KNOW ALL MEN BY THESE PRESENTS: That the ZURICH AMERICAN INSURANCE COMPANY, a corporation of the State of New York, the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, a corporation of the State of Illinois, and the FIDELITY AND DEPOSIT COMPANY OF MARYLAND a corporation of the State of Illinois (herein collectively called the "Companies"), by Christopher Nolan, Vice President, in pursuance of authority granted by Article V, Section 8, of the By-Laws of said Companies, which are set forth on the reverse side hereof and are hereby certified to be in full force and effect on the date hereof, do hereby nominate, constitute, and appoint Wes BRADFORD, Elizabeth AGUINAGA, Johannah GRIFFITH, Lorinda HOFFMANN, Julie SANDERS, Lori MCQUILLIAMS of Bakersfield, California, its true and lawful agent and Attorney-in-Fact, to make, execute, seal and deliver, for, and on its behalf as surety, and as its act and deed: **any and all bonds and undertakings**, and the execution of such bonds or undertakings in pursuance of these presents, shall be as binding upon said Companies, as fully and amply, to all intents and purposes, as if they had been duly executed and acknowledged by the regularly elected officers of the ZURICH AMERICAN INSURANCE COMPANY at its office in New York, New York., the regularly elected officers of the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY at its office in Owings Mills, Maryland., and the regularly elected officers of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND at its office in Owings Mills, Maryland., in their own proper persons.

The said Vice President does hereby certify that the extract set forth on the reverse side hereof is a true copy of Article V, Section 8, of the By-Laws of said Companies, and is now in force.

IN WITNESS WHEREOF, the said Vice-President has hereunto subscribed his/her names and affixed the Corporate Seals of the said ZURICH AMERICAN INSURANCE COMPANY, COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, and FIDELITY AND DEPOSIT COMPANY OF MARYLAND, this 28th day of January, A.D. 2025.



ATTEST:
ZURICH AMERICAN INSURANCE COMPANY
COLONIAL AMERICAN CASUALTY AND SURETY COMPANY
FIDELITY AND DEPOSIT COMPANY OF MARYLAND

By: Christopher Nolan
Vice President

By: Dawn E. Brown
Secretary

**State of Maryland
County of Baltimore**

On this 28th day of January, A.D. 2025, before the subscriber, a Notary Public of the State of Maryland, duly commissioned and qualified, **Christopher Nolan, Vice President and Dawn E. Brown, Secretary** of the Companies, to me personally known to be the individuals and officers described in and who executed the preceding instrument, and acknowledged the execution of same, and being by me duly sworn, depose and saith, that he/she is the said officer of the Company aforesaid, and that the seals affixed to the preceding instrument are the Corporate Seals of said Companies, and that the said Corporate Seals and the signature as such officer were duly affixed and subscribed to the said instrument by the authority and direction of the said Corporations.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my Official Seal the day and year first above written.

Genevieve M. Molson
Notary Public
My Commission Expires January 27, 2029



Authenticity of this bond can be confirmed at bondvalidator.zurichna.com or 410-559-8790

EXTRACT FROM BY-LAWS OF THE COMPANIES

"Article V, Section 8, Attorneys-in-Fact. The Chief Executive Officer, the President, or any Executive Vice President or Vice President may, by written instrument under the attested corporate seal, appoint attorneys-in-fact with authority to execute bonds, policies, recognizances, stipulations, undertakings, or other like instruments on behalf of the Company, and may authorize any officer or any such attorney-in-fact to affix the corporate seal thereto; and may with or without cause modify or revoke any such appointment or authority at any time."

CERTIFICATE

I, the undersigned, Vice President of the ZURICH AMERICAN INSURANCE COMPANY, the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, and the FIDELITY AND DEPOSIT COMPANY OF MARYLAND, do hereby certify that the foregoing Power of Attorney is still in full force and effect on the date of this certificate; and I do further certify that Article V, Section 8, of the By-Laws of the Companies is still in force.

This Power of Attorney and Certificate may be signed by facsimile under and by authority of the following resolution of the Board of Directors of the ZURICH AMERICAN INSURANCE COMPANY at a meeting duly called and held on the 15th day of December 1998.

RESOLVED: "That the signature of the President or a Vice President and the attesting signature of a Secretary or an Assistant Secretary and the Seal of the Company may be affixed by facsimile on any Power of Attorney...Any such Power of any certificate thereof bearing such facsimile signature and seal shall be valid and binding on the Company."

This Power of Attorney and Certificate may be signed by facsimile under and by authority of the following resolution of the Board of Directors of the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY at a meeting duly called and held on the 5th day of May, 1994, and the following resolution of the Board of Directors of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND at a meeting duly called and held on the 10th day of May, 1990.

RESOLVED: "That the facsimile or mechanically reproduced seal of the company and facsimile or mechanically reproduced signature of any Vice-President, Secretary, or Assistant Secretary of the Company, whether made heretofore or hereafter, wherever appearing upon a certified copy of any power of attorney issued by the Company, shall be valid and binding upon the Company with the same force and effect as though manually affixed.

IN TESTIMONY WHEREOF, I have hereunto subscribed my name and affixed the corporate seals of the said Companies, this 14th day of January, 2026.



MJ Pethick

Mary Jean Pethick
Vice President

TO REPORT A CLAIM WITH REGARD TO A SURETY BOND, PLEASE SUBMIT A COMPLETE DESCRIPTION OF THE CLAIM INCLUDING THE PRINCIPAL ON THE BOND, THE BOND NUMBER, AND YOUR CONTACT INFORMATION TO:

Zurich Surety Claims
1299 Zurich Way
Schaumburg, IL 60196-1056
reportsfclaims@zurichna.com
800-626-4577

Authenticity of this bond can be confirmed at bondvalidator.zurichna.com or 410-559-8790

ATTACHMENTS

ATTACHMENT A
SCOPE OF WORK

SCOPE OF WORK

1. **SCOPE OF WORK:** Replacement of (3) chillers, (3) condenser water pumps, (2) cooling towers and electrical upgrades for new equipment.
 - 1.1. The Work shall be performed in accordance with:
 - 1.1.1. The Notice Inviting Bids and Plans numbered **0100701-1-D** through **0100701-46-D**, inclusive.
2. **LOCATION OF WORK:** The location of the Work is as follows:

4949 Eastgate Mall San Diego, CA 92121

See **Appendix E – Location Map**
3. **CONTRACT TIME:** The Contract Time for completion of the Work shall be **500 Working Days**.

ATTACHMENT B

RESERVED

ATTACHMENT C
EQUAL OPPORTUNITY CONTRACTING PROGRAM

EQUAL OPPORTUNITY CONTRACTING PROGRAM (EOCP)

SECTION A - GENERAL REQUIREMENTS

A. INTRODUCTION.

1. This document sets forth the following specifications:
 - a) The City's general EOCP requirements for all Construction Contracts.
 - b) Special Provisions for Contracts subject to SLBE and ELBE requirements only.
2. Additional requirements may apply for state or federally funded projects.
3. These requirements shall be included as Contract provisions for all Subcontracts.
4. The City specified forms, instructions, and guides are available for download from the EOCP's web site at: <http://www.sandiego.gov/eoc/forms/index.shtml>

B. GENERAL.

1. The City of San Diego promotes equal employment and subcontracting opportunities.
2. The City is committed to ensuring that taxpayer dollars spent on public Contracts are not paid to businesses that practice discrimination in employment or subcontracting.
3. The City encourages all companies seeking to do business with the City to share this commitment.

C. DEFINITIONS.

1. For the purpose of these requirements: Terms "Bid" and "Proposal", "Bidder" and "Proposer", "Subcontractor" and "Subconsultant", "Contractor" and "Consultant", "Contractor" and "Prime Contractor", "Consultant" and "Professional Service Provider", "Suppliers" and "Vendors", "Suppliers" and "Dealers", and "Suppliers" and "Manufacturers" may have been used interchangeably.
2. The following definitions apply:
 - a) **Emerging Business Enterprise (EBE)** - A for-profit business that is independently owned and operated; that is not a subsidiary or franchise of another business and whose gross annual receipts do not exceed the amount set by the City Manager and that meets all other criteria set forth in regulations implementing Municipal Code Chapter 2, Article 2, Division 36. The City Manager shall review the threshold amount for EBEs on an annual basis and adjust as necessary to reflect changes in the marketplace.
 - b) **Emerging Local Business Enterprise (ELBE)** - A Local Business Enterprise that is also an Emerging Business Enterprise.

- c) **Minority Business Enterprise (MBE)** - A certified business that is at least fifty-one percent (51%) owned by one or more minority individuals, or, in the case of a publicly owned business at least fifty-one percent (51%) of the stock is owned by one or more minority individuals; and (2) whose daily business operations are managed and directed by one or more minorities owners. Minorities include the groups with the following ethnic origins: African, Asian Pacific, Asian Subcontinent, Hispanic, Native Alaskan, Native American, and Native Hawaiian.
- d) **Women Business Enterprise (WBE)** - A certified business that is at least fifty-one percent (51%) owned by a woman or women, or, in the case of a publicly owned business at least fifty-one percent (51%) of the stock is owned by one or more women; and (2) whose daily business operations are managed and directed by one or more women owners.
- e) **Disadvantaged Business Enterprise (DBE)** - a certified business that is at least fifty-one percent (51%) owned by socially and economically disadvantaged individuals, or, in the case of a publicly owned business at least fifty-one percent (51%) of the stock is owned by one or more socially and economically disadvantaged individuals; and (2) whose daily business operations are managed and directed by one or more socially and economically disadvantaged owners.
- f) **Disabled Veteran Business Enterprise (DVBE)** - A certified business that is at least fifty-one percent (51%) owned by one or more disabled veterans; and (2) business operations must be managed and controlled by one or more disabled veterans. Disabled Veteran is a veteran of the U.S. military, naval, or air service; the veteran must have a service-connected disability of at least 10% or more; and the veteran must reside in California.
- g) **Other Business Enterprise (OBE)** - Any business which does not otherwise qualify as a Minority, Woman, Disadvantaged, or Disabled Veteran Business Enterprise.
- h) **Small Business Enterprise (SBE)** - A for-profit business that is independently owned and operated; that is not a subsidiary or franchise of another business and whose gross annual receipts do not exceed the amount set by the City Manager and that meets all other criteria set forth in regulations implementing Municipal Code Chapter 2, Article 2, Division 36. The City Manager shall review the threshold amount for SBEs on an annual basis and adjust as necessary to reflect changes in the marketplace. A business certified as a Micro Business (MB) or a Disabled Veteran Business Enterprise (DVBE) by the State of California and that has provided proof of such certification to the City Manager shall be deemed to be an SBE.

- i) **Small Local Business Enterprise (SLBE)** - A Local Business Enterprise that is also a Small Business Enterprise.

D. CITY'S EQUAL OPPORTUNITY COMMITMENT.

1. Nondiscrimination in Contracting Ordinance.

- a) You, your Subcontractors, and Suppliers shall comply with the requirements of the City's Nondiscrimination in Contracting Ordinance, San Diego Municipal Code §§22.3501 through 22.3517.

You shall not discriminate on the basis of race, gender, gender expression, gender identity, religion, national origin, ethnicity, sexual orientation, age, or disability in the solicitation, selection, hiring, or treatment of subcontractors, vendors, or suppliers. You shall provide equal opportunity for Subcontractors to participate in subcontracting opportunities. You understand and agree that the violation of this clause shall be considered a material breach of the Contract and may result in Contract termination, debarment, or other sanctions.

You shall include the foregoing clause in all Contracts between you and your Subcontractors and Suppliers.

- b) **Disclosure of Discrimination Complaints.** As part of its Bid or Proposal, you shall provide to the City a list of all instances within the past 10 years where a complaint was filed or pending against you in a legal or administrative proceeding alleging that you discriminated against your employees, Subcontractors, vendors, or suppliers, and a description of the status or resolution of that complaint, including any remedial action taken.
- c) Upon the City's request, You agree to provide to the City, within 60 Calendar Days, a truthful and complete list of the names of all Subcontractors and Suppliers that you have used in the past 5 years on any of your Contracts that were undertaken within the San Diego County, including the total dollar amount paid by you for each Subcontract or supply Contract.
- d) You further agree to fully cooperate in any investigation conducted by the City pursuant to the City's Nondiscrimination in Contracting Ordinance, Municipal Code §§22.3501 through 22.3517. You understand and agree that violation of this clause shall be considered a material breach of the Contract and may result in remedies being ordered against you up to and including contract termination, debarment, and other sanctions for the violation of the provisions of the Nondiscrimination in Contracting Ordinance. You further understand and agree that the procedures, remedies, and sanctions provided for in the Nondiscrimination in Contracting Ordinance apply only to violations of the Ordinance.

E.

EQUAL EMPLOYMENT OPPORTUNITY OUTREACH PROGRAM.

1. You, your Subcontractors, and Suppliers shall comply with the City's Equal Employment Opportunity Outreach Program, San Diego Municipal Code §§22.2701 through 22.2707.

You shall not discriminate against any employee or applicant for employment on any basis prohibited by law. You shall provide equal opportunity in all employment practices. You shall ensure that your Subcontractors comply with this program. Nothing in this section shall be interpreted to hold you liable for any discriminatory practices of your Subcontractors.

You shall include the foregoing clause in all Contracts between you and your Subcontractors and Suppliers.

2. If the Contract is competitively solicited, the selected Bidder shall submit a Work Force Report (Form BB05) within 10 Working Days after receipt by the Bidder to the City for approval as specified in the Notice of Intent to Award letter.
3. The selected Bidder shall submit an Equal Employment Opportunity Plan if a Work Force Report is submitted and if the City determines that there are under-representations when compared to County Labor Force Availability data.
4. If the selected Bidder submits an Equal Employment Opportunity Plan, it shall include the following assurances:
 - a) You shall maintain a working environment free of discrimination, harassment, intimidation, and coercion at all Sites and in all facilities at which your employees are assigned to Work.
 - b) You shall review your EEO Policy annually with all on-Site supervisors involved in employment decisions.
 - c) You shall disseminate and review your EEO Policy with all employees at least once a year, post the policy statement and EEO posters on all company bulletin boards and job sites, and document every dissemination, review, and posting with a written record to identify the time, place, employees present, subject matter, and disposition of meetings.
 - d) You shall review, at least annually, all supervisors' adherence to and performance under the EEO Policy and maintain written documentation of these reviews.
 - e) You shall discuss your EEO Policy Statement with Subcontractors with whom you anticipate doing business, including the EEO Policy Statement in your Subcontracts, and provide such documentation to the City upon request.

- f) You shall document and maintain a record of all Bid solicitations and outreach efforts to and from Subcontractors, contractor associations, and other business associations.
- g) You shall disseminate your EEO Policy externally through various media, including the media of people of color and women, in advertisements to recruit. Maintain files documenting these efforts and provide copies of these advertisements to the City upon request.
- h) You shall disseminate your EEO Policy to union and community organizations.
- i) You shall provide immediate written notification to the City when any union referral process has impeded your efforts to maintain your EEO Policy.
- j) You shall maintain a current list of recruitment sources, including those outreaching to people of color and women, and provide written notification of employment opportunities to these recruitment sources with a record of the organizations' responses.
- k) You shall maintain a current file of names, addresses and phone numbers of each walk-in applicant, including people of color and women, and referrals from unions, recruitment sources, or community organizations with a description of the employment action taken.
- l) You shall encourage all present employees, including people of color and women employees, to recruit others.
- m) You shall maintain all employment selection process information with records of all tests and other selection criteria.
- n) You shall develop and maintain documentation for on-the-job training opportunities, participate in training programs, or both for all of your employees, including people of color and women, and establish apprenticeship, trainee, and upgrade programs relevant to your employment needs.
- o) You shall conduct, at least annually, an inventory and evaluation of all employees for promotional opportunities and encourage all employees to seek and prepare appropriately for such opportunities.
- p) You shall ensure that the company's working environment and activities are non-segregated except for providing separate or single-user toilets and necessary changing facilities to assure privacy between the sexes.

F. SUBCONTRACTING.

1. The City encourages all eligible business enterprises to participate in City contracts as a Contractor, Subcontractor, and joint venture partner with you, your Subcontractors, or your Suppliers. You are encouraged to take positive steps to diversify and expand your Subcontractor solicitation base and to offer

subcontracting opportunities to all eligible business firms including SLBEs, ELBEs, MBEs, WBEs, DBEs, DVBES, and OBEs.

2. For Subcontractor participation level requirements, see the Contract Documents where applicable.
3. For the purposes of achieving the mandatory Subcontractor participation percentages, City percentage calculations will not account for the following:
 - a) "Field Orders" and "City Contingency" Bid items.
 - b) Alternate Bid items.
 - c) Allowance Bid items designated as "EOC Type II".
4. Allowance Bid items designated as "EOC Type I" will be considered as part of the Base Bid and will be included in the percentage calculation.
5. Each joint venture partner shall be responsible for a clearly defined Scope of Work. In addition, an agreement shall be submitted and signed by all parties identifying the extent to which each joint venture partner shares in ownership, control, management, risk, and profits of the joint venture.

G. LISTS OF SUBCONTRACTORS AND SUPPLIERS.

1. You shall comply with the Subletting and Subcontracting Fair Practices Act, Public Contract Code §§4100 through 4113, inclusive.
2. You shall list all Subcontractors who will receive more than 0.5% of the total Bid amount or \$10,000, whichever is greater on the form provided in the Contract Documents (Subcontractors list).
3. The Subcontractors list shall include the Subcontractor's name, telephone number including area code, physical address, Scope of Work, the dollar amount of the proposed Subcontract, the California contractor license number, the Public Works contractor registration number issued pursuant to Section 1725.5 of the Labor Code, and the Subcontractor's certification status with the name of the certifying agency.
4. The listed Subcontractor shall be appropriately licensed pursuant to Contractor License Laws.
5. For Design-Build Contracts, refer to the RFQ and RFP for each Project or Task Order.

H. SUBCONTRACTOR AND SUPPLIER SUBSTITUTIONS.

1. Listed Subcontractors and Suppliers shall not be substituted without the Express authorization of the City or its duly authorized agent.
2. Request for Subcontractor or Supplier substitution shall be made in writing to Purchasing & Contracting Department, Public Works Division, Attention Contract Specialist, 1200 3rd Ave., Suite 200, MS 56P, San Diego, CA 92101 with a copy to the Engineer.
3. The request shall include a thorough explanation of the reason(s) for the substitution, including dollar amounts and a letter from each substituted

Subcontractor or Supplier stating that they (the Subcontractors or Suppliers) release all interest in working on the Project and written confirmation from the new Subcontractor or Supplier stating that they agree to work on the Project along with the dollar value of the Work to be performed.

4. Written approval of the substitution request shall be received by you or from the City or its authorized officer prior to any unlisted Subcontractor or Supplier performing Work on the Project.
5. Substitution of Subcontractors and Suppliers without authorization shall subject you to those penalties set forth in Public Contract Code §4110.
6. Requests for Supplier substitution shall be made in writing at least 10 Days prior to the provision of materials, supplies, or services by the proposed Supplier and shall include proof of written notice to the originally listed Supplier of the proposed substitution.
7. A Contractor whose Bid is accepted shall not:
 - a) Substitute a person as Subcontractor or Supplier in place of the Subcontractor or Supplier listed in the original bid, except that the City, or its duly authorized officer, may consent to the substitution of another person as a Subcontractor or Supplier in any of the following situations:
 - i. When the Subcontractor or Supplier listed in the Bid, after having a reasonable opportunity to do so, fails or refuses to execute a written Contract for the scope of work specified in the subcontractor's bid and at the price specified in the subcontractor's bid, when that written contract, based upon the general terms, conditions, plans, and specifications for the project involved or the terms of the subcontractor's written bid, is presented to the subcontractor by the prime contractor.
 - ii. When the listed Subcontractor or Supplier becomes insolvent or the subject of an order for relief in bankruptcy.
 - iii. When the listed Subcontractor or Supplier fails or refuses to perform his or her subcontract.
 - iv. When the listed Subcontractor fails or refuses to meet bond requirements as set forth in Public Contract Code §4108.
 - v. When you demonstrate to the City or its duly authorized officer, subject to the provisions set forth in Public Contract Code §4107.5, that the name of the Subcontractor was listed as the result of an inadvertent clerical error.
 - vi. When the listed Subcontractor is not licensed pursuant to Contractor License Law.
 - vii. When the City, or its duly authorized officer, determines that the Work performed by the listed Subcontractor or that the materials or supplies provided by the listed Supplier are

substantially unsatisfactory and not in substantial accordance with the Plans and specifications or that the Subcontractor or Supplier is substantially delaying or disrupting the progress of the Work.

- viii. When the listed Subcontractor is ineligible to work on a public works project pursuant to §§1777.1 or 1777.7 of the Labor Code.
 - ix. When the City or its duly authorized agent determines that the listed Subcontractor is not a responsible contractor.
 - b) Permit a Contract to be voluntarily assigned or transferred or allow it to be performed by anyone other than the original Subcontractor, Supplier listed in the original Bid without the consent of the City, or its duly authorized officer.
 - c) Other than in the performance of "Change Orders" causing changes or deviations from the Contract, sublet or subcontract any portion of the Work, or contract for materials or supplies in excess of 0.5% of your total bid or \$10,000, whichever is greater, as to which his or her original Bid did not designate a Subcontractor or Supplier.
8. Following receipt of notice from you of the proposed substitution of a Subcontractor or Supplier, the listed Subcontractor or Supplier who has been so notified shall have 5 Working Days within which to submit written objections to the substitution to the Contract Specialist with a copy to the Engineer. Failure to file these written objections shall constitute the listed Subcontractor or Supplier's consent to the substitution. If written objections are filed, the City shall give notice in writing of at least 5 Working Days to the listed Subcontractor or Supplier of a hearing by the City on your request for substitution.

I. PROMPT PAYMENT.

- 1. You or your Subcontractors shall pay to any subcontractor, not later than 7 Calendar Days of receipt of each progress payment, unless otherwise agreed to in writing, the respective amounts allowed you on account of the Work performed by the Subcontractors, to the extent of each Subcontractor's interest therein. In cases of Subcontractor performance deficiencies, you shall make written notice of any withholding to the Subcontractor with a copy to the Contracts Specialist. Upon correction of the deficiency, you shall pay the Subcontractor the amount previously withheld within 14 Calendar Days after payment by the City.
- 2. Any violation of California Business and Professions Code, §7108.5 concerning prompt payment to Subcontractors shall subject the violating Contractor or Subcontractor to the penalties, sanctions, and other remedies of that section. This requirement shall not be construed to limit or impair any contractual, administrative, or judicial remedies otherwise available to you or your

Subcontractor in the event of a dispute involving late payment or nonpayment by the Prime Contractor, deficient subcontract performance, or noncompliance by a Subcontractor.

J. PROMPT PAYMENT OF FUNDS WITHHELD TO SUBCONTRACTORS.

1. The City will hold retention from you and will make prompt and regular incremental acceptances of portions, as determined by the Engineer, of the Work and pay retention to you based on these acceptances.
2. You or your Subcontractors shall return all monies withheld in retention from a Subcontractor within 30 Calendar Days after receiving payment for Work satisfactorily completed and accepted including incremental acceptances of portions of the Work by the City.
3. Federal law (49CFR26.29) requires that any delay or postponement of payment over 30 Calendar Days may take place only for good cause and with the City's prior written approval. Any violation of this provision by you or your Subcontractor shall subject you or your Subcontractor to the penalties, sanctions, and other remedies specified in §7108.5 of the Business and Professions Code.
4. These requirements shall not be construed to limit or impair any contractual, administrative, or judicial remedies otherwise available to you or your Subcontractor in the event of a dispute involving late payment or nonpayment by you, deficient subcontract performance, or noncompliance by a Subcontractor.

K. CERTIFICATION.

1. The City accepts certifications of DBE, DVBE, MBE, SMBE, SWBE, or WBE by any of the following certifying agencies:
 - a) Current certification by the State of California Department of Transportation (CALTRANS) as DBE, SMBE, or SWBE.
 - b) Current MBE, WBE, or DVBE certification from the California Public Utilities Commission.
 - c) DVBE certification is received from the State of California's Department of General Services, Office of Small and Minority Business.
 - d) Current certification by the City of Los Angeles as DBE, WBE, or MBE.
 - e) Subcontractors' valid proof of certification status (copies of MBE, WBE, DBE, or DVBE certifications) shall be submitted as required.

L. CONTRACT RECORDS AND REPORTS.

1. You shall maintain records of all subcontracts and invoices from your Subcontractors and Suppliers for work on this project. Records shall show name, telephone number including area code, and business address of each Subcontractor, Supplier, and joint venture partner, and the total amount

actually paid to each firm. Project relevant records, regardless of tier, may be periodically reviewed by the City.

2. You shall retain all records, books, papers, and documents pertinent to the Contract for a period of not less than 5 years after Notice of Completion and allow access to said records by the City's authorized representatives.
3. You shall submit the following reports using the City's web-based contract compliance (Prism® portal):
 - a. **Monthly Payment.** You shall submit Monthly Payment Reporting by the 10th day of the subsequent month. Incomplete and/or delinquent reporting may cause payment delays, non-payment of invoices, or both.
4. The records maintained under item 1, described above, shall be consolidated into a Final Summary Report, certified as correct by an authorized representative of the Contractor. The Final Summary Report shall include all subcontracting activities and be sent to the EOCP Program Manager prior to Acceptance. Failure to comply may result in assessment of liquidated damages or withholding of retention. The City will review and verify 100% of subcontract participation reported in the Final Summary Report prior to approval and release of final retention to you. In the event your Subcontractors are owed money for completed Work, the City may authorize payment to subcontractor via a joint check from the withheld retention.

EQUAL OPPORTUNITY CONTRACTING PROGRAM (EOCP)

SECTION B - SLBE-ELBE SUBCONTRACTING REQUIREMENTS

THESE SPECIAL PROVISIONS SUPPLEMENT THE POLICIES AND REQUIREMENTS ESTABLISHED BY THE CITY OF SAN DIEGO EQUAL OPPORTUNITY CONTRACTING PROGRAM SPECIFIED IN THE CITY'S GENERAL EOCP REQUIREMENTS.

A. GENERAL.

1. It is the City's policy to encourage greater availability, capacity development, and contract participation by SLBE and ELBE firms in City contracts. This policy is, in part, intended to further the City's compelling interest to stimulate economic development through the support and empowerment of the local community, ensure that it is neither an active nor passive participant in marketplace discrimination, and promote equal opportunity for all segments of the contracting community.
2. The City is committed to maximizing subcontracting opportunities for all qualified and available firms.
3. This policy applies to City-funded construction contracts. Bidders shall be fully informed of this policy as set forth in these specifications. Mandatory or voluntary subcontracting percentages, Bid Discounts, and restricted competitions are specified in the Contract Documents.
4. You shall make subcontracting opportunities available to a broad base of qualified Subcontractors and shall achieve the minimum SLBE-ELBE Subcontractor participation identified for your project.
5. Failure to subcontract the specified minimum (mandatory) percentages of the Bid to qualified available SLBE-ELBE Subcontractors will cause a Bid to be rejected as non-responsive unless the Bidder has demonstrated compliance with the affirmative steps as specified in the City's document titled "Small Local Business (SLBE) Program, INSTRUCTIONS FOR BIDDERS COMPLETING THE GOOD FAITH EFFORT SUBMITTAL" and has submitted documentation showing that all required positive efforts were made prior to the Bid submittal due date. The required Good Faith Effort (GFE) documentation shall be submitted to the Contract Specialist. The instructions for completing the good faith effort submittal can be found on the City's website:
<https://www.sandiego.gov/sites/default/files/legacy/eoc/pdf/slbegeinst.pdf>
6. The current list of certified SLBE-ELBE firms and information for completing the GFE submittal can be found on the City's EOC Department website:
<http://www.sandiego.gov/eoc/programs/slbe>
7. These requirements may be waived, at the City's sole discretion, on projects deemed inappropriate for subcontracting participation.

B.

DEFINITIONS.

1. The following definitions shall be used in conjunction with these specifications:

- a) **Bid Discount** – Additional inducements or enhancements in the bidding process that are designed to increase the chances for the selection of SLBE firms in competition with other firms.
- b) **Commercially Useful Function** – An SLBE-ELBE performs a commercially useful function when it is responsible for the execution of the Work and is carrying out its responsibilities by actually performing, managing, and supervising the Work involved. To perform a commercially useful function, the SLBE-ELBE shall also be responsible, with respect to materials and supplies used on the Contract, for negotiating price, determining quantity and quality, ordering the material, and installing (where applicable) and paying for the material itself.

To determine whether an SLBE-ELBE is performing a commercially useful function, an evaluation will be performed of the amount of Work subcontracted, normal industry practices, whether the amount the SLBE-ELBE firm is to be paid under the contract is commensurate with the Work it is actually performing and the SLBE-ELBE credit claimed for its performance of the Work, and other relevant factors. Specifically, an SLBE-ELBE does not perform a commercially useful function if its role is limited to that of an extra participant in a transaction, contract, or project through which funds are passed in order to obtain the appearance of meaningful and useful SLBE-ELBE participation, when in similar transactions in which SLBE-ELBE firms do not participate, there is no such role performed.

- c) **Good Faith Efforts (GFE)** – Documentation of the Bidder's intent to comply with SLBE Program goals and procedures included in the City's SLBE Program, Instructions for Completing Good Faith Effort Submittal available from the City's EOCP website or the Contract Specialist.
- d) **Independently Owned, Managed, and Operated** – Ownership of a SLBE-ELBE firm shall be direct, independent, and by individuals only. Business firms that are owned by other businesses or by the principals or owners of other businesses that cannot themselves qualify under the SLBE-ELBE eligibility requirements shall not be eligible to participate in the Program. Moreover, the day-to-day management of the SLBE-ELBE firm shall be direct and independent of the influence of any other businesses that cannot themselves qualify under the SLBE-ELBE eligibility requirements.
- e) **Joint Venture** – An association of two or more persons or business entities that is formed for the single purpose of carrying out a single defined business enterprise for which purpose they combine their

capital, efforts, skills, knowledge, or property. Joint ventures shall be established by written agreement to qualify for this program.

- f) **Local Business Enterprise (“LBE”)** – A firm having a Principal Place of Business and a Significant Employment Presence in San Diego County, California that has been in operation for 12 consecutive months and a valid business tax certificate. This definition is subsumed within the definition of Small Local Business Enterprise.
- g) **Minor Construction Program** – A program developed for bidding exclusively among SLBE-ELBE Construction firms.
- h) **Principal Place of Business** – A location wherein a firm maintains a physical office and through which it obtains no less than 50% of its overall customers or sales dollars.
- i) **Protégé** – A firm that has been approved and is an active participant in the City’s Mentor-Protégé Program and that has signed the required program participation agreement and has been assigned a mentor.
- j) **Significant Employee Presence** – No less than 25% of a firm’s total number of employees are domiciled in San Diego County.

C. SUBCONTRACTOR PARTICIPATION.

1. For the purpose of satisfying subcontracting participation requirements, only 1st tier SLBE–ELBE Subcontractors will be recognized as participants in the Contract according to the following criteria:
 - a) For credit to be allowed toward a respective participation level, all listed SLBE-ELBE firms shall have been certified by the Bid due date.
 - b) The Subcontractor shall perform a commercially useful function for credit to be allowed toward subcontractor participation levels. The Subcontractor shall be required by you to be responsible for the execution of a distinct element of the Work and shall carry out its responsibility by actually performing and supervising its own workforce.
 - c) If the Bidder is seeking the recognition of materials, supplies, or both towards achieving any mandatory subcontracting participation level, the Bidder shall indicate on Form AA40 – Named Equipment/Material Supplier List with the Bid the following:
 - i. If the materials or supplies are obtained from a SLBE-ELBE manufacturer, the Bidder will receive 100% of the cost of the materials or supplies toward SLBE participation. For the purposes of counting SLBE-ELBE participation, a manufacturer is a firm that operates or maintains a factory or establishment that produces, on the premises, the materials, supplies, articles, or equipment required under the Contract and of the general character described by the specifications.

- ii. If the materials or supplies are obtained from a SLBE-ELBE supplier, the Bidder will receive 60% of the cost of the materials or supplies toward SLBE participation. For the purposes of counting SLBE-ELBE participation a Supplier is a firm that owns, operates, or maintains a store, warehouse, or other establishment in which the materials, supplies, articles or equipment of the general character described by the specifications and required under the Contract are bought, kept in stock, and regularly sold or leased to the public in the usual course of business. To be a supplier, the firm shall be an established, regular business that engages, as its principal business and under its own name, in the purchase and sale or lease of the products in question. A person may be a supplier in such bulk items as petroleum products, steel, cement, gravel, stone, or asphalt without owning, operating, or maintaining a place of business if the person both owns and operates distribution equipment for the products. Any supplementing of the suppliers' own distribution equipment shall be by a long-term lease agreement and shall not be on an ad hoc or contract-by-contract basis.
 - iii. If the materials or supplies are obtained from a SLBE-ELBE, which is neither a manufacturer nor a supplier, the entire amount of fees or commissions charged for assistance in the procurement of the materials and supplies, fees or transportation charges for the delivery of materials or supplies required on a job site will be counted toward SLBE-ELBE participation, provided the fees are reasonable and not excessive as compared with fees customarily allowed for similar services. No portion of the cost of the materials and supplies themselves will be counted toward SLBE-ELBE participation.
- d) If the Bidder is seeking the recognition of SLBE-ELBE Trucking towards achieving any mandatory subcontracting participation level, the Bidder shall indicate it on Form AA35 – List of Subcontractors with the Bid. The following factors will be evaluated in determining the credit to be allowed toward the respective participation level:
- i. The SLBE-ELBE shall be responsible for the management and supervision of the entire trucking operation for which it is getting credit on a particular Contract and there shall not be a contrived arrangement for the purpose of counting SLBE-ELBE participation.
 - ii. The SLBE-ELBE shall itself own and operate at least 1 fully licensed, insured, and operational truck used on the Contract.

- iii. The SLBE-ELBE receives credit for the total value of the transportation services it provides on the Contract using trucks it owns, insures, and operates using drivers it employs.
- iv. The SLBE-ELBE may lease trucks from another SLBE-ELBE firm including an owner-operator who is certified as a SLBE-ELBE. The SLBE-ELBE who leases trucks from another SLBE-ELBE receives credit for the total value of the transportation services the lessee SLBE-ELBE provides on the contract.
- v. The SLBE-ELBE may also lease trucks from a non-SLBE-ELBE firm, including an owner-operator. The SLBE-ELBE who leases trucks from a non-SLBE-ELBE is entitled to credit for the total value of transportation services provided by non-SLBE-ELBE lessees not to exceed the value of transportation services provided by SLBE-ELBE owned trucks on the contract. Additional participation by non-SLBE-ELBE lessees receive credit only for the fee or commission it receives as a result of the lease arrangement.
- vi. A lease shall indicate that the SLBE-ELBE has exclusive use of and control over the truck. This does not preclude the leased truck from working for others during the term of the lease with the consent of the SLBE-ELBE so long as the lease gives the SLBE-ELBE absolute priority for use of the leased truck.

D. SLBE-ELBE SUBCONTRACTOR PARTICIPATION PERCENTAGES.

- 1. Contracts valued at \$1,500,000 and above will be considered Major Public Works Contracts and will include a mandatory Subcontractor participation requirement for SLBE-ELBE firms.
 - a) The Bidder shall achieve the mandatory Subcontractor participation requirement or demonstrate GFE.
 - b) The Bidders shall indicate the participation on Forms AA35 - List of Subcontractors and AA40 - Named Equipment/Material Supplier List as applicable regardless of the dollar value.
 - c) An SLBE-ELBE Bidder may count its own participation toward achieving the mandatory goal as long as the SLBE-ELBE Bidder performs 51% of the Contract Price.
- 2. Contracts Valued over \$1,000,000 and under \$1,500,000 will also be considered Major Public Works Contracts and will include the mandatory subcontractor participation requirements described above and the following:
 - a) 5% bid discount for SLBE-ELBE firms.
 - b) Non-certified Contractor will receive 5% bid discount if they achieve the specified mandatory Subcontracting participations.
 - c) Bid discounts shall not apply if the award will result in a total contract cost of \$50,000 in excess of the apparent lowest Bid.

- d) In the event of a tie bid between a SLBE-ELBE Bidder and a non-SLBE-ELBE Bidder, the SLBE-ELBE Bidder will be awarded the Contract.
 - e) In the event of a tie bid between a discounted Bid and a non-discounted Bid, the discounted Bid will be awarded the Contract.
- 3. Contracts valued over \$500,000 up to \$1,000,000 will be considered Minor Public Works Contracts and will be awarded through a competitive Bid process open only to City certified SLBE-ELBE firms. If there are no bidders or no responsible bidders, the Contract will be made available to all Bidders and will be subject to requirements listed in items 1 and 2 for Major Public Works Contracts above.
- 4. Contracts valued at \$500,000 and below will also be considered Minor Public Works Contracts and will be awarded through a competitive bid process open only to City certified ELBEs unless there are less than 2 firms available at which it will be awarded through a competitive process open only to the City certified SLBE-ELBE firms. If there are no bidders or no responsible bidders, the Contract will be made available to all Bidders and subject to requirements listed in items 1 and 2 for Major Public Works Contracts above.

E. JOINT VENTURES.

- 1. The City may allow for Joint Venture bid discounts on some Contracts. Contracts that allow for Joint Venture bid discounts will be designated in Bid documents. A firm that is bidding or competing for City Contracts may partner with a certified SLBE or ELBE to compete for Contracts as a Joint Venture.
- 2. A Joint Venture shall be between two entities with the same discipline or license as required by the City. Joint ventures will receive bid discounts depending on the SLBE or ELBE percentage of participation. To be eligible for a discount, a Joint Venture Agreement shall be approved by the City at the time of Bid submittal. The maximum allowable discount shall be 5%. The parties shall agree to enter in the relationship for the life of the projects.
- 3. Joint Venture shall submit a Joint Venture Management Plan, a Joint Venture Agreement, or both at least 2 weeks prior to the Bid due date. Copies of the Joint Venture applications are available upon request to the Contract Specialist. Each agreement or management plan shall include the following:
 - a) Detailed explanation of the financial contribution for each partner.
 - b) List of personnel and equipment used by each partner.
 - c) Detailed breakdown of the responsibilities of each partner.
 - d) Explanation of how the profits and losses will be distributed.
 - e) Description of the bonding capacity of each partner.
 - f) Management or incentive fees available for any one of the partners (if any).

4. Each Joint Venture partner shall perform a Commercially Useful Function. An SLBE or ELBE that relies on the resources and personnel of a non-SLBE or ELBE firm will not be deemed to perform a Commercially Useful Function.
5. Each Joint Venture partner shall possess licenses appropriate for the discipline for which a proposal is being submitted. If a Joint Venture is bidding on a single trade project, at the time of bid submittal, each Joint Venture partner shall possess the requisite specialty license for that trade bid.
6. The SLBE or ELBE partner shall clearly define the portion of the Work to be performed. This Work shall be of the similar type of Work the SLBE or ELBE partner performs in the normal course of its business. The Joint Venture Participation Form shall specify the Bid items to be performed by each individual Joint Venture partner. Lump sum Joint Venture participation shall not be acceptable.
7. Responsibilities of the SLBE or ELBE Joint Venture Partner:
 - a) The SLBE or ELBE partner shall share in the control, management responsibilities, risks and profits of the Joint Venture in proportion with the level of participation in the project.
 - b) The SLBE or ELBE partner shall perform Work that is commensurate with its experience.
 - c) The SLBE or ELBE partner shall use its own employees and equipment to perform its portion of the Work.
 - d) The Joint Venture as a whole shall perform Bid items that equal or exceed 50% of the Contract Price, excluding the cost of manufactured items, in order to be eligible for a Joint Venture discount.

F. MAINTAINING PARTICIPATION LEVELS.

1. Credit and preference points are earned based on the level of participation proposed prior to the award of the Contract. Once the Project begins you shall achieve and maintain the SLBE-ELBE participation levels for which credit and preference points were earned. You shall maintain the SLBE-ELBE percentages indicated at the Award of Contract and throughout the Contract Time.
2. If the City modifies the original Scope of Work, you shall make reasonable efforts to maintain the SLBE-ELBE participation for which creditor preference points were earned. If participation levels will be reduced, approval shall be received from the City prior to making changes.
3. You shall notify and obtain written approval from the City in advance of any reduction in subcontract scope, termination, or substitution for a designated SLBE-ELBE Subcontractor. Failure to do so shall constitute a material breach of the Contract.
4. If you fail to maintain the SLBE-ELBE participation listed at the time the Contract is awarded and have not received prior approval from the City, the

City may declare you in default and will be considered grounds for debarment under Chapter 2, Article 2, Division 8, of the San Diego Municipal Code.

G. SUBCONTRACTING EFFORTS REVIEW AND EVALUATION.

1. Documentation of your subcontracting efforts will be reviewed by EOCP to verify that you made subcontracting opportunities available to a broad base of qualified Subcontractors, negotiated in good faith with interested Subcontractors, and did not reject any bid for unlawful discriminatory reasons. The EOCP review is based on the federal "Six Good Faith Efforts" model.
2. The GFEs are required methods to ensure that all ELBE and SLBE firms have had the opportunity to compete for the City's Public Works procurements. The Six Good Faith Efforts, also known as affirmative steps, attract and utilize ELBE and SLBE firms:
 - a) Ensure ELBE firms are made aware of contracting opportunities to the fullest extent practicable through outreach and recruitment activities.
 - b) Make information of forthcoming opportunities available to SLBE-ELBE firms and arrange time for Contracts and establish delivery schedules, where requirements permit, in a way that encourages and facilitates participation by SLBE-ELBE firms in the competitive process. This includes posting solicitations for Bids or proposals to SLBE-ELBE firms for a minimum of 10 Working Days before the Bid or Proposal due date.
 - c) Consider in the contracting process whether firms competing for large Contracts could subcontract with SLBE-ELBE firms.
 - d) Encourage contracting with a consortium of ELBE-SLBE firms when a Contract is too large for one of these firms to handle individually.
 - e) Use the services and assistance of the City's EOC Office and the SLBE-ELBE Directory.
 - f) If you award subcontracts, require your Subcontractors to take the steps listed above.

H. GOOD FAITH EFFORT DOCUMENTATION.

1. If the specified SLBE-ELBE Subcontractor participation percentages are not met, you shall submit information necessary to establish that adequate GFEs were taken to meet the Contract Subcontractor participation percentages. See the City's document titled "Small Local Business (SLBE) Program, INSTRUCTIONS FOR BIDDERS COMPLETING THE GOOD FAITH EFFORT SUBMITTAL." The instructions for completing the good faith effort submittal can be found on the City's website:

<https://www.sandiego.gov/sites/default/files/legacy/eoc/pdf/slbegfeinst.pdf>

I. SUBCONTRACTOR SUBSTITUTION.

1. Evidence of fraud or discrimination in the substitution of Subcontractors will result in sanctions including assessment of penalty fines, termination of Contract, or debarment. This section does not replace applicable California Public Contract Code.

J. FALSIFICATION OF SUB-AGREEMENT AND FRAUD.

1. Falsification or misrepresentation of a sub-agreement as to company name, Contract amount or actual Work performed by Subcontractors, or any falsification or fraud on the part your submission of documentation and forms pursuant to this program, will result in sanctions against you including assessment of penalty fines, termination of the Contract, or debarment. Instances of falsification or fraud which are indicative of an attempt by you to avoid subcontracting with certain categories of Subcontractors on the basis of race, gender, gender expression, gender identity, religion, national origin, ethnicity, sexual orientation, age, or disability shall be referred to the Equal Opportunity Contracting Program's Investigative Unit for possible violations of Article 2, Division 35 of the City Administrative Code, §§22.3501 et seq. (Nondiscrimination in Contracting).

K. RESOURCES.

1. The current list of certified SLBE-ELBE firms and information for completing the GFE submittal can be found on the City's EOC Department website:
<http://www.sandiego.gov/eoc/programs/slbe>
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ATTACHMENT D
PREVAILING WAGE

PREVAILING WAGE

- 1. PREVAILING WAGE RATES:** Pursuant to San Diego Municipal Code section 22.3019, construction, alteration, demolition, repair and maintenance work performed under this Contract is subject to State prevailing wage laws. For construction work performed under this Contract cumulatively exceeding \$25,000 and for alteration, demolition, repair and maintenance work performed under this Contract cumulatively exceeding \$15,000, the Contractor and its subcontractors shall comply with State prevailing wage laws including, but not limited to, the requirements listed below.
 - 1.1. Compliance with Prevailing Wage Requirements.** Pursuant to sections 1720 through 1861 of the California Labor Code, the Contractor and its subcontractors shall ensure that all workers who perform work under this Contract are paid not less than the prevailing rate of per diem wages as determined by the Director of the California Department of Industrial Relations (DIR). This includes work performed during the design and preconstruction phases of construction including, but not limited to, inspection and land surveying work.
 - 1.1.1.** Copies of such prevailing rate of per diem wages are on file at the City and are available for inspection to any interested party on request. Copies of the prevailing rate of per diem wages also may be found at <http://www.dir.ca.gov/OPRL/DPreWageDetermination.htm>. Contractor and its subcontractors shall post a copy of the prevailing rate of per diem wages determination at each job site and shall make them available to any interested party upon request.
 - 1.1.2.** The wage rates determined by the DIR refer to expiration dates. If the published wage rate does not refer to a predetermined wage rate to be paid after the expiration date, then the published rate of wage shall be in effect for the life of this Contract. If the published wage rate refers to a predetermined wage rate to become effective upon expiration of the published wage rate and the predetermined wage rate is on file with the DIR, such predetermined wage rate shall become effective on the date following the expiration date and shall apply to this Contract in the same manner as if it had been published in said publication. If the predetermined wage rate refers to one or more additional expiration dates with additional predetermined wage rates, which expiration dates occur during the life of this Contract, each successive predetermined wage rate shall apply to this Contract on the date following the expiration date of the previous wage rate. If the last of such predetermined wage rates expires during the life of this Contract, such wage rate shall apply to the balance of the Contract.
 - 1.2. Penalties for Violations.** Contractor and its subcontractors shall comply with California Labor Code section 1775 in the event a worker is paid less than the prevailing wage rate for the work or craft in which the worker is employed. This shall be in addition to any other applicable penalties allowed under Labor Code sections 1720 – 1861.

- 1.3. Payroll Records.** Contractor and its subcontractors shall comply with California Labor Code section 1776, which generally requires keeping accurate payroll records, verifying and certifying payroll records, and making them available for inspection. Contractor shall require its subcontractors to also comply with section 1776. Contractor and its subcontractors shall submit weekly certified payroll records online via the City's web-based Labor Compliance Program. Contractor is responsible for ensuring its subcontractors submit certified payroll records to the City.
- 1.3.1.** Contractor and their subcontractors shall also furnish records specified in Labor Code section 1776 directly to the Labor Commissioner in the manner required by Labor Code section 1771.4.
- 1.4. Apprentices.** Contractor and its subcontractors shall comply with California Labor Code sections 1777.5, 1777.6 and 1777.7 concerning the employment and wages of apprentices. Contractor is held responsible for the compliance of their subcontractors with sections 1777.5, 1777.6 and 1777.7.
- 1.5. Working Hours.** Contractor and their subcontractors shall comply with California Labor Code sections 1810 through 1815, including but not limited to: (i) restrict working hours on public works contracts to eight hours a day and forty hours a week, unless all hours worked in excess of 8 hours per day are compensated at not less than 1½ times the basic rate of pay; and (ii) specify penalties to be imposed on contractors and subcontractors of \$25 per worker per day for each day the worker works more than 8 hours per day and 40 hours per week in violation of California Labor Code sections 1810 through 1815.
- 1.6. Required Provisions for Subcontracts.** Contractor shall include at a minimum a copy of the following provisions in any contract they enter into with a subcontractor: California Labor Code sections 1771, 1771.1, 1775, 1776, 1777.5, 1810, 1813, 1815, 1860 and 1861.
- 1.7. Labor Code Section 1861 Certification.** Contractor in accordance with California Labor Code section 3700 is required to secure the payment of compensation of its employees and by signing this Contract, Contractor certifies that "I am aware of the provisions of Section 3700 of the California Labor Code which require every employer to be insured against liability for workers' compensation or to undertake self-insurance in accordance with the provisions of that code, and I will comply with such provisions before commencing the performance of the work of this Contract."
- 1.8. Labor Compliance Program.** The City has its own Labor Compliance Program authorized in August 2011 by the DIR. The City will withhold contract payments when payroll records are delinquent or deemed inadequate by the City or other governmental entity, or it has been established after an investigation by the City or other governmental entity that underpayment(s) have occurred. For questions or assistance, please contact the City of San Diego's Prevailing Wage Unit at PWDPprevailingWage@sandiego.gov.

- 1.9. Contractor and Subcontractor Registration Requirements.** This project is subject to compliance monitoring and enforcement by the DIR. A contractor or subcontractor shall not be qualified to bid on, be listed in a bid or proposal, subject to the requirements of section 4104 of the Public Contract Code, or engage in the performance of any contract for public work, unless currently registered and qualified to perform public work pursuant to Labor Code section 1725.5. It is not a violation of this section for an unregistered contractor to submit a bid that is authorized by Section 7029.1 of the Business and Professions code or by Section 10164 or 20103.5 of the Public Contract Code, provided the contractor is registered to perform public work pursuant to Section 1725.5 at the time the contract is awarded.
- 1.9.1.** A Contractor's inadvertent error in listing a subcontractor who is not registered pursuant to Labor Code section 1725.5 in response to a solicitation shall not be grounds for filing a bid protest or grounds for considering the bid non-responsive provided that any of the following apply: (1) the subcontractor is registered prior to bid opening; (2) within twenty-four hours after the bid opening, the subcontractor is registered and has paid the penalty registration fee specified in Labor Code section 1725.5; or (3) the subcontractor is replaced by another registered subcontractor pursuant to Public Contract Code section 4107.
- 1.9.2.** By submitting a bid or proposal to the City, Contractor is certifying that he or she has verified that all subcontractors used on this public work project are registered with the DIR in compliance with Labor Code sections 1771.1 and 1725.5, and Contractor shall provide proof of registration for themselves and all listed subcontractors to the City at the time of bid or proposal due date or upon request.
- 1.10. Stop Order.** For Contractor or its subcontractors engaging in the performance of any public work contract without having been registered in violation of Labor Code sections 1725.5 or 1771.1, the Labor Commissioner shall issue and serve a stop order prohibiting the use of the unregistered contractors or unregistered subcontractor(s) on ALL public works until the unregistered contractor or unregistered subcontractor(s) is registered. Failure to observe a stop order is a misdemeanor.
- 1.11. List of all Subcontractors.** The Contractor shall provide the list of subcontractors (regardless of tier), along with their DIR registration numbers, utilized on this Contract prior to any work being performed; and the Contractor shall provide a complete list of all subcontractors with each invoice. Additionally, Contractor shall provide the City with a complete list of all subcontractors (regardless of tier) utilized on this contract within ten working days of the completion of the contract, along with their DIR registration numbers. The City shall withhold final payment to Construction Management Professional until at least thirty (30) days after this information is provided to the City.

1.12. Exemptions for Small Projects. There are limited exemptions for installation, alteration, demolition, or repair work done on projects of \$25,000 or less. The Contractor shall still comply with Labor Code sections 1720 et. seq. The only recognized exemptions are listed below:

1.12.1. Registration. The Contractor will not be required to register with the DIR for small projects. (Labor Code section 1771.1).

1.12.2. Certified Payroll Records. The records required in Labor Code section 1776 shall be required to be kept and submitted to the City of San Diego, but will not be required to be submitted online with the DIR directly. The Contractor will need to keep those records for at least three years following the completion of the Contract. (Labor Code section 1771.4).

1.12.3. List of all Subcontractors. The Contractor shall not be required to hire only registered subcontractors and is exempt from submitting the list of all subcontractors that is required in section 1.11. above. (Labor code section 1773.3).

ATTACHMENT E
SUPPLEMENTARY SPECIAL PROVISIONS

SUPPLEMENTARY SPECIAL PROVISIONS

The following Supplementary Special Provisions (SSP) modifies the following documents:

1. The **2021 Edition** of the Standard Specifications for Public Works Construction (The "GREENBOOK").
2. The **2021 Edition** of the City of San Diego Standard Specifications for Public Works Construction (The "WHITEBOOK"), including the following:
 - a) General Provisions (A) for all Construction Contracts.

SECTION 1 – GENERAL, TERMS, DEFINITIONS, ABBREVIATIONS, UNITS OF MEASURE, AND SYMBOLS

1-2 TERMS AND DEFINITIONS. To The "WHITEBOOK":

To item 47, "Holiday", ADD the following:

Holiday	Observed On
Juneteenth	June 19

To item 55, "Normal Working Hours", DELETE in its entirety and SUBSTITUTE with the following:

Normal Working Hours: Normal Working Hours shall be **7:30 AM to 3:30 PM, Monday through Friday**, inclusive. Saturdays, Sundays, and City Holidays are excluded. Unless otherwise specified on the Traffic Control Permits.

SECTION 2 - SCOPE OF THE WORK

2-2 PERMITS, FEES, AND NOTICES. To the "WHITEBOOK", ADD the following:

2. The Contractor will obtain the following permits:
 - a) San Diego Fire Department Hazardous Materials Permit

SECTION 3 – CONTROL OF THE WORK

3-2 SELF-PERFORMANCE. To the "GREENBOOK", DELETE in its entirety and SUBSTITUTE with the following:

1. The self performance percentage requirement will be waived for Prime Contractors meeting the Class B License requirement of this Contract.

3-4 **AUTHORITY OF THE BOARD AND THE ENGINEER.** To the "WHITEBOOK", ADD the following:

4. See **Appendix H - Sample Contractor Performance Evaluation (CPE) Form.**

3-10 **SURVEYING.** To the "GREENBOOK" and "WHITEBOOK", DELETE in its entirety and SUBSTITUTE with the following:

3-10 **SURVEYING (DESIGN-BID-BUILD).**

3-10.1 **General.**

1. You shall provide all required site layout and general grade checking work not specified in 3-10.2, "Survey Services Provided by City".
2. Notify the City, in writing, at least 2 Working Days prior to requesting survey services provided by the City.

3-10.2 **Survey Services Provided by City.**

1. Unless otherwise noted, monument perpetuation, including mark-outs, will be performed by the City. Coordination of these services will be your duty, through the Resident Engineer. If, at any time, an existing survey monument is, or will be, destroyed or disturbed during the course of construction you shall notify the Resident Engineer so that the monument is preserved or perpetuated in accordance with state law.
2. The following surveying services, as defined in Cal. Bus. & Prof. Code §8726, shall be provided by the City:
 - a) Locating or establishing a minimum of 4 project geodetic survey control points that provide horizontal and vertical reference values for site feature and structure layout reference locations.
 - b) Locating, establishing, or reestablishing project site boundary lines, survey monuments, right-of-way lines, or easement lines.
 - c) Locating or establishing building design structure locations (building corners or envelope limits) sufficient for structure construction.

3-10.3 **Payment.**

1. The payment for site layout and general grade checking Work, coordination, and preservation of all survey related marks shall be included in the Contract Price.

3-15.3 Coordination. To The “WHITEBOOK”, ADD the following:

2. Other adjacent City projects are scheduled for construction for the same time period in the vicinity of the Chiller Room at North City Water Reclamation Plant. See **Appendix F – Adjacent Project Map** for the approximate location. Coordinate the Work with the adjacent projects as listed below:
 - a) North City Water Reclamation Plant Expansion and NCPWF Influent Pump Station and Pipeline Project
Resident Engineer: Maria Castillo, (619) 318-1004

SECTION 4 - CONTROL OF MATERIALS

ADD:

4-3.4 Specialty Inspection Paid for by the Contractor. To The “WHITEBOOK”, ADD the following:

2. The specialty inspections required are listed as follows:
 - a) Welding Inspections
 - b) Fasteners, Connecting Elements, and Bolting Inspections
 - c) Anchors to Concrete Inspection and Seismic Resistance

4-6 TRADE NAMES. To The “WHITEBOOK”, ADD the following:

11. You shall submit your list of proposed substitutions for an “equal” item **no less than 15 Working Days prior to Bid due date**, and on the City’s Product Submittal Form available at:

<https://www.sandiego.gov/ecp/edocref/>

SECTION 5 – LEGAL RELATIONS AND RESPONSIBILITIES

5-4 INSURANCE. To The “GREENBOOK”, DELETE in its entirety and SUBSTITUTE with the following:

5-4 INSURANCE.

1. The insurance provisions herein shall not be construed to limit your indemnity and defense duties set forth in the Contract.

5-4.1 Policies and Procedures.

1. You shall procure the insurance described below, at your sole cost and expense, to provide coverage against claims for loss including injuries to persons or damage to property, which may arise out of or in connection with the performance of the Work by you, your agents, representatives, officers, employees or Subcontractors.

2. Insurance coverage for property damage resulting from your operations is on a replacement cost valuation. The market value will not be accepted.
3. You shall maintain this insurance as required by this Contract and at all times thereafter when you are correcting, removing, or replacing Work in accordance with this Contract. Your duties under the Contract, including your indemnity obligations, are not limited to the insurance coverage required by this Contract.
4. If you maintain broader coverage or higher limits than the minimums shown below, City requires and shall be entitled to the broader coverage or the higher limits maintained by you. Any available insurance proceeds in excess of the specified minimum limits of insurance and coverage shall be available to City.
5. Your payment for insurance shall be included in the Contract Price you bid. You are not entitled to any additional payment from the City to cover your insurance, unless the City specifically agrees to payment in writing. Do not begin any Work under this Contract or allow any Subcontractors to begin work, until you have provided, and the City has approved, all required insurance.
6. Policies of insurance shall provide that the City is entitled to 30 days advance written notice of cancellation or non-renewal of the policy or 10 days advance written notice for cancellation due to non-payment of premium. Maintenance of specified insurance coverage is a material element of the Contract. Your failure to maintain or renew coverage and to provide evidence of renewal during the term of the Contract may be treated by the City as a material breach of the Contract.

5-4.2 Types of Insurance.

5-4.2.1 General Liability Insurance.

1. Commercial General Liability Insurance shall be written on the current version of the ISO Occurrence form CG 00 01 07 98 or an equivalent form providing coverage at least as broad.
2. The policy shall cover liability arising from premises and operations, XCU (explosions, underground, and collapse), independent contractors, products/completed operations, personal injury and advertising injury, bodily injury, property damage, and liability assumed under an insured's contract (including the tort liability of another assumed in a business contract).
3. There shall be no endorsement or modification limiting the scope of coverage for either "insured vs. insured" claims or contractual liability. You shall maintain the same or equivalent insurance for at least 10 years following completion of the Work.

4. All costs of defense shall be outside the policy limits. Policy coverage shall be in liability limits of not less than the following:

<u>General Annual Aggregate Limit</u>	<u>Limits of Liability</u>
Other than Products/Completed Operations	\$10,000,000
Products/Completed Operations Aggregate Limit	\$10,000,000
Personal Injury Limit	\$5,000,000
Each Occurrence	\$5,000,000

5-4.2.2 Commercial Automobile Liability Insurance.

1. You shall provide a policy or policies of Commercial Automobile Liability Insurance written on the current version of the ISO form CA 00 01 12 90 or later version or equivalent form providing coverage at least as broad in the amount of \$1,000,000 combined single limit per accident, covering bodily injury and property damage for owned, non-owned, and hired automobiles ("Any Auto").
2. All costs of defense shall be outside the limits of the policy.

5-4.2.3 Workers' Compensation Insurance and Employers Liability Insurance.

1. In accordance with the provisions of California Labor Code section 3700, you shall provide, at your expense, Workers' Compensation Insurance and Employers Liability Insurance to protect you against all claims under applicable state workers' compensation laws. The City, its elected officials, and employees will not be responsible for any claims in law or equity occasioned by your failure to comply with this requirement.
2. Statutory Limits shall be provided for Workers' Compensation Insurance as required by the state of California, and Employer's Liability Insurance with limits of no less than \$1,000,000 per accident for bodily injury or disease.
3. By signing and returning the Contract, you certify that you are aware of the provisions of California's Workers' Compensation laws, including Labor Code section 3700, which requires every employer to be insured against liability for workers' compensation or to undertake self-insurance, and that you will comply with these provisions before commencing the Work.

5-4.2.4 Contractors Pollution Liability Insurance.

1. You shall procure and maintain at your expense or require your Subcontractor, as described below, to procure and maintain Contractors Pollution Liability Insurance applicable to the Work being performed, with a limit no less than \$2,000,000 per claim or occurrence and \$4,000,000 aggregate per policy period of one year.
2. All costs of defense shall be outside the limits of the policy.

3. You shall obtain written approval from the City for any insurance provided by your Subcontractor instead of you.
4. For approval of a substitution of your Subcontractor's insurance, you shall certify that all activities for which the Contractors Pollution Liability Insurance will provide coverage will be performed exclusively by the Subcontractor providing the insurance. The deductible shall not exceed \$25,000 per claim unless the City has provided prior, written approval.
5. Occurrence based policies shall be procured before the Work commences. Claims Made policies shall be procured before the Work commences, shall be maintained for the Contract Time, and shall include a 12-month extended Claims Discovery Period applicable to this contract or the existing policy or policies that shall continue to be maintained for 12 months after the completion of the Work without advancing the retroactive date.

5-4.2.5 Contractors Hazardous Transporters Pollution Liability Insurance.

1. You shall procure and maintain at your expense or require your Subcontractor, as described below, to procure and maintain Contractors Hazardous Transporters Pollution Liability Insurance, including contractual liability coverage to cover liability arising out of transportation of hazardous or toxic, materials, substances, or any other pollutants by you or any Subcontractor in an amount no less than \$2,000,000 limit per occurrence and \$4,000,000 aggregate per policy period of one year.
2. All costs of defense shall be outside the limits of the policy.
3. You shall obtain written approval from the City from any insurance provided by a Subcontractor instead of you.
4. To obtain City approval of a Subcontractor's insurance coverage in lieu of the Contractor's insurance, the Contractor shall certify that all activities under the Contractor's Hazardous Transporters Pollution Liability Insurance will be performed exclusively by the Subcontractor providing the insurance. The deductible shall not exceed \$25,000 per claim without prior approval of the City.
5. Occurrence based policies shall be procured before the Work commences. Claims Made policies shall be procured before the Work commences, shall be maintained for the duration of this contract, and shall include a 12-month extended Claims Discovery Period applicable to this Contract or the existing policy or policies that shall continue to be maintained for 12 months after the completion of the Work under this Contract without advancing the retroactive date.

5-4.3 Rating Requirements. Except for the State Compensation Insurance Fund, all insurance required by this Contract shall be carried only by responsible insurance

companies with a rating of, or equivalent to, at least "A-, VI" by A.M. Best Company, that are authorized by the California Insurance Commissioner to do business in the state of California, and that have been approved by the City.

5-4.3.1 Non-Admitted Carriers. The City will accept insurance provided by non-admitted, "surplus lines" carriers only if the carrier is authorized to do business in the state of California and is included on the List of Approved Surplus Lines Insurers (LASLI list).

All policies of insurance carried by non-admitted carriers shall be subject to all of the requirements for policies of insurance provided by admitted carriers described in this Contract.

5-4.4 Evidence of Insurance. You shall furnish the City with original Certificates of Insurance, including all required amendatory endorsements (or copies of the applicable policy language effecting coverage required by this clause), prior to your commencement of Work under this Contract. In addition, The City reserves the right to require complete, certified copies of all required insurance policies, including endorsements, required by these specifications, at any time.

5-4.5 Policy Endorsements.

5-4.5.1 Commercial General Liability Insurance.

5-4.5.1.1 Additional Insured. To the fullest extent permitted by law and consistent with the limiting provisions set forth at California Civil Code section 2782, California Insurance Code section 11580.04, and any applicable successor statutes limiting indemnification of public agencies that bind the City, the policy or policies shall be endorsed to include as an Additional Insured the City and its respective elected officials, officers, employees, agents, and representatives, with respect to liability arising out of:

1. Ongoing operations performed by you or on your behalf,
2. your products,
3. your work, e.g., your completed operations performed by you on your behalf, or
4. premises owned, leased, controlled, or used by you.

5-4.5.1.2 Primary and Non-Contributory Coverage. The policy shall be endorsed to provide that the coverage with respect to operations, including the completed operations, if appropriate, of the Named Insured is primary to any insurance or self-insurance of the City and its elected officials, officers, employees, agents and representatives. Further, it shall provide that any insurance maintained by the City and its elected officials, officers, employees, agents and representatives shall be in excess of your insurance and shall not contribute to it.

5-4.5.1.3 Project General Aggregate Limit. The policy or policies shall be endorsed to provide a Designated Construction Project General Aggregate Limit that will apply only to the Work. Only claims payments which arise from the Work shall reduce the Designated Construction Project General Aggregate Limit. The Designated Construction Project General Aggregate Limit shall be in addition to the aggregate limit provided for the products-completed operations hazard.

5-4.5.2 Workers' Compensation Insurance and Employers Liability Insurance.

5-4.5.2.1 Waiver of Subrogation. The policy or policies shall be endorsed to provide that the insurer will waive all rights of subrogation against the City and its respective elected officials, officers, employees, agents, and representatives for losses paid under the terms of the policy or policies and which arise from Work performed by the Named Insured for the City.

5-4.5.3 Contractors Pollution Liability Insurance Endorsements.

5-4.5.3.1 Additional Insured. To the fullest extent permitted by law and consistent with the limiting provisions set forth at California Civil Code section 2782, California Insurance Code section 11580.04, and any applicable successor statutes limiting indemnification of public agencies that bind the City, the policy or policies shall be endorsed to include as an Additional Insured the City and its respective elected officials, officers, employees, agents, and representatives, with respect to liability arising out of:

1. Ongoing operations performed by you or on your behalf,
2. your products,
3. your work, e.g., your completed operations performed by you on your behalf, or
4. premises owned, leased, controlled, or used by you.

5-4.5.3.2 Primary and Non-Contributory Coverage. The policy or policies shall be endorsed to provide that the insurance afforded by the Contractors Pollution Liability Insurance policy or policies is primary to any insurance or self-insurance of the City and its elected officials, officers, employees, agents and representatives with respect to operations including the completed operations of the Named Insured. Any insurance maintained by the City and its elected officials, officers, employees, agents and representatives shall be in excess of your insurance and shall not contribute to it.

5-4.5.3.3 Severability of Interest. For Contractors Pollution Liability Insurance, the policy or policies shall provide that your insurance shall apply separately to each insured against whom claim is made or suit is brought, except with respect to the limits of the insurer's liability and shall provide cross-liability coverage.

5-4.5.4 Contractors Hazardous Transporters Pollution Liability Insurance Endorsements.

5-4.5.4.1 Additional Insured. To the fullest extent permitted by law and consistent with the limiting provisions set forth at California Civil Code section 2782, California Insurance Code section 11580.04, and any applicable successor statutes limiting indemnification of public agencies that bind the City, the policy or policies shall be endorsed to include as an Additional Insured the City and its respective elected officials, officers, employees, agents, and representatives, with respect to liability arising out of:

1. Ongoing operations performed by you or on your behalf,
2. your products,

3. your work, e.g., your completed operations performed by you on your behalf, or
4. premises owned, leased, controlled, or used by you.

5-4.5.4.2 Primary and Non-Contributory Coverage. The policy or policies shall be endorsed to provide that the insurance afforded by the Contractors Pollution Liability Insurance policy or policies is primary to any insurance or self-insurance of the City and its elected officials, officers, employees, agents and representatives with respect to operations including the completed operations of the Named Insured. Any insurance maintained by the City and its elected officials, officers, employees, agents and representatives shall be in excess of your insurance and shall not contribute to it.

5-4.5.4.3 Severability of Interest. For Contractors Hazardous Transporters Pollution Liability Insurance, the policy or policies shall provide that your insurance shall apply separately to each insured against whom claim is made or suit is brought, except with respect to the limits of the insurer's liability, and shall provide cross-liability coverage.

5-4.6 Deductibles and Self-Insured Retentions. You shall disclose deductibles and self-insured retentions to the City at the time the evidence of insurance is provided. The City may require you to purchase coverage with a lower retention or provide proof of ability to pay losses and related investigations, claim administration, and defense expenses within the retention. The policy language shall provide, or be endorsed to provide, that the self-insured retention may be satisfied by either the named insured or City.

5-4.7 Reservation of Rights. The City reserves the right, from time to time, to review your insurance coverage, limits, deductibles, and self-insured retentions to determine if they are acceptable to the City. The City will reimburse you, without overhead, profit, or any other markup, for the cost of additional premium for any coverage requested by the Engineer, but not required by this Contract.

5-4.8 Notice of Changes to Insurance. You shall notify the City, in writing, 30 days prior to any material change to the policies of insurance provided under this Contract. This written notice is in addition to the requirements of paragraph 6 of Section 5-4.1.

5-4.9 Excess Insurance. Policies providing excess coverage shall follow the form of the primary policy or policies, including, all endorsements.

5-10.2.1 Public Notice by Contractor. To the "WHITEBOOK", DELETE in its entirety and SUBSTITUTE with the following:

5-10.2.1 Public Notice by Contractor.

1. Post Project Identification Signs in accordance with 3-11.2, "Project Identification Signs". No less than 5 and no more than 10 Working Days in advance of Project construction activities and utility service interruptions, you shall notify all critical facilities, businesses, institutions, property owners, residents, or any other impacted stakeholders within a minimum 300-foot (90 m) radius of the Project i.e., work area and any other affected areas as

shown on the "Notification of Planned Water Shutdown" when you perform the Work.

2. The notification process must be repeated for delays and long pauses in construction activities. Verbal and written notifications, such as door hangers, shall be sent to critical facilities (including but not limited to police stations, fire stations, hospitals, and schools). A copy of written notifications sent to any critical facility shall also be sent to the Engineer.
3. You shall keep records of the people contacted, along with the dates of notification, and shall provide the record e.g., time-stamped pictures of the notices, to the Engineer upon request. You shall identify all other critical facilities that need to be notified.
4. Verbal and written notifications shall also include specific impacts from the construction of the City facilities, e.g., fire hydrants, air vacuum and blow-off devices, pedestrian ramps, and sidewalks, e.g., the loss of parking, access, and impact to private property, e.g., landscaping.
5. Furnish and distribute public notices in the form of door hangers using the City's format to all occupants and/or property owners along streets and all critical facilities such as police stations, fire stations, hospitals, and schools.
6. Where Work is to be performed at least 5 and at most 10 Working Days before starting construction, survey activities, or impacting the community as approved by the Engineer.
7. Within 5 Working Days of the completion or pausing of your construction activities where Work was performed, you shall distribute public notices in the form of door hangers, which outline the anticipated dates of Asphalt Resurfacing, Slurry Seal, Sidewalk, or Curb Ramp Work. Upon resuming construction activities, you shall redistribute door hangers.
8. "No Parking" signs shall be placed 72 hours before the scheduled construction activities and must include the name and phone number of the Contractor. The Contractor shall document the placement of the signs with time-stamped pictures.
9. Leave the door hanger notices on or at the front door of each dwelling and apartment unit and at each commercial building tenant abutting each street block segment.
10. Where the front doors of apartment units are inaccessible or occupants are unavailable, distribute the door hanger notices to the apartment manager or security officer and leave your contact information, such as business cards.
11. Provide time-stamped pictures of the notices to the Engineer.
12. Door Hanger Material: You shall use Blanks/USA brand, Item Number DHJ5B6WH, 1¼ inch (31.8 mm) Holes (removed), 2-up Jumbo Door Hanger in Bristol White, or approved equal.
13. Door hangers shall include the funding source if project is funded in part by State Gas Tax Revenue (SB1).

14. Mailed Notice Material: You shall use Cougar by Domtar, Item Number 2834, or approved equal.
15. For all Work on private property, contact each owner and occupant individually a minimum of 15 Working Days before the Work. If the Work has been delayed, re-notify owners and occupants of the new Work schedule, as directed by the Engineer.
16. A sample of public notices will be included in the Contract.

SECTION 6 – PROSECUTION AND PROGRESS OF THE WORK

6-1.1 Construction Schedule. To the “WHITEBOOK”, ADD the following:

3. Refer to the Sample City Invoice in **Appendix D – Sample City Invoice** and use the format shown.

ADD:

6-6.1.1 Environmental Document.

1. The City of San Diego has prepared a **Notice of Exemption** for **North City Water Reclamation Plant Chiller Replacement**, Project No. **B-20148.02.06**, as referenced in the Contract Appendix. You shall comply with all requirements of the **Notice of Exemption** as set forth in **Appendix A**.
2. Compliance with the City’s environmental document shall be included in the Contract Price, unless separate bid items have been provided.

6-9 LIQUIDATED DAMAGES. To The “WHITEBOOK”, item 2, DELETE in its entirety and SUBSTITUTE with the following:

2. The execution of the Contract shall constitute agreement between you and the City that the liquidated damage amount described in the table below is the value of the damage caused by your failure to complete the Work within the allotted time. Such sum shall not be construed as a penalty and may be deducted from your payments if such delay occurs.

Contract Value	Liquidated Damages Daily Amount
Less than \$200,001	\$1,000
\$200,001 to \$500,000	\$1,500
\$500,001 to \$1,000,000	\$2,000
\$1,000,001 to \$2,000,000	\$2,500
\$2,000,001 to \$5,000,000	\$3,000

Contract Value	Liquidated Damages Daily Amount
\$5,000,001 to \$10,000,000	\$5,500
\$10,000,001 to \$20,000,000	\$6,500
Greater Than \$20,000,000	\$7,000

SECTION 7 – MEASUREMENT AND PAYMENT

7-3.1

General. To The “WHITEBOOK”, ADD the following: `

4. The Lump Sum Bid item for “**Construction of Chillers and Cooling Towers**” shall include full compensation for furnishing all labor, tools, materials, equipment, installation, specialty inspections, and other descriptions associated and applicable under this bid item. Work shall include the replacement of three (3) existing chillers with units of equal performance and size to fit on the existing pads; the replacement of two (2) existing cooling towers with units of equal performance and size to fit on the existing pads; and new sequences of operation for the chillers, associated primary and secondary chilled water pumps, as well as cooling towers, condenser water pumps, and isolation valves. Also included is the new connections for the new chillers and cooling towers to the new controls and recommissioning the sequences for the new equipment. The existing Electrical systems are to be upgraded to account for the higher demand of the new units as well. All work can be found as specified in the Plans **(0100701-1-D through 0100701-46-D)** and Contract Documents.

7-3.9

Field Orders. To The “WHITEBOOK”, DELETE in its entirety and SUBSTITUTE with the following:

1. If the cumulative total of Field Order items of Work does not exceed the “**Field Orders**” Bid Item, the City shall pay those Field Orders as shown below:

**TABLE 7-3.9
FIELD ORDER LIMITS**

Contract Price	Maximum Each Field Order Work Amount
Less than \$1,000,001	\$10,000
\$1,000,001 to \$5,000,000	\$20,000
\$5,000,001 to \$10,000,000	\$25,000
\$10,000,001 to \$30,000,000	\$40,000
Greater than \$30,000,000	\$70,000

7-3.11 Compensation Adjustments for Price Index Fluctuations. To the "WHITEBOOK", ADD the following:

5. This Contract **is not** subject to the provisions of The "WHITEBOOK" for Compensation Adjustments for Price Index Fluctuations for paving asphalt.

SECTION 1001 – CONSTRUCTION BEST MANAGEMENT PRACTICES (BMPs)

1001-1 GENERAL. To The "WHITEBOOK", ADD the following:

8. Based on a preliminary assessment by the City, this Contract is subject to **WPCP**.
-

SUPPLEMENTARY SPECIAL PROVISIONS

APPENDICES

APPENDIX A

NOTICE OF EXEMPTION

NOTICE OF EXEMPTION

(Check one or both)

TO: _____ Recorder/County Clerk
P.O. Box 1750, MS A-33
1600 Pacific Hwy, Room 260
San Diego, CA 92101-2400

FROM: City of San Diego
Engineering & Capital Projects Department
525 B Street, Suite 750, MS 908A
San Diego, CA 92101

_____ Office of Planning and Research
1400 Tenth Street, Room 121
Sacramento, CA 95814

Project Name: North City Water Reclamation Plant Chiller Replacement

WBS No.: B-20148.02.06

Project Location-Specific: The project is located at the North City Water Reclamation Plant (NCWRP) at 4949 Eastgate Mall, San Diego, CA 92121 within the University Community Planning Area (Council District 6).

Project Location-City/County: San Diego/San Diego

Description of nature and purpose of the Project: The project proposes the following improvements within the existing structures of the North City Water Reclamation Plant (NCWRP): replacement of three existing chillers, replacement of three existing condenser water pumps, replacement of two existing cooling towers, replacement of existing electrical appurtenances to accommodate new improvements, installation of approximately 100 linear feet of centrate line piping, and replacement and installation of other related appurtenances such as system controls and isolation valves. All work will occur within the existing structures of the NCWRP.

Name of Public Agency Approving Project: City of San Diego

Name of Person or Agency Carrying Out Project: City of San Diego
Engineering and Capital Projects Department
Contact: Thomas Park
Email/Phone No.: TPark@sandiego.gov / (619) 533-4612
525 B Street, Suite 750 (MS 908A), San Diego, CA 92101

Exempt Status:

- ☐ Ministerial (Sec. 21080(b)(1); 15268);
- ☐ Declared Emergency (Sec. 21080(b)(3); 15269(a));
- ☐ Emergency Project (Sec. 21080(b)(4); 15269 (b)(c))
- ☒ (X) Categorical Exemption: 15301(a) and (b) (Existing Facilities); 15302(c) (Replacement or Reconstruction); 15303(d) (New Construction or Conversion of Small Structures)
- ☐ Statutory Exemptions:

Reasons why project is exempt: The City of San Diego conducted an environmental review which determined that the project meets the categorical exemption criteria set forth in CEQA State Guidelines, Section 15301(a) and (b) (Existing Facilities), which allows for the maintenance and minor alteration of existing public facilities involving negligible or no expansion of existing or former use, such as interior alteration to existing water facilities and their related appurtenances; Section 15302(c) (Replacement or Reconstruction), which allows for the replacement of existing structures and facilities where the new structure will be located on the same site as the structure replaced and will have substantially the same purpose and capacity as the structure replaced, such as the replacement of existing condenser water pumps, chillers, cooling towers, and their related appurtenances; Section 15303(d) (New Construction or Conversion of Small Structures), which allows for the construction and location of limited numbers of new, small facilities, such as the installation of new piping and appurtenances

required to accommodate replacement water facilities; and where the exceptions listed in Section 15300.2 would not apply.

Lead Agency Contact Person: Thomas Park

Telephone: (619) 533-4612

If filed by applicant:

1. Attach certified document of exemption finding.
2. Has a notice of exemption been filed by the public agency approving the project? ☐ Yes ☐ No

It is hereby certified that the City of San Diego has determined the above activity to be exempt from CEQA.

Carrie Purcell
Carrie Purcell, Deputy Director

7/8/24
Date

Check One:

- (X) Signed By Lead Agency
() Signed by Applicant

Date Received for Filing with County Clerk or OPR:

APPENDIX B

RESERVED

APPENDIX C

MATERIALS TYPICALLY ACCEPTED BY CERTIFICATE OF COMPLIANCE

MATERIALS TYPICALLY ACCEPTED BY CERTIFICATE OF COMPLIANCE

1. Soil amendment
2. Fiber mulch
3. PVC or PE pipe up to 16 inch diameter
4. Stabilizing emulsion
5. Lime
6. Preformed elastomeric joint seal
7. Plain and fabric reinforced elastomeric bearing pads
8. Steel reinforced elastomeric bearing pads
9. Waterstops (Special Condition)
10. Epoxy coated bar reinforcement
11. Plain and reinforcing steel
12. Structural steel
13. Structural timber and lumber
14. Treated timber and lumber
15. Lumber and timber
16. Aluminum pipe and aluminum pipe arch
17. Corrugated steel pipe and corrugated steel pipe arch
18. Structural metal plate pipe arches and pipe arches
19. Perforated steel pipe
20. Aluminum underdrain pipe
21. Aluminum or steel entrance tapers, pipe downdrains, reducers, coupling bands and slip joints
22. Metal target plates
23. Paint (traffic striping)
24. Conductors
25. Painting of electrical equipment
26. Electrical components
27. Engineering fabric
28. Portland Cement
29. PCC admixtures
30. Minor concrete, asphalt
31. Asphalt (oil)
32. Liquid asphalt emulsion
33. Epoxy

APPENDIX D

SAMPLE CITY INVOICE

City of San Diego, CM&FE Div., 9573 Chesapeake Drive, SD CA 92123

Project Name:

Work Order No or Job Order No.

City Purchase Order No.

Resident Engineer (RE):

RE Phone#: Fax#:

Contractor's Name:

Contractor's Address:

Contractor's Phone #:

Contractor's fax #:

Contact Name:

Invoice No.

Invoice Date:

Billing Period: (To)

Trigger Asset	Item #	Item Description	Contract Authorization				Previous Totals To Date		This Estimate		Totals to Date		Amount Remaining
			Unit	Price	Qty	Extension	%/QTY	Amount	% / QTY	Amount	% / QTY	Amount	
	1				1.00	\$ -		\$0.00		\$0.00	0.00	\$0.00	\$ -
	2				1.00	\$ -		\$0.00		\$0.00	0.00%	\$0.00	\$ -
	3				1.00	\$ -		\$0.00		\$0.00	0.00%	\$0.00	\$ -
	4				1.00	\$ -		\$0.00		\$0.00	0.00%	\$0.00	\$ -
	5				1.00	\$ -		\$0.00		\$0.00	0.00%	\$0.00	\$ -
	6				1.00	\$ -		\$0.00		\$0.00	0.00%	\$0.00	\$ -
	7				1.00	\$ -		\$0.00		\$0.00	0.00%	\$0.00	\$ -
	8				1.00	\$ -		\$0.00		\$0.00	0.00%	\$0.00	\$ -
	5				1.00	\$ -		\$0.00		\$0.00	0.00%	\$0.00	\$ -
	6					\$ -		\$0.00		\$0.00	0.00%	\$0.00	\$ -
	7					\$ -		\$0.00		\$0.00	0.00%	\$0.00	\$ -
	8					\$ -		\$0.00		\$0.00	0.00%	\$0.00	\$ -
	9					\$ -		\$0.00		\$0.00	0.00%	\$0.00	\$ -
	10					\$ -		\$0.00		\$0.00	0.00%	\$0.00	\$ -
	11					\$ -		\$0.00		\$0.00	0.00%	\$0.00	\$ -
	12					\$ -		\$0.00		\$0.00	0.00%	\$0.00	\$ -
	13					\$ -		\$0.00		\$0.00	0.00%	\$0.00	\$ -
	14					\$ -		\$0.00		\$0.00	0.00%	\$0.00	\$ -
	15					\$ -		\$0.00		\$0.00	0.00%	\$0.00	\$ -
	16					\$ -		\$0.00		\$0.00	0.00%	\$0.00	\$ -
	17					\$ -		\$0.00		\$0.00	0.00%	\$0.00	\$ -
						\$ -		\$0.00		\$0.00	0.00%	\$0.00	\$ -
		CHANGE ORDER No.				\$ -		\$0.00		\$0.00	0.00%	\$0.00	\$ -
						\$ -		\$0.00		\$0.00	0.00%	\$0.00	\$ -
		Total Auhtorized Amount (Original)				\$ -		\$0.00		\$0.00		\$0.00	\$ -
		Total Authorized Amount (including approved Change Order)				\$ -		\$0.00		\$0.00	Total Billed	\$0.00	Total Amount Remaining
								\$0.00		\$0.00		\$ -	

SUMMARY

A. Original Contract Amount	\$0.00
B. Approved Change Order #00 Thru #00	\$0.00
C. Total Authorized Amount (A+B)	\$0.00
D. Total Billed to Date	\$0.00
E. Less Total Retention (5% of D)	\$0.00
F. Less Total Previous Payments	\$0.00
G. Payment Due Less Retention	\$0.00
H. Remaining Authorized Amount	\$0.00

I certify that the materials have been received by me, or services have been rendered, in the quality and quantity specified per the approved contracted amounts, and is approved for payment

Resident Engineer

Construction Engineer

Date

Date

Retention and/or Escrow Payment Schedule

Total Retention Required as of this billing (Item E)	\$0.00
Previous Retention Withheld in PO or in Escrow	\$0.00
Add'l Amt to Withhold in PO/Transfer in Escrow:	\$0.00
Amt to Release to Contractor from PO/Escrow:	\$0.00

Contractor Signature and Date: _____

1/10/2024 Rev

North City Reclamation Plant Chiller Replacement
K-26-2330-DBB-3

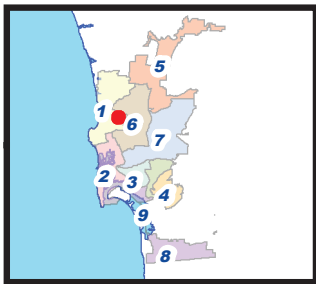
72 | Page

APPENDIX E
LOCATION MAP

NCWRP - CHILLER REPLACEMENT PROJECT (CHIRP)

PROJECT MANAGER
JACOB RIVERA
619-533-4160

LOCATION MAP



● WORK LOCATION



No Scale

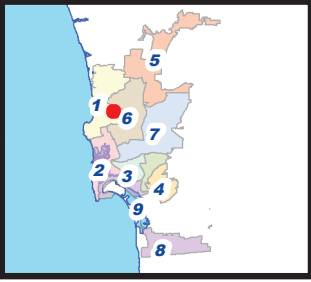
Document Path: \\ad\DFS\PWD-Shared\PTTS-PTTS-CIP-Preliminary-Engineering-and-Program-Coordination\PUD PE Active\B20148 NCWRP - Chiller Replacement Project (CHIRP)\Drafting\Location Map\Location Map.mxd

APPENDIX F

ADJACENT PROJECT MAP

**NORTH CITY WATER RECLAMATION PLANT CHILLER
AND COOLING TOWER REPLACEMENT PROJECT**

ADJACENT PROJECT MAP



● WORK LOCATION

● ADJACENT PROJECT



No Scale

Document Path: \\ad\DFS\PWD-Shared\PTTS-PTTS-CIP-Preliminary-Engineering-and-Program-Coordination\PUD PE Active\B20148 NCWRP - Chiller Replacement Project (CHIRP)\Drafting\Location Map\Location Map.mxd

APPENDIX G

HAZARDOUS WASTE LABEL/FORMS

HAZARDOUS WASTE

STATE AND FEDERAL LAW PROHIBITS IMPROPER DISPOSAL
IF FOUND, CONTACT THE NEAREST POLICE, OR PUBLIC SAFETY
AUTHORITY, OR THE U.S. ENVIRONMENTAL PROTECTION AGENCY
OR THE CALIFORNIA DEPARTMENT OF HEALTH SERVICES

GENERATOR NAME _____ 24 HR. PHONE () _____
ADDRESS _____
CITY _____ STATE _____ ZIP _____
EPA ID NO. _____ MANIFEST DOCUMENT NO. _____
EPA WASTE NO. _____ CA WASTE NO. _____ ACCUMULATION START DATE / /
CONTENTS, COMPOSITION _____
PROPER DOT SHIPPING NAME _____
TECHNICAL NAME (S) _____
UN/NA NO. WITH PREFIX _____
PHYSICAL STATE | HAZARDOUS PROPERTIES ☐ FLAMMABLE ☐ TOXIC
☐ SOLID ☐ LIQUID | ☐ CORROSIVE ☐ REACTIVE ☐ OTHER _____

HANDLE WITH CARE!
CONTAINS HAZARDOUS OR TOXIC WASTES

INCIDENT/RELEASE ASSESSMENT FORM ¹

If you have an emergency, Call 911

Handlers of hazardous materials are required to report releases. The following is a tool to be used for assessing if a release is reportable. Additionally, a non-reportable release incident form is provided to document why a release is not reported (see back).

Questions for Incident Assessment:

	YES	NO
1. Was anyone killed or injured, or did they require medical care or admitted to a hospital for observation?	☐	☐
2. Did anyone, other than employees in the immediate area of the release, evacuate?	☐	☐
3. Did the release cause off-site damage to public or private property?	☐	☐
4. Is the release greater than or equal to a reportable quantity (RQ)?	☐	☐
5. Was there an uncontrolled or unpermitted release to the air?	☐	☐
6. Did an uncontrolled or unpermitted release escape secondary containment, or extend into any sewers, storm water conveyance systems, utility vaults and conduits, wetlands, waterways, public roads, or off site?	☐	☐
7. Will control, containment, decontamination, and/or clean up require the assistance of federal, state, county, or municipal response elements?	☐	☐
8. Was the release or threatened release involving an unknown material or contains an unknown hazardous constituent?	☐	☐
9. Is the incident a threatened release (a condition creating a substantial probability of harm that requires immediate action to prevent, reduce, or mitigate damages to persons, property, or the environment)?	☐	☐
10. Is there an increased potential for secondary effects including fire, explosion, line rupture, equipment failure, or other outcomes that may endanger or cause exposure to employees, the general public, or the environment?	☐	☐

If the answer is YES to any of the above questions – report the release to the California Office of Emergency Services at 800-852-7550 and the local CUPA daytime: (619) 338-2284, after hours: (858) 565-5255. Note: other state and federal agencies may require notification depending on the circumstances.

Call 911 in an emergency

If all answers are NO, complete a Non Reportable Release Incident Form (page 2 of 2) and keep readily available. Documenting why a “no” response was made to each question will serve useful in the event questions are asked in the future, and to justify not reporting to an outside regulatory agency.

If in doubt, report the release.

¹ This document is a guide for accessing when hazardous materials release reporting is required by Chapter 6.95 of the California Health and Safety Code. It does not replace good judgment, Chapter 6.95, or other state or federal release reporting requirements.

NON REPORTABLE RELEASE INCIDENT FORM

1. RELEASE AND RESPONSE DESCRIPTION

Incident #_____

Date/Time Discovered	Date/Time Discharge	Discharge Stopped ☐ Yes ☐ No
Incident Date / Time:		
Incident Business / Site Name:		
Incident Address:		
Other Locators (Bldg, Room, Oil Field, Lease, Well #, GIS)		
Please describe the incident and indicate specific causes and area affected. Photos Attached?: ☐ Yes ☐ No		
Indicate actions to be taken to prevent similar releases from occurring in the future.		

2. ADMINISTRATIVE INFORMATION

Supervisor in charge at time of incident:	Phone:
Contact Person:	Phone:

3. CHEMICAL INFORMATION

Chemical	Quantity	☐	GAL	☐	LBS	☐	FT ³
Chemical	Quantity	☐	GAL	☐	LBS	☐	FT ³
Chemical	Quantity	☐	GAL	☐	LBS	☐	FT ³
Clean-Up Procedures & Timeline:							
Completed By:				Phone:			
Print Name:				Title:			

EMERGENCY RELEASE FOLLOW - UP NOTICE REPORTING FORM

A	BUSINESS NAME	FACILITY EMERGENCY CONTACT & PHONE NUMBER () -	
B	INCIDENT DATE MO DAY YR TIME OES NOTIFIED (use 24 hr time) OES CONTROL NO.		
C	INCIDENT ADDRESS LOCATION	CITY / COMMUNITY	COUNTY ZIP
D	CHEMICAL OR TRADE NAME (print or type)		CAS Number
	CHECK IF CHEMICAL IS LISTED IN 40 CFR 355, APPENDIX A ☐	CHECK IF RELEASE REQUIRES NOTIFICATION UNDER 42 U.S.C. Section 9603 (a) ☐	
	PHYSICAL STATE CONTAINED ☐ SOLID ☐ LIQUID ☐ GAS	PHYSICAL STATE RELEASED ☐ SOLID ☐ LIQUID ☐ GAS	QUANTITY RELEASED
	ENVIRONMENTAL CONTAMINATION ☐ AIR ☐ WATER ☐ GROUND ☐ OTHER	TIME OF RELEASE	DURATION OF RELEASE ____ DAYS ____ HOURS ____ MINUTES
E	ACTIONS TAKEN		
F	KNOWN OR ANTICIPATED HEALTH EFFECTS (Use the comments section for addition information) ☐ ACUTE OR IMMEDIATE (explain) _____ ☐ CHRONIC OR DELAYED (explain) _____ ☐ NOTKNOWN (explain) _____		
G	ADVICE REGARDING MEDICAL ATTENTION NECESSARY FOR EXPOSED INDIVIDUALS		
H	COMMENTS (INDICATE SECTION (A - G) AND ITEM WITH COMMENTS OR ADDITIONAL INFORMATION)		
I	CERTIFICATION: I certify under penalty of law that I have personally examined and I am familiar with the information submitted and believe the submitted information is true, accurate, and complete. REPORTING FACILITY REPRESENTATIVE (print or type) _____ SIGNATURE OF REPORTING FACILITY REPRESENTATIVE _____ DATE: _____		

EMERGENCY RELEASE FOLLOW-UP NOTICE REPORTING FORM INSTRUCTIONS

GENERAL INFORMATION:

Chapter 6.95 of Division 20 of the California Health and Safety Code requires that written emergency release follow-up notices prepared pursuant to 42 U.S.C. § 11004, be submitted using this reporting form. Non-permitted releases of reportable quantities of Extremely Hazardous Substances (listed in 40 CFR 355, appendix A) or of chemicals that require release reporting under section 103(a) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 [42 U.S.C. § 9603(a)] must be reported on the form, as soon as practicable, but no later than 30 days, following a release. The written follow-up report is required in addition to the verbal notification.

BASIC INSTRUCTIONS:

- The form, when filled out, reports follow-up information required by 42 U.S.C § 11004. Ensure that all information requested by the form is provided as completely as possible.
- If the incident involves reportable releases of more than one chemical, prepare one report form for each chemical released.
- If the incident involves a series of separate releases of chemical(s) at different times, the releases should be reported on separate reporting forms.

SPECIFIC INSTRUCTIONS:

Block A: Enter the name of the business and the name and phone number of a contact person who can provide detailed facility information concerning the release.

Block B: Enter the date of the incident and the time that verbal notification was made to OES. The OES control number is provided to the caller by OES at the time verbal notification is made. Enter this control number in the space provided.

Block C: Provide information pertaining to the location where the release occurred. Include the street address, the city or community, the county and the zip code.

Block D: Provide information concerning the specific chemical that was released. Include the chemical or trade name and the Chemical Abstract Service (CAS) number. Check all categories that apply. Provide best available information on quantity, time and duration of the release.

Block E: Indicate all actions taken to respond to and contain the release as specified in 42 U.S.C. § 11004(c).

Block F: Check the categories that apply to the health effects that occurred or could result from the release. Provide an explanation or description of the effects in the space provided. Use Block H for additional comments/information if necessary to meet requirements specified in 42 U.S.C. § 11004(c).

Block G: Include information on the type of medical attention required for exposure to the chemical released. Indicate when and how this information was made available to individuals exposed and to medical personnel, if appropriate for the incident, as specified in 42 U.S.C. § 11004(c).

Block H: List any additional pertinent information.

Block I: Print or type the name of the facility representative submitting the report. Include the official signature and the date that the form was prepared.

MAIL THE COMPLETED REPORT TO:

**State Emergency Response Commission (SERC)
Attn: Section 304 Reports
Hazardous Materials Unit
3650 Schriever Avenue
Mather, CA 95655**

NOTE: Authority cited: Sections 25503, 25503.1 and 25507.1, Health and Safety Code. Reference: Sections 25503(b)(4), 25503.1, 25507.1, 25518 and 25520, Health and Safety Code.

APPENDIX H

SAMPLE CONTRACTOR PERFORMANCE EVALUATION (CPE) FORM



**CITY OF SAN DIEGO
CONTRACTOR PERFORMANCE EVALUATION (CPE) FORM**

Date: _____

☐ **INTERIM EVALUATION:** at _____% of a _____ ☐ Working Day ☐ Calendar Day
☐ **FINAL EVALUATION:** Submitted at completion of a _____ ☐ Working Day ☐ Calendar Day

TITLE OF CONTRACT: Title of Contract

CONTRACT AMOUNT (ORIGINAL/FINAL) _____ / _____

FIRM NAME: Contractor Firm Name

FIRM ADDRESS: _____

CONTRACTOR REPRESENTATIVE'S NAME: _____

CONTRACTOR SUPERINTENDENT'S NAME: _____

CONTRACTOR FOREMAN'S NAME: _____

WBS #:

BID #:

TYPE OF WORK (CHECK ALL THAT APPLY):

TREATMENT PLANT	☐	PUMP STATION	☒	SEWER MAIN	☐	STORM DRAIN	☐
WATER MAIN	☐	FLOOD CONTROL	☐	ENVTL. MITIGATION	☐	BRIDGE	☐
STREETS/HIGHWAYS	☐	TRAFFIC SIGNAL	☐	STREET LIGHTS	☐	PARK	☐
BUILDING [specify]	☐	PIPING SYSTEM	☐	OTHER (SPECIFY)	☐	_____	

CPE are one of the tools the City uses to determine if a contractor has the quality, fitness, and capacity to perform proposed work satisfactorily and is, therefore, a responsible contractor. See San Diego Municipal Code sections 22.3003 and 22.3004. This evaluation represents the observations and conclusions of the City of San Diego, prepared by City staff in the course of their official duties. The Contractor may agree with or dispute the contents and conclusions of this evaluation. Anyone not affiliated with the City of San Diego should conduct his/her investigation to confirm or dispel the conclusions expressed herein.

Notes:

- The Contractor will be allowed (60) calendar days after notice of the final performance evaluation pursuant to SDMC 22.0806 to protest this evaluation in writing; otherwise, the City will deem the evaluation accepted by the Contractor.
- Refer to the end of the form for definitions used in this evaluation.

1. Contract Administration

The Contractor's overall rating for Section 1 is (check one):

☐ Outstanding ☐ Above Satisfactory ☐ Satisfactory ☐ Needs Improvement ☐ Unsatisfactory

2. Compliance with Contract Documents

The Contractor's overall rating for Section 2 is (check one):

☐ Outstanding ☐ Above Satisfactory ☐ Satisfactory ☐ Needs Improvement ☐ Unsatisfactory

3. Construction Workmanship

The Contractor's overall rating for Section 3 is (check one):

☐ Outstanding ☐ Above Satisfactory ☐ Satisfactory ☐ Needs Improvement ☐ Unsatisfactory

4. Safety

The Contractor's overall rating for Section 4 is (check one):

☐ Outstanding ☐ Above Satisfactory ☐ Satisfactory ☐ Needs Improvement ☐ Unsatisfactory

5. Storm Water / BMP Compliance

The Contractor's overall rating for Section 5 is (check one):

☐ Outstanding ☐ Above Satisfactory ☐ Satisfactory ☒ Needs Improvement ☐ Unsatisfactory

6. Cooperation, Professionalism, Communication & Public Outreach

The Contractor's overall rating for Section 6 is (check one):

☐ Outstanding ☐ Above Satisfactory ☐ Satisfactory ☐ Needs Improvement ☐ Unsatisfactory

7. Subcontracting Performance and Management

The Contractor's overall rating for Section 7 is (check one):

☐ Outstanding ☐ Above Satisfactory ☐ Satisfactory ☐ Needs Improvement ☐ Unsatisfactory

OVERALL EVALUATION

THE OVERALL EVALUATION IS DERIVED FROM THE HOLISTIC REVIEW OF THE SEVEN FACTORS ABOVE.

The Contractor's overall rating (check one):

☐ Outstanding ☐ Above Satisfactory ☐ Satisfactory ☐ Needs Improvement ☐ Unsatisfactory

OVERALL SUMMARY:

RESIDENT ENGINEER

SUPERVISOR

By:

(signature / date)

(signature / date)

(print name)

(print name)

Section Head's Initial_____

Asst. Deputy Director's Initials_____

ADD:

Date:_____

CC:

- Contractor
- Program Coordinator, Engineering & Capital Projects/Contracting Group, Pre-qualification Program
- Director, Purchasing & Contracting
- Deputy Director, Purchasing & Contracting
- eFile CityHub/SDShare

SAMPLE

Definitions:

- 1. Performance Areas** - These include the Contractor's record of conforming to the requirements and standards of Contract Administration, Compliance with Contract Documents, Construction Workmanship, Safety, Stormwater Best Management Practices, Cooperation, Professionalism, Communication and Public Outreach, and Subcontracting Performance and Management.

Here are definitions for the specified terms within the context of contractor performance areas:

- Contract Administration: Managing all aspects of a construction contract to ensure compliance with its terms and conditions. This includes handling project documentation, managing changes or modifications, e.g., requests for changes, processing payments, monitoring timelines, requests for information, submittals, resolving disputes, and ensuring all parties fulfill their contractual obligations.
- Compliance with Contract Documents: Adherence to the plans, specifications, and other legally binding documents that outline the scope of work, quality standards, and technical requirements. This involves ensuring all construction activities align with approved designs, materials, and regulations specified in the contract.
- Construction Workmanship: The quality and standard of the physical work performed on the project. It reflects the Contractor's ability to deliver durable, precise, and code-compliant construction through skilled labor and proper techniques specified in the contract.
- Safety: Implementing and maintaining measures to protect workers, site visitors, and the public from hazards. This includes compliance with Occupational Safety and Health Administration standards, site-specific safety plans, and accident prevention strategies throughout the project lifecycle.
- Stormwater Best Management Practices (BMPs): Techniques and measures used to control and reduce the impact of stormwater runoff during and after construction. This includes erosion control, sediment barriers, proper waste management, and other strategies to minimize pollution and protect water quality in compliance with environmental regulations.
- Cooperation: The Contractor's ability to work collaboratively and effectively with the City, subcontractors, government agencies, and other stakeholders. This involves being responsive and adaptable and maintaining a solution-oriented approach to project challenges.
- Professionalism: Demonstrating ethical conduct, integrity, and respect in all aspects of the Contractor's work. It includes maintaining a positive work environment, adhering to industry standards, and fostering trust through reliable and responsible business practices.
- Communication and Public Outreach: Providing clear, timely, and accurate information to stakeholders and the public as specified in the Contract Documents. This involves regular project updates, responding to concerns, and maintaining transparency to build positive community relations and ensure all parties remain informed.
- Subcontracting Performance and Management: The contractor's ability to select, oversee, and coordinate Subcontractors to ensure their work meets quality standards, deadlines, and compliance requirements. Effective management includes monitoring performance, enforcing contractual terms, and resolving issues to maintain project continuity.

The above criteria are not equally weighted. For example, though the Contractor may receive an outstanding rating for Contract Administration, Cooperation, Professionalism and/or Communication, the frequent lapses in safety on the job site or disregard for stormwater compliance resulting in serious injury or damages on site justify the Contractor receiving an overall unsatisfactory rating. Therefore, in the context of the Contractor performance ratings, the definitions can be adjusted to focus more on the quality of the Work, timeliness, and adherence to safety standards than other areas.

- 2. Performance Rating** - See below for a breakdown of the Contractor's performance rating definitions. These definitions provide a set of expectations across multiple areas of the Contractor's performance, ensuring the Contractor is evaluated holistically on various critical aspects of contract execution.

a) Outstanding:

- Contract Administration: Consistently submits all required documentation on time and maintains proper documentation. Fully adheres to the contract's terms and proactively resolves any issues.
- Compliance with Contract Documents: Demonstrates full understanding of and strict adherence to Contract Documents. Any changes or deviations are well-communicated and documented.
- Construction Workmanship: The quality of the Work consistently exceeds expectations, with few to no defects, attention to detail, and thorough craftsmanship.

- Safety: Safety is a top priority, with zero safety incidents, proactive safety training, and implementing additional safety measures beyond required.
- Storm Water Best Management Practices: Consistently implements and exceeds all environmental guidelines for stormwater management and addresses issues before they arise.
- Cooperation: Fully cooperative with all stakeholders, including the client, Subcontractors, and suppliers, with a strong emphasis on team collaboration and problem-solving.
- Professionalism: Maintains the highest standards of conduct, integrity, and respect in all dealings with stakeholders and regulatory agencies.
- Communication and Public Outreach: Regularly updates stakeholders, responds promptly to concerns, and engages with the public in a respectful and transparent manner. Issues are resolved proactively.
- Subcontracting Performance and Management: Subcontractors are managed effectively, adhering to contract terms and producing high-quality work. Coordination between Subcontractors is seamless.

b) Above Satisfactory:

- Contract Administration: Completes necessary documentation with minimal errors and on time. Any issues or changes are addressed promptly.
- Compliance with Contract Documents: Follows Contract Documents well, with only minor discrepancies or deviations that are communicated and resolved.
- Construction Workmanship: Work quality is generally excellent, with a few minor issues or areas for improvement that are promptly corrected.
- Safety: Strong safety record, with minor issues addressed quickly. Safety practices generally meet or exceed expectations.
- Stormwater Best Management Practices: Stormwater management practices are followed effectively, with few issues. Implements best practices and corrects problems when they arise.
- Cooperation: Works well with all parties, addressing issues with minimal conflict. Collaboration is generally smooth.
- Professionalism: Maintains a professional demeanor, resolving conflicts appropriately, and adhering to industry standards.
- Communication and Public Outreach: Communication is proactive and responsive, with timely updates to stakeholders and the public. Public outreach is effective but could be more frequent.
- Subcontracting Performance and Management: Subcontractors are effectively managed, but minor coordination issues may arise. Work is generally on time and meets the standards.

c) Satisfactory:

- Contract Administration: Documentation is completed as required, with occasional delays or missing information. Issues are resolved, but reminders may be required.
- Compliance with Contract Documents: Generally, complies with contract documents, with occasional deviations addressed upon discovery but may result in delays or minor issues.
- Construction Workmanship: Meets the minimum expected quality, with some defects or areas that could be improved. Issues are typically addressed once raised.
- Safety: Safety protocols are followed, though there may be occasional minor incidents or near-misses. The overall safety record is acceptable but not exemplary.
- Stormwater Best Management Practices: Meets basic requirements for stormwater management but may not always go above and beyond to exceed environmental standards.
- Cooperation: Cooperation with others is generally acceptable but may not be proactive. Occasionally requires intervention to resolve conflicts or issues.

- Professionalism: Conducts business professionally, though there may be occasional lapses in communication or judgment.
- Communication and Public Outreach: Provides regular updates but may not always engage proactively with stakeholders or the public. Responses are typically timely but occasionally delayed.
- Subcontracting Performance and Management: Subcontractors are managed adequately, though there may be some delays or quality issues. Coordination could be improved.

d) Needs Improvement:

- Contract Administration: Frequently submits documentation late or incomplete. Requires frequent reminders to stay on track with contract requirements.
- Compliance with Contract Documents: Regularly deviates from contract documents or fails to follow specifications. Changes or deviations are not always communicated effectively.
- Construction Workmanship: Work quality does not consistently meet the minimum standards. There are frequent defects or the need for rework.
- Safety: Safety violations occur, or safety protocols are inconsistently followed. There are notable safety incidents or risks that need to be addressed.
- Stormwater Best Management Practices: Fails to comply consistently with stormwater management practices, leading to potential environmental concerns or violations.
- Cooperation: Struggles to cooperate with others, leading to frequent conflicts, delays, or miscommunications.
- Professionalism: Displays unprofessional behavior, including poor communication, lack of respect for other stakeholders, or failure to resolve conflicts properly.
- Communication and Public Outreach: Communication is often reactive rather than proactive, failing to inform stakeholders or the public promptly or transparently.
- Subcontracting Performance and Management: Subcontractors are not properly managed, leading to frequent delays, quality issues, or resource mismanagement.

e) Unsatisfactory:

- Contract Administration: Consistently fails to submit required documentation, and there are significant discrepancies or ongoing issues with contract compliance.
- Compliance with Contract Documents: Major deviations from contract documents are frequent and unaddressed. The Contractor fails to follow essential specifications or standards.
- Construction Workmanship: The quality of the Work is consistently poor, with widespread defects and the need for significant rework. It is below industry standards.
- Safety: Serious safety violations or significant incidents affecting worker safety or project progress. Safety regulations are often ignored or not implemented.
- Stormwater Best Management Practices: Failure to implement or adhere to environmental best practices leads to violations or significant environmental impacts.
- Cooperation: Exhibits a lack of cooperation, leading to frequent conflicts with stakeholders, delays, and disruptions in project progress.
- Professionalism: Consistently unprofessional behavior, lack of integrity, failure to meet basic expectations for respect and conduct.
- Communication and Public Outreach: Poor or nonexistent communication, leaving stakeholders or the public uninformed. Issues are ignored or not addressed on time.
- Subcontracting Performance and Management: Subcontractors are poorly managed, leading to significant delays, quality issues, or violations of contract terms. Coordination and oversight are lacking.

ATTACHMENT F

**IN-USE OFF-ROAD DIESEL FUELED FLEET REGULATION (OFF-ROAD REGULATION)
COMPLIANCE (CARB)**

ATTACHMENT F

IN-USE OFF-ROAD DIESEL FUELED FLEET REGULATION (OFF-ROAD REGULATION) COMPLIANCE

The California Air Resources Board (CARB) approved amendments to the Off-Road Regulations which can be found at 13 California Code of Regulations (CCR) sections 2449, 2449.1, and 2449.2. These amendments apply to any person, business, or government agency who owns or operates within California any vehicles with a diesel-fueled or alternative diesel fueled off-road compression-ignition engine with maximum power (max hp) of 25 horsepower (hp) or greater provided that the vehicle cannot be registered and driven safely on-road or was not designed to be driven on-road, even if it has been modified so that it can be driven safely on-road. See 13 CCR section 2449 (b) for the full list of vehicles covered by these Off-Road Regulations.

Beginning **January 1, 2024**, Contractor shall be subject to the requirements below. No Contractor or public works awarding body, as applicable, shall enter into a contract with a fleet for which it does not have a valid Certificate of Reported Compliance for the fleet and its listed subcontractors, if applicable, prior to entering into a new or renewed contract with that fleet. Contractor shall comply with the following requirements:

- (1) For a project involving the use of vehicles subject to the Off-Road Regulation, Contractor must obtain copies of the valid Certificates of Reported Compliance, as described in 13 CCR section 2449(n), for the fleet selected for this Contract and their listed subcontractors, if applicable, prior to entering into a new or renewed contract with that fleet and provide copies of such Certificates of Reported Compliance to the City within 10 days of issuance of the Notice of Intent to Award letter. Contractor shall enter into a contract with a fleet for which it does not have a valid Certificates of Reported Compliance for the fleet and its listed subcontractors. City shall not enter into a contract with Contractor until all current Certificates of Reported Compliance for the fleet to be used on this Project are provided by Contractor.
- (2) The Certificates of Reported Compliance received by Contractor for this Project must be retained by Contractor for three years after the Project's completion. Upon request by CARB, these records must be provided to CARB within five business days of the request. Additionally, upon request by City, these records must be produced to City within five business days of the request.
- (3) For emergency contracts that meet the definition of "emergency operations" as defined in 13 CCR section 2449(c)(18), they are exempt from the requirements in 13 CCR section 2449(i)(1)-(3) and sections (1) and (2) above, but must still retain records verifying vehicles subject to the regulation that are operating on the "emergency operations" project are actually being operated on the project for "emergency operations" only. These records, as described in more detail below in section (B) must be retained by Contractor for three years after completion of the Project and upon request from either CARB or the City, Contractor shall provide those records to the requesting party within five business days. All other emergency contracts that do not meet the definition of "emergency operations" must comply with the requirements above and 13 CCR section 2449(i)(1) – (3).

- A. "Emergency Operations" is defined as:
1. Any activity for a project conducted during emergency, life threatening situations, where a sudden, unexpected occurrence that poses a clear and imminent danger, requiring immediate action to prevent or mitigate the loss or impairment of life, health, property, or an essential public service; or in conjunction with any officially declared disaster or state of emergency, as declared by an authorized health officer, agricultural commissioner, fire protection officer, or other authorized health officer;
 2. Any activity for a project conducted by essential service utilities to provide electricity, natural gas, telephone, water, or sewer during periods of service outages and emergency; or
 3. Operations including repairing or preventing damage to roads, buildings, terrain, and infrastructure as a result of an earthquake, flood, storm, fire, other infrequent act of nature, or terrorism. Routine maintenance or construction to prevent public health risks does not constitute emergency operations under the Off-Road Regulations.
- B. The records retained by Contractor for "emergency operations" projects must include:
1. A description of the emergency;
 2. The address or a description of the specific location of the emergency;
 3. The dates on which the emergency operations were performed; and
 4. An attestation by the fleet that the vehicles are operated on the Project for "emergency operations" only.

Beginning **January 1, 2024**, Contractor is also subject to the requirements described in 13 CCR section 2449(j).

- (1) Between March 1 and June 1 of each year, Contractor must collect new valid Certificates of Reported Compliance for the current compliance year, as defined in 13 CCR section 2449(n), from all fleets that have an ongoing contract with Contractor as of March 1 of that year. Contractors shall not write contracts to evade this requirement.
- (2) Contractor shall only allow fleets with valid Certificates of Reported Compliance on the Contractor's job sites.
- (3) If Contractor discovers that any fleet intending to operate vehicles subject to this regulation for Contractor does not have a valid Certificate of Reported Compliance, as defined in 13 CCR section 2449(n), or if Contractor observes any noncompliant vehicles subject to the regulation on Contractor's job site, then Contractor must report the that to CARB at <https://calepacomplaints.secure.force.com/complaints/Complaint>, or email **dieselcomplaints@arb.ca.gov**, for each fleet without a valid Certificate of Reported Compliance or each noncompliant vehicle, as applicable, within five business days of such discovery. See 13 CCR 2449(n) for the information required to be disclosed to CARB when reporting non-compliance.

- (4) Upon request by CARB, Contractor must immediately disclose to CARB the name and contact information of each responsible party for all vehicles subject to this regulation operating at the job site or for Contractor.
- (5) Contractor shall prominently display signage for any project where vehicles subject to this Off-Road Regulation will operate for 8 calendar days or more. The signage must be posted by the eighth calendar day from which the first vehicle operates. The signage will be in lettering larger than size 14-point type and displayed in a conspicuous place where notices to employees are customarily posted at the job site or where there is employee foot traffic. If one of the above locations is also viewable by the public, it should be posted at that location. An exemption to this posting requirement is permitted if the operational time of a project is 7 calendar days or less. The signage must include the following language, verbatim:

(A) Who does the In-Use Off-Road Regulation Apply to?

The In-Use Off-Road Diesel-Fueled Fleets Regulation (Off-Road Regulation) applies to all self-propelled off-road diesel vehicles 25 horsepower or greater and most two-engine vehicles (except on-road two-engine sweepers) owned or operated in California. This includes vehicles that are rented or leased (rental or leased fleets)."

(B) "In-Use Off-Road Regulation Requirements

Idling Limit: Vehicles cannot idle longer than five minutes. There are exceptions for vehicles that need to idle to perform work.

Labeling: Vehicles must be labeled with a CARB assigned equipment identification number (EIN). The EIN shall be white on a red background, unless the vehicle is part of a captive attainment area fleet, in which case the EIN shall be white on a green background.

The EIN shall be located in clear view on both sides of the outside of the vehicle."

ATTACHMENT G
CONTRACT AGREEMENT

ATTACHMENT G
CONTRACT AGREEMENT

CONSTRUCTION CONTRACT

This contract is made and entered into between THE CITY OF SAN DIEGO, a municipal corporation, herein called "City", and HPS Mechanical, Inc, herein called "Contractor" for construction of **North City Reclamation Plant Chiller Replacement** Bid No. **K-26-2330-DBB-3**; in the total amount of **Two Million Five Hundred Seventy Five Thousand Dollars and Zero Cents (\$2,575,000.00).**

IN CONSIDERATION of the payments to be made hereunder and the mutual undertakings of the parties hereto, City and Contractor agree as follows:

1. The following are incorporated into this contract as though fully set forth herein:
 - (a) The attached Faithful Performance and Payment Bonds.
 - (b) The attached Proposal included in the Bid documents by the Contractor.
 - (c) Reference Standards listed in the Instruction to Bidders and the Supplementary Special Provisions (SSP).
 - (d) That certain documents entitled **North City Reclamation Plant Chiller Replacement**, on file in the office of the Purchasing & Contracting Department as Document No. **B-20148**, as well as all matters referenced therein.
2. The Contractor shall perform and be bound by all the terms and conditions of this contract and in strict conformity therewith shall perform and complete in a good and workmanlike manner **North City Reclamation Plant Chiller Replacement**, Bid Number **K-26-2330-DBB-3**, San Diego, California.
3. For such performances, the City shall pay to Contractor the amounts set forth at the times and in the manner and with such additions or deductions as are provided for in this contract, and the Contractor shall accept such payment in full satisfaction of all claims incident to such performances. (See WHITEBOOK, Section 7-3.10, Phased Funding Compensation).
4. No claim or suit whatsoever shall be made or brought by Contractor against any officer, agent, or employee of the City for or on account of anything done or omitted to be done in connection with this contract, nor shall any such officer, agent, or employee be liable hereunder.
5. This contract is effective as of the date that the Mayor or designee signs the agreement and is approved by the City Attorney in accordance with San Diego Charter Section 40.

CONTRACT AGREEMENT (continued)

IN WITNESS WHEREOF, this Agreement is signed by the City of San Diego, acting by and through its Mayor or designee, pursuant to Municipal Code §22.3102 authorizing such execution.

HPS Mechanical, Inc.

CONTRACTOR

By: 

Print Name: Jamie Ramos

Title: Chief Administrative Officer

Date: January 21, 2026

City of San Diego License No.: B2000008006

State Contractor's License No.: 793014

DEPARTMENT OF INDUSTRIAL RELATIONS (DIR) REGISTRATION NUMBER: 1000001107

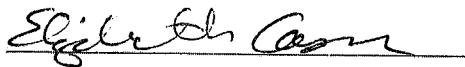
THE CITY OF SAN DIEGO

By: 

Print Name: Stephen Samara
Principal Contract Specialist
Purchasing & Contracting Department

Date: 3/18/2026

**APPROVED AS TO FORM
Heather Ferbert, City Attorney**

By: 

Print Name: Elizabeth Cass
Deputy City Attorney

Date: 3/26/2026

CORPORATE RESOLUTION

RESOLVED that

Scott DenHerder, President

Stephanie DenHerder, Secretary/Treasurer

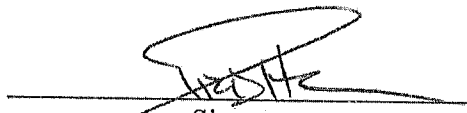
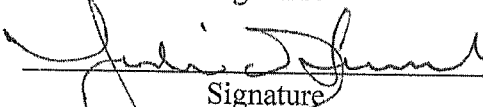
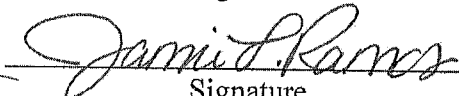
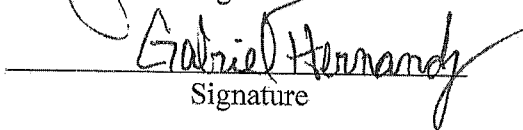
Leslie E. DenHerder, Director

Jamie Ramos, Chief Administrative Officer

Gabriel Hernandez, Director of New Construction

whose signatures appear below, or any of them, are hereby authorized, directed and empowered for and on behalf of this corporation and in its name with respect to any construction project or construction contract including, without limitations: Signing and submission of bid and related documents; signing of contract and related documents, whether resulting from bid, negotiations, or otherwise; signing of any other documents in connection with negotiating, bidding, entering into, or performing the project or contract; and applying for or signing any bonds in connection with the project or contract, or to sign any Labor Compliance Documents.

Authorized signatures:

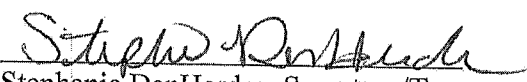
 Signature	 Signature
 Signature	 Signature
 Signature	

I, Stephanie DenHerder, Secretary/Treasurer of HPS Mechanical, Inc., a corporation, do hereby certify that the resolution appearing above is a full, true and correct copy of a resolution of the Board of Directors of said corporation which was duly and regularly called and held in all respects as required by law and by the bylaws of said corporation on the 31st day of December of 2024, and that the signatures appearing on the above-mentioned copy of said resolutions are the genuine signatures of the persons mentioned in said resolution and authorized to act on behalf of said corporation as set forth in said resolution.

I further certify that said resolution has not been amended or revoked and is still in full force and effect.

IN WITNESS WHEREOF, I have hereunto set my hand as such Secretary/Treasurer this 31st day of December, 2024

Corporate Seal


Stephanie DenHerder- Secretary/Treasurer

CERTIFICATIONS AND FORMS

The Bidder, by submitting its electronic bid, agrees to and certifies under penalty of perjury under the laws of the State of California, that the certifications, forms and affidavits submitted as part of this bid are true and correct.

BIDDER'S GENERAL INFORMATION

To the City of San Diego:

Pursuant to "Notice Inviting Bids", specifications, and requirements on file with the City Clerk, and subject to all provisions of the Charter and Ordinances of the City of San Diego and applicable laws and regulations of the United States and the State of California, the undersigned hereby proposes to furnish to the City of San Diego, complete at the prices stated herein, the items or services hereinafter mentioned. The undersigned further warrants that this bid is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization, or corporation; that the bid is genuine and not collusive or sham; that the bidder has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid, and has not directly or indirectly colluded, conspired, connived, or agreed with any bidder or anyone else to put in a sham bid, or that anyone shall refrain from bidding; that the bidder has not in any manner, directly or indirectly, sought by agreement, communication, or conference with anyone to fix the bid price of the bidder or any other bidder, or to fix any overhead, profit, or cost element of the bid price, or of that of any other bidder, or to secure any advantage against the public body awarding the contract of anyone interested in the proposed contract; that all statements contained in the bid are true; and, further, that the bidder has not, directly or indirectly, submitted his or her bid price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, or paid, and will not pay, any fee to any corporation, partnership, company, association, organization, bid depository, or to any member or agent thereof to effectuate a collusive or sham bid.

The undersigned bidder(s) further warrants that bidder(s) has thoroughly examined and understands the entire Contract Documents (plans and specifications) and the Bidding Documents therefore, and that by submitting said Bidding Documents as its bid proposal, bidder(s) acknowledges and is bound by the entire Contract Documents, including any addenda issued thereto, as such Contract Documents incorporated by reference in the Bidding Documents.

**NON-COLLUSION AFFIDAVIT TO BE EXECUTED BY BIDDER AND SUBMITTED WITH BID UNDER 23
UNITED STATES CODE 112 AND PUBLIC CONTRACT CODE 7106**

State of California

County of San Diego

The bidder, being first duly sworn, deposes and says that he or she is authorized by the party making the foregoing bid that the bid is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization, or corporation; that the bid is genuine and not collusive or sham; that the bidder has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid, and has not directly or indirectly colluded, conspired, connived, or agreed with any bidder or anyone else to put in a sham bid, or that anyone shall refrain from bidding; that the bidder has not in any manner, directly or indirectly, sought by agreement, communication, or conference with anyone to fix the bid price of the bidder or any other bidder, or to fix any overhead, profit, or cost element of the bid price, or of that of any other bidder, or to secure any advantage against the public body awarding the contract of anyone interested in the proposed contract; that all statements contained in the bid are true; and further, that the bidder has not, directly or indirectly, submitted his or her bid price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, or paid, and will not pay, any fee to any corporation, partnership, company association, organization, bid depository, or to any member or agent thereof to effectuate a collusive or sham bid.

CONTRACTOR CERTIFICATION

DRUG-FREE WORKPLACE

I hereby certify that I am familiar with the requirements of San Diego City Council Policy No. 100-17 regarding Drug-Free Workplace as outlined in the WHITEBOOK, Section 5-1.3, "Drug-Free Workplace", of the project specifications, and that;

This company has in place a drug-free workplace program that complies with said policy. I further certify that each subcontract agreement for this project contains language which indicates the subcontractor's agreement to abide by the provisions of subdivisions a) through c) of the policy as outlined.

CONTRACTOR CERTIFICATION

AMERICANS WITH DISABILITIES ACT (ADA) COMPLIANCE CERTIFICATION

I hereby certify that I am familiar with the requirements of San Diego City Council Policy No. 100-4 regarding the Americans With Disabilities Act (ADA) outlined in the WHITEBOOK, Section 5-1.2, "California Building Code, California Code of Regulations Title 24 and Americans with Disabilities Act". of the project specifications, and that:

This company has in place workplace program that complies with said policy. I further certify that each subcontract agreement for this project contains language which indicates the subcontractor's agreement to abide by the provisions of the policy as outlined.

CONTRACTOR CERTIFICATION

CONTRACTOR STANDARDS – PLEDGE OF COMPLIANCE

I declare under penalty of perjury that I am authorized to make this certification on behalf of the company submitting this bid/proposal, that as Contractor, I am familiar with the requirements of City of San Diego Municipal Code § 22.3004 regarding Contractor Standards as outlined in the WHITEBOOK, Section 5-1.4, ("Contractor Standards and Pledge of Compliance"), of the project specifications, and that Contractor has complied with those requirements.

I further certify that each of the Contractor's subcontractors has completed a Pledge of Compliance attesting under penalty of perjury of having complied with City of San Diego Municipal Code § 22.3004.

CONTRACTOR CERTIFICATION

EQUAL BENEFITS ORDINANCE CERTIFICATION

I declare under penalty of perjury that I am familiar with the requirements of and in compliance with the City of San Diego Municipal Code § 22.4300 regarding Equal Benefits Ordinance.

CONTRACTOR CERTIFICATION

EQUAL PAY ORDINANCE CERTIFICATION

Contractor shall comply with the Equal Pay Ordinance (EPO) codified in the San Diego Municipal Code (SDMC) at section 22.4801 through 22.4809, unless compliance is not required based on an exception listed in SDMC section 22.4804.

Contractor shall require all of its subcontractors to certify compliance with the EPO in their written subcontracts.

Contractor must post a notice informing its employees of their rights under the EPO in the workplace or job site.

By signing this Contract with the City of San Diego, Contractor acknowledges the EPO requirements and pledges ongoing compliance with the requirements of SDMC Division 48, section 22.4801 et seq., throughout the duration of this Contract.

CONTRACTOR CERTIFICATION

IN-USE OFF-ROAD DIESEL FUELED FLEET REGULATION (OFF-ROAD REGULATION) COMPLIANCE

I hereby certify that Contractor is familiar with the requirements 13 CCR 2449, 2449.1, and 2449.2, as well as Attachment F, In-Use Off-Road Diesel Fueled Fleet Regulation (Off-Road Regulation) Compliance (CARB), and that Contractor shall comply with these requirements.

I further certify that each of the Contractor's listed subcontractors is familiar with these requirements and shall also comply.

CONTRACTOR CERTIFICATION

PRODUCT ENDORSEMENT

I declare under penalty of perjury that I acknowledge and agree to comply with the provisions of City of San Diego Administrative Regulation 95.65, concerning product endorsement. Any advertisement identifying or referring to the City as the user of a product or service requires the prior written approval of the City.

AFFIDAVIT OF DISPOSAL

(To be submitted upon completion of Construction pursuant to the contracts Certificate of Completion)

WHEREAS, on the _____ DAY OF _____, 2____ the undersigned entered into and executed a contract with the City of San Diego, a municipal corporation, for:

North City Reclamation Plant Chiller Replacement

(Project Title)

as particularly described in said contract and identified as Bid No. **K-26-2330-DBB-3**; SAP No. (WBS) **B-20148**; and **WHEREAS**, the specification of said contract requires the Contractor to affirm that "all brush, trash, debris, and surplus materials resulting from this project have been disposed of in a legal manner"; and **WHEREAS**, said contract has been completed and all surplus materials disposed of:

NOW, THEREFORE, in consideration of the final payment by the City of San Diego to said Contractor under the terms of said contract, the undersigned Contractor, does hereby affirm that all surplus materials as described in said contract have been disposed of at the following location(s)

and that they have been disposed of according to all applicable laws and regulations.

Dated this _____ DAY OF _____, _____.

By: _____
Contractor

ATTEST:

State of _____ County of _____

On this _____ DAY OF _____, 2____, before the undersigned, a Notary Public in and for said County and State, duly commissioned and sworn, personally appeared _____ known to me to be the _____ Contractor named in the foregoing Release, and whose name is subscribed thereto, and acknowledged to me that said Contractor executed the said Release.

Notary Public in and for said County and State

ELECTRONICALLY SUBMITTED FORMS

FAILURE TO FULLY COMPLETE AND SUBMIT ANY OF THE FOLLOWING FORMS WILL DEEM YOUR BID NON-RESPONSIVE.

PLANETBIDS WILL NOT ALLOW FOR BID SUBMISSIONS WITHOUT THE ATTACHMENT OF THESE FORMS

The following forms are to be completed by the bidder and submitted (uploaded) electronically with the bid in PlanetBids.

- A. BID BOND – See Instructions to Bidders, Bidders Guarantee of Good Faith (Bid Security) for further instructions**
- B. CONTRACTOR’S CERTIFICATION OF PENDING ACTIONS**
- C. MANDATORY DISCLOSURE OF BUSINESS INTERESTS FORM**
- D. DEBARMENT AND SUSPENSION CERTIFICATION FOR PRIME CONTRACTOR**
- E. DEBARMENT AND SUSPENSION CERTIFICATION FOR SUBCONTRACTORS, SUPPLIERS AND MANUFACTURERS**

BID BOND

See Instructions to Bidders, Bidder Guarantee of Good Faith (Bid Security)

KNOW ALL MEN BY THESE PRESENTS,

That HPS MECHANICAL, INC. as Principal,
and FIDELITY AND DEPOSIT COMPANY OF MARYLAND as Surety, are held
and firmly bound unto The City of San Diego hereinafter called "OWNER," in the sum
of **10% OF THE TOTAL BID AMOUNT** for the payment of which sum, well and truly to be made, we
bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally,
firmly by these presents.

WHEREAS, said Principal has submitted a Bid to said OWNER to perform the WORK required under
the bidding schedule(s) of the OWNER's Contract Documents entitled

NORTH CITY RECLAMATION PLANT CHILLER REPLACEMENT - SAN DIEGO

NOW THEREFORE, if said Principal is awarded a contract by said OWNER and, within the time and in
the manner required in the "Notice Inviting Bids" enters into a written Agreement on the form of
agreement bound with said Contract Documents, furnishes the required certificates of insurance, and
furnishes the required Performance Bond and Payment Bond, then this obligation shall be null and
void, otherwise it shall remain in full force and effect. In the event suit is brought upon this bond by
said OWNER and OWNER prevails, said Surety shall pay all costs incurred by said OWNER in such suit,
including a reasonable attorney's fee to be fixed by the court.

SIGNED AND SEALED, this 25TH day of NOVEMBER, 2025

HPS MECHANICAL, INC. (SEAL)
(Principal)

By: [Signature]
(Signature)
SCOTT DENHERDER, PRESIDENT

FIDELITY AND DEPOSIT COMPANY
OF MARYLAND (SEAL)
(Surety)

By: [Signature]
(Signature)
JOHANNAH GRIFFITH, ATTORNEY-IN-FACT

(SEAL AND NOTARIAL ACKNOWLEDGEMENT OF SURETY)

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

State of California

County of KERN

On 11/25/2025
Date

before me,

Amy Lynn Cowan, Notary Public

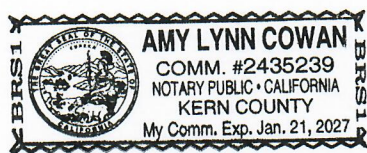
Name and Title of Officer (e.g., "Jane Doe, Notary Public")

personally appeared

Johannah Griffith

Name(s) of Signer(s)

who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.



Place Notary Seal Above

I certify under the PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Amy Lynn Cowan
Signature of Notary

OPTIONAL

Though the data below is not required by law, it may prove valuable to persons relying on the document and could prevent fraudulent reattachment of this form.

Description of Attached Document

Title or Type of Document: Bid Bond

Document Date: 11/25/2025

Number of Pages: _____

Signer(s) Other Than Named Above: _____

Capacity(ies) Claimed by Signer

Signer's Name: _____

- ☐ Corporate Officer – Titles(s) _____
☐ Partner(s) ☐ Limited ☐ General
☐ Individual ☒ Attorney in Fact
☐ Trustee(s) ☐ Guardian/Conservator
☐ Other: _____

Signer is Representing: Fidelity and Deposit Company of Maryland

Name of Person(s) or Entity(ies) _____

RIGHT THUMBPRINT

OF SIGNER

CALIFORNIA ACKNOWLEDGMENT

CIVIL CODE § 1189

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

State of California

County of KernOn 11/25/2025

Date

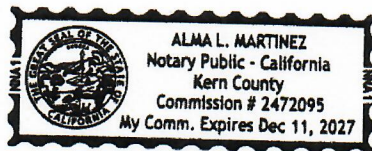
before me, Alma L. Martinez, Notary Public

Here Insert Name and Title of the Officer

personally appeared Scott DenHerder

Name(x) of Signer(x)

who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/~~she/it~~ executed the same in his/~~her/its~~ authorized capacity(~~ies~~), and that by his/~~her/its~~ signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.



I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Signature

Signature of Notary Public

Place Notary Seal and/or Stamp Above

OPTIONAL

Completing this information can deter alteration of the document or fraudulent reattachment of this form to an unintended document.

Description of Attached Document

Title or Type of Document: _____

Document Date: _____ Number of Pages: _____

Signer(s) Other Than Named Above: _____

Capacity(ies) Claimed by Signer(s)

Signer's Name: _____

☐ Corporate Officer – Title(s): _____☐ Partner – ☐ Limited ☐ General☐ Individual ☐ Attorney in Fact☐ Trustee ☐ Guardian or Conservator☐ Other: _____

Signer is Representing: _____

Signer's Name: _____

☐ Corporate Officer – Title(s): _____☐ Partner – ☐ Limited ☐ General☐ Individual ☐ Attorney in Fact☐ Trustee ☐ Guardian or Conservator☐ Other: _____

Signer is Representing: _____

**ZURICH AMERICAN INSURANCE COMPANY
COLONIAL AMERICAN CASUALTY AND SURETY COMPANY
FIDELITY AND DEPOSIT COMPANY OF MARYLAND
POWER OF ATTORNEY**

KNOW ALL MEN BY THESE PRESENTS: That the ZURICH AMERICAN INSURANCE COMPANY, a corporation of the State of New York, the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, a corporation of the State of Illinois, and the FIDELITY AND DEPOSIT COMPANY OF MARYLAND a corporation of the State of Illinois (herein collectively called the "Companies"), by Christopher Nolan, Vice President, in pursuance of authority granted by Article V, Section 8, of the By-Laws of said Companies, which are set forth on the reverse side hereof and are hereby certified to be in full force and effect on the date hereof, do hereby nominate, constitute, and appoint Wes BRADFORD, Elizabeth AGUINAGA, Johannah GRIFFITH, Lorinda HOFFMANN, Julie SANDERS, Lori MCQUILLIAMS of Bakersfield, California, its true and lawful agent and Attorney-in-Fact, to make, execute, seal and deliver, for, and on its behalf as surety, and as its act and deed: **any and all bonds and undertakings**, and the execution of such bonds or undertakings in pursuance of these presents, shall be as binding upon said Companies, as fully and amply, to all intents and purposes, as if they had been duly executed and acknowledged by the regularly elected officers of the ZURICH AMERICAN INSURANCE COMPANY at its office in New York, New York., the regularly elected officers of the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY at its office in Owings Mills, Maryland., and the regularly elected officers of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND at its office in Owings Mills, Maryland., in their own proper persons.

The said Vice President does hereby certify that the extract set forth on the reverse side hereof is a true copy of Article V, Section 8, of the By-Laws of said Companies, and is now in force.

IN WITNESS WHEREOF, the said Vice-President has hereunto subscribed his/her names and affixed the Corporate Seals of the said **ZURICH AMERICAN INSURANCE COMPANY, COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, and FIDELITY AND DEPOSIT COMPANY OF MARYLAND**, this 28th day of January, A.D. 2025.



ATTEST:
**ZURICH AMERICAN INSURANCE COMPANY
COLONIAL AMERICAN CASUALTY AND SURETY COMPANY
FIDELITY AND DEPOSIT COMPANY OF MARYLAND**

By: Christopher Nolan
Vice President

By: Dawn E. Brown
Secretary

**State of Maryland
County of Baltimore**

On this 28th day of January, A.D. 2025, before the subscriber, a Notary Public of the State of Maryland, duly commissioned and qualified, **Christopher Nolan, Vice President and Dawn E. Brown, Secretary** of the Companies, to me personally known to be the individuals and officers described in and who executed the preceding instrument, and acknowledged the execution of same, and being by me duly sworn, depose and saith, that he/she is the said officer of the Company aforesaid, and that the seals affixed to the preceding instrument are the Corporate Seals of said Companies, and that the said Corporate Seals and the signature as such officer were duly affixed and subscribed to the said instrument by the authority and direction of the said Corporations.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my Official Seal the day and year first above written.

Genevieve M. Maison
Notary Public
My Commission Expires January 27, 2029



EXTRACT FROM BY-LAWS OF THE COMPANIES

"Article V, Section 8, Attorneys-in-Fact. The Chief Executive Officer, the President, or any Executive Vice President or Vice President may, by written instrument under the attested corporate seal, appoint attorneys-in-fact with authority to execute bonds, policies, recognizances, stipulations, undertakings, or other like instruments on behalf of the Company, and may authorize any officer or any such attorney-in-fact to affix the corporate seal thereto; and may with or without cause modify or revoke any such appointment or authority at any time."

CERTIFICATE

I, the undersigned, Vice President of the ZURICH AMERICAN INSURANCE COMPANY, the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, and the FIDELITY AND DEPOSIT COMPANY OF MARYLAND, do hereby certify that the foregoing Power of Attorney is still in full force and effect on the date of this certificate; and I do further certify that Article V, Section 8, of the By-Laws of the Companies is still in force.

This Power of Attorney and Certificate may be signed by facsimile under and by authority of the following resolution of the Board of Directors of the ZURICH AMERICAN INSURANCE COMPANY at a meeting duly called and held on the 15th day of December 1998.

RESOLVED: "That the signature of the President or a Vice President and the attesting signature of a Secretary or an Assistant Secretary and the Seal of the Company may be affixed by facsimile on any Power of Attorney...Any such Power or any certificate thereof bearing such facsimile signature and seal shall be valid and binding on the Company."

This Power of Attorney and Certificate may be signed by facsimile under and by authority of the following resolution of the Board of Directors of the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY at a meeting duly called and held on the 5th day of May, 1994, and the following resolution of the Board of Directors of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND at a meeting duly called and held on the 10th day of May, 1990.

RESOLVED: "That the facsimile or mechanically reproduced seal of the company and facsimile or mechanically reproduced signature of any Vice-President, Secretary, or Assistant Secretary of the Company, whether made heretofore or hereafter, wherever appearing upon a certified copy of any power of attorney issued by the Company, shall be valid and binding upon the Company with the same force and effect as though manually affixed.

IN TESTIMONY WHEREOF, I have hereunto subscribed my name and affixed the corporate seals of the said Companies,
this 25TH day of NOVEMBER, 2025.



MJ Pethick

Mary Jean Pethick
Vice President

TO REPORT A CLAIM WITH REGARD TO A SURETY BOND, PLEASE SUBMIT A COMPLETE DESCRIPTION OF THE CLAIM INCLUDING THE PRINCIPAL ON THE BOND, THE BOND NUMBER, AND YOUR CONTACT INFORMATION TO:

Zurich Surety Claims
1299 Zurich Way
Schaumburg, IL 60196-1056
reportsfclains@zurichna.com
800-626-4577

Authenticity of this bond can be confirmed at bondvalidator.zurichna.com or 410-559-8790

CONTRACTOR'S CERTIFICATION OF PENDING ACTIONS

As part of its bid or proposal (Non-Price Proposal in the case of Design-Build contracts), the Bidder shall provide to the City a list of all instances within the past 10 years where a complaint was filed or pending against the Bidder in a legal or administrative proceeding alleging that Bidder discriminated against its employees, subcontractors, vendors or suppliers, and a description of the status or resolution of that complaint, including any remedial action taken.

CHECK ONE BOX ONLY.

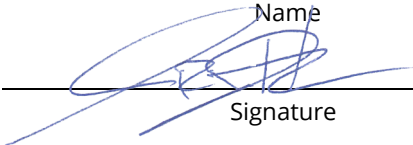
- ☒ The undersigned certifies that within the past 10 years the Bidder has NOT been the subject of a complaint or pending action in a legal administrative proceeding alleging that Bidder discriminated against its employees, subcontractors, vendors or suppliers.
- ☐ The undersigned certifies that within the past 10 years the Bidder has been the subject of a complaint or pending action in a legal administrative proceeding alleging that Bidder discriminated against its employees, subcontractors, vendors or suppliers. A description of the status or resolution of that complaint, including any remedial action taken and the applicable dates is as follows:

DATE OF CLAIM	LOCATION	DESCRIPTION OF CLAIM	LITIGATION (Y/N)	STATUS	RESOLUTION/REMEDIAL ACTION TAKEN

Contractor Name: HPS Mechanical, Inc.

Certified By Scott DenHerder Title President

Name



Signature

Date December 4, 2025

USE ADDITIONAL FORMS AS NECESSARY

Mandatory Disclosure of Business Interests Form

BIDDER/PROPOSER INFORMATION

Legal Name		DBA	
HPS Mechanical, Inc.		HPS Plumbing Services	
Street Address	City	State	Zip
3100 E Belle Terrace, Bakersfield	CA	93307	
Contact Person, Title		Phone	Fax
Scott DenHerder, President		661/397-2121	661/396-2589

Provide the name, identity, and precise nature of the interest* of all persons who are directly or indirectly involved** in this proposed transaction (SDMC § 21.0103).

* The precise nature of the interest includes:

- the percentage ownership interest in a party to the transaction,
- the percentage ownership interest in any firm, corporation, or partnership that will receive funds from the transaction, the value of any financial interest in the transaction,
- any contingent interest in the transaction and the value of such interest should the contingency be satisfied, and any philanthropic, scientific, artistic, or property interest in the transaction.

** Directly or indirectly involved means pursuing the transaction by:

- communicating or negotiating with City officers or employees,
- submitting or preparing applications, bids, proposals or other documents for purposes of contracting with the City,
- or directing or supervising the actions of persons engaged in the above activity.

Name	Title/Position
Scott DenHerder	President
City and State of Residence	Employer (if different than Bidder/Proposer)
Bakersfield, CA	HPS Mechanical, Inc.
Interest in the transaction	
Corporate Officer (100%)	

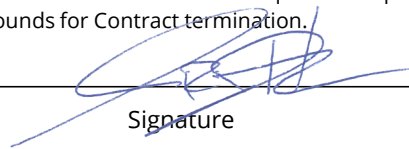
Name	Title/Position
Stephanie DenHerder	Secretary
City and State of Residence	Employer (if different than Bidder/Proposer)
Bakersfield, CA	HPS Mechanical, Inc.
Interest in the transaction	
Corporate Officer	

* Use Additional Pages if Necessary *

Under penalty of perjury under the laws of the State of California, I certify that I am responsible for the completeness and accuracy of the responses contained herein, and that all information provided is true, full and complete to the best of my knowledge and belief. I agree to provide written notice to the Mayor or Designee within five (5) business days if, at any time, I learn that any portion of this Mandatory Disclosure of Business Interests Form requires an updated response. Failure to timely provide the Mayor or Designee with written notice is grounds for Contract termination.

Scott DenHerder, President

Print Name, Title


Signature

December 4, 2025

Date

Failure to sign and submit this form with the bid/proposal shall make the bid/proposal non-responsive. In the case of an informal solicitation, the contract will not be awarded unless a signed and completed Mandatory Disclosure of Business Interests Form is submitted.

DEBARMENT AND SUSPENSION CERTIFICATION
PRIME CONTRACTOR
FAILURE TO COMPLETE AND SUBMIT AT TIME OF BID SHALL RENDER BID NON-RESPONSIVE

EFFECT OF DEBARMENT OR SUSPENSION
To promote integrity in the City's contracting processes and to protect the public interest, the City shall only enter into contracts with responsible- bidders and contractors. In accordance with San Diego Municipal Code §22.0814 (a): <i>Bidders</i> and <i>contractors</i> who have been <i>debarred</i> or <i>suspended</i> are excluded from submitting bids, submitting responses to requests for proposal or qualifications, receiving <i>contract</i> awards, executing <i>contracts</i> , participating as a <i>subcontractor</i> , employee, agent or representative of another <i>person</i> contracting with the City.

As part of its bid or proposal (Non-Price Proposal in the case of Design-Build contracts), the Bidder shall provide to the City a list of Names of the Principal Individual owner(s).

The names of all persons interested in the foregoing proposal as Principals are as follows:

NAME	TITLE
Scott DenHerder	President
Stephanie DenHerder	Secretary

IMPORTANT NOTICE: If Bidder or other interested person is a corporation, state secretary, treasurer, and manager thereof; if a co-partnership, state true name of firm, also names of all individual co-partners composing firm; if Bidder or other interested person is an individual, state first and last names in full.

The Bidder, under penalty of perjury, certifies that, except as noted below, he/she or any person associated therewith in the capacity of owner, partner, director, officer, manager:

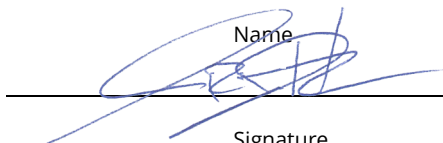
- Is not currently under suspension, debarment, voluntary exclusion, or determination of ineligibility by any Federal, State or local agency;
- has not been suspended, debarred, voluntarily excluded or determined ineligible by any Federal, State or local agency within the past 3 years;
- does not have a proposed debarment pending; and
- has not been indicted, convicted, or had a civil judgment rendered against it by a court of competent jurisdiction in any matter involving fraud or official misconduct within the past 3 years.

If there are any exceptions to this certification, insert the exceptions in the following space.

Exceptions will be considered in determining bidder responsibility. For any exception noted above, indicate below to whom it applies, initiating agency, and dates of action.

Contractor Name: HPS Mechanical, Inc.

Certified By Scott DenHerder Title President


 Name
 Signature

Date 12/04/2025

NOTE: Providing false information may result in criminal prosecution or administrative sanctions.

DEBARMENT AND SUSPENSION CERTIFICATION
SUBCONTRACTORS, SUPPLIERS AND MANUFACTURERS
TO BE COMPLETED BY BIDDER
FAILURE TO COMPLETE AND SUBMIT AT TIME OF BID SHALL RENDER BID NON-RESPONSIVE

Names of the Principal individual owner(s)

As part of its bid or proposal (Non-Price Proposal in the case of Design-Build contracts), the Bidder shall provide to the City a list of Names of the Principal Individual owner(s) for their subcontractor/supplier/manufacturers.

Please indicate if principal owner is serving in the capacity of **subcontractor**, **supplier**, and/or **manufacturer**:

☒ SUBCONTRACTOR ☐ SUPPLIER ☐ MANUFACTURER

NAME	TITLE
Shane Sullivan	President for Karcher Insulation, Inc.

☒ SUBCONTRACTOR ☐ SUPPLIER ☐ MANUFACTURER

NAME	TITLE
Timothy A Dudek	President for Saturn Electric, Inc.

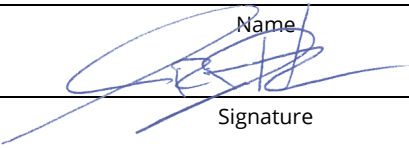
☒ SUBCONTRACTOR ☐ SUPPLIER ☐ MANUFACTURER

NAME	TITLE
Roman Volf	Owner/COO, Chief Operating Officer Owner for Performance Automation Solutions

☐ SUBCONTRACTOR ☐ SUPPLIER ☐ MANUFACTURER

NAME	TITLE

Contractor Name: HPS Mechanical, Inc.

Certified By Scott DenHerder Title President

 Name
 Signature
 Date December 4, 2025

USE ADDITIONAL FORMS AS NECESSARY*

DEBARMENT AND SUSPENSION CERTIFICATION
SUBCONTRACTORS, SUPPLIERS AND MANUFACTURERS

TO BE COMPLETED BY BIDDER

FAILURE TO COMPLETE AND SUBMIT AT TIME OF BID SHALL RENDER BID NON-RESPONSIVE

Names of the Principal individual owner(s)

As part of its bid or proposal (Non-Price Proposal in the case of Design-Build contracts), the Bidder shall provide to the City a list of Names of the Principal Individual owner(s) for their subcontractor/supplier/manufacturers.

Please indicate if principal owner is serving in the capacity of **subcontractor**, **supplier**, and/or **manufacturer**:

☒ SUBCONTRACTOR ☐ SUPPLIER ☐ MANUFACTURER

NAME	TITLE
Timothy A. Dudek	President
Saturn Electric, Inc.	
7552 Trade Street, San Diego, CA 92121	
SLBE # 14SE1044	

☐ SUBCONTRACTOR ☐ SUPPLIER ☐ MANUFACTURER

NAME	TITLE

☐ SUBCONTRACTOR ☐ SUPPLIER ☐ MANUFACTURER

NAME	TITLE

☐ SUBCONTRACTOR ☐ SUPPLIER ☐ MANUFACTURER

NAME	TITLE

Contractor Name: Saturn Electric, Inc.

Certified By Timothy A. Dudek Title President
 Name
Signature Date December 4, 2025

USE ADDITIONAL FORMS AS NECESSARY*

DEBARMENT AND SUSPENSION CERTIFICATION
SUBCONTRACTORS, SUPPLIERS AND MANUFACTURERS
TO BE COMPLETED BY BIDDER
FAILURE TO COMPLETE AND SUBMIT AT TIME OF BID SHALL RENDER BID NON-RESPONSIVE

Names of the Principal individual owner(s)

As part of its bid or proposal (Non-Price Proposal in the case of Design-Build contracts), the Bidder shall provide to the City a list of Names of the Principal Individual owner(s) for their subcontractor/supplier/manufacturers.

Please indicate if principal owner is serving in the capacity of **subcontractor**, **supplier**, and/or **manufacturer**:

☒ SUBCONTRACTOR ☐ SUPPLIER ☐ MANUFACTURER

NAME	TITLE
Shane Sullivan	Karcher Insulation, Inc. (President)

☐ SUBCONTRACTOR ☐ SUPPLIER ☐ MANUFACTURER

NAME	TITLE

☐ SUBCONTRACTOR ☐ SUPPLIER ☐ MANUFACTURER

NAME	TITLE

☐ SUBCONTRACTOR ☐ SUPPLIER ☐ MANUFACTURER

NAME	TITLE

Contractor Name: HPS Mechanical, Inc.

Certified By Scott DenHerder Title President


 Name
 Signature

Date December 4, 2025

USE ADDITIONAL FORMS AS NECESSARY*

City of San Diego

CITY CONTACT: Rosa Riego, Senior Contract Specialist, Email: RRiego@sandiego.gov
Phone No. (619) 533-3426

ADDENDUM A



FOR

NORTH CITY RECLAMATION PLANT CHILLER REPLACEMENT

BID NO.:	K-26-2330-DBB-3
SAP NO. (WBS/IO/CC):	B-20148
CLIENT DEPARTMENT:	2000
COUNCIL DISTRICT:	1
PROJECT TYPE:	HB

BID DUE DATE:

**2:00 PM
AUGUST 12, 2025**

CITY OF SAN DIEGO'S ELECTRONIC BIDDING SITE, PLANETBIDS

<http://www.sandiego.gov/cip/bidopps/index.shtml>

A. CHANGES TO CONTRACT DOCUMENTS

The following changes to the Contract Documents are hereby made effective as though originally issued with the bid package. Bidders are reminded that all previous requirements to this solicitation remain in full force and effect.

B. NOTICE INVITING BIDS

1. To Section 8, PRE-BID MEETING, subsection 8.2 **PRE-BID SITE VISIT**, page 7, **DELETE** in its entirety and **SUBSTITUTE** with the following:

8.2 PRE-BID SITE VISIT: All those wishing to submit a bid are **Encouraged** to visit the Work Site with the Engineer. The purpose of the Site visit is to acquaint Bidders with the Site conditions. To request a sign language or oral interpreter for this visit, call the Purchasing & Contracting Department, Public Works Division at (619) 533-3450 at least 5 Working Days prior to the meeting to ensure availability. The Pre-Bid Site Visit is scheduled as follows:

Time: 1:00pm – 2:00pm

Date: July 22, 2025

Location: 4940 Eastgate Mall, San Diego, CA 92121

If you wish to attend the **Encouraged PRE-BID SITE VISIT**, please confirm your attendance and the total number of attendees by calling the Project Manager, Jacob Rivera, at (619) 209-9652 **at least 2 Working days prior to the meeting to ensure availability.**

Rania Amen, Director
Engineering & Capital Projects Department

Dated: *July 17, 2025*
San Diego, California

RA/JL/lir

City of San Diego

CITY CONTACT: Rosa Riego, Senior Contract Specialist, Email: RRiego@sanidiego.gov
Phone No. (619) 533-3426

ADDENDUM B



FOR

NORTH CITY RECLAMATION PLANT CHILLER REPLACEMENT

BID NO.:	K-26-2330-DBB-3
SAP NO. (WBS/IO/CC):	B-20148
CLIENT DEPARTMENT:	2000
COUNCIL DISTRICT:	1
PROJECT TYPE:	HB

BID DUE DATE:

2:00 PM

SEPTEMBER 16, 2025

CITY OF SAN DIEGO'S ELECTRONIC BIDDING SITE, PLANETBIDS

<http://www.sandiego.gov/cip/bidopps/>

A. CHANGES TO CONTRACT DOCUMENTS

The following changes to the Contract Documents are hereby made effective as though originally issued with the bid package. Bidders are reminded that all previous requirements to this solicitation remain in full force and effect.

THE SUBMITTAL DATE FOR THIS PROJECT HAS BEEN **EXTENDED AS STATED ON THE COVER PAGE.**

Rania Amen, Director
Engineering & Capital Projects Department

Dated: *August 6, 2025*
San Diego, California

RA/JL/kv

City of San Diego

CITY CONTACT: Rosa Riego, Senior Contract Specialist, Email: RRiego@sandiego.gov
Phone No. (619) 533-3426

ADDENDUM C



FOR

NORTH CITY RECLAMATION PLANT CHILLER REPLACEMENT

BID NO.:	K-26-2330-DBB-3
SAP NO. (WBS/IO/CC):	B-20148
CLIENT DEPARTMENT:	2000
COUNCIL DISTRICT:	1
PROJECT TYPE:	HB

BID DUE DATE:

**2:00 PM
OCTOBER 16, 2025**

CITY OF SAN DIEGO'S ELECTRONIC BIDDING SITE, PLANETBIDS

<http://www.sandiego.gov/cip/bidopps/>

ENGINEER OF WORK

The Engineering Specifications and Special Provisions contained herein have been prepared by or under the direction of the following Registered Engineer:

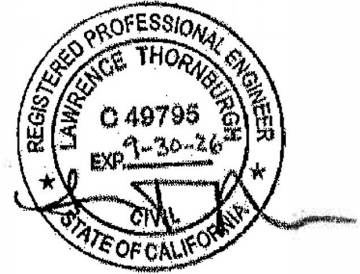
Lawrence Thornburgh, RCE 49795

8/27/25

Seal:

1) Registered Engineer

Date



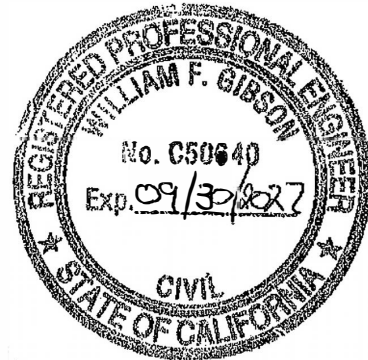
William F. Gibson

08/28/2025

Seal:

2) For City Engineer

Date



A. CHANGES TO CONTRACT DOCUMENTS

The following changes to the Contract Documents are hereby made effective as though originally issued with the bid package. Bidders are reminded that all previous requirements to this solicitation remain in full force and effect.

THE SUBMITTAL DATE FOR THIS PROJECT HAS BEEN **EXTENDED AS STATED ON THE COVER PAGE.**

B. BIDDER'S QUESTIONS

Q1. The schedule does not list the materials of the tower. Will this be full stainless to match the existing?

A1. Please match materials to existing, unless Technical Specifications call for specific Material, which shall supersede this response. Technical Specifications shall be included in Addendum D, which will be issued at a future date.

Q2. E-sheet E201, keynote 1 notes to provide 4#12's in existing ¾" conduit for 01P410 and 01P412 pumps . During job walk on Tuesday the 22nd, the conduit that is feeding these pumps stubs into the concrete slab below the pumps. With the drawings provided we are unable to determine wire footage. Please provide footage of wire needed in existing conduit and as-builts that show how many pull boxes are located between the panel and the pumps.

A2. As-Builts have been provided and can be accessed by following the link on Page 6 of 6 of this Addendum C.

Q3. E-sheet E201, keynote 1 notes to provide 4#12's in existing ¾" conduit for 01P411 pump . During job walk on Tuesday the 22nd, the conduit that is feeding these pumps stubs into the concrete slab below the pumps. With the drawings provided we are unable to determine wire footage. Please provide footage of wire needed in existing conduit and as-builts that show how many pull boxes are located between the panel and the pumps.

A3. As-Builts have been provided and can be accessed by following the link on Page 6 of 6 of this Addendum C.

- Q4. E-sheet E202, keynote 2 notes to provide 3#250 & 1#4 in existing 3" conduit for chiller 01WC425 . During job walk on Tuesday the 22nd, the conduit that is feeding the chiller stubs down into the concrete slab below the chiller. With the drawings provided we are unable to determine wire footage. Please provide footage of wire needed in existing conduit and as-builts that show how many pull boxes are located between the motor control panel 01MCC6101 and the chiller.
- A4. As-Builts have been provided and can be accessed by following the link on Page 6 of 6 of this Addendum C.
- Q5. E-sheet E202, keynote 2 notes to provide 3#250 & 1#4 in existing 3" conduit for chillers 01WC424 & 01WC426 . During job walk on Tuesday the 22nd, the conduit that is feeding chillers stubs down into the concrete slab below the chillers. With the drawings provided we are unable to determine wire footage. Please provide footage of wire needed in existing conduit and as-builts that show how many pull boxes are located between the motor control panel 01MCC6102 and the chillers.
- A5. As-Builts have been provided and can be accessed by following the link on Page 6 of 6 of this Addendum C.
- Q6. Please provide Technical Specifications for this project. I have called Eaton to have the new MCC gear quoted, and they cannot quote without the Technical Specifications that detail out what requirements have to be met. I'm surprised the other General Contractors haven't asked in regards to the mechanical equipment they are providing.
- Please advise if Technical Specifications will be provided, or at minimum please provide Technical Specifications for the new MCC modifications.
- A6. Technical Specifications, including MCCs, shall be included in Addendum D, which will be issued at a future date.
- Q7. There is also new VFD's shown on sheet E204. There is no specifications for these, and no clarification if these are to be provided by the Electrical Contractor, or if they will be supplied with the chiller components.
- A7. Technical Specifications, including VFDs, shall be included in Addendum D, which will be issued at a future date.

C. ATTACHMENTS

1. **ADD APPENDIX I, AS-BUILTS** page 6 of 6 of this Addendum.

Rania Amen, Director
Engineering & Capital Projects Department

Dated: *September 2, 2025*
San Diego, California

RA/JL/lir

APPENDIX I

AS-BUILTS

To access the As-Builts for North City Reclamation Plant Chiller Replacement, click on the below link:

https://drive.google.com/drive/folders/1SmnblLmUpu4_30FV9HIOMkmaqk1cHSweB?usp=sharing

City of San Diego

CITY CONTACT: Rosa Riego, Senior Contract Specialist, Email: RRiego@sandiego.gov
Phone No. (619) 533-3426

ADDENDUM D



FOR

NORTH CITY RECLAMATION PLANT CHILLER REPLACEMENT

BID NO.:	K-26-2330-DBB-3
SAP NO. (WBS/IO/CC):	B-20148
CLIENT DEPARTMENT:	2000
COUNCIL DISTRICT:	1
PROJECT TYPE:	HB

BID DUE DATE:

**2:00 PM
DECEMBER 4, 2025**

CITY OF SAN DIEGO'S ELECTRONIC BIDDING SITE, PLANETBIDS

<http://www.sandiego.gov/cip/bidopps>

A. CHANGES TO CONTRACT DOCUMENTS

The following changes to the Contract Documents are hereby made effective as though originally issued with the bid package. Bidders are reminded that all previous requirements to this solicitation remain in full force and effect.

THE SUBMITTAL DATE FOR THIS PROJECT HAS BEEN **EXTENDED AS STATED ON THE COVER PAGE.**

Rania Amen, Director
Engineering & Capital Projects Department

Dated: *October 7, 2025*
San Diego, California

RA/JL/lir

City of San Diego

CITY CONTACT: Rosa Riego, Senior Contract Specialist, Email: RRiego@sandiego.gov
Phone No. (619) 533-3426

ADDENDUM E



FOR

NORTH CITY RECLAMATION PLANT CHILLER REPLACEMENT

BID NO.:	K-26-2330-DBB-3
SAP NO. (WBS/IO/CC):	B-20148
CLIENT DEPARTMENT:	2000
COUNCIL DISTRICT:	1
PROJECT TYPE:	HB

BID DUE DATE:

**2:00 PM
DECEMBER 4, 2025**

CITY OF SAN DIEGO'S ELECTRONIC BIDDING SITE, PLANETBIDS

<http://www.sandiego.gov/cip/bidopps/index.shtml>

ENGINEER OF WORK

The Engineering Specifications and Special Provisions contained herein have been prepared by or under the direction of the following Registered Engineer:

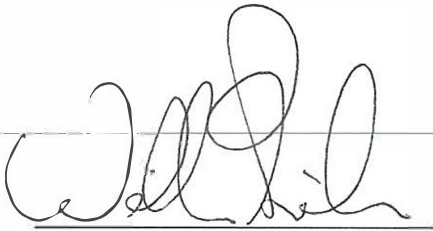


1) Registered Engineer

10/28/25

Date

Seal:



2) For City Engineer

10/28/2025

Date

Seal:



A. CHANGES TO CONTRACT DOCUMENTS

The following changes to the Contract Documents are hereby made effective as though originally issued with the bid package. Bidders are reminded that all previous requirements to this solicitation remain in full force and effect.

B. ADDENDUM

1. To ADDENDUM C, Section C, ATTACHMENTS, **item 1**, page 5, **DELETE** in its entirety and **SUBSTITUTE** with the following:
 1. To Attachments, Attachment E, Supplementary Special Provisions, **ADD APPENDIX I, AS-BUILTS**, page 5 of this Addendum.

C. ATTACHMENTS

1. To Attachments, Attachment E, Supplementary Special Provisions, **ADD APPENDIX J, TECHNICAL SPECIFICATIONS**, pages 6 through 232 of this Addendum.

D. SUPPLEMENTARY SPECIAL PROVISIONS

1. To Attachment E, Supplementary Special Provisions, Section 3 – SCOPE OF WORK, Sub-section **3-15.3, Coordination**, page 53, **ADD** the following:
 3. Another separate Contractor shall perform the work for Distributed Control System (DCS) Integration, including (but not limited to) DCS hardware configuration and software configuration, such as point names and graphics for the NCWRP Chillers and Cooling Towers. CONTRACTOR shall coordinate workshops with the Contractor, the City, and the separate Contractor. A maximum of 5 coordination/workshop meetings should be expected at 2 hours each.
2. To Attachment E, Supplementary Special Provisions, Section 7 – MEASUREMENT AND PAYMENT, Sub-section **7-3.1, General**, page 62, **ADD** the following:
 5. The Allowance Bid Item for “Distributed Control System (DCS) Hardware” shall include compensation for the purchase and installation of materials (Ethernet Link Controller, Field Lan Router, and Network Cabling, including patch cables, and cabling from chillers system to DCS PCM Cabinet) listed by the City. Details of the material shall be provided to the Contractor at a later date during Construction Operations.

E. ADDITIONAL CHANGES

1. The following are additional changes to the Line Items in the PlanetBids Tab:

For clarity where applicable, **ADDITIONS**, if any, have been **Underlined** and **DELETIONS**, if any, have been **~~Stricken out.~~**

Section	Item Code	Description	UoM	Quantity	Payment Reference	Extension
<u>Main Bid</u>	<u>238210</u>	<u>Distributed Control System (DCS) Hardware (EOC Type I)</u>	<u>AL</u>	<u>1</u>	<u>7-3.1</u>	<u>50,000</u>
Main Bid		Field Orders (EOC Type II)	AL	1	7-3.9	~~180,000~~ <u>130,000</u>

Rania Amen, Director
Engineering & Capital Projects Department

Dated: *November 20, 2025*
San Diego, California

RA/JL/kv

APPENDIX I

AS-BUILTS

To access the As-Builts for North City Reclamation Plant Chiller Replacement, click on the below link:

https://ecpfiles.sandiego.gov/CIP_Contracts/K-26-2330-DBB-3/Addendum%20C%20K-26-2330-DBB-3.zip

APPENDIX J

TECHNICAL SPECIFICATIONS

TABLE OF CONTENTS - TECHNICAL SPECIFICATIONS

NORTH CITY WATER RECLAMATION PLANT CHILLERS AND COOLING TOWERS REPLACEMENT

<u>SECTION NUMBER</u>	<u>SECTION NAME</u>
DIVISION 23	HVAC
23 00 00	GENERAL MECHANICAL REQUIREMENTS
23 05 00	COMMON WORK RESULTS FOR HVAC
23 05 14	VARIABLE FREQUENCY DRIVES
23 05 23.12	BALL VALVES FOR HVAC PIPING
23 05 23.13	BUTTERFLY VALVES FOR HVAC PIPING
23 05 23.14	CHECK VALVES FOR HVAC PIPING
23 05 29	HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
23 05 48	VIBRATION AND SEISMIC CONTROLS FOR HVAC
23 05 53	IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT
23 07 19	HVAC PIPING INSULATION
23 09 23	DIRECT DIGITAL CONTROL (DDC) FOR HVAC SYSTEM
23 09 95	MECHANICAL SYSTEM COMMISSIONING
23 21 13	HYDRONIC PIPING
23 21 16	HYDRONIC PIPING SPECIALTIES
23 21 23	HYDRONIC PUMPS
23 64 16	CENTRIFUGAL WATER CHILLERS
23 65 14.13	OPEN-CIRCUIT, INDUCED-DRAFT, COUNTERFLOW COOLING TOWERS
DIVISION 26	ELECTRICAL
26 05 19	LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
26 05 23	CONTROL-VOLTAGE ELECTRICAL POWER CABLES
26 05 26	GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
26 05 29	HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
26 05 33	RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS
26 05 53	IDENTIFICATION FOR ELECTRICAL SYSTEMS
26 27 26	WIRING DEVICES
26 28 13	FUSES
26 28 16	ENCLOSED SWITCHES AND CIRCUIT BREAKERS

**SECTION 23 00 00
GENERAL MECHANICAL REQUIREMENTS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. RFP, City of San Diego Whitebook, City of San Diego General Contract Terms and Provisions, and Drawings apply to this section.

1.2 SCOPE

- A. Basic mechanical requirements specifically applicable to Division 23 and 26 Sections.
- B. Work includes but is not necessarily limited to the following:
 - a. Labor, materials, services, equipment, and appliances required for completion of tasks as indicated on drawing or in specification or as inherently necessary to prepare spaces and systems for new installations as follows:
 - b. Heating, ventilating and air conditioning systems and equipment.
 - c. Testing, adjusting, and balancing.

1.3 SPECIFICATIONS

- A. The Specifications show intent of Work to be done. Specifications shall identify quality and grade of installation and where equipment and hardware is not particularly specified, Contractor shall provide submittals for all products and install them per manufacturers' recommendations, and in a workmanlike manner.
- B. Examine Specifications and drawings for elements in connection with this Work; determine existing and new general construction conditions and be familiar with all limitations caused by such conditions.
- C. The Specifications and Drawings show general requirements and extent of Work contemplated. Exact location and arrangement of parts shall be determined after the Owner has reviewed equipment, as Work progresses, to conform in best possible manner with surroundings, and as directed by the Owner's Representative.
- D. Drawing content is diagrammatic and intended to show the scope and general arrangement of the Work under this Contract. The Contractor shall follow the RFP in laying out the equipment, piping, and ductwork. The drawings are not intended to be scaled for roughing in measurements or to serve as shop drawings. Where job conditions require minor changes or adjustments in the indicated locations or arrangement of the Work, such changes shall be made without change in the Contract amount.

1.4 UTILITIES

- A. Location and sizes of electrical, mechanical, and plumbing service facilities are shown in accordance with data secured from existing record documents and site observations. Data shown is offered as an estimating guide without guarantee of accuracy. Check and verify all data given and verify exact location of all utility services pertaining to Work prior to excavation or performing Work.

1.5 APPLICABLE REFERENCE STANDARDS, CODES AND REGULATIONS

- A. Meet requirements of all state codes having jurisdiction.
- B. State of California Code of Regulations:
 - 1. Title 8, Industrial Relations
 - 2. Title 19, State Fire Marshal Regulations
 - 3. Current California Building Code (CBC), Title 24, Part 2

4. Current California Electrical Code, Title 24, Part 3
 5. Current California Mechanical Code, Title 24, Part 4
 6. Current California Plumbing Code, Title 24, Part 5
 7. Current California Energy Code, Title 24, Part 6
 8. Current California Fire Code, Title 24, Part 9
 9. Current California Standards Code, Title 24, Part 12
- C. Additional Referenced Standards:
1. AABC Associated Air Balance Council
 2. AMCA Air Moving and Conditioning Association
 3. AHRI Air-Conditioning, Heating and Refrigeration Institute
 4. ASHRAE American Society of Heating, Refrigeration and Air Conditioning Engineers
 5. ASME American Society of Mechanical Engineers
 6. ASTM American Society for Testing and Materials
 7. NEMA National Electrical Manufacturer's Association
 8. NFPA National Fire Protection Association Standards
 9. PDI Plumbing and Drainage Institute
 10. UL Underwriters Laboratories
- D. Codes and ordinances having jurisdiction over Work are minimum requirements; but, if Contract Documents indicate requirements, which are in excess of those minimum requirements, then requirements of the Contract Documents shall be followed. Should there be any conflicts between Contract Documents or codes or any ordinances having jurisdiction, report these to the Owner's Representative.
- E. Obtain permits, and request inspections from authority having jurisdiction.

1.6 PROJECT AND SITE CONDITIONS

- A. The arrangement of and connection to equipment shown in the RFP is based upon information available and is not intended to show exact dimensions peculiar to a specific manufacturer. The RFP is diagrammatic and some features of the illustrated equipment installations may require revision to meet actual equipment installation requirements. Structural supports, housekeeping pads, piping connections and adjacent equipment may have to be altered to accommodate the equipment provided. No additional payment will be made for such revisions or alterations.
- B. Examine all RFP documents, site conditions and Specifications to be fully cognizant of all work required under this Division.
- C. Examine site related work and surfaces before starting work of any Section.
- D. Install Work in locations shown on RFP, unless prevented by Project conditions.
- E. Prepare layout drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission from the Owner's Representative before proceeding.

1.7 COOPERATION WITH WORK UNDER OTHER DIVISIONS

- A. Cooperate with other trades to facilitate general progress of Work. Allow all other trades every reasonable opportunity for installation of their work.
- B. Work under this Division shall follow general building construction closely. Set pipe sleeves and inserts and verify that openings for chases and pipes are provided.
- C. Work with other trades in determining exact location of outlets, pipes, and pieces of equipment to avoid interference with lines required to maintain proper installation of Work.
- D. Make such progress in the Work to not delay work of other trades.
- E. Mechanical Work shall have precedence over the other in the following sequence:
 - 1. Soil and waste piping
 - 2. Hydronic piping
 - 3. Ductwork
 - 4. Domestic water piping
 - 5. Fire sprinkler piping

1.8 DISCREPANCIES

- A. The Contractor shall check all documents furnished to them immediately upon their receipt and shall promptly notify the Owner's Representative of any discrepancies. Figures marked on RFP documents shall in general be followed in preference to scale measurements. Piping and instrumentation diagrams shall in general govern floor plans and sections.
- B. Where requirements between RFP and Specifications conflict, the more restrictive provisions shall apply.
- C. If any part of the Specifications or RFP appears unclear or contradictory, apply to Owner's Representative for interpretation and decision as early as possible, including during bidding period. Do not proceed with such work without Owner Representatives decision. Beginning work of any Section constitutes acceptance of conditions.

1.9 CHANGES

- A. The Contractor shall be responsible to make and obtain approval from the Owner's Representative for all necessary adjustments in piping and equipment layouts as required to accommodate the relocations of equipment and/or devices, which are affected by any approved authorized changes or Product substitutions. All changes shall be clearly indicated on the "Record" drawings.

1.10 SUBMITTALS

- A. The manufacturer, contractor or supplier shall include a written statement that the submitted equipment, hardware or accessory complies with the requirement of that particular specification section.
- B. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section.
- C. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.
- D. Note that prior to acceptance of submittals for review, a submittal schedule noting all submittals that the contractor plans to provide for completion of the scope of work of this project shall be submitted to the Owner's Representative.

- E. Submit all Division 23 shop drawings and product data grouped and referenced by the specification technical section number in one complete submittal package.
- F. Shop Drawings:
 - 1. Include installation details of equipment indicating proposed location, layout and arrangement, accessories, piping, and other items that must be shown to assure a coordinated installation.
 - 2. Indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.
 - 3. If equipment is rejected, revise drawings to show acceptable equipment and resubmit.
- G. Whenever more than one (1) manufacturer's product is specified, the named product is the basis of design used in the RFP and the use of alternate-named manufacturer's products or substitutes requires approval from engineer and owner's representative. Any modifications or custom configurations due to the submittal of an "or equal" product will be at the contractor's expense.
- H. The Contractor shall be responsible for all equipment ordered and/or installed prior to receipt of shop drawings returned from the Owner's Representative bearing the Owner's Representative stamp of "Reviewed". All corrections or modifications to the equipment as noted on the shop drawings shall be performed and equipment removed from the job site at the request of the Owner's Representative without additional compensation.
- I. Manufacturer's Data: For each manufactured item, provide current manufacturer's descriptive literature of cataloged products, certified equipment drawings, diagrams, performance, and characteristic curves if applicable, and catalog cuts.
- J. Standard Compliance: When materials or equipment provided by the Contractor must conform to the standards of organizations such as American National Standards Institute (ANSI) or UL, submit proof of such conformance to the Owner Representative for approval. If an organization uses a label or listing to indicate compliance with a particular standard, the label or listing will be acceptable evidence, unless otherwise specified. In lieu of the label or listing, submit a certificate from an independent testing organization, which is competent to perform acceptance testing and is approved by the Owner Representative. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item conforms to the specified organization's standard.
- K. Certified Test Reports: Before delivery of materials and equipment, certified copies of all test reports specified in individual sections shall be submitted for approval.
- L. Certificates of Compliance or Conformance: Submit manufacturer's certifications as required on products, materials, finish, and equipment indicated in the technical sections. Certifications shall be documents prepared specifically for this Contract. Pre-printed certifications and copies of previously submitted documents will not be acceptable. The manufacturer's certifications shall name the appropriate products, equipment, or materials and the publication specified as controlling the quality of that item. Certification shall not contain statements to imply that the item does not meet requirements specified, such as "as good as"; or "achieve the same end use and results as materials formulated in accordance with the referenced publications"; or "equal or exceed the service and performance of the specified material." Certifications shall simply state that the item conforms to the requirements specified. Certificates shall be printed on the manufacturer's letterhead and shall be signed by the manufacturer's official authorized to sign certificates of compliance or conformance.

1.11 PROJECT RECORD DOCUMENTS

- A. Refer to Division 01 for additional requirements.

1. All changes, deviations and information recorded on the "Project Record drawings" set during Construction shall be redrafted onto the latest version of AutoCAD or Revit, where applicable.
2. Submit completed shop drawings to the Owner prior to completion in AutoCAD format. Contractor hand marked or drafted redlined "Project Record RFP" will not be accepted.

1.12 PRODUCT ALTERNATIVES OR SUBSTITUTIONS

- A. Refer to General Conditions and Division 01 for additional requirements.

1.13 OPERATING INSTRUCTIONS

- A. Furnish approved operating instructions for systems and equipment indicated in the technical sections for use by operation and maintenance personnel.

1.14 MANUFACTURER'S RECOMMENDATIONS

- A. Where installation procedures or any part thereof are required to be in accordance with manufacturer's recommendations, furnish printed copies of the recommendations prior to installation. Installation of the item shall not proceed until recommendations are received. Failure to provide recommendations will cause rejection of the equipment or material.

1.15 DELIVERY AND STORAGE

- A. Refer to Division 01 for additional requirements.
- B. Handle, store, and protect equipment and materials in accordance with the manufacturer's recommendations and with the requirements of NFPA 70B P. Contractor to schedule the vendor to verify that no non-visual defects have developed due to lack of proper preventative maintenance and storage of equipment. Replace damaged or defective items with new items.

1.16 GUARANTEE

- A. Except as may be specified under other sections in the Specifications, guarantee all equipment furnished under the Specifications for a period of one year from date of project acceptance against defective workmanship and material and improper installation. Upon notification of failure, correct deficiency immediately and without cost to the Owner.
- B. Standard warranty of manufacturer shall apply for replacement of parts after expiration of the above period. Manufacturer shall furnish replacement parts to the Owner for their service agency as directed.

PART 2 - PRODUCTS

Not Applicable.

PART 3 - EXECUTION

3.1 GENERAL

- A. Obtain and pay for all permits and inspections, including any independent testing required to verify standard compliance, and deliver certificates for same to the Owner's Representative as an informational submittal.

3.2 WORK RESPONSIBILITIES

- A. The drawings indicate diagrammatically the desired locations or arrangement of piping, equipment, etc., and are to be followed as closely as possible. Proper judgment must be exercised in executing the work to secure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference with structural conditions.

- B. The Contractor is responsible for the correct placing of Work and the proper location and connection of Work in relation to the work of other trades. Advise appropriate trade as to locations of access panels.
- C. In the event changes in the indicated locations or arrangements are necessary, due to developed conditions in the building construction or rearrangement of furnishings or equipment, such changes shall be made without extra cost, providing the change is ordered before the ductwork, piping, etc. and work directly connected to same is installed and no extra materials are required.
- D. Where equipment is furnished by others, verify dimensions and the correct locations of this equipment before proceeding with the roughing-in of connections.
- E. All scaled and figured dimensions are approximate of typical equipment of the class indicated. Before proceeding with any work, carefully check and verify all dimensions, sizes, etc. with the RFP to see that the equipment will fit into the spaces provided without violation of applicable codes.
- F. Should any changes to the Work indicated on the RFP or described in the Specifications be necessary in order to comply with the above requirements, notify the Owner immediately and cease work on all parts of the contract, which are affected until approval for any required modifications to the construction has been obtained from the Owner.
- G. Be responsible for any cooperative work, which must be altered due to lack of proper supervision or failure to make proper provisions in time. Such changes shall be under direction of the Owner and shall be made to his satisfaction. Perform all Work with competent and skilled personnel.
- H. All work, including aesthetic as well as mechanical aspects of the Work, shall be of the highest quality consistent with the best practices of the trade.
- I. Replace or repair, without additional compensation, any Work, which, in the opinion of the Owner, does not comply with these requirements.

3.3 PAINTING

- A. Factory Applied:
 - 1. Mechanical equipment shall have factory-applied painting systems, which shall, as a minimum, meet the requirements of NEMA ICS 6 corrosion-resistance test, except equipment specified to meet requirements of ANSI C37.20 shall have a finish as specified in ANSI C37.20.
- B. Field Applied:
 - 1. Paint all mechanical equipment as required to touch up, to match finish on other equipment in adjacent spaces or to meet safety criteria.
 - 2. Paint all exposed, uninsulated mechanical piping, valves, supports, hangers, and appurtenances. Provide minimum 5 mils dry film thickness.
 - 3. Paint ductwork flat black that are visible behind air outlets and inlets.
 - 4. Paint all exposed and rooftop ductwork, roof mounted mechanical equipment, ductwork supports, hangers and appurtenances.
 - 5. Paint shall be a high-performance polyurethane enamel coating system.
 - a. Acceptable paint manufacturers include Ameron, Tnemec or engineer approved equal.

- b. Acceptable primer manufacturers include Ameron Amershield VOC, Tnemec's Series 1075 (1074) Endura-Shield, semi-gloss (gloss) sheen or equal.
- c. Provide minimum 5 mils dry film thickness.

END OF SECTION

SECTION 23 05 00
COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Motors.
 - 2. Packless expansion joints.
 - 3. Sleeve-seal systems.
 - 4. Grout.
 - 5. Silicone sealants.
 - 6. Escutcheons.
 - 7. Thermometers filled system.
 - 8. Thermometers, light activated.
 - 9. Duct-thermometer mounting brackets.
 - 10. Thermowells.
 - 11. Pressure gauges, dial type.
 - 12. Gauge attachments.
 - 13. Test plugs.

1.2 DEFINITIONS

- A. Existing Piping To Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. For each type of product, excluding motors which are included in Part 1 of HVAC equipment Sections.
 - a. Include construction details, material descriptions, and dimensions of individual components, and finishes.
 - b. Include operating characteristics and furnished accessories.
- B. Delegated Design Submittals: For each anchor and alignment guide, including analysis data, signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
 - 2. Alignment Guide Details: Detail field assembly and attachment to building structure.
 - 3. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of meter.
- B. Welding certificates.
- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

- B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators in accordance with 2021 ASME Boiler and Pressure Vessel Code, Section IX.

1.6 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 MOTORS

- A. Motor Requirements, General:
 - 1. Content includes motors for use on alternating-current power systems of up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.
 - 2. Comply with requirements in this Section except when stricter requirements are specified in equipment schedules or Sections.
 - 3. Comply with NEMA MG 1 unless otherwise indicated.
 - 4. Comply with IEEE 841 for severe-duty motors.
- B. Motor Characteristics:
 - 1. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 ft. above sea level.
 - 2. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
- C. Polyphase Motors:
 - 1. Description: NEMA MG 1, Design B, medium induction motor.
 - 2. Efficiency: Premium Efficient, as defined in NEMA MG 1.
 - 3. Service Factor: 1.15.
 - 4. Multispeed Motors: Variable torque.
 - a. For motors with 2:1 speed ratio, consequent pole, single winding.
 - b. For motors with other than 2:1 speed ratio, separate winding for each speed.
 - 5. Multispeed Motors, Two Winding: Separate winding for each speed.
 - 6. Rotor: Random-wound, squirrel cage.
 - 7. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
 - 8. Temperature Rise: Match insulation rating.
 - 9. Insulation: [Class F] <Insert class>.
 - 10. Code Letter Designation:
 - a. Motors 15 Hp and Larger: NEMA starting Code F or Code G.
 - b. Motors Smaller Than 15 Hp: Manufacturer's standard starting characteristic.

11. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

D. Additional Requirements for Polyphase Motors:

1. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
2. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - a. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time-rise pulses produced by pulse-width-modulated inverters.
 - b. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - c. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - d. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
3. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

E. Single-Phase Motors:

1. Motors larger than 1/20 hp must be one of the following, to suit starting torque and requirements of specific motor application:
 - a. Permanent-split capacitor.
 - b. Split phase.
 - c. Capacitor start, inductor run.
 - d. Capacitor start, capacitor run.
2. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
3. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
4. Motors 1/20 hp and Smaller: Shaded-pole type.
5. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device will automatically reset when motor temperature returns to normal range.

F. Electronically Commutated Motors:

1. Microprocessor-Based Electronic Control Module: Converts 120 V or] 240 V single-phase AC power to three-phase DC power to operate the brushless DC motor.
2. Three-phase power motor module with permanent magnet rotor.
3. Circuit board] or digital speed controller/LED display.
4. Building Automation System Interface: Via AC voltage signal DC voltage signal or Digital Serial Interface (DSI).

2.2 EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

A. Performance Requirements:

1. Compatibility: Provide products suitable for piping service fluids, materials, working pressures, and temperatures.
2. Capability: Provide products and installations that will accommodate maximum axial movement as scheduled or indicated on Drawings.

B. Packless Expansion Joints:

1. Flexible-Hose Packless Expansion Joints: .

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Flex-Hose Co., Inc.
 - 2) Flexicraft Industries.
 - 3) Metraflex Company (The).
 - 4) Or approved equal.
- b. Source Limitations: Obtain flexible-hose packless expansion joints from single manufacturer.
- c. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
- d. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
- e. Expansion Joints for Copper Tubing NPS 2 (DN 50) and Smaller: Copper-alloy fittings with solder-joint end connections.
 - 1) Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F and 340 psig at 450 deg F ratings.
 - 2) Bronze hoses and double-braid bronze sheaths with 700 psig at 70 deg F and 500 psig at 450 deg F ratings.
- f. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Copper-alloy fittings with flanged end connections.
 - 1) Stainless steel hoses and single-braid, stainless steel sheaths with 300 psig at 70 deg F and 225 psig at 450 deg F ratings.
 - 2) Stainless steel hoses and double-braid, stainless steel sheaths with 420 psig at 70 deg F and 315 psig at 450 deg F ratings.
- g. Expansion Joints for Steel Piping NPS 2 (DN 50) and Smaller: Carbon-steel fittings with threaded end connections.
 - 1) Stainless steel hoses and single-braid, stainless steel sheaths with 450 psig at 70 deg F and 325 psig at 600 deg F ratings.
 - 2) Stainless steel hoses and double-braid, stainless steel sheaths with 700 psig at 70 deg F and 515 psig at 600 deg F ratings.
- h. Expansion Joints for Steel Piping NPS 2-1/2 to NPS 6 (DN 65 to DN 150): Carbon-steel fittings with flanged or welded end connections.
 - 1) Stainless steel hoses and single-braid, stainless steel sheaths with 200 psig at 70 deg F and 145 psig at 600 deg F ratings.
 - 2) Stainless steel hoses and double-braid, stainless steel sheaths with 275 psig at 70 deg F and 200 psig at 600 deg F ratings.
- i. Expansion Joints for Steel Piping NPS 8 to NPS 12 (DN 200 to DN 300): Carbon steel fittings with flanged or welded end connections.

- 1) Stainless steel hoses and single-braid, stainless steel sheaths with 125 psig at 70 deg F and 90 psig at 600 deg F ratings.
- 2) Stainless steel hoses and double-braid, stainless steel sheaths with 165 psig at 70 deg F and 120 psig at 600 deg F ratings.

2.3 SLEEVES AND SLEEVE SEALS

A. Sleeve-Seal Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, LLC.
 - b. CALPICO, Inc.
 - c. Metraflex Company (The).
 - d. Or approved equal.
2. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 - a. Hydrostatic seal: 20 psig.
 - b. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.
 - c. Pressure Plates: Stainless steel].
 - d. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

B. Grout:

1. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
2. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
3. Design Mix: 5000 psi, 28-day compressive strength.
4. Packaging: Premixed and factory packaged.

C. Silicone Sealants:

1. Silicone Sealant, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Polymeric Systems, Inc.
 - 2) Sherwin-Williams Company (The).
 - 3) The Dow Chemical Company.
 - 4) Tremco Incorporated.
 - 5) Or approved equal.
 - b. Standard: ASTM C920, Type S, Grade NS, Class 25, Use NT.

2.4 ESCUTCHEONS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. BrassCraft Manufacturing Co.; a Masco company.

2. Keeney Manufacturing Company (The).
 3. Mid-America Fittings, LLC; A Midland Industries Company.
 4. Or approved equal.
- B. Escutcheon Types:
1. One-Piece, Stainless Steel Type: With polished stainless steel finish.
- C. Floor Plates:
1. Split Floor Plates: Steel with concealed hinge.

2.5 METERS AND GAUGES FOR HVAC PIPING

- A. Thermometers, Filled System - Direct-Mounted, Metal-Case, Vapor-Actuated:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Marsh Bellofram.
 - b. Terice, H. O. Co.
 - c. Weiss Instruments, Inc.
 - d. Or approved equal.
 2. Source Limitations: Provide filled-system, direct-mounted, metal-case, vapor-actuated thermometers from a single manufacturer.
 3. Standard: ASME B40.200.
 4. Case: Sealed type, cast aluminum or drawn steel] <Insert material>; 5-inch<Insert dimension> nominal diameter.
 5. Element: Bourdon tube or other type of pressure element.
 6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F
 7. Pointer: Dark-colored metal.
 8. Window: Glass >.
 9. Ring: Stainless steel
 10. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device with ASME B1.1 screw threads.
- B. Thermometers, Light Activated - Direct Mounted:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Terice, H. O. Co.
 - b. Weiss Instruments, Inc.
 - c. Weksler Glass Thermometer Corp.
 - d. Or approved equal.
 2. Source Limitations: Provide light-activated, direct-mounted thermometers from single manufacturer.
 3. Case: Metal 9-inch nominal size unless otherwise indicated.
 4. Scale(s): Deg F
 5. Case Form: Adjustable angle >.
 6. Connector: 1-1/4 inches with ASME B1.1 screw threads.

7. Stem: Aluminum and of length to suit installation.
 - a. Design for Air-Duct Installation: With ventilated shroud.
 - b. Design for Thermowell Installation: Bare stem.
8. Display: Digital.
9. Accuracy: Plus or minus 2 deg F.
- C. Duct-Thermometer Mounting Brackets:
 1. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.
- D. Thermowells:
 1. Standard: ASME B40.200.
 2. Description: Pressure-tight, socket-type fitting made for insertion in piping tee fitting.
 3. Material for Use with Copper Tubing: CNR or CUNI
 4. Material for Use with Steel Piping: CRES or CSA
 5. Type: Stepped shank unless straight or tapered shank is indicated.
 6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
 7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
 8. Bore: Diameter required to match thermometer bulb or stem.
 9. Insertion Length: Length required to match thermometer bulb or stem.
 10. Lagging Extension: Include on thermowells for insulated piping and tubing.
 11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
 12. Heat-Transfer Medium: Mixture of graphite and glycerin >.
- E. Pressure Gauges, Dial Type - Direct Mounted, Metal Case:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ametek U.S. Gauge.
 - b. Ernst Flow Industries.
 - c. Marsh Bellofram.
 - d. Or approved equal.
 2. Source Limitations: Provide dial-type, direct-mounted, metal-case pressure gauges from single manufacturer.
 3. Standard: ASME B40.100.
 4. Case: Liquid-filled Sealed cast aluminum or drawn steel 4-1/2-inch > nominal diameter.
 5. Pressure-Element Assembly: Bourdon tube.
 6. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
 7. Movement: Mechanical, with link to pressure element and connection to pointer.
 8. Dial: Nonreflective aluminum with permanent scale markings graduated in psi
 9. Pointer: Dark-colored metal.
 10. Window: Glass
 11. Ring: Stainless steel

12. Accuracy: Grade A, plus or minus 1 percent of middle half of span.
- F. Test Plugs:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Peterson Equipment Co., Inc.
 - b. Terice, H. O. Co.
 - c. WATTS; A Watts Water Technologies Company.
 - d. Or approved equal.
 2. Source Limitations: Provide test plugs from single manufacturer.
 3. Description: Test-station fitting made for insertion in piping tee fitting.
 4. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
 5. Thread Size: [PS 1/4ASME B1.20.1 pipe thread.
 6. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F
 7. Core Inserts: EPDM self-sealing rubber.

PART 3 - EXECUTION

3.1 INSTALLATION OF EXPANSION JOINTS - GENERAL

- A. Install expansion joints of sizes matching sizes of piping in which they are installed.

3.2 INSTALLATION OF PACKLESS EXPANSION JOINTS

- A. Install metal-bellows packless expansion joints in accordance with EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
- B. Install rubber packless expansion joints in accordance with FSA-PSJ-703.

3.3 INSTALLATION OF SLEEVE-SEAL SYSTEMS

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building, and passing through exterior walls.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 INSTALLATION OF ESCUTCHEONS

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

3.5 INSTALLATION OF METERS AND GAUGES

- A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing, and support tubing to prevent kinks. Use minimum tubing length.

- G. Install pipe-mounted thermal-energy temperature sensors in thermowells and extend wiring to indicator.
- H. Install duct-thermometer-mounting brackets in walls of ducts. Attach to duct with screws.
- I. Install direct-mounted pressure gauges in piping tees with pressure gauge located on pipe at the most readable position.
- J. Install remote-mounted pressure gauges on panel.
- K. Install valve and snubber in piping for each pressure gauge for fluids (except steam).
- L. Install valve and syphon fitting in piping for each pressure gauge for steam.
- M. Install test plugs in piping tees.
- N. Install flow indicators in piping systems in accessible positions for easy viewing.
- O. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.
- P. Install flowmeter elements in accessible positions in piping systems.
- Q. Install wafer-orifice flowmeter elements between orifice-type pipe flanges.
- R. Install permanent indicators on walls or brackets in accessible and readable positions.
- S. Install connection fittings in accessible locations for attachment to portable indicators.
- T. Install thermometers in the following locations:
 - 1. Inlet and outlet of each hydronic boiler.
 - 2. Two inlets and two outlets of each chiller.
 - 3. Inlet and outlet of each hydronic coil in air-handling units.
- U. Install pressure gauges in the following locations:
 - 1. Discharge of each pressure-reducing valve.
 - 2. Inlet and outlet of each chiller chilled-water and condenser-water connection.
 - 3. Suction and discharge of each pump.

3.6 CONNECTIONS

- A. Install meters and gauges adjacent to machines and equipment to allow space for service and maintenance of meters, gauges, machines, and equipment.

3.7 ADJUSTING

- A. After installation, calibrate meters according to manufacturer's written instructions.
- B. Adjust faces of meters and gauges to proper angle for best visibility.

3.8 FIELD QUALITY CONTROL

- A. Sleeves and Sleeve Seals:
 - 1. Perform the following tests and inspections:
 - a. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
 - b. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.
 - 2. Prepare test and inspection reports.
- B. Escutcheons:
 - 1. Using new materials, replace broken and damaged escutcheons and floor plates.

3.9 ESCUTCHEONS APPLICATION

- A. Escutcheons for New Piping and Relocated Existing Piping:
 - 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 - 2. Chrome-Plated Piping: One piece, steel with polished, chrome-plated finish.
 - 3. Bare Piping at Wall and Floor Penetrations in Finished Spaces:
 - a. One piece, stainless steel with polished stainless steel finish.
 - 4. Bare Piping at Ceiling Penetrations in Finished Spaces:
 - a. One piece, stainless steel with polished stainless steel finish.
 - 5. Bare Piping in Unfinished Service Spaces:
 - a. One piece, steel with polished, chrome-plated finish.
 - 6. Bare Piping in Equipment Rooms:
 - a. One piece, steel with polished, chrome-plated finish.
- B. Escutcheons for Existing Piping to Remain:
 - 1. Chrome-Plated Piping: Split plate, stamped steel with concealed or hinge with polished, chrome-plated finish.
 - 2. Insulated Piping: Split plate, stamped steel with concealed or] hinge with polished, chrome-plated finish.
 - 3. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split plate, stamped steel with concealed hinge with polished, chrome-plated finish.
 - 4. Bare Piping at Ceiling Penetrations in Finished Spaces: Split plate, stamped steel with concealed hinge with polished, chrome-plated finish.
 - 5. Bare Piping in Unfinished Service Spaces: Split plate, stamped steel with concealed hinge with polished, chrome-plated finish.
 - 6. Bare Piping in Equipment Rooms: Split plate, stamped steel with concealed hinge with polished, chrome-plated finish.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. New Piping and Relocated Existing Piping: Split floor plate.
 - 2. Existing Piping to Remain: Split floor plate.

3.10 THERMOMETER APPLICATION

- A. Thermometers at inlet and outlet of each hydronic zone are to be the following:
 - 1. Directmounted, light-activated type.
 - 2. Test plug with EPDM self-sealing rubber inserts.
- B. Thermometers at inlet and outlet of each hydronic boiler are to be the following:
 - 1. Directmounted, light-activated type.
 - 2. Test plug with EPDM self-sealing rubber inserts.
- C. Thermometers at inlets and outlets of each chiller are to be the following:
 - 1. Directmounted, metalcase, vapor-actuated type.
 - 2. Directmounted, light-activated type.
 - 3. Test plug with EPDM self-sealing rubber inserts.

- D. Thermometers at inlet and outlet of each hydronic coil in air-handling units and built-up central systems are to be the following:
 - 1. Directmounted, light-activated type.
 - 2. Test plug with EPDM self-sealing rubber inserts.
- E. Thermometer stems are to be of length to match thermowell insertion length.

3.11 THERMOMETER SCALE-RANGE APPLICATION

- A. Scale Range for Chilled-Water Piping:
 - 1. 0 to 100 deg F
- B. Scale Range for Condenser-Water Piping:
 - 1. 0 to 100 deg F].
- C. Scale Range for Heating, Hot-Water Piping:
 - 1. 0 to 250 deg F].

3.12 PRESSURE-GAUGE APPLICATION

- A. Pressure gauges at suction and discharge of each pump are to be the following:
 - 1. Liquid-filled Sealed[directmounted, metal case.

END OF SECTION

SECTION 23 05 14
VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes solid-state, PWM, VFDs for speed control of three-phase, squirrel-cage induction motors.

1.2 DEFINITIONS

- A. BMS: Building management system.
- B. IGBT: Integrated gate bipolar transistor.
- C. LAN: Local area network.
- D. PID: Control action, proportional plus integral plus derivative.
- E. PWM: Pulse-width modulated.
- F. VFD: Variable frequency controller.

1.3 SUBMITTALS

- A. Product Data: For each type of VFD. Include 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 VFD.
 - 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 rating of integrated unit.
 - d. Listed and labeled for series rating of overcurrent protective devices in combination drives by an NRTL acceptable to authorities having jurisdiction.
 - e. Features, characteristics, ratings, and factory settings of each motor-control center unit.
 - 2. Wiring Diagrams: Power, signal, and control wiring for VFDs. Provide schematic wiring diagram for each type of VFD.
- C. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around VFDs where pipe and ducts are prohibited. Show VFD 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. Manufacturer Seismic Qualification Certification: Submit certification that VFDs, accessories, and components will withstand seismic forces. Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- E. Qualification Data: For manufacturer and testing agency.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For VFDs, all installed devices, and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Project Closeout," include the following:
1. Routine maintenance requirements for VFDs and all installed components.
 2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer. 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 agency, with the experience and capability to conduct the testing indicated, that is a member company of the International Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- C. Source Limitations: Obtain VFDs of a single type through one source from a single manufacturer.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. Comply with NFPA 70.
- F. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFDs, minimum clearances between VFDs, and adjacent surfaces and other items. Comply with indicated maximum dimensions and clearances.
- G. Qualifications:
1. VFDs and options shall be UL listed as a complete assembly. The base VFD shall be UL listed for 100 KAIC without the need for input fuses.
 2. CE Mark – The VFD shall conform to the European Union Electromagnetic Compatibility directive, a requirement for CE marking. The VFD shall meet product standard EN 61800-3 for the First Environment restricted level.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver VFDs in shipping splits of lengths that can be moved past obstructions in delivery path as indicated.
- B. Store VFDs indoors in clean, dry space with uniform temperature to prevent condensation. Protect VFDs from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- C. If stored in areas subject to weather, cover VFDs to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside drives; install electric heating of sufficient wattage to prevent condensation.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation, capable of driving full load without derating, under the following conditions, unless otherwise indicated:
 - 1. Ambient Temperature: 32 to 104 deg F.
 - 2. Humidity: Less than 90 percent (noncondensing).
 - 3. Altitude: Not exceeding 3300 feet.
 - 4. Salt Air Atmosphere
- B. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of electrical service.
 - 2. Indicate method of providing temporary electrical service.
 - 3. Do not proceed with interruption of electrical service without Owner written permission.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFDs, including clearances between VFDs, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.7 COORDINATION

- A. Coordinate layout and installation of VFDs 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 size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."
- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section "Roof Accessories."
- D. Coordinate features of VFDs, installed units, and accessory devices with pilot devices and control circuits to which they connect.
- E. Coordinate features, accessories, and functions of each VFD and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Spare Fuses: Furnish one spare for every five installed, but no less than one set of three of each type and rating.
 - 2. Keypad: 1 for every 10 drives.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ABB Power Distribution, Inc.; ABB Control, Inc. Subsidiary.
 - 2. Danfoss Inc.; Danfoss Electronic Drives Div.
 - 3. Or Approved Equal

- B. All VFDs supplied for the project must be from the same manufacturer. This applies to but not limited to pumps, fan motors and etc.

2.2 VARIABLE FREQUENCY DRIVES

- A. Description: NEMA ICS 2, IGBT, PWM, VFD; listed and labeled as a complete unit and arranged to provide variable speed of an NEMA MG 1, Design B, 3-phase induction motor by adjusting output voltage and frequency.
 - 1. Provide unit suitable for operation of premium-efficiency motor as defined by NEMA MG 1.
 - 2. VFD type to be Active Front End.
- B. Design and Rating: Match load type such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.
- C. Output Rating: 3-phase; 6 to 120 Hz, with horsepower constant throughout speed range. Output voltage must be within 100% - 115% of the input voltage
- D. Unit Operating Requirements:
 - 1. Input ac voltage tolerance of 380 to 500 V, plus or minus 10 percent.
 - 2. Input frequency tolerance of 50/60 Hz, plus or minus 6 percent.
 - 3. Minimum Efficiency: 96 percent at 60 Hz, full load.
 - 4. Minimum Displacement Primary-Side Power Factor: 96 percent.
 - 5. Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3 seconds.
 - 6. Starting Torque: 100 percent of rated torque or as indicated.
- E. Isolated control interface to allow controller to follow control signal over an 11:1 speed range.
 - 1. Electrical Signal: 4 to 20 mA at 24 V.
- F. Internal Adjustability Capabilities:
 - 1. Minimum Speed: 5 to 25 percent of maximum rpm.
 - 2. Maximum Speed: 80 to 100 percent of maximum rpm.
 - 3. Acceleration: 2 to a minimum of 22 seconds.
 - 4. Deceleration: 2 to a minimum of 22 seconds.
 - 5. Current Limit: 50 to a minimum of 110 percent of maximum rating.
- G. Self-Protection and Reliability Features:
 - 1. Input transient protection by means of surge suppressors.
 - 2. Under- and overvoltage trips; inverter over temperature, overload, and overcurrent trips.
 - 3. Motor Overload Relay: Adjustable and capable of NEMA ICS 2, Class 20 performance.
 - 4. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.
 - 5. Instantaneous line-to-line and line-to-ground overcurrent trips.
 - 6. Loss-of-phase protection.
 - 7. Reverse-phase protection.
 - 8. Short-circuit protection.
 - 9. Motor over temperature fault.

10. A minimum of Class 20 12t electronic motor overload protection for single motor applications and thermal-mechanical overloads for multiple motor applications shall be provided.
 11. Protection against input transients, loss of AC line phase, output short circuit, output ground fault, overvoltage, under voltage, VFD over temperature and motor over temperature. The VFD shall display all faults in plain English. Codes are not acceptable.
 12. Protect VFD from sustained power or phase loss. The VFD shall provide full rated output with an input voltage as low as 90% of the nominal. The VFD will continue to operate with reduced output with an input voltage as low as 164 V AC for 208/230 volt units, 313 V AC for 460 volt units, and 394 volts for 600 volts units.
 13. The VFD shall incorporate a motor preheat circuit to keep the motor warm and prevent condensation build up in the stator.
 14. VFD package shall include semi-conductor rated input fuses to protect power components.
 15. To prevent breakdown of the motor winding insulation, the VFD shall be designed to comply with IEC Part 34-17. Otherwise the VFD manufacturer must ensure that inverter rated motors are supplied.
 16. VFD shall include a "signal loss detection" circuit to sense the loss of an analog input signal such as 4 to 20 mA or 2 to 10 V DC, and shall be programmable to react as desired in such an instance.
 17. VFD shall function normally when the keypad is removed while the VFD is running and continue to follow remote commands. No warnings or alarms shall be issued as a result of removing the keypad.
 18. VFD shall catch a rotating motor operating forward or reverse up to full speed.
 19. VFD shall be rated for 100,000 amp interrupting capacity (AIC).
 20. VFD shall include current sensors on all three output phases to detect and report phase loss to the motor. The VFD will identify which of the output phases is low or lost.
- H. Multiple-Motor Capability: Controller suitable for service to multiple motors and having a separate overload relay and protection for each controlled motor. Overload relay shall shut off controller and motors served by it when overload relay is tripped.
- I. Automatic Reset/Restart: Attempts three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Bidirectional auto speed search shall be capable of starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.
- J. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped.
- K. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.
- L. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.
- M. Input Line Conditioning: The VFD shall include an input full-wave bridge rectifier and maintain a fundamental power factor of 0.95 or greater regardless of speed or load
- N. Status Lights: Door-mounted LED indicators shall indicate the following conditions:
1. Power on.
 2. Run.
 3. Overvoltage.

4. Line fault.
 5. Overcurrent.
 6. External fault.
- O. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual speed control potentiometer and elapsed time meter.
- P. Indicating Devices: Meters or digital readout devices and selector switch, mounted flush in controller door and connected to indicate the following controller parameters:
1. Output frequency (Hz).
 2. Motor speed (rpm).
 3. Motor status (running, stop, fault).
 4. Motor current (amperes).
 5. Motor torque (percent).
 6. Fault or alarming status (code).
 7. PID feedback signal (percent).
 8. DC-link voltage (VDC).
 9. Set-point frequency (Hz).
 10. Motor output voltage (V).
- Q. Control Signal Interface:
1. Electric Input Signal Interface: A minimum of 2 analog inputs (0 to 10 V or 0/4-20 mA) and 6 programmable digital inputs.
 2. Pneumatic Input Signal Interface: 3 to 15 psig.
 3. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BMS or other control systems:
 - a. 0 to 10-V dc.
 - b. 0-20 or 4-20 mA.
 - c. Potentiometer using up/down digital inputs.
 - d. Fixed frequencies using digital inputs.
 - e. RS485.
 - f. Keypad display for local hand operation.
 4. Output Signal Interface:
 - a. A minimum of 1 analog output signal (0/4-20 mA), which can be programmed to any of the following:
 - 1) Output frequency (Hz).
 - 2) Output current (load).
 - 3) DC-link voltage (VDC).
 - 4) Motor torque (percent).
 - 5) Motor speed (rpm).
 - 6) Set-point frequency (Hz).
 5. Remote Indication Interface: A minimum of 2 dry circuit relay outputs (120-V ac, 1 A) for remote indication of the following:
 - a. Motor running.

- b. Set-point speed reached.
 - c. Fault and warning indication (over temperature or overcurrent).
 - d. PID high- or low-speed limits reached.
- R. Communications: Provide an RS485 interface allowing VFD to be used with an external system within a multi-drop LAN configuration. Interface shall allow all parameter settings of VFD to be programmed via BMS control. Provide capability for VFD to retain these settings within the nonvolatile memory. All VFDs are to be furnished with BACnet compatible cards that will allow communication with the EMS using the BACnet protocols.
- S. Manual Bypass: Magnetic contactor arranged to safely transfer motor between controller output and bypass controller circuit when motor is at zero speed. Controller-off-bypass selector switch sets mode, and indicator lights give indication of mode selected. Unit shall be capable of stable operation (starting, stopping, and running), with motor completely disconnected from controller (no load).
- T. Bypass Controller: NEMA ICS 2, full-voltage, non-reversing enclosed controller with across-the-line starting capability in manual-bypass mode. Provide motor overload protection under both modes of operation with control logic that allows common start-stop capability in either mode.
- U. Integral Disconnecting Means: NEMA AB 1, instantaneous-trip circuit breaker with lockable handle.

2.3 ENCLOSURES

- A. VFD Enclosures Shall Be Furnished as Follows:
 - 1. Indoor Mechanical Room Installations: VFD's are to be self-ventilated, NEMA 12 rated.
- B. Outdoor Installations: VFD's are to be installed in self-ventilated NEMA 3RX, stainless steel enclosures, with NEMA 12 rated drives within the enclosure.

2.4 ACCESSORIES

- A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.
- B. Control Relays: Auxiliary and adjustable time-delay relays.
- C. Standard Displays:
 - 1. Output frequency (Hz).
 - 2. Set-point frequency (Hz).
 - 3. Motor current (amperes).
 - 4. DC-link voltage (VDC).
 - 5. Motor torque (percent).
 - 6. Motor speed (rpm).
 - 7. Motor output voltage (V).
- D. Historical Logging Information and Displays:
 - 1. Real-time clock with current time and date.
 - 2. Running log of total power versus time.
 - 3. Total run time.
 - 4. Fault log, maintaining last four faults with time and date stamp for each.

2.5 FACTORY FINISHES

- A. Finish: Outdoor enclosures shall be Stainless Steel finish.

2.6 ADJUSTMENTS

- A. The VFD shall have an adjustable carrier frequency in steps of not less than 0.1 kHz to allow tuning the VFD to the motor.
- B. Sixteen preset speeds shall be provided.
- C. Four acceleration and four deceleration ramps shall be provided. Acceleration and deceleration time shall be adjustable over the range from 0 to 3,600 seconds to base speed. The shape of these curves shall be automatically contoured to ensure no-trip acceleration and deceleration.
- D. Four current limit settings shall be provided.
- E. If the VFD trips on one of the following conditions, the VFD shall be programmable for automatic or manual reset: under voltage, overvoltage, current limit and inverter overload.
- F. The number of restart attempts shall be selectable from 0 through 20 or infinitely and the time between attempts shall be adjustable from 0 through 600 seconds.
- G. An automatic "on delay" may be selected from 0 to 120 seconds.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, surfaces, and substrates to receive VFDs for compliance with requirements, installation tolerances, and other conditions affecting performance.
- B. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFD installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. VFD provided must not affect the existing arc flash study for NCWRP.

3.2 APPLICATIONS

- A. Select features of each VFD to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; and duty cycle of motor, controller, and load.
- B. Select horsepower rating of drives to suit motor controlled.

3.3 INSTALLATION

- A. Anchor each VFD assembly to steel-channel sills arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and grout sills flush with mounting surface.
- B. Install VFDs as noted on Contract Documents.
- C. Comply with mounting and anchoring requirements specified in Division 16 Section "Electrical Supports and Seismic Restraints."
- D. Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Division 16 Section "Fuses."

3.4 IDENTIFICATION

- A. Identify VFDs, components, and control wiring according to Division 16 Section "Electrical Identification."
- B. Operating Instructions: Frame printed operating instructions for VFDs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFD units.

3.5 CONTROL WIRING INSTALLATION

- A. Install wiring between VFDs and remote devices according to Division 16 Section "Conductors and Cables."
- B. Bundle, train, and support wiring in enclosures.

- C. Connect hand-off-automatic switch and other automatic-control devices where applicable.
 - 1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.
 - 2. Connect selector switches with control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.6 CONNECTIONS

- A. Conduit installation requirements are specified in other Division 16 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.
- B. Ground equipment according to Division 16 "Grounding and Bonding."

3.7 FIELD QUALITY CONTROL

- A. Engage a factory authorized service representative to perform the following:
 - 1. Complete factory certified startup per manufacturers IOM.
 - 2. Certificate of completion shall extend warranty from 12 months to 24 months upon factory authorized startup.

3.8 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges.
- B. Program the VFD minimum speed to be zero hertz. The energy management system will provide the analog output signal to maintain the desired minimum fan or pump speed.
- C. The fans are frequently being selected with maximum operating speeds in excess of 60 hertz. Identify maximum operating speed for the fans based on the equipment schedule in the contract documents. This value is to be programmed into the VFD as the maximum operating speed with the energy management speed command at 100%. Confirm selection with the air balancer.

3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train owner's maintenance personnel to adjust, operate, and maintain variable frequency drives. Refer to Division 1 Section "Project Closeout."

END OF SECTION

SECTION 23 05 23.12
BALL VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Bronze ball valves.
 - 2. Steel ball valves.

1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. RPTFE: Reinforced polytetrafluoroethylene.
- C. SWP: Steam working pressure.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of valve.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, and weld ends.
 - 3. Set ball valves open to minimize exposure of functional surfaces.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each type of valve from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. ASME Compliance:
 - 1. ASME B1.20.1 for threads for threaded-end valves.
 - 2. ASME B16.1 for flanges on iron valves.
 - 3. ASME B16.5 for flanges on steel valves.
 - 4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 5. ASME B16.18 for cast copper solder-joint connections.
 - 6. ASME B16.22 for wrought copper and copper alloy solder-joint connections.
 - 7. ASME B16.34 for flanged and threaded end connections.
 - 8. ASME B31.1 for power piping valves.
 - 9. ASME B31.9 for building services piping valves.
- B. Provide bronze valves made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

- C. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- D. Valve Sizes: Same as upstream piping unless otherwise indicated.
- E. Valve Actuator Types:
 - 1. Gear Actuator: For quarter-turn valves NPS 4 and larger.
 - 2. Hand Lever: For quarter-turn valves smaller than NPS 4 .
- F. Valves in Insulated Piping:
 - 1. Provide 2-inch extended neck stems.
 - 2. Extended operating handles with nonthermal-conductive covering material, and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
 - 3. Memory stops that are fully adjustable after insulation is applied.
- G. Valve Bypass and Drain Connections: MSS SP-45.

2.3 BRONZE BALL VALVES

- A. Bronze Ball Valves, Two Piece with Full Port and Stainless Steel Trim, Threaded or Soldered Ends:
 - 1. Manufacturers:
 - a. Conbraco (Apollo)
 - b. Nibco
 - c. Watts
 - d. Or approved equal
 - 2. Standard: MSS SP-110.
 - 3. SWP Rating: 150 psig.
 - 4. CWP Rating: 600 psig.
 - 5. Body Design: Two piece.
 - 6. Body Material: Bronze.
 - 7. Ends: Threaded or soldered.
 - 8. Seats: PTFE.
 - 9. Stem: Stainless steel.
 - 10. Ball: Stainless steel, vented.
 - 11. Port: Full.
- B. Bronze Ball Valves, Two Piece with Regular Port and Bronze or Brass Trim, Threaded Ends:
 - 1. Manufacturers:
 - a. Conbraco (Apollo)
 - b. Nibco
 - c. Watts
 - d. Or approved equal
 - 2. Standard: MSS SP-110.
 - 3. SWP Rating: 150 psig.
 - 4. CWP Rating: 600 psig.

5. Body Design: Two piece.
6. Body Material: Bronze.
7. Ends: Threaded.
8. Seats: PTFE.
9. Stem: Bronze.
10. Ball: Chrome-plated brass.
11. Port: Regular.

2.4 STEEL BALL VALVES

A. Steel Ball Valves with Full Port and Stainless Steel Trim, Class 150:

1. Manufacturers:
 - a. Conbraco (Apollo)
 - b. Nibco
 - c. Watts
 - d. Or approved equal
2. Standard: MSS SP-72.
3. CWP Rating: 285 psig.
4. Body Design: Split body.
5. Body Material: Carbon steel, ASTM A216/A216M, Type WCB.
6. Ends: Flanged.
7. Seats: PTFE.
8. Stem: Stainless steel.
9. Ball: Stainless steel, vented.
10. Port: Full.

B. Steel Ball Valves with Full Port and Stainless Steel Trim, Class 300:

1. Manufacturers:
 - a. Conbraco (Apollo)
 - b. Nibco
 - c. Watts
 - d. Or approved equal
2. Standard: MSS SP-72.
3. CWP Rating: 720 psig.
4. Body Design: Split body.
5. Body Material: Carbon steel, ASTM A216/A216M, Type WCB.
6. Ends: Flanged.
7. Seats: PTFE.
8. Stem: Stainless steel.
9. Ball: Stainless steel, vented.
10. Port: Full.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves. Remove defective valves from site.

3.2 INSTALLATION OF VALVES

- A. Install valves with unions or flanges at each piece of equipment arranged to allow space for service, maintenance, and equipment removal without system shutdown.
- B. Provide support of piping adjacent to valves such that no force is imposed upon valves.
- C. Locate valves for easy access.
- D. Install valves in horizontal piping with stem at or above center of pipe.
- E. Install valves in position to allow full valve actuation movement.
- F. Valve Tags: Comply with requirements in Section 23 05 53 "Identification for HVAC Piping and Equipment" for valve tags and schedules.
- G. Adhere to manufacturer's written installation instructions. When soldering or brazing valves, do not heat valves above maximum permitted temperature. Do not use solder with melting point temperature above valve manufacturer's recommended maximum.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves exhibiting leakage.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valves with specified SWP classes or CWP ratings are unavailable, provide the same types of valves with higher SWP classes or CWP ratings.
- B. Select valves with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option or press-end option is indicated in valve schedules below.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
 - 4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 - 5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 6. For Steel Piping, NPS 5 and Larger: Flanged ends.
 - 7. For Stainless Steel Piping, NPS 2 and Smaller: Threaded ends.
 - 8. For Stainless Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends.

3.5 CHILLED-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller: bronze ball valves, two piece, with stainless steel trim, full port, and threaded or solder joint ends.
 - 1. Valves may be provided with solder-joint ends instead of threaded ends.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. Iron ball valves, Class 125.
 - a. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
 - 2. Steel ball valves, Class 150.

3.6 CONDENSER-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller: bronze ball valves, two piece with steel trim, full port, and threaded or solder joint ends.
 - 1. Valves may be provided with solder-joint ends instead of threaded ends.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. Iron ball valves, Class 125.
 - a. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
 - 2. Steel ball valves, Class 150.

END OF SECTION

SECTION 23 05 23.13
BUTTERFLY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. High-performance butterfly valves.
 - 2. Chainwheels.

1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: ABS, Buna-N, or nitrile butadiene rubber.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of valve.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set butterfly valves closed or slightly open.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each type of valve from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. ASME Compliance:
 - 1. ASME B16.1 for flanges on iron valves.
 - 2. ASME B16.5 for flanges on steel valves.
 - 3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 4. ASME B31.1 for power piping valves.
 - 5. ASME B31.9 for building services valves.
- B. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.
- C. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- D. Valve Sizes: Same as upstream piping unless otherwise indicated.
- E. Valve Actuator Types:

1. Gear Actuator: For valves NPS 8 and larger.
2. Hand Lever: For valves NPS 6 and smaller.
3. Chainwheel: Device for attachment to gear, stem, or other actuator of size and with chain for mounting height, according to "Installation of Valves" Article.

F. Valves in Insulated Piping: Provide with 2-inch extended neck stems.

2.3 HIGH-PERFORMANCE BUTTERFLY VALVES

A. Single-Flange (Lug-Type), High-Performance Butterfly Valves, Class 150:

1. Manufacturers
 - a. Bray
 - b. Keystone
 - c. Red and White Valve
 - d. Or Approved equal.
2. Standard: MSS SP-68.
3. CWP Rating: 285 psig at 100 deg F.
4. Body Design: Single flange (lug type), suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
5. Body Material: Carbon steel.
6. Seat: Reinforced PTFE or metal.
7. Stem: Stainless steel; offset from seat plane.
8. Disc: Type 316 stainless steel.
9. Service: Bidirectional.

2.4 CHAINWHEELS

- A. Description: Valve actuation assembly with sprocket rim, chain guides, chain, and attachment brackets for mounting chainwheels directly to hand wheels.
1. Sprocket Rim with Chain Guides: Ductile iron of type and size required for valve. Include zinc or epoxy coating.
 2. Chain: Hot-dip, galvanized steel of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine mating flange faces for damage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- D. Do not attempt to repair defective valves; replace with new valves. Remove defective valves from site.

3.2 INSTALLATION OF VALVES

- A. Install valves with unions or flanges at each piece of equipment arranged to allow space for service, maintenance, and equipment removal without system shutdown.

- B. Provide support of piping adjacent to valves such that no force is imposed upon valves.
- C. Locate valves for easy access.
- D. Install valves in horizontal piping with stem at or above center of pipe.
- E. Install valves in position to allow full valve actuation movement.
- F. Install chainwheels on manual actuators for butterfly valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.
- G. Valve Tags: Comply with requirements in Section 23 05 53 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service, but before final adjusting and balancing. If leakage cannot be repaired, replace valve.

3.4 CHILLED-WATER VALVE SCHEDULE

- A. Pipe NPS 2-1/2 and Larger:
 - 1. High-Performance Butterfly Valves: Single flange, carbon-steel body, and Class 150 .

3.5 CONDENSER-WATER VALVE SCHEDULE

- A. Pipe NPS 2-1/2 and Larger:
 - 1. High-Performance Butterfly Valves: Single flange, carbon-steel body, and Class 150 .

END OF SECTION

SECTION 23 05 23.14
CHECK VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Bronze swing check valves.
 - 2. Iron swing check valves.
 - 3. Iron, globe center-guided check valves.

1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene-propylene-diene monomer.
- C. NBR: Nitrile butadiene rubber (also known as "Buna-N").
- D. SWP: Steam working pressure.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of valve.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, press connections, and weld ends.
 - 3. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use stems or other components as lifting or rigging points unless specifically indicated for this purpose in manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each type of valve from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. ASME Compliance:
 - 1. ASME B1.20.1 for threads for threaded-end valves.
 - 2. ASME B16.1 for flanges on iron valves.
 - 3. ASME B16.5 for flanges for metric standard piping.
 - 4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 5. ASME B16.18 for cast copper solder joint.
 - 6. ASME B16.22 for wrought copper solder joint.
 - 7. ASME B16.51 for press joint.
 - 8. ASME B31.1 for power piping valves.

- 9. ASME B31.9 for building services piping valves.
- B. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.
- C. Provide bronze valves made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are unacceptable.
- D. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- E. Valve Sizes: Same as upstream piping unless otherwise indicated.
- F. Valve Bypass and Drain Connections: MSS SP-45.

2.3 BRONZE SWING CHECK VALVES

- A. Bronze Swing Check Valves with Bronze Disc, Class 300:
 - 1. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 300 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.

2.4 IRON SWING CHECK VALVES

- A. Iron Swing Check Valves with Metal Seats, Class 250:
 - 1. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 500 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 300 psig.
 - d. Body Design: Clear or full waterway.
 - e. Body Material: ASTM A126, gray iron with bolted bonnet.
 - f. Ends: Flanged.
 - g. Trim: Bronze.
 - h. Gasket: Asbestos free.

2.5 IRON, CENTER-GUIDED CHECK VALVES

- A. Iron, Globe, Center-Guided Check Valves with Metal Seat, Class 250:
 - 1. Manufacturer's
 - a. Keckley
 - b. Titan
 - c. Or approved equal.
 - 2. Description:
 - a. Standard: MSS SP-125.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 400 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 300 psig.
 - d. Body Material: ASTM A126, gray iron.
 - e. Style: Globe, spring loaded.

- f. Ends: Flanged.
- g. Seat: Bronze.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Examine press fittings to verify they have been properly pressed.
- F. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION OF VALVES

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Provide support of piping adjacent to valves such that no force is imposed upon valves.
- C. Locate valves for easy access and where not blocked by equipment, other piping, or building components.
- D. Install valves with stem at or above center of pipe.
- E. Install valves in position that does not project into aisles or block access to other equipment.
- F. Install valves in position to allow full stem and manual operator movement.
- G. Verify that joints of each valve have been properly installed and sealed to ensure that there is no leakage or damage.
- H. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Center-Guided Check Valves: In horizontal or vertical position, between flanges. Provide minimum 5 pipe diameters of pipe length between pump discharge and check valve.
- I. Install valve tags. Comply with requirements for valve tags and schedules in Section 23 05 53 "Identification for HVAC Piping and Equipment."
- J. Adhere to manufacturer's written installation instructions. When soldering or brazing valves, do not heat valves above maximum permitted temperature. Do not use solder with melting point temperature above valve of manufacturer's recommended maximum.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.

- b. NPS 2-1/2 and Larger: Center-guided globe, metal seat check valves.
- B. If valves with specified SWP classes or CWP ratings are unavailable, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. End Connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends, except where solder-joint or press valve-end option is indicated in valve schedules.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends, except where threaded valve-end option is indicated in valve schedules.
 - 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
 - 4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 - 5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends, except where threaded valve-end option is indicated in valve schedules.
 - 6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.5 CHILLED-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 - 2. Bronze swing check valves with bronze disc, Class 150.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. NPS 2-1/2 to NPS 4: Iron valves may be provided with threaded ends instead of flanged ends.
 - 2. NPS 2-1/2 to NPS 12: Iron swing check valves with lever and weight-closure control, Class 125.
 - 3. NPS 3 to NPS 12: Iron, grooved-end swing check valves, 300 CWP.
 - 4. Iron, globe, center-guided check valves metal seat, Class 250

3.6 CONDENSER-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze Valves: May be provided with solder-joint [or press]ends instead of threaded ends.
 - 2. Bronze swing check valves with bronze disc, Class 125
- B. Pipe NPS 2-1/2 and Larger:
 - 1. NPS 2-1/2 to NPS 4: Iron valves may be provided with threaded ends instead of flanged ends.
 - 2. NPS 2-1/2 to NPS 12: Iron swing check valves with lever and closure control, Class 125.
 - 3. NPS 2-1/2 to NPS 24: Iron, globe, center-guided check valves with metal seat, Class 250

END OF SECTION

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Thermal-hanger shield inserts.
 - 5. Fastener systems.
 - 6. Equipment supports.
- B. Related Sections:
 - 1. Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation devices.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 - 3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - 1. Trapeze pipe hangers.
 - 2. Metal framing systems.
 - 3. Equipment supports.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Design Calculations: Calculate requirements for designing trapeze hangers.

D. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- B. Copper Pipe Hangers:
 1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

- A. MFMA Manufacturer Metal Framing Systems:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.
 - c. Flex-Strut Inc.
 - d. Unistrut Corporation; Tyco International, Ltd.
 - e. Or approved equal
 2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
 3. Standard: MFMA-4.
 4. Channels: Continuous slotted steel channel with intumed lips.
 5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
 6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

7. Metallic Coating: Electroplated zinc.

2.4 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Carpenter & Paterson, Inc.
 2. Clement Support Services.
 3. ERICO International Corporation.
 4. National Pipe Hanger Corporation.
 5. PHS Industries, Inc.
 6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
 7. Piping Technology & Products, Inc.
 8. Rilco Manufacturing Co., Inc.
 9. Value Engineered Products, Inc.
 10. Or approved equal
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.6 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.7 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Pipe Stand Installation:
 - 1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 - 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Division 07 Section "Roof Accessories" for curbs.
- G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- J. Install lateral bracing with pipe hangers and supports to prevent swaying.
- K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- L. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- N. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.

- c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
- 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
- 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
- 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
- 5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
- 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- F. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal-hanger shield inserts for insulated piping and tubing.
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold pipes NPS 1/2 to NPS 24 if little or no insulation is required.
 - 5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
 - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.

11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
 12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
 17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
 19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.

2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.

6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Warning tape.
 - 4. Pipe labels.
 - 5. Stencils.
 - 6. Valve tags.
 - 7. Warning tags.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment-Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve-numbering scheme.
- E. Valve Schedules: Provide for each piping system. Include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. Manufacturers
 - a. Craftmark
 - b. Seton
 - c. Or approved equal.
 - 2. Material and Thickness: Brass, 0.032-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
 - 3. Letter and Background Color: As indicated for specific application under Part 3.
 - 4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 6. Fasteners: Stainless steel rivets or self-tapping screws.
 - 7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

2.2 WARNING SIGNS AND LABELS

- A. Manufacturers
 - 1. Craftmark

2. Seton
 3. Or approved equal.
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
 - C. Letter and Background Color: As indicated for specific application under Part 3.
 - D. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
 - E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - G. Fasteners: Stainless steel rivets or self-taping screws.
 - H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
 - I. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 WARNING TAPE

- A. Material: Vinyl.
- B. Minimum Thickness: 0.005 inch.
- C. Letter, Pattern, and Background Color: As indicated for specific application under Part 3.
- D. Waterproof Adhesive Backing: Suitable for indoor or outdoor use.
- E. Maximum Temperature: 160 deg F.
- F. Minimum Width: 2 inches.

2.4 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.
- B. Letter and Background Color: As indicated for specific application under Part 3.
- C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include:
 1. Pipe size.
 2. Flow-Direction Arrows: Include flow-direction arrows on[main] distribution piping. Arrows may be either integral with label or applied separately.
 3. Lettering Size: At least 1/2 inch for viewing distances of up to 72 inches and proportionately larger lettering for greater viewing distances.

2.5 VALVE TAGS

- A. Manufacturers
 1. Craftmark
 2. Brady Corporation
 3. Seton
 4. Or approved equal.

- B. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Brass, 0.04-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass link chain
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Include valve-tag schedule in operation and maintenance data.

2.6 WARNING TAGS

- A. Description: Preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.
 - 1. Size: 4 by 7 inches
 - 2. Fasteners: Brass grommet and wire
 - 3. Nomenclature: Large-size primary caption, such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Letter and Background Color: As indicated for specific application under Part 3.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 INSTALLATION, GENERAL REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.
- D. Locate identifying devices so that they are readily visible from the point of normal approach.

3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

- A. Permanently fasten labels on each item of mechanical equipment.
- B. Sign and Label Colors:
 - 1. White letters on an ANSI Z535.1 safety-blue background
- C. Locate equipment labels where accessible and visible.
- D. Arc-Flash Warning Signs: Provide arc-flash warning signs on electrical disconnects and other equipment where arc-flash hazard exists, as indicated on Drawings, and in accordance with requirements of OSHA and NFPA 70E

3.4 INSTALLATION OF WARNING TAPE

- A. Warning Tape Color and Pattern: Yellow background with black diagonal stripes
- B. Install warning tape on pipes and ducts, with cross-designated walkways providing less than 6 ft. of clearance.
- C. Locate tape so as to be readily visible from the point of normal approach.

3.5 INSTALLATION OF PIPE LABELS

- A. Stenciled Pipe Label Option: Stenciled labels showing service and flow direction may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.
 - 1. Identification Paint: Use for contrasting background.
 - 2. Stencil Paint: Use for pipe marking.
- B. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Within 3 ft. of each valve and control device.
 - 2. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 3. Within 3 ft. of equipment items and other points of origination and termination.
 - 4. Spaced at maximum intervals of 25 ft. along each run. Reduce intervals to [10 ft.] <Insert dimension> in areas of congested piping, ductwork, and equipment.
- C. Do not apply plastic pipe labels or plastic tapes directly to bare pipes conveying fluids at temperatures of 125 deg F or higher. Where these pipes are to remain uninsulated, use a short section of insulation or use stenciled labels.
- D. Flow-Direction Arrows: Use arrows to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- E. Pipe-Label Color Schedule:
 - 1. Chilled-Water Piping: White letters on an ANSI Z535.1 safety-green background
 - 2. Condenser-Water Piping: White letters on an ANSI Z535.1 safety-green background

3.6 INSTALLATION OF VALVE TAGS

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule in the operating and maintenance manual.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below.
 - 1. Valve-Tag Size and Shape:
 - a. Chilled Water: 2 inches, round]
 - b. Condenser Water: 2 inches], [round
 - 2. Valve-Tag Colors:
 - a. For each piping system, use the same lettering and background coloring system on valve tags as used for the Pipe Label Schedule text and background.

3.7 INSTALLATION OF WARNING TAGS

- A. Warning Tag Color: Black letters on an ANSI Z535.1 safety-yellow background. .

END OF SECTION

SECTION 23 07 19
HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes insulation for HVAC piping systems.
- B. Related Requirements:

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied, if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail attachment and covering of heat tracing inside insulation.
 - 3. Detail insulation application at pipe expansion joints for each type of insulation.
 - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 5. Detail removable insulation at piping specialties.
 - 6. Detail application of field-applied jackets.
 - 7. Detail application at linkages of control devices.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or craft training program.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation system materials are to be delivered to the Project site in unopened containers. The packaging is to include name of manufacturer, fabricator, type, description, and size, as well as ASTM standard designation, and maximum use temperature.

1.6 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84 by a testing agency acceptable to authority having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.
 - 1. All Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials are applied.
- B. Products do not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come into contact with stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- D. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.
- E. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric: Closed-cell, or expanded-rubber materials; suitable for maximum use temperature between minus 70 deg F and 220 deg F. Comply with ASTM C534/C534M, Type I, for tubular materials, Type II for sheet materials.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aeroflex USA.
 - b. Armacell LLC.
 - c. Or approved equal.
- G. Glass-Fiber, Preformed Pipe: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 850 deg F in accordance with ASTM C411. Comply with ASTM C547.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. Knauf Insulation.
 - c. Owens Corning.
 - d. Or approved equal.
 - 2. Preformed Pipe Insulation: Type I, Grade A with factory-applied ASJ.
 - 3. Fabricated shapes in accordance with ASTM C450 and ASTM C585.
 - 4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

- H. Glass-Fiber, Pipe and Tank: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature between 35 deg F and 850 deg F, in accordance with ASTM C411. Comply with ASTM C1393.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. Knauf Insulation.
 - c. Owens Corning.
 - d. Or approved equal
 - 2. Semirigid board material with factory-applied ASJ jacket.
 - 3. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- I. Phenolic: Prefabricated pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C1126, Type III.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Polyguard Products, Inc.
 - b. Resolco Inc.
 - c. Or approved equal.
 - 2. Prefabricated Pipe Insulation: Type III with factory-applied ASJ+ jacket
 - 3. Prefabricated shapes in accordance with ASTM C450 and ASTM C585.
 - 4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.3 INSULATING CEMENTS

- A. Glass-Fiber and Mineral Wool Insulating Cement: Comply with ASTM C195.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Ramco Insulation, Inc.
 - b. Or approved equal.

2.4 ADHESIVES

- A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Phenolic and Polyisocyanurate Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller.
 - c. Or approved equal.
- C. Flexible Elastomeric and Polyolefin Adhesive: Solvent-based adhesive.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aeroflex USA.

- b. Armacell LLC.
 - c. Or approved equal.
- 2. Flame-spread index is 25 or less and smoke-developed index is 50 or less as tested in accordance with ASTM E84.
- 3. Wet Flash Point: Below 0 deg F.
- 4. Service Temperature Range: 40 to 200 deg F.
- 5. Color: Black >.
- D. Glass-Fiber and Mineral Wool Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller.
 - c. Or approved equal.
- E. ASJ Adhesive and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller.
 - c. Or approved equal.
- F. PVC Jacket Adhesive: Compatible with PVC jacket.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. Speedline Corporation.
 - c. Or approved equal.

2.5 MASTICS AND COATINGS

- A. Materials are compatible with insulation materials, jackets, and substrates.
- B. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aeroflex USA.
 - b. Childers Brand; H. B. Fuller Construction Products.
 - c. Knauf Insulation.
 - d. Or approved equal
 - 2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
 - 3. Service Temperature Range: 0 to plus 180 deg F
 - 4. Color: White
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller.
 - c. Knauf Insulation.
 - d. Or approved equal.
2. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm at manufacturer's recommended dry film thickness.
3. Service Temperature Range: 0 to plus 180 deg F
4. Color: White.

2.6 SEALANTS

- A. Materials are as recommended by the insulation manufacturer and are compatible with insulation materials, jackets, and substrates.
- B. Joint Sealants:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller.
 - c. Owens Corning.
 - d. Or approved equal
 2. Permanently flexible, elastomeric sealant.
 - a. Service Temperature Range: Minus 100 to plus 300 deg F.
 - b. Color: White or gray.
- C. FSK and Metal Jacket Flashing Sealants:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller.
 - c. Or approved equal.
 2. Fire- and water-resistant, flexible, elastomeric sealant.
 3. Service Temperature Range: Minus 40 to plus 250 deg F.
 4. Color: Aluminum.
- D. ASJ Flashing Sealants and PVDC and PVC Jacket Flashing Sealants:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller.
 - c. Or approved equal.
 2. Fire- and water-resistant, flexible, elastomeric sealant.
 3. Service Temperature Range: Minus 40 to plus 250 deg F.
 4. Color: White.

2.7 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.
 4. ASJ+: Aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film leaving no paper exposed; complying with ASTM C1136, Types I, II, III, IV, and VII.
 5. PSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C1136, Type II.

2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets comply with ASTM C1136, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Airex Manufacturing Inc.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Speedline Corporation.
 - d. Or approved equal.
 2. Adhesive: As recommended by jacket material manufacturer.
 3. Color: Color-code jackets based on system. Color as selected by Engineer.
 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
- D. Metal Jacket:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. RPR Products, Inc.
 - c. Childers
 - d. Or approved equal.
 2. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Factory cut and rolled to size.
 - b. Finish and thickness are indicated in field-applied jacket schedules.

- c. Moisture Barrier for Indoor Applications: 53-mil-thick polysurlyn.
- d. Moisture Barrier for Outdoor Applications: 53-mil-thick polysurlyn.
- e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.9 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Industrial Adhesives and Tapes Division.
 - b. Aeroflex USA.
 - c. Knauf Insulation.
 - d. Or approved equal.
 - 2. Width: 3 inches
 - 3. Thickness: 11.5 mils.
 - 4. Adhesion: 90 ounces force/inch in width.
 - 5. Elongation: 2 percent.
 - 6. Tensile Strength: 40 lbf/inch in width.
 - 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Industrial Adhesives and Tapes Division.
 - b. Avery Dennison Corporation, Specialty Tapes Division.
 - c. Knauf Insulation.
 - d. Or approved equal.
 - 2. Width: 3 inches
 - 3. Thickness: 6.5 mils
 - 4. Adhesion: 90 ounces force/inch > in width.
 - 5. Elongation: 2percent.

6. Tensile Strength: 40 lbf/inch in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Industrial Adhesives and Tapes Division.
 - b. Ideal Tape Co., Inc., an American Biltrite Company.
 - c. Or approved equal.
 2. Width: 2 inches
 3. Thickness: 6 mils
 4. Adhesion: 64 ounces force/inch in width.
 5. Elongation: 500percent.
 6. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Industrial Adhesives and Tapes Division.
 - b. Ideal Tape Co., Inc., an American Biltrite Company.
 - c. Knauf Insulation.
 - d. Or approved equal.
 2. Width: 2 inches
 3. Thickness: 3.7 mils
 4. Adhesion: 100 ounces force/inch in width.
 5. Elongation: 5percent.
 6. Tensile Strength: 34 lbf/inch in width.

2.10 SECUREMENTS

- A. Bands:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. RPR Products, Inc.
 - c. Or approved equal.
 2. Stainless Steel: ASTM A240/A240M, Type 3040.015 inch thick, 1/2 inch wide with closed seal.
 3. Springs: Twin spring set constructed of stainless steel, with ends flat and slotted to accept metal bands. Spring size is determined by manufacturer for application.
- B. Staples: Outward-clinching insulation staples, nominal 3/4 inch wide, stainless steel or Monel.
- C. Wire: 0.062-inch soft-annealed, stainless steel

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. RPR Products, Inc.
 - c. Or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 1. Verify that systems to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
 2. Carbon Steel: Coat carbon steel operating at a service temperature of between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.
- D. Install insulation with longitudinal seams at top and bottom (12 o'clock and 6 o'clock positions) of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with the Contract Documents, unless otherwise approved by the engineer of record.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
 - 3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
 - 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 4 inches o.c.
 - 4. For below-ambient services, apply vapor-barrier mastic over staples.
 - 5. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
 - 6. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.
- P. For above-ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install

- insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles below.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 2. Insulate pipe elbows using prefabricated fitting insulation made from same material and density as that of adjacent pipe insulation. Each piece is butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with prefabricated fitting insulation of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using prefabricated fitting insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

5. Insulate strainers using prefabricated fitting insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers, so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges, mechanical couplings, and unions using a section of oversized preformed pipe insulation to fit. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers. Installation conforms to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as that of adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as that of pipe insulation.
 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install sections of pipe insulation and miter if required in accordance with manufacturer's written instructions.
 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install prefabricated valve covers manufactured of same material as that of pipe insulation when available.
 2. When prefabricated valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 3. Install insulation to flanges as specified for flange insulation application.
 4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 INSTALLATION OF GLASS-FIBER AND MINERAL WOOL INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 3. For insulation with jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
 4. For insulation with jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
1. Install prefabricated pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with glass-fiber or mineral-wool blanket insulation.
 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.

2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When prefabricated sections are not available, install fabricated sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 INSTALLATION OF PHENOLIC INSULATION

A. General Installation Requirements:

1. Secure single-layer insulation with stainless steel bands at 12-inch intervals, and tighten bands without deforming insulation materials.
2. Install two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch wire spaced at 12-inch intervals. Secure outer layer with stainless steel bands at 12-inch intervals.

B. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with jackets with vapor retarder on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

C. Insulation Installation on Pipe Flanges:

1. Install prefabricated pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as that of pipe insulation. Where voids are difficult to fill with block insulation, fill the voids with a fibrous insulation material suitable for the specific operating temperature.

D. Insulation Installation on Pipe Fittings and Elbows:

1. Install prefabricated insulation sections, or mitered or routed fittings, of same material as that of straight segments of pipe insulation. Secure according to manufacturer's written instructions.

E. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated insulation sections of same material as that of straight segments of pipe insulation. Secure according to manufacturer's written instructions.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

3. Install insulation to flanges as specified for flange insulation application.

3.9 INSTALLATION OF FIELD-APPLIED JACKETS

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
 1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
 2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
 1. Draw jacket material smooth and tight.
 2. Install lap or joint strips with same material as jacket.
 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated and for horizontal applications, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches o.c. and at end joints.
- E. Where PVDC jackets are indicated, install as follows:
 1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
 2. Wrap pre-sized jackets around individual pipe insulation sections, with one end overlapping the previously installed sheet. Install pre-sized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
 3. Continuous jacket can be spiral-wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
 4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch-circumference limit allows for 2-inch-overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fish mouthing," and use PVDC tape along lap seal to secure joint.
 5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.10 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless steel jackets.

3.11 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections.
- B. Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections
- E. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Engineer, by removing field-applied jacket and insulation in layers in reverse order of their installation. All insulation applications will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.

3.12 PIPING INSULATION SCHEDULE, GENERAL

- A. Insulation conductivity and thickness per pipe size comply with schedules in this Section or with requirements of authorities having jurisdiction, whichever is more stringent.
- B. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- C. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 1. Underground piping.
 2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.13 INDOOR PIPING INSULATION SCHEDULE

- A. Condensate and Equipment Drain Water below 60 Deg F:
 1. All Pipe Sizes: Insulation is the following:
 - a. Phenolic: 1 inch thick.
 - b. Chilled Water and Brine, 40 Deg F and below:
 2. NPS 3 and Smaller: Insulation is the following:
 - a. Phenolic: 2 inches thick.
 3. NPS 4 to NPS 12 Insulation is the following:
 - a. Phenolic: 2 inches thick.
- B. Condenser-Water Supply and Return:
 1. Phenolic 1-1/2 inches thick.

3.14 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Chilled Water and Brine:

1. All Pipe Sizes: Insulation is the following:
 - a. Phenolic: 2 inches thick.
- B. Condenser-Water Supply and Return:

1. All Pipe Sizes: Insulation is[one of] the following:
 - a. Phenolic: 2 inches thick.

3.15 OUTDOOR, UNDERGROUND, PIPING INSULATION SCHEDULE

- A. Chilled Water, All Sizes: Cellular glass, 2 inches thick.
- B. Condenser-Water Supply and Return, All Sizes: Cellular glass, 2 inches thick.

3.16 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
 1. None.
- D. Piping, Exposed:
 1. PVC, Color-Coded by System: 30 mils thick.

3.17 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
 1. None.
- D. Piping, Exposed:
 1. Locking Seam 0.024 inch thick.
 2. Stainless Steel,

3.18 UNDERGROUND, FIELD-APPLIED INSULATION JACKET

- A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION

SECTION 23 05 48
VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Elastomeric isolation pads.
 - 2. Spring hangers Restraints - rigid type.
 - 3. Restraints - cable type.
 - 4. Restraint accessories.
 - 5. Post-installed concrete anchors.
 - 6. Concrete inserts.

1.2 DEFINITIONS

- A. Designated Seismic System: An HVAC component that requires design in accordance with ASCE/SEI 7, Ch. 13, and for which the Component Importance Factor is greater than 1.0.
- B. IBC: International Building Code.
- C. OSHPD: Office of Statewide Health Planning and Development (State of California).

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Include load rating for each wind-force-restraint fitting and assembly.
 - 3. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic- restraint component.
 - 4. Annotate types and sizes of seismic restraints and accessories, complete with listing markings or report numbers and load rating in tension and compression as evaluated by ICC-ES product listing
 - 5. Annotate to indicate application of each product submitted and compliance with requirements.
 - 6. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- B. Shop Drawings:
 - 1. Detail fabrication and assembly of equipment bases.
 - 2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.
- B. Qualification Data: For professional engineer and testing agency.
- C. Welding certificates.
- D. Field quality-control reports.

- E. Seismic Qualification Data: Provide special certification for designated seismic systems as indicated in ASCE/SEI 7-10, Paragraph 13.2.2, "

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct testing indicated, be an NRTL as defined by OSHA in 29 CFR 1910.7, and be acceptable to authorities having jurisdiction.
- B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Seismic-Restraint Device Load Ratings: Devices to be tested and rated in accordance with applicable code requirements and authorities having jurisdiction. Devices to be listed by a nationally recognized third party that requires periodic follow-up inspections and has a listing directory available to the public. Provide third-party listing by one or more of the following: ICC-ES product listing

PART 2 - PRODUCTS

2.1 ELASTOMERIC ISOLATION PADS

- A. Elastomeric Isolation Pads: <Insert drawing designation>.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. California Dynamics Corporation.
 - b. Mason Industries, Inc.
 - c. Or approved equal.
 - 2. Source Limitations: Obtain elastomeric isolation pads from single manufacturer.
 - 3. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
 - 4. Size: Factory or field cut to match requirements of supported equipment.
 - 5. Pad Material: Oil and water resistant with elastomeric properties. Neoprene rubber, silicone rubber, or other elastomeric material.
 - 6. Surface Pattern: Smooth, ribbed, or waffle pattern.
 - 7. Infused nonwoven cotton or synthetic fibers.
 - 8. Load-bearing metal plates adhered to pads.
 - 9. Sandwich-Core Material: Resilient and elastomeric.
 - a. Surface Pattern: Smooth, ribbed, or waffle pattern.
 - b. Infused nonwoven cotton or synthetic fibers.

2.2 SPRING HANGERS

- A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. California Dynamics Corporation.
 - b. Mason Industries Inc.
 - c. Or approved equal.
 - 2. Source Limitations: Obtain spring hangers from single manufacturer.

3. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
5. Minimum Additional Travel: 50 percent of the required deflection at rated load.
6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
8. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
9. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
10. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

2.3 RESTRAINTS - RIGID TYPE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Cooper B-line; brand of Eaton, Electrical Sector.
 2. TOLCO Incorporated.
 3. Or approved equal.
- B. Source Limitations: Obtain rigid-type restraints from single manufacturer.
- C. Description: Shop- or field-fabricated bracing assembly made of AISI S110-07-S1 slotted steel channels, ANSI/ASTM A53/A53M steel pipe as per NFPA 13, or other rigid steel brace member. Includes accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.4 RESTRAINTS - CABLE TYPE

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 1. Cooper B-line; brand of Eaton, Electrical Sector.
 2. Mason Industries Inc.
 3. Or approved equal.
- B. Source Limitations: Obtain cable-type restraints from single manufacturer.
- C. Seismic-Restraint Cables: ASTM A492 stainless steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for seismic-restraining cable service; with fittings attached by means of poured socket, swaged socket or mechanical (Flemish eye) loop.
- D. Restraint cable assembly with cable fittings must comply with ASCE/SEI 19. All cable fittings and complete cable assembly must maintain the minimum cable breaking force. U-shaped cable clips and wedge-type end fittings do not comply and are unacceptable.

2.5 RESTRAINT ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Cooper B-line; brand of Eaton, Electrical Sector.
 2. TOLCO Incorporated.

3. Mason Industries Inc
 4. Or approved equal
- B. Source Limitations: Obtain restraint accessories from single manufacturer.
 - C. Hanger-Rod Stiffener: Reinforcing steel angle clamped to hanger rod. Non-metallic stiffeners are unacceptable.
 - D. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.
 - E. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
 - F. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.
 - G. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.6 POST-INSTALLED CONCRETE ANCHORS

- A. Mechanical Anchor Bolts:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper B-line; brand of Eaton, Electrical Sector.
 - b. Hilti, Inc.
 - c. Or approved equal.
 2. Source Limitations: Obtain mechanical anchor bolts from single manufacturer.
 3. Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength for anchor and as tested according to ASTM E488/E488M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger-Rod Stiffeners: Install where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.3 INSTALLATION OF VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICES

- A. Provide vibration-control devices for systems and equipment where indicated in Equipment Schedules or Vibration-Control Devices Schedules, where indicated on Drawings, or where Specifications indicate they are to be installed on specific equipment and systems.

- B. Equipment Restraints:
 - 1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
 - 2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
- C. Piping Restraints:
 - 1. Comply with requirements in MSS SP-127.
 - 2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
 - 3. Brace a change of direction longer than 12 feet.
- D. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- E. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- F. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- G. Mechanical Anchor Bolts:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge-Type Anchor Bolts: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors to be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Adhesive-Type Anchor Bolts: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
 - 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 6. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.4 ADJUSTING

- A. Adjust isolators after system is at operating weight.
- B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

- C. Tests and Inspections:
1. Perform tests and inspections
 2. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 3. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
 4. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 5. Test no fewer than four of each type and size of installed anchors and fasteners selected by Architect.
 6. Test to 90 percent of rated proof load of device.
 7. Measure isolator restraint clearance.
 8. Measure isolator deflection.
 9. Verify snubber minimum clearances.
 10. Test and adjust restrained-air-spring isolator controls and safeties.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Units will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION

SECTION 23 09 23

DIRECT DIGITAL CONTROL (DDC) FOR HVAC SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Direct digital control (DDC) system for HVAC.

1.02 DEFINITIONS

- A. Algorithm: A logical procedure for solving a recurrent mathematical problem. A prescribed set of well-defined rules or processes for solving a problem in a finite number of steps.
- B. Analog: A continuously varying signal value, such as current, flow, pressure, or temperature.
- C. BACnet Specific Definitions:
 - 1. BACnet: Building Automation Control Network Protocol, ASHRAE 135. A communications protocol allowing devices to communicate data and services over a network.
 - 2. BACnet Interoperability Building Blocks (BIBBs): 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.
 - 3. BACnet/IP: Defines and allows using a reserved UDP socket to transmit BACnet messages over IP networks. A BACnet/IP network is a collection of one or more IP subnetworks that share the same BACnet network number.
 - 4. BACnet Testing Laboratories (BTL): Organization responsible for testing products for compliance with ASHRAE 135, operated under direction of BACnet International.
- D. Binary: Two-state signal where a high signal level represents "ON" or "OPEN" condition and a low signal level represents "OFF" or "CLOSED" condition. "Digital" is sometimes used interchangeably with "Binary" to indicate a two-state signal.
- E. Controller: Generic term for any standalone, microprocessor-based, digital controller residing on a network, used for local or global control. Three types of controllers are indicated: network controllers, programmable application controllers, and application-specific controllers.
- F. Control System Integrator: An entity that assists in expansion of existing enterprise system and support of additional operator interfaces to I/O being added to existing enterprise system.
- G. COV: Changes of value.
- H. DDC System Provider: Authorized representative of, and trained by, DDC system manufacturer and responsible for execution of DDC system Work indicated.
- I. Distributed Control: Processing of system data is decentralized and control decisions are made at subsystem level. System operational programs and information are provided to remote subsystems and status is reported back. On loss of communication, subsystems to be capable of operating in a standalone mode using the last best available data.
- J. E/P: Voltage to pneumatic.

- K. Gateway: Bidirectional protocol translator that connects control systems that use different communication protocols.
- L. HLC: Heavy load conditions.
- M. I/O: System through which information is received and transmitted. I/O refers to analog input (AI), binary input (BI), analog output (AO) and binary output (BO). Analog signals are continuous and represent control influences such as flow, level, moisture, pressure, and temperature. Binary signals convert electronic signals to digital pulses (values) and generally represent two-position operating and alarm status. "Digital," (DI) and (DO), is sometimes used interchangeably with "Binary," (BI) and (BO), respectively.
- N. I/P: Current to pneumatic.
- O. LAN: Local area network.
- P. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
- Q. Mobile Device: A data-enabled phone or tablet computer capable of connecting to a cellular data network and running a native control application or accessing a web interface.
- R. Modbus TCP/IP: An open protocol for exchange of process data.
- S. MS/TP: Master-slave/token-passing, ISO/IEC/IEEE 8802-3. Datalink protocol LAN option that uses twisted-pair wire for low-speed communication.
- T. MTBF: Mean time between failures.
- U. Network Controller: Digital controller, which supports a family of programmable application controllers and application-specific controllers, that communicates on peer-to-peer network for transmission of global data.
- V. Network Repeater: Device that receives data packet from one network and rebroadcasts it to another network. No routing information is added to protocol.
- W. Peer to Peer: Networking architecture that treats all network stations as equal partners.
- X. POT: Portable operator's terminal.
- Y. RAM: Random access memory.
- Z. RF: Radio frequency.
- AA. Router: Device connecting two or more networks at network layer.
- BB. Server: Computer used to maintain system configuration, historical and programming database.
- CC. TCP/IP: Transport control protocol/Internet protocol.
- DD. UPS: Uninterruptible power supply.
- EE. USB: Universal Serial Bus.

FF. User Datagram Protocol (UDP): This protocol assumes that the IP is used as the underlying protocol.

GG. VAV: Variable air volume.

HH. WLED: White light emitting diode.

1.03 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.04 ACTION SUBMITTALS

A. Multiple Submissions:

1. If multiple submissions are required to execute work within schedule, first submit a coordinated schedule clearly defining intent of multiple submissions. Include a proposed date of each submission with a detailed description of submittal content to be included in each submission.
2. Clearly identify each submittal requirement indicated and in which submission the information will be provided.
3. Include an updated schedule in each subsequent submission with changes highlighted to easily track the changes made to previous submitted schedule.

B. Product Data:

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
3. Product description with complete technical data, performance curves, and product specification sheets.
4. Installation, operation, and maintenance instructions including factors affecting performance.
5. Bill of materials of indicating quantity, manufacturer, and extended model number for each unique product.
 - a. Workstations.
 - b. Printers.
 - c. Servers.
 - d. Gateways.
 - e. Routers.
 - f. Protocol analyzers.
 - g. DDC controllers.
 - h. Enclosures.
 - i. Electrical power devices.
 - j. UPS units.
 - k. Accessories.
 - l. Instruments.
 - m. Control dampers and actuators.

- n. Control valves and actuators.
 - o. <Insert product>.
6. When manufacturer's product datasheets apply to a product series rather than a specific product model, clearly indicate and highlight only applicable information.
 7. Each submitted piece of product literature to clearly cross reference specification and drawings that submittal is to cover.

C. Software Submittal:

1. Cross-referenced listing of software to be loaded on each operator workstation, server, gateway, and DDC controller.
2. Description and technical data of all software provided and cross-referenced to products in which software will be installed.
3. Operating system software, operator interface and programming software, color graphic software, DDC controller software, maintenance management software, and third-party software.
4. Include a flow diagram and an outline of each subroutine that indicates each program variable name and units of measure.
5. Listing and description of each engineering equation used with reference source.
6. Listing and description of each constant used in engineering equations and a reference source to prove origin of each constant.
7. Description of operator interface to alphanumeric and graphic programming.
8. Description of each network communication protocol.
9. Description of system database, including all data included in database, database capacity, and limitations to expand database.
10. Description of each application program and device drivers to be generated, including specific information on data acquisition and control strategies showing their relationship to system timing, speed, processing burden, and system throughout.
11. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.

D. Shop Drawings:

1. General Requirements:
 - a. Include cover drawing with Project name, location, Owner, Architect, Contractor, and issue date with each Shop Drawings submission.
 - b. Include a drawing index sheet listing each drawing number and title that matches information in each title block.
2. Include plans, elevations, sections, and mounting details where applicable.
3. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
4. Detail means of vibration isolation and show attachments to rotating equipment.
5. Plan Drawings indicating the following:
 - a. Screened backgrounds of walls, structural grid lines, HVAC equipment, ductwork, and piping.
 - b. Room names and numbers with coordinated placement to avoid interference with control products indicated.
 - c. Each desktop workstation network port, server, gateway, router, DDC controller, control panel instrument connecting to DDC controller, and damper and valve connecting to DDC controller, if included in Project.

- d. Exact placement of products in rooms, ducts, and piping to reflect proposed installed condition.
 - e. Network communication cable and raceway routing.
 - f. Information, drawn to scale, of <Insert requirements>.
 - g. Proposed routing of wiring, cabling, conduit, and tubing; coordinated with building services for review before installation.
6. Schematic drawings for each controlled HVAC system indicating the following:
- a. I/O points labeled with point names shown. Indicate instrument range, normal operating set points, and alarm set points. Indicate fail position of each damper and valve, if included in Project.
 - b. I/O listed in table format showing point name, type of device, manufacturer, model number, and cross-reference to product data sheet number.
 - c. A graphic showing location of control I/O in proper relationship to HVAC system.
 - d. Wiring diagram with each I/O point having a unique identification and indicating labels for all wiring terminals.
 - e. Unique identification of each I/O that to be consistently used between different drawings showing same point.
 - f. Elementary wiring diagrams of controls for HVAC equipment motor circuits including interlocks, switches, relays, and interface to DDC controllers.
 - g. Narrative sequence of operation.
 - h. Graphic sequence of operation, showing all inputs and output logical blocks.
7. Control panel drawings indicating the following:
- a. Panel dimensions, materials, size, and location of field cable, raceways, and tubing connections.
 - b. Interior subpanel layout, drawn to scale and showing all internal components, cabling, and wiring raceways, nameplates, and allocated spare space.
 - c. Front, rear, and side elevations and nameplate legend.
 - d. Unique drawing for each panel.
8. DDC system network riser diagram indicating the following:
- a. Each device is connected to network with unique identification for each.
 - b. Interconnection of each different network in DDC system.
 - c. For each network, indicate communication protocol, speed, and physical means of interconnecting network devices, such as copper cable type, or optical fiber cable type. Indicate raceway type and size for each.
 - d. Each network port for connection of an operator workstation or other type of operator interface with unique identification for each.
9. DDC system electrical power riser diagram indicating the following:
- a. Each point of connection to field power with requirements (volts/phase/hertz/amperes/connection type) listed for each.
 - b. Each control power supply includes, as applicable, transformers, power-line conditioners, transient voltage suppression and high filter noise units, DC power supplies, and UPS units with unique identification for each.
 - c. Each product requiring power with requirements (volts/phase/hertz/amperes/connection type) listed for each.
 - d. Power wiring type and size, race type, and size for each.
10. Monitoring and control signal diagrams indicating the following:

- a. Control signal cable and wiring between controllers and I/O.
- b. Point-to-point schematic wiring diagrams for each product.
- c. Control signal tubing to sensors, switches, and transmitters.
- d. Process signal tubing to sensors, switches, and transmitters.

11. Color graphics indicating the following:

- a. Itemized list of color graphic displays to be provided.
- b. For each display screen to be provided, a true color copy showing layout of pictures, graphics, and data displayed.
- c. Intended operator access between related hierarchical display screens.

E. System Description:

- 1. Full description of DDC system architecture, network configuration, operator interfaces and peripherals, servers, controller types and applications, gateways, routers and other network devices, and power supplies.
- 2. Complete listing and description of each report, log and trend for format and timing, and events that initiate generation.
- 3. System and product operation under each potential failure condition including, but not limited to, the following:
 - a. Loss of power.
 - b. Loss of network communication signal.
 - c. Loss of controller signals to inputs and outpoints.
 - d. Operator workstation failure.
 - e. Server failure.
 - f. Gateway failure.
 - g. Network failure.
 - h. Controller failure.
 - i. Instrument failure.
 - j. Control damper and valve actuator failure.
- 4. Complete bibliography of documentation and media to be delivered to Owner.
- 5. Description of testing plans and procedures.
- 6. Description of Owner training.

F. Delegated Design Submittals: For DDC system products and installation indicated as being delegated.

- 1. Supporting documentation showing DDC system design complies with performance requirements indicated, including calculations and other documentation necessary to prove compliance.
- 2. Schedule and design calculations for control dampers and actuators.
 - a. Flow at Project design and minimum flow conditions.
 - b. Face velocity at Project design and minimum airflow conditions.
 - c. Pressure drop across damper at Project design and minimum airflow conditions.
 - d. AMCA 500-D damper installation arrangement used to calculate and schedule pressure drop, as applicable to installation.
 - e. Maximum close-off pressure.
 - f. Leakage airflow at maximum system pressure differential (fan close-off pressure).
 - g. Torque is required at worst case condition for sizing actuator.
 - h. Actuator selection indicating torque provided.
 - i. Actuator signal to control damper (on, close, or modulate).

- j. Actuator position on loss of power.
- k. Actuator position on loss of control signal.

1.05 INFORMATIONAL SUBMITTALS

A. Coordination Drawings:

- 1. Plan drawings, reflected ceiling plans, or Building Information Model (BIM), and corresponding product installation details, drawn to scale, showing the items described in this Section and coordinated with all building trades.

B. Qualification Statements:

1. Systems Provider's Qualification Data:

- a. Resume of project manager assigned to Project.
- b. Resumes of application engineering staff assigned to Project.
- c. Resumes of installation and programming technicians assigned to Project.
- d. Resumes of service technicians assigned to Project.
- e. Brief description of past project including physical address, floor area, number of floors, building system cooling capacity, and building's primary function.
- f. Description of past project DDC system, noting similarities to Project scope and complexity indicated.
- g. Names of staff assigned to past project that will also be assigned to execute work of this Project.
- h. Owner contact information for past project including name, phone number, and email address.
- i. Contractor contact information for past project including name, phone number, and email address.
- j. Architect contact information for past project including name, phone number, and email address.

2. Manufacturer's qualification data.

3. Testing agency's qualification data.

C. Welding certificates.

D. Product Certificates:

1. Data Communications Protocol Certificates:

- a. Certifying that each proposed DDC system component complies with ASHRAE 135.
- b. Certifying that each proposed DDC system component complies with LonWorks.

E. Test and Evaluation Reports:

- 1. Product Test Reports: For DDC system equipment and components, for tests performed by a qualified testing agency.
- 2. Preconstruction Test Reports: For each separate test performed.

F. Source Quality-Control Reports: For DDC system equipment and components.

G. Field Quality-Control Reports: For DDC system equipment and components.

- H. Sample warranty.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For DDC system.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Project Record Drawings of as-built versions of submittal Shop Drawings provided in electronic PDF format.
 - b. Testing and commissioning reports and checklists of completed final versions of reports, checklists, and trend logs.
 - c. As-built versions of submittal Product Data.
 - d. Names, addresses, email addresses, and 24-hour telephone numbers of Installer and service representatives for DDC system and products.
 - e. Operator's manual with procedures for operating control systems including logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing set points and variables.
 - f. Programming manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
 - g. Engineering, installation, and maintenance manuals that explain how to do the following:
 - 1) Design and install new points, panels, and other hardware.
 - 2) Perform preventive maintenance and calibration.
 - 3) Debug hardware problems.
 - 4) Repair or replace hardware.
 - h. Documentation of all programs created using custom programming language including set points, tuning parameters, and object database.
 - i. Backup copy of graphic files, programs, and databases on electronic media.
 - j. List of recommended spare parts with part numbers and suppliers.
 - k. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
 - l. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation software, and graphics software.
 - m. Licenses, guarantees, and warranty documents.
 - n. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.
 - o. Owner training materials.

1.07 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Stock Material: Furnish extra materials and parts to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- B. Include product manufacturers' recommended parts lists for proper product operation over four-year period following warranty period. Parts list to be indicated for each year.

- C. Furnish parts, as indicated by manufacturer's recommended parts list, for product operation during one-year period following warranty period.
- D. Furnish quantity indicated of matching product(s) in Project inventory for each unique size and type of following:
 - 1. Network Controller: One.
 - 2. Programmable Application Controller: One.
 - 3. Application-Specific Controller: One.
 - 4. General-Purpose Relay: One.
 - 5. Multifunction Time-Delay Relay: One.
 - 6. Latching Relay: One.
 - 7. Current-Sensing Relay: One.
 - 8. Combination On-Off Status Sensor and On-Off Relay: One.
 - 9. Transformer: One.
 - 10. DC Power Supply: One.

1.08 QUALITY ASSURANCE

A. DDC System Manufacturer Qualifications:

- 1. Nationally recognized manufacturer of DDC systems and products.
- 2. DDC systems with similar requirements to those indicated for a continuous period of five years within time of bid.
- 3. DDC systems and products that have been successfully tested and in use on at least three past projects.
- 4. Having complete published catalog literature, installation, operation, and maintenance manuals for all products intended for use.
- 5. Having full-time in-house employees for the following:
 - a. Product research and development.
 - b. Product and application engineering.
 - c. Product manufacturing, testing, and quality control.
 - d. Technical support for DDC system installation training, commissioning, and troubleshooting of installations.
 - e. Owner operator training.

B. DDC System Provider Qualifications:

- 1. Authorized representative of, and trained by, DDC system manufacturer.
- 2. Demonstrate past experience with installation of DDC system products being installed for period within three consecutive years before time of bid.
- 3. Demonstrate past experience on five projects of similar complexity, scope, and value.
- 4. Demonstrate past experience of each person assigned to Project.
- 5. Staffing resources of competent and experienced full-time employees that are assigned to execute work according to schedule.
- 6. Service and maintenance staff assigned to support Project during warranty period.
- 7. Product parts inventory to support ongoing DDC system operation for a period of not less than five years after Substantial Completion.
- 8. DDC system manufacturer's backing to take over execution of the Work if necessary to comply with requirements indicated. Include Project-specific written letter, signed by manufacturer's corporate officer, if requested.

C. Testing Agency Qualifications: Member company of NETA.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.
- D. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:
1. AWS D1.1/D1.1M.
 2. AWS D1.2/D1.2M.
 3. AWS D1.3/D1.3M.
 4. AWS D1.4/D1.4M.
- E. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators in accordance with ASME Boiler and Pressure Vessel Code.

1.09 MOCKUPS

- A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, to set quality standards for materials and execution, and to set quality standards for fabrication and installation.
1. Build mockups of completed installation where products are exposed to view and are located in areas with aesthetic requirements that warrant special attention, including the following spaces:
 2. Build mockups of completed installation for areas as indicated on Drawings.
 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.10 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on field mockups.
1. Provide test assemblies representative of proposed materials and construction.
 2. Build laboratory mockups at testing agency facility; use personnel, materials, and methods of construction that will be used at Project site.
 3. Notify Architect seven days in advance of dates and times when laboratory mockups will be tested.

1.11 WARRANTY

- A. Special Warranty: Manufacturer and Installer agree to repair or replace products that fail in materials or workmanship within specified warranty period.
1. Adjust, repair, or replace failures at no additional cost or reduction in service to Owner.
 2. Include updates or upgrades to software and firmware if necessary to resolve deficiencies.
 - a. Install updates only after receiving Owner's written authorization.

3. Perform warranty service during normal business hours and commence within 24 hours of Owner's warranty service request.
4. Warranty Period: Two year(s) from date of Substantial Completion.
 - a. For Gateway: Three-year parts and labor warranty for each.

PART 2 - PRODUCTS

2.1 Acceptable System Manufacturers and Contractors

1. Provide a building automation system supplied by a company regularly engaged in the manufacturing and distribution of building automation systems for a minimum of 5 years.
2. The manufacturer of the hardware and software components shall have a technical support group accessible via a toll-free number that is staffed with qualified personnel, capable of providing instruction and technical support service for networked control systems.
3. BACnet/IP communication protocol must be used for all BAS manufacturer provided controllers (including terminal devices such as VAVs, FCUs, etc.)
4. Any approved manufacturer that can supply both equipment and controls must provide controls pricing separately from equipment pricing.
5. Acceptable Manufacturers
 1. Distech Controls (Basis of Design)
 2. Or Approved Equal (controls brand must be based on the Tridium (Niagara 4) platform.
6. All other manufacturers/contractors besides the "Basis of Design" manufacturer (including those listed above) must submit a compliance matrix outlining "C – Comply," "D – Does Not Comply", and "E – Exclude" for the entirety of the 23 09 00 section prior to bid award.
 1. Being listed as an approved manufacturer/contractor does not preclude the bidder from meeting all aspects and requirements of this specification.
 2. Those bidders not prequalified prior to review of bids will not be considered responsive. To be prequalified a bidder must be accepted to bid the project by the engineer either by a bid addendum or documented RFI response from the engineer. No other prequalifications shall be acceptable.

2.2 Quality Assurance

1. All new building automation system products on this project shall be provided by a firm that is a registered ISO 9001:2015 manufacturer, for a minimum duration of 5 years, at time of bid.

2.3 Computer Hardware

1. Provide the following computer hardware for this project:
 1. Onsite Server(s)

2. Workstation Computer(s)
3. Uninterruptable Power Supplies
2. Server Hardware Requirements
 1. The Server shall adhere to the following minimum requirements: the latest generation Intel Core i5 processor, 16 GB RAM, and a 1TB solid state hard drive. It shall include the latest Windows 64-bit operating system (Windows 10 pro or newer), VM support, and an ethernet adapter (10/100MB with RJ45 connector). Connection to the BAS LAN network shall be via an Ethernet network interface card, 100 Mbps.
 2. The server shall support all network/building controllers, OWSs, and 3rd party mechanical / electrical systems connected to the Facility Management Control / Building Automation System Local Area Network.
 3. Acceptable Manufacturers are:
 1. Dell
 2. Lenovo
 3. HP (Hewlett Packard)
 4. Or approved equal.
3. Workstation Hardware Requirements
 1. The Workstation shall adhere to the following minimum requirements: the latest generation Intel Core i5 processor, 8 GB RAM, and a 500GB solid state hard drive. It shall include the latest Windows 64-bit operating system (Windows 10 pro or newer), Microsoft Office programs, VM support, an ethernet adapter (10/100MB with RJ45 connector), 32X CD-ROM drive, and 2-USB ports.
 2. A minimum 21", HDMI, DVI-D video interfaces, minimum 1024 x 768 resolution, 4x3 Widescreen, LED color monitor with a minimum 60 Hz refresh rate shall also be included.
 3. A mouse and keyboard shall be provided.
 4. Connection to the BAS LAN network shall be via an Ethernet network interface card, 100 Mbps.
 5. Workstation(s) should be loaded with Programming Tools
 6. Acceptable Manufacturers are:
 1. Dell
 2. Lenovo
 3. HP (Hewlett Packard)
 4. Or approved equal.

4. Uninterruptable Power Supplies

1. Provide the OWS, Server, and each network/building controller with individual UPS to provide clean, reliable, noise-filtered power at all times and to protect and maintain systems operation throughout short-term power interruptions of up to 15 minutes duration.
2. Acceptable Manufacturer is APC or approved equal.

2.4 Remote Access and Cyber Security Best Practices

1. Remote Access

1. The BAS contractor shall comply with owner IT infrastructure security policies for remote access. The owner IT team shall provide VPN, firewalls, etc. as needed for secure remote access.
2. A VPN and firewall must be used for secure remote access.

2. Cyber Security Best Practices

1. Unless predetermined by the owner IT team the BAS network shall be separate from the owners IT infrastructure besides a single point connection for remote access (owner provided internet access). All ethernet switches and communication backbone required for a fully operational BAS shall be provided by the BAS contractor.
2. Refer to "Communication Backbone" section of this specification for further details on segmenting the network (VLANs, subnets) and when edge or managed switches are required based on building size / type.
3. Do not use factory provided usernames and passwords. Update passwords and usernames regularly for strong system security.
4. Update software and firmware regularly.
5. Adhere to controls manufacturer hardening guidelines where applicable.

2.5 Operator Software

1. Real-Time Displays

1. Provide a visual graphical representation of buildings, floor layouts, each piece of mechanical equipment and/or mechanical system that duplicates the represented system, presented as a web page via any industry standard web browser, where applicable.
2. Graphics shall include at a minimum the value of each input, each output, each setpoint, alarms and graphical representation of trend logs.

2. On-Line Help

1. Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system.

3. Security

1. Each operator shall be required to log on to that system with a username and password in order to view, edit, add, or delete data.
2. System security shall be selectable for each operator.
3. The system administrator shall have the ability to set passwords and security levels for all other operators.
4. Each operator password shall be able to restrict the operators' access for viewing and/or changing each system application, full screen editor, and object.
5. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected.
6. This auto log-off time shall be set per operator password.
7. All system security data shall be stored in an encrypted format.

4. System Diagnostics.

1. The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers.
2. The failure of any device shall be annunciated to the operator.

5. Third-Party Windows-Based Programs

1. The system shall be capable of utilizing third-party Windows-based programs for such things as spreadsheet analysis, graphing, charting, custom report generation, and graphics design packages.
2. Graphics generation shall be done using standard Windows packages.
3. No proprietary graphics generation software shall be needed.

6. Overrides

1. It shall be possible for the operator to override automatic analog and digital output commands.
2. Where the BAS software normally originates these outputs, the provision shall exist for the operator to terminate automatic BAS control of any particular output and to originate a manual analog or digital output command.
3. The provision shall exist for the operator to return analog or digital output command functions to automatic BAS software control.

7. Password Protection

1. Provide security system that prevents unauthorized use unless operator is logged on.

8. Trend Data

1. System shall periodically gather historically recorded selected samples of object data stored in the field equipment (global controllers, field controllers) and archive the information on the operator's workstation (server) hard disk.
 1. Archived files shall be appended with new sample data, allowing samples to be accumulated over 3 years.
 2. Systems that write over archived data shall not be allowed unless limited file size is specified.
 3. Samples may be viewed at the operator's terminal in a trend log.
 4. Logged data shall be stored in spreadsheet format.
 5. Operator shall be able to scroll through all trend log data.
2. Software shall be included that is capable of graphing the trend logged object data. Software shall be capable of creating two-axis (x, y) graphs that display up to six object types at the same time in different colours and these Graphs shall show object type value relative to time.
3. Operator shall be able to change trend log setup information such as time intervals and objects logged.

9. Graphics

1. The operator's workstation shall display all data associated with the project.
 1. Operator's workstation shall display all data using 3-D graphic representations of all mechanical equipment.
2. System shall be capable of displaying graphic file, text, and dynamic object data together on each display.
 1. Information shall be labelled with descriptors and shall be shown with the appropriate engineering units.
 2. All information on any display shall be dynamically updated without any action by the user.
 3. Terminal shall allow user to change all field-resident BAS functions associated with the project, such as setpoints, weekly schedules, exception schedules, etc. from any screen no matter if that screen shows all text or a complete graphic display.
3. Animated graphic objects shall be displayed as a sequence of multiple bitmaps to simulate motion.
4. Analog objects may also be assigned to an area of a system graphic, where the colour of the defined area would change based on the analog objects value.
 1. For example, an area of a floor-plan graphic served by a single control zone would change colour with respect to the temperature of the zone or its deviation from setpoint.

5. Separate Displays shall be supplied, specific to the project, to form the following overall presentation style.
 6. All Displays will be linked in a logical fashion using hyperlink style (single left mouse click on text/display object/dynamic to load linked display if programmed)
 7. Entire system shall operate without dependency on the operator's terminal. Provide graphic generation software at each workstation.
10. Alarms
1. Operator's terminal shall provide audible, visual, electronic, and printed means of alarm indication.
 2. Any alarm may be handled based on its individual or assigned class actions.
 1. Displayed on the Alarm console.
 1. The system shall be provided with a dedicated alarm window or console.
 2. This window will notify the operator of an alarm condition, and allow the operator to view details of the alarm and acknowledge the alarm.
 2. Alarm reports shall be viewable via the BAS system and available for delivery by electronic mail (e-mail) or printing.
 3. System shall provide log of alarm messages. Alarm log shall be archived to the hard disk of the system operator's terminal.
 1. Each entry shall include a description of the event-initiating object generating the alarm, time and date of alarm occurrence, time, and date of object state return to normal, and time and date of alarm acknowledgement.
11. Scheduling
1. Operator's terminal display of weekly schedules shall show all information in easy-to-read 7-day (weekly) format for each schedule.
 2. Exception schedules (non-normal schedules, such as holidays or special events) shall display all dates that are an exception to the weekly schedules.
 3. At the operator's terminal, the system user shall be able to change all information for a given weekly or exception schedule if logged on with the appropriate security access.
12. Archiving
1. Store back-up copies of all controller databases in at least one OWS and the server.
 2. Provide continuous supervision of integrity of all controller databases.

3. Data base back up and downloading to occur over LAN without operator intervention.
4. Operator to be able to manually download entire controller database or parts thereof.

13. Reports

1. Provide a report facility to generate and format for display, printing, or permanent storage, as selected by the operator, the reports as specified in this section.
2. Provide the software to automatically generate any report specified; the user will be able to specify the type of report, start time and date, interval between reports (hourly, daily, weekly, monthly) and output device.
3. As a minimum, the following reports shall be configured on the system:
 1. Dynamic Reports: To allow operator to request a display of the dynamic value for the user specified points which shall indicate the status at the time the request was entered and updated at an operator modifiable scan frequency.
 2. Summary Report: To permit the display or printing of the dynamic values for the user specified points.
 3. Trend Reports: To permit the trending of points selected by the operator, including as a minimum digital input and output, analog input and output, set points, and calculated values.
 4. Historical Data Collection: Provision shall be made to ensure historical data is not lost.
 5. Alarm Summary: Provide a summary of all points in alarm and include as a minimum; point acronym, point description, current value, alarm type, limit exceeded, and time and date of occurrence.
 6. Disable Point Summary: Provide a summary of all points in the disabled state and include as a minimum point acronym and point description.
 7. Run Time Summary: Provide a summary of the accumulated running time of selected pieces of equipment with point acronym and description, run time to date, alarm limit setting. The run time shall continue to accumulate until reset individually by means of suitable operator selection.
 8. Schedule Summary: Provide a summary of all schedules and indicate as a minimum, which days are holidays and, for each section, the day of the week, the schedule times and associated values; for digital schedules value will be on or off; for analog schedules value will be an analog value.
 9. User Record Summary: Provide a summary of all user records to include as a minimum; username, password, initials, command access level and point groups assigned.

2.6 BAS Controllers

1. All controllers on the job shall have the following minimum requirements:
 1. IP Communication (BACnet/IP)
 1. BACnet/IP communication protocol shall be used for all BAS manufacturer provided controllers (including terminal devices such as VAVs, FCUs, etc.)
 2. Support for IPv4 addressing.
 3. DHCP support and Auto DNS
 4. Baud rate of not less than 100 Mbps
 5. 2 - RJ45 ports each capable of supporting 10/100 Base-T.
 1. Supporting controller daisy chaining on the Ethernet network via integral switch functionality.
 2. Integrated fail-safe should allow for communication when the controller is powered down.
 6. All controllers shall be able to communicate peer-to-peer without the need for a Network Control Unit and shall be capable of assuming all responsibilities typically assumed by a Network Control Unit.
 1. Any controller on the Ethernet Data Link/Physical layer shall be able to act as a Master to allow for the exchange and sharing of data variables and messages with any other controller connected on the same communication cabling. Slave controllers are not acceptable.
 2. The resulting network will be a 'Flat' topology with all devices (controllers, workstations, ...) connecting at the same physical network level.
 2. Memory and Processing
 1. 512MB of RAM and 4GB of non-volatile flash memory.
 2. 32-bit microprocessor operating at a minimum of 600 MHz
 3. Each individual controller shall have an embedded web based HTML5 visual interface with the following functionality without reliance on any other controller for access:
 1. Typical and custom control processes
 2. Scheduling
 3. Energy management applications
 4. Alarm management applications
 5. Historical/trend data for points specified.
 6. Maintenance support applications

7. Graphical interface
4. Shall be capable of monitoring/controlling the following types of inputs/outputs:
 1. Digital inputs from dry contact closure, pulse accumulators, voltage sensing.
 2. Analog inputs of 4-20 mA, 0-10 Vdc, thermistor and RTD in the range 0 to 350,000 ohm.
 3. Digital outputs including Form C relay outputs and Triac outputs.
 4. Analog outputs of 4-20 mA and 0-10 Vdc.
5. A minimum of 10% spare capacity shall be provided for each point type for future point connection.
6. Any software required for programming shall be unlicensed and openly available.
7. Auto commissioning features shall be available for VAVs and FCUs to schedule automatic testing and record values (air flows, pressures, temperatures, etc.) for different operating modes. The auto commissioning feature shall be able to email reports and run commissioning on a specified schedule.
8. Power and Environmental Requirements:
 1. 24 VAC with local transformer power
 2. The controllers shall also function normally under ambient conditions of 32 °F to 122 °F and 0% to 90% RH (non-condensing).
 3. Provide each controller with a suitable cover or enclosure to protect the intelligence board assembly.
9. Code Compliance:
 1. "FIPS 140-2 Level 1 Compliant" cryptographic module
 2. BACnet Testing Laboratory (BTL listed) using Device Profile BACnet Building Controller (B-BC) with outlined enhanced features.
 3. UL916 Energy management equipment
 4. FCC rules part 15, subpart B, class B
 5. UL94-V0 flammability rating
 6. State of California Senate Bill No. 327, Chapter 886, TITLE 1.81.26. SECURITY OF CONNECTED DEVICE

2.7 ECLYPSE APEX

1. In addition to providing control capabilities for HVAC equipment the controller shall offer multitasking through quad core microprocessor, an AI (artificial intelligence) coprocessor, larger trend storage capacity, and developer technologies. The controller shall be capable of facilitating interactions with IoT (Internet of Things) devices and allow for advanced processing functionalities using AI (artificial intelligence) technology.
2. Communication:
 1. IP Communication (BACnet/IP)
 1. Two Ethernet ports (1Gbps each)
 2. Support for IPv4 or Hostname addressing.
 3. DHCP support and Auto DNS
 2. Web Server Application REST API
 3. BACnet MS/TP or Modbus RTU Routing via (1) onboard RS-485 communications port or additional communications module
 1. Supporting baud rates of 9600, 19 200, 38 400, or 76 800 bps
 2. 50 BACnet MS/TP or Modbus RTU controllers per RS-485 port
 4. Modbus TCP support for devices on the same subnet
 5. BACnet / Wi-Fi communication via optional wireless adapter with USB port connection
3. Memory and Processing
 1. Quad core 1.6 GHz ARM Cortex A53 64-bit microprocessor operating at a minimum of 1.6 GHz.
 2. AI coprocessor with machine learning accelerator
 3. 2 GB RAM and 32 GB Flash memory
4. Controller shall have an embedded web based HTML5 visual interface with the following functionality without reliance on any other controller for access:
 1. Typical and custom control processes
 2. Scheduling
 3. Energy management applications
 4. Alarm management applications
 5. Historical/trend data for points specified.
 6. Maintenance support applications
 7. Graphical interface

5. Onboard Developer Tools:
 1. Available Docker containers and Azure IoT Edge technologies extend gateway features at the edge and allow IoT/AI third-party developers to embed advanced processing functionalities.
 2. On-board AI coprocessor, designed to run AI at the edge, adds intelligence to any building and opens the door to new control applications.
 3. Secure boot and additional physical security measures
6. Shall be capable of monitoring/controlling up to 320 total inputs/outputs via expansion I/O modules:
 1. Digital inputs from dry contact closure, pulse accumulators, voltage sensing.
 2. Analog inputs of 4-20 mA, 0-10 Vdc, thermistor and RTD in the range 0 to 350,000 ohm.
 3. Digital outputs including Form C relay outputs and Triac outputs.
 4. Analog outputs of 4-20 mA and 0-10 Vdc.
7. A minimum of 10% spare capacity shall be provided for each point type for future point connection.
8. Any software required for programming shall be unlicensed and openly available.
9. Power and Environmental Requirements:
 1. 24 VAC with local transformer power (recommended transformer size of 100VA)
 2. The controller shall function normally under ambient conditions of 32 °F to 122 °F and 0% to 90% RH (non-condensing).
 3. Provide each controller with a suitable cover or enclosure to protect the intelligence board assembly.
10. Code Compliance:
 1. "FIPS 140-2 Level 1 Compliant" cryptographic module
 2. BACnet Testing Laboratory (BTL listed) using Device Profile BACnet Building Controller (B-BC) with outlined enhanced features.
 3. UL916 Energy management equipment
 4. FCC rules part 15, subpart B, class B
 5. UL94-5VB flammability rating
 6. State of California Senate Bill No. 327, Chapter 886, TITLE 1.81.26. SECURITY OF CONNECTED DEVICE

2.8 Control Panels

1. Indoor control cabinets located in offices or dry/dust free environments shall be fully enclosed NEMA 1 Type construction with hinged door, and removable sub-panels or electrical sub-assemblies.
2. All outdoor control cabinets and control cabinets located in mechanical/electrical rooms shall be NEMA 4.
3. Control panels containing more than 4 controllers shall be provided with a terminal strip for field wiring. All control wiring inside the panel shall be between a terminal strip and controller inputs/outputs. All field control wiring shall be terminated at the terminal strip. Field control wiring inputs/outputs shall not be run directly to inputs/outputs of controller.

2.9 Variable Frequency Drives (VFDs)

1. Provision of variable frequency drives shall be provided by another section of this specification (the BAS contractor shall only be responsible for providing associated low voltage wiring and controls programming for the VFDs).

2.10 Auxiliary Control Devices, Sensors, and Transmitters

1. Control Valves
2. Butterfly Control Valves:
 1. Butterfly Valve (valves 6" to 12"): Valve body shall be full lugged cast iron 200 psig [1380 kPa] body with a 304 stainless steel disc, EPDM seat, extended neck and shall meet ANSI Class 125/150 flange standards. Disc-to-stem connection shall utilize an internal spline. External mechanical methods to achieve this mechanical connection, such as pins or screws, are not acceptable. The shaft shall be supported at four locations by RPTFE bushings. Close-off pressure rating of 200 psi [1380 kPa] bubble tighter shut-off.
 2. Butterfly Valve (valves 14" [350 mm] and larger): Valve body shall be full lugged cast iron 150 psig [1035 kPa] body with a 304 stainless steel disc, EPDM seat, extended neck and shall meet ANSI Class 125/150 flange standards. Disc-to-stem connection shall utilize a dual-pin method to prevent the disc from settling onto the liner. The shaft shall be supported at four locations by RPTFE bushings. Close-off pressure rating of 150 psi [1035 kPa] bubble tighter shut-off.
3. Sizing:
4. Two-Position: Line size or size using a pressure differential of 1 psi.
5. Modulating: [5 psig [35 kPa]] or twice the load pressure drop, whichever is greater. Size for the design flow with the disc in a 60° open-position with the design velocity less than 12 feet [3.7 m] per second.
6. Power Requirements: 24 VAC, 24 VDC, or 120VAC as required by manufacturer
7. Water Differential Pressure Sensor

8. Features: Provide water differential or gage pressure sensors as indicated within the sequences of operations and/or controls diagrams suitable for application. Select range such that it covers from zero differential pressure up to a differential static pressure of 20% to 50% in excess of the maximum static pressure that could be encountered. Remember that if the sensor is used for the control of a chilled water bypass and is located across, for example, a chilled water AHU coil, the pressure drop of both the coil and the associated valve at full design flow have to be taken into account. Sensor shall include over pressure input protection of a minimum two times rated input, burst pressure of a minimum five times rated input, and 17-4PH stainless steel wetted parts.
9. Operating Temperature: -4° F to 185° F (-20° C to 85° C)
10. Protection / Rating: NEMA 4 or NEMA4X if enclosure provided
11. Input/Output: 4-20 mA output proportional to pressure sensed
12. Power: 3-wire circuit for power and output (COM, OUT, EXC) with EXC being 15-30 VDC (18-30 VAC)
13. Accuracy: $\pm 1\%$ of full scale
14. Range: selectable pressure range 1 – 500 psi
15. Agency Approvals: CE & RoHS Compliant
16. Approved Manufacturer / Model:
17. Setra (Model 231)
- 18.
19. Current Relay/Switch
 1. Features: Provide current sensing relays as indicated within the sequences of operations and/or control diagrams. The current sensing relay shall be rated for the applicable load, shall have input and output isolation via current transformer, and the output relay shall have an accessible trip adjustment over its complete operating range. Whenever the status of a single speed motor is monitored it shall be done via a current sensing relay. The BAS contractor shall provide current sensing relays at the MCC starters (or at the local starter for motors without a MCC starter).
 2. Operating Temperature: 5° F to 140° F (-15° C to 60° C)
 3. Input/Output: digital input from dry contact closure
 4. Power: Current relay shall be self-powered with no insertion loss
 5. Accuracy: $\pm 2\%$ of full scale
20. Current Sensor
 1. Features: Provide current sensors as indicated within the sequences of operations and/or control diagrams. The current sensors shall be rated for the applicable load and shall be reverse polarity protected and output limited.

2. Operating Temperature: -20° F to 120° F (-29° C to 49° C)
3. Input/Output: 4-20 mA, 0-10 or 0-5 Vdc output proportional to current draw.
4. Power: Current sensor shall be self-powered with no insertion loss
5. Accuracy: $\pm 1\%$ of full scale

PART 3 - EXECUTION

3.1 Communication Backbone

1. To allow for future expandability, cyber security measures, optimal bandwidth, and enhanced data trending this project shall adhere to the below communication backbone requirements.
2. Fiber Optic Network
 1. Required for all projects exceeding 10 levels (including rooftops/cellars), 100m between ethernet connections, 500 controllers, or more than 1 type of operational technology residing on the same network (CCTV, lighting, access, etc.).
 2. BACnet/IP communication protocol shall be used for all BAS manufacturer provided controllers (including terminal devices such as VAVs, FCUs, etc.)
 3. Network edge ethernet switches provided for each floor with provisions for expansion capability.
 4. Fiber optic cable shall be run between aggregation switch and edge ethernet switches.
 5. Must be a managed fiber / ethernet network with the following network features:
 1. Packet switching and loop detection.
 2. Port security with MAC address lockdown and the ability to close all open ports including port connected to a daisy-chain of IP devices.
 3. Segregation / isolation with VLAN configuration capabilities. The system shall allow system-wide auto-creation of a VLAN simply by specifying one or more ports to be on that VLAN, and automatically ensure that traffic passes between the selected ports. There must not be any restriction on port location.
 4. Web browser based graphical user interface for information logging (network overloads, bandwidth consumption, port status, connection status, and trending)
 5. Support both Ethernet and Power over Ethernet (PoE)
 6. Support fiber optic backbone(s) with Single-strand, Single-mode Optical Fiber OS1/OS2 9/125 μm , up to 12.5 miles reach.

7. BACnet protocol specific network traffic support and support for all other communication protocols
8. Expansion capability of up to 256 Edge Ethernet Switches
6. Edge Ethernet Switch Hardware Requirements
 1. Shall provide 1 per floor.
 2. Must be compatible with Centralized Ethernet Network Controller with Aggregation Switch and support the managed network features described above.
 3. Support Fiber, Ethernet, Power over Ethernet (PoE), and Spanning Tree Protocol
 4. Support all communication protocols.
 5. Minimum of 8 RJ45 ethernet ports (all controllers on floor must be connected to the edge ethernet switch directly or via daisy-chain IP topology)
7. Ethernet Network Controller Hardware Requirements
 1. Shall provide 1 per building.
 2. Must be compatible with Edge Ethernet Switches and Aggregation Switch and support the managed network features described above.
 3. Support Fiber, Ethernet, Power over Ethernet (PoE), and Spanning Tree Protocol
 4. Support all communication protocols.
 5. Provide network management software with management of all ports from all edge switches in a single graphical view.
8. Aggregation Switch Hardware Requirements
 1. Shall provide 1 per building.
 2. Must be compatible with Edge Ethernet Switches and Aggregation Switch and support the managed network features described above.
 3. Support Fiber, Ethernet, Power over Ethernet (PoE), and Spanning Tree Protocol
9. Support all communication protocols Security Provisions:
 1. Individual VLAN provided for every 2 levels.
10. Acceptable Manufacturers for Fiber Network Devices:
 1. Optigo, or approved equal.
3. IP (CAT 5 / RJ45) Network

1. For all projects with less than 10 levels (including rooftops/cellars), less than 100m between ethernet connections, less than 500 controllers, and only BAS controls on the same network. Otherwise refer to Fiber Optic requirements described above.
2. Gigabit Ethernet Switches shall be provided as needed to support a fully functional BAS.
3. Provide an industrial router as the interface between the BAS network and the single point connection to the owner provided internet network.
 1. Approved Manufacturer / Model:
 1. Teltonika (Model RUTX11) or approved equal.
4. BACnet IP
 1. BACnet/IP communication protocol shall be used for all BAS manufacturer provided controllers (including terminal devices such as VAVs, FCUs, etc.)
5. Modbus RTU, Modbus TCP, and BACnet MS/TP (RS-485)
 1. Modbus RTU and BACnet MS/TP shall only be used for third party systems / equipment that do not have IP provisions (VFDs, boilers, etc.)
 2. Modbus TCP shall only be used for third party systems / equipment that do not support BACnet/IP

3.2 Installation of Sensors

1. Install sensors according to manufacturer's recommendations.
2. Mount sensors rigidly and adequately for operating environment.
3. Install mixing plenum low-limit sensors in a serpentine manner horizontally across duct. Support each bend with a capillary clip. Provide 1 ft. of sensing element for each 1 ft² of coil area.
4. Install pipe-mounted temperature sensors in wells. Install liquid temperature sensors with heat-conducting fluid in thermal wells.
5. Install outdoor air temperature sensors on north wall at designated location with sun shield.
6. Install building pressure pipe pressure sensor's low-pressure port to the static pressure port located on the outside of the building through a high-volume accumulator. Pipe high-pressure port to a location behind a thermostat cover.
7. High and low limit thermostats, high-pressure cut-offs, and other safety switches shall be hard-wired to de-energize equipment as described in the sequence of operation. Switches shall require manual reset. Provide contacts that allow DDC software to monitor safety switch status.

3.3 Coordination

1. All work shall be performed at times acceptable to the Engineer/Construction Manager. Provide work schedule at the start of the job for the approval of the Engineer / Construction Manager. Schedule shall show when all staff and sub-contractors shall be on-site.

3.4 Electrical Work, Wiring and Safety

1. Electrical work shall be in accordance ANSI/NFPA 70 and the local Electrical Code.
2. Based on project location, Regional Regulation Compliance Certifications (CSA C22.1) will be required.
3. Electrical wiring, terminal blocks and other high voltage contacts shall be fully enclosed or properly guarded and marked to prevent accidental injury to personnel.
4. Control and interlock wiring and installation shall comply with national and local electrical codes, Division 26 00 00, and manufacturer's recommendations. Where the requirements of this Section differ from other Divisions, this Section shall take precedence.
 1. Power wiring to mechanical equipment, variable air volume boxes, and motor controllers shall be provided by the Electrical contractor (Division 26).
 2. EMT conduit shall be used in mechanical/electrical rooms and exposed spaces.
 3. Rigid Galvanized Steel conduit shall be used outdoors.
 4. Plenum rated cable shall be used in concealed spaces/hung ceilings.
5. All wiring associated with and required by the BAS shall be the responsibility of this contractor.
 1. The term "wiring" shall be construed to include furnishing of wire, conduit, and miscellaneous material and labor as required to install a total working system.
 2. If departures from the contract documents are deemed necessary by the contractor, details of such departures, including changes in related portions of the project and the reasons, therefore, shall be submitted with the drawings to the Engineer for approval.
6. Terminate control and interlock wiring related to the work of this section. Maintain at the job site updated (as-built) wiring diagrams that identify terminations.
7. Install equipment, piping, and wiring or raceway horizontally, vertically, and parallel to walls wherever possible.
8. Provide sufficient slack and flexible connections to allow for piping and equipment vibration isolation.
9. Each run of communication wiring shall be a continuous length without splices when that length is commercially available.
10. Label communication wiring to indicate origination and destination.
11. Fiber optic cable shall comply with the following requirements:

1. Optical Cable. Optical cables shall be duplex 900 mm tight-buffer construction designed for intra-building environments. Sheath shall be UL listed OFNP in accordance with NEC Article 770. Optical fiber shall meet the requirements of FDDI, ANSI X3T9.5 PMD for 62.5/125 μm .
2. Connectors. Field terminate optical fibers with ST type connectors. Connectors shall have ceramic ferrules and metal bayonet latching bodies.

3.5 Submittals

1. Schematic diagram of each controlled system. Label control points with point names.
2. Bill of Material for each controlled system. List each control system element in a table. Show element name, type of device, manufacturer, model number, and product data sheet number.
3. Specification sheets for each item including manufacturers descriptive literature, drawings, diagrams, performance and characteristic curves, manufacturer and model number, size, layout, dimensions, capacity, etc.
4. Control schematics with narrative description and control descriptive logic fully showing and describing operation and/or manual procedures available to operating personnel to achieve proper operation of the building, including under complete failure of the BAS.
5. Shop drawings for each input/output point showing all information associated with each particular point including sensing element type and location; details of associated field wiring schematics and schedules; point address; software and programming details associated with each point; and manufacturer's recommended installation instructions and procedures for each type of sensor and/or transmitter.
6. Riser diagrams showing control network layout, communication protocol, and wire types.
7. Network diagram of control, communication, and power wiring for BAS Server and OWS installation.

3.6 As-built Documentation

1. As-built documentation shall consist of 4 hard copies and one soft copy for all information described below.
2. The final documentation package shall include:
 1. As-built Submittals: Final as built control submittals and technical data sheets.
 2. Programming, Sequences, and Graphics: All programming, sequences, and graphics saved to an external hard drive.
 3. Operation and Maintenance Manuals: Factory operating and maintenance manuals with any customization required.
 4. Test Procedures and Reports: The test implementation shall be recorded with a description of the test exercise script of events and documented as test procedures.

3.7 Warranty

1. The BAS system labor and materials shall be warranted free from defects for a period of 1 year(s) after final commissioning and owner acceptance.

3.8 Training

1. BAS Contractor shall provide a minimum of 8 hours of training with course outline and materials for personnel designated by the owner.
2. If desired manufacturer provided training on the use and operation of all products provided within these specifications shall be available for purchase and attendance by the Owner or his designated agent. A list of training courses with detailed course outline and duration with the associated cost shall be provided as part of the BAS submittals.

3.9 Balancing and Commissioning

1. BAS Contractor shall provide commissioning assistance with a commissioning agent and balancing assistance with a balancing agent as required to complete commissioning and balancing. Balancing and commissioning agents shall NOT be provided by BAS contractor – BAS contractor is responsible for assistance only.
2. For projects without balancing and commissioning agents the BAS contractor shall self commission the system utilizing the allotted hours stated above.
3. For projects including gas detection / air quality sensors involved in life safety operations a minimum of 8 hours shall be provided within BAS scope of work for the gas sensor manufacturer to provide checkout, calibration, and owner training.
4. Provide commissioning data sheets prior to acceptance testing.

END OF SECTION

SECTION 23 09 95
MECHANICAL SYSTEMS COMMISSIONING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. System specific commissioning
2. Mechanical systems to be commissioned are as follows:
 - a. Centrifugal Water Cooled Electric Chiller(s)
 - b. Chilled Water Pump(s)
 - c. Cooling tower(s)
 - d. Condenser Water Pump(s)
 - e. All Direct Digital Controls and control sequences related to HVAC systems incorporated into the contract documents.
 - f. Building Metering Systems including water, chilled water, thermal (BTU) and electricity (KWH) measurement meters
 - g. Process measurement instruments and gauges
 - h. Alarms and notification
 - i. Trending and data export
 - j. Graphical user interface
 - k. Control system and sequences

1.2 DESCRIPTION OF WORK – Provide commissioning services for the following systems:

1. **Three (3) pumps**
2. **Three (3) 175 Ton Chillers**
3. **Two (2) 220 Ton Cooling Towers**

1.3 SUBMITTALS – Commissioning report, including the completed exhibit A and exhibit B, located at the end of this Section 23 09 95.

PART 2 - PRODUCTS – (Not Used)

PART 3 - EXECUTION

3.1 COMMISSIONING PROCESS AND PROCEDURES – Refer to owners commissioning requirements

3.2 PRE-FUNCTIONAL CHECKLIST

- A. These checklists do not take the place of the manufacturer's recommended checkout and start-up procedures or report.
- B. Regardless of whether the Commissioning Authority (CA) includes them or not, checks, inspections, safety measures, quality control measures and start-up procedures recommended by the manufacturer shall be implemented by the Contractor prior to initiation of the commissioning activity.
- C. The Commissioning Coordinator (CC) employed by the Contractor shall be responsible for directing all Pre-Functional Check lists provided by the CA. The CC shall engage subcontractors and vendors service representatives with expertise in the specific equipment or system to determine whether the equipment or system passes the checks detailed in the Pre-Functional Checklist.
- D. CC shall communicate the actual schedule for the execution of the Pre-Functional Checks to the CA as provided by the owner.

- E. The Commissioning Authority (CA) may choose to participate in the inspection of items along with the Contractor and his specialty subcontractors and vendors. In addition, CA reserves the right to inspect any or all of the items on his own in order to satisfy that the installation conforms to the design objectives and the system is ready for Functional Testing.
- F. For additional information on how the Pre-Functional Checklists fits within the overall framework of Commissioning as well as the Contractor's obligations under the same, please Refer to owners commissioning requirements.

3.3 FUNCTIONAL PERFORMANCE TESTING

- A. Contractor shall assist the Commissioning Authority (CA) in developing the Working Functional Performance Test (FPT) Procedures (also named Functional Test Plans - FTPs) as specified in owners commissioning requirements. For any given equipment or system subcontractors and equipment suppliers associated with and specializing in the specific equipment are required to participate in developing the working procedures for the indicated FPTs. It is conceivable that for certain equipment and systems, multiple subcontractors and specialties may be required to participate to contribute to the development of the Functional Test. Contractor shall extend his full cooperation to the CA in securing the subcontractor or supplier resources necessary to develop and implement the Functional Tests.
- B. The Contractor's Commissioning Coordinator is required to manage the subcontractors in developing the Working FPT Procedures and Data Forms, and in performing all FPT's.
- C. Though not developed specifically for this project, the sample Functional Test procedures shown in Section 23 09 95 - Exhibit B are provided as an indication of the format and rigor of the required functional testing procedures and documentation.
- D. CA may approve certain equipment performance tests to be conducted at the factory. If so, Contractor shall make arrangements and pay for travel costs for Owner and the CA to visit the factory and witness such tests at the factory.
- E. Contractor shall be responsible for demonstrating the successful testing of 100% of the systems to be commissioned per the Functional Test plans and procedures provided by the CA.
- F. CA shall develop the Functional Test following review of all contractor submittals. The Functional Test documents shall be made available immediately upon the successful completion of the Pre-Functional Check Lists and correction of all issues identified in the Pre-Functional Checklist.
- G. Contractor shall allow a reasonable time frame after the completion of TAB activities to schedule and conduct the Functional Tests. Functional tests shall commence only upon completion of the TAB activities and all flows and measurement data established through the TAB process are available for the Commissioning Agent's review. In no event shall the commissioning Functional Test duration be less than four weeks, plus what is reasonably required to correct issues identified and time required for retest and back-check. Contractor shall coordinate the work of other disciplines so that commissioning test procedures are not interrupted as a result of work that needs to be performed inside or outside the building.
- H. Refer to owners commissioning requirements for additional requirements regarding Functional Tests.

END OF SECTION

SECTION 23 09 95
EXHIBIT A - SAMPLE PRE-FUNCTIONAL CHECKLIST (PFC)

A. Submittal/Approvals

Project Name:			
Equipment Tag (ID)		Installed On:	
Location:		PFC Completion Date:	
Sub-Contractor(s) Signature:		Date:	
Contractor(s) Signature:		Date:	

By signing this check list, the sub-contractor performing work and contractor confirm that they have diligently examined the installation with respect to the items shown herein and the installation details match what is specified in the plans and specifications and conform to manufacturer's written instructions. Exceptions are noted under the comment column as noted below.

B. Model Verification

Manufacturer	
Model	
Serial Number	
Capacity BTUH	
Peak Design Flowrate (GPM)	

C. Pre-Functional Checks

Tag		YES	NO	Comments
1	DOCUMENTATION			
	<i>Verify if the following items have been submitted:</i>			
1.01	Manufacturer's cut sheets including performance data (if available)			
1.02	Installation and startup manual / plan			
1.03	O&M manuals			
1.04	Control sequences			

Tag		YES	NO	Comments
2	GENERAL INSTALLATION			
2.01	General appearance good, no apparent damage			
2.02	Proper vibration isolators installed and adjusted			
2.03	Seismic restraints in place			
2.04	Hydronic systems checked out			
2.05	Combustion air provided			
2.06	Drains provided			
2.07	Gas piping connected			
2.09	No gas leakage			
2.17	Adequate Hydronic Equipment & accessory access for maintenance			
3	PIPING			
3.01	Hydronic piping complete			
3.02	Hydronic system flushing complete and strainers cleaned			
3.03	Piping insulation in good condition where visible			
3.04	Piping not supported on chiller or valves			
3.05	Pipe fittings and accessories complete			
3.06	Piping type and flow direction labeled on piping			
3.07	Isolation valves and balancing valves installed			
3.08	Pressure gauges & thermometers installed where specified			
3.09	Test ports/plugs installed near all control sensors and per spec			
3.10	Flow switch installed as required			
3.11	Flow meters installed as required			
4	ELECTRICAL & CONTROLS			
4.01	Power wiring installed properly			
4.02	All electrical components grounded properly			
4.03	Control wiring and control system hooked up			

Tag		YES	NO	Comments
4.04	Sensors calibrated (see calibration section below)			
4.05	Control system interlocks hooked up and functional			
4.07	All control devices and wiring complete			
4.08	Safeties installed and safe operating ranges for this equipment provided to the commissioning agent			
4.09	Heating, Hot- water pumps pre-functional checklists completed			
5	OPERATIONAL			
5.01	No unusual noise and vibration when running			
5.06	Test and balance report reviewed for hydronic system flows			
5.07	Specified sequences of operation and operating schedules have been implemented with all variations documented			
5.08	Specified point-to-point checks have been completed and documentation record submitted for this system			
5.09	Startup report completed with this checklist attached. (Includes full listing of all internal settings with notes as to which settings are BAS controlled or monitored and which are integral.			
5.10	Startup report includes written certification from boiler manufacturer that all specified features, controls and safeties have been installed and are functioning properly and that the installation and application comply with the manufacturer's recommendations.			
5.11	Piping gages, BAS and chiller and cooling tower panel temperature and pressure readouts match (see calibration section below)			

END OF EXHIBIT

SECTION 23 09 95
EXHIBIT B - SAMPLE FUNCTIONAL TEST PROCEDURE (FTP)

Functional Test Plan

System

Project: Scripps Anderson Outpatient Clinic Boiler Replacement

1. Objective:

Confirm satisfactory operation of chilled water system, and condenser water system.

2. Equipment:

	EQUIPMENT	MARK	MODEL
1.			

3. Participants

	NAME	COMPANY	FUNCTION	ROLE
1.				Party filling out this form
2.				Party operating equipment and executing the test
3.				Party witnessing / observing the test

4. Prerequisite Checklist:

	ITEM	√
1.	The following have been started up and startup reports and prefunctional checklists submitted and approved ready for functional testing: ___ Chilled water pumps ___ Cooling Towers ___ VFDs for pumps and fans ___ Condenser water pumps ___ Chiller	
2.	All control system functions for this and all interlocking systems are programmed and operable per contract documents, including final setpoints and schedules and with debugging, loop tuning and sensor and device calibrations completed.	
4.	Piping system flushing complete and required report approved.	
5.	Occupants (if any) notified that testing in progress and zone temperatures will be significantly out of normal range	

	ITEM	√
7.	Vibration control report approved (if required).	
8.	Test and balance (TAB) complete and approved for the hydronic system	
9.	All A/E punchlist items for this equipment corrected.	
10.	These functional test procedures reviewed and approved by installing contractor.	
11.	Safeties and operating ranges reviewed.	
12.	Sufficient clearance around equipment for servicing.	
14.	Parameters, setpoints and logic sequences appear to follow the specified written sequences. Attach sequence of operation to this test.	
15.	Record made of all values (i.e., Setpoints, Control Parameters, Limits, Delays, Lockouts, Schedules, etc.) changed to accommodate testing. Attach as necessary.	

END OF EXHIBIT

SECTION 23 21 13
HYDRONIC PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Copper tube and fittings.
 - 2. Steel pipe and fittings.
 - 3. Piping joining materials.
 - 4. Transition fittings.
 - 5. Dielectric fittings.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Pipe and tube.
 - 2. Fittings.
 - 3. Joining materials.
- B. Delegated Design Submittals:
 - 1. Locations of and details for penetration and firestopping for fire- and smoke-rated wall and floor and ceiling assemblies.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Piping layout, or BIM model, drawn to scale, indicating the items described in this Section, and coordinated with all building trades.
- B. Qualification Data: For Installer.
- C. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.
- B. Pipe Welding: Qualify procedures and operators in accordance with ASME Boiler and Pressure Vessel Code: Section IX.
 - 1. Comply with ASME B31.9 for materials, products, and installation.
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

1.5 WARRANTY

- A. PP-R and PP-RCT Manufacturer's Warranty: Manufacturer agrees to repair or replace PP-R and PP-RCT pipe and fittings that fail in materials or workmanship within 10 years from date of Substantial Completion.
 - 1. Warranty is to cover labor and material costs of repairing and/or replacing defective materials and repairing any incidental damage caused by failure of the piping system due to defects in materials or manufacturing.
 - 2. Warranty is to be in effect only upon submission by Contractor to manufacturer of valid pressure/leak documentation indicating that the system was tested and passed manufacturer's pressure/leak test and any other manufacturer requirements.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation are to be capable of withstanding the following minimum working pressures and temperatures unless otherwise indicated:
 - 1. Chilled-Water Piping: 150 psig at 73 deg F.
 - 2. Condenser-Water Piping: 150 psig at 73 deg F
 - 3. Makeup-Water Piping: 150 psig at 73 deg F

2.2 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tube: ASTM B88, Type L.
- B. Annealed-Temper Copper Tube: ASTM B88, Type KJ and ASTM B88, Type L.
- C. DWV Copper Tube: ASTM B306, Type DWV.
- D. Cast-Copper, Solder-Joint Fittings: ASME B16.18 pressure fittings. Do not use solder joints on pipe sizes greater than NPS 4.
- E. Wrought-Copper, Solder-Joint Fittings: ASME B16.22 pressure fittings. Do not use solder joints on pipe sizes greater than NPS 4.
- F. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Do not use solder joints on pipe sizes greater than NPS 4.
- G. Cast-Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends. Do not use solder joints on pipe sizes greater than NPS 4.
- H. Wrought-Copper Unions: ASME B16.22. Do not use solder joints on pipe sizes greater than NPS 4.
- I. Grooved, Mechanical-Joint, Copper Tube Appurtenances (*for use in boiler room on exposed piping and at equipment connections only*):
 - 1. Manufacturer's
 - a. Gruvlok
 - b. Victaulic
 - c. Or approved equal.
 - 2. Source Limitations: Obtain grooved mechanical-joint copper tube appurtenances from single manufacturer.
 - 3. Grooved-End Copper Fittings: ASTM B75 copper tube or ASTM B584 bronze castings.
 - 4. Grooved-End-Tube Couplings: To fit copper-tube dimensions; rigid pattern unless otherwise indicated; gasketed fitting EPDM gasket rated for minimum 230 deg F for use with ferrous housing, and steel bolts and nuts; 300 psig minimum CWP pressure rating.

2.3 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A53/A53M black steel with plain ends; welded and seamless, Grade B, and schedule number as indicated in Part 3, "Piping Applications" Article.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3, "Piping Applications" Article.
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in Part 3, "Piping Applications" Article.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3, "Piping Applications" Article.

- E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in "Piping Applications" Article.
- F. Wrought-Steel Fittings: ASTM A234/A234M; wall thickness to match adjoining pipe.
- G. Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - 1. Material Group: 1.1.
 - 2. End Connections: Butt welding.
 - 3. Facings: Raised face.
- H. Grooved Mechanical-Joint Fittings and Couplings:
 - 1. Manufacturer's
 - a. Gruvlok
 - b. Victaulic
 - c. Or approved equal.
 - 2. Source Limitations: Obtain grooved mechanical-joint fittings and couplings from single manufacturer.
 - 3. Joint Fittings: ASTM A536, Grade 65-45-12 ductile iron; ASTM A47/A47M, Grade 32510 malleable iron; ASTM A53/A53M, Type F, E, or S, Grade B fabricated steel; or ASTM A106/A106M, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
 - 4. Couplings: Ductile- or malleable-iron housing and EPDM gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
- I. Steel Pipe Nipples: ASTM A733, made of same materials and wall thicknesses as pipe in which they are installed.
- J. Smoke and Fire Ratings:
 - 1. Where indicated on Drawings that a plenum-rated piping system is required, the pipe is to be wrapped and/or insulated with fiberglass or mineral wool pipe insulation; field installed.
 - a. The system is to have a flame-spread classification of less than 25 and smoke-developed rating of less than 50.
 - b. Pipe, wrap, or insulation as a system to comply with the requirements of CAN/ULC-S102.2, ASTM E84, or UL 2846.
 - c. For insulation required for thermal and condensation conditions, see Section 23 07 19 "HVAC Piping Insulation."

2.4 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless otherwise indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Solder Filler Metals: ASTM B32, lead-free alloys.
- D. Flux: ASTM B813, water flushable.

- E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.
- F. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.5 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
 - 1. Manufacturer's
 - a. Zurn
 - b. Watts
 - c. Calpico
 - d. Or approved equal
 - 2. Source Limitations: Obtain dielectric unions from single manufacturer.
 - 3. Description:
 - a. Standard: ASSE 1079.
 - b. Pressure Rating: 125 psig minimum at 180 deg F.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous. Solder joints are not to be used on pipe sizes greater than NPS 4.
- C. Dielectric Flanges:
 - 1. Manufacturer's
 - a. Zurn
 - b. Watts
 - c. Calpico
 - d. Or approved equal
 - 2. Source Limitations: Obtain dielectric flanges from single manufacturer.
 - 3. Description:
 - a. Standard: ASSE 1079.
 - b. Factory-fabricated, bolted, companion-flange assembly.
 - c. Pressure Rating: [125 psig minimum at 180 deg F] [150 psig] [175 psig] [300 psig] <Insert value>.
 - d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
 - 4. Manufacturer's
 - a. Calpico
 - b. Watts
 - c. Zurn
 - d. Or approved equal.
 - 5. Source Limitations: Obtain dielectric-flange insulating kits from single manufacturer.
 - 6. Description:
 - a. Nonconducting materials for field assembly of companion flanges.

- b. Pressure Rating: 150 psig
- c. Gasket: Neoprene or phenolic.
- d. Bolt Sleeves: Phenolic or polyethylene.
- e. Washers: Phenolic with steel backing washers.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Chilled-Water Piping, Aboveground, NPS 2 (DN 50) and Smaller, to be Any of the Following:
 - 1. Type L drawn-temper copper tubing, wrought-copper fittings, and [soldered] joints.
- B. Chilled-Water Piping, Aboveground, NPS 2-1/2 (DN 65) and Larger, to Be Any of the Following:
 - 1. Type K drawn-temper copper tubing, wrought-copper fittings, and [soldered] [brazed] [grooved mechanical] joints.
 - 2. Schedule 40 Grade B, steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
- C. Condenser-Water Piping, Aboveground, NPS 2 (DN 50) and Smaller, to Be Any of the Following:
 - 1. Type K drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
 - 2. Schedule 40 Grade B, steel pipe; Class 150, malleable-iron fittings; and threaded joints.
- D. Condenser-Water Piping, Aboveground, NPS 2-1/2 (DN 65) and Larger, to Be Any of the Following:
 - 1. Type K drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
 - 2. Schedule 40, Grade B, steel pipe, Class 150, malleable-iron fittings; welded joints, cast-iron flanges and flange-fittings; and flanged joints.
- E. Makeup-Water Piping Installed Aboveground to Be Any of the Following:
 - 1. Type L drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
- F. Air-Vent Piping:
 - 1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems, according to piping manufacturer's written instructions.
 - 2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

3.2 INSTALLATION OF PIPING

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.

- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- P. Install valves according to the following:
 - 1. Section 23 05 23.12 "Ball Valves for HVAC Piping."
 - 2. Section 23 05 23.13 "Butterfly Valves for HVAC Piping."
 - 3. Section 23 05 23.14 "Check Valves for HVAC Piping."
- Q. Install air vents and pressure-relief valves in accordance with Section 23 21 16 "Hydronic Piping Specialties."
- R. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- S. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- T. Install shutoff valve immediately upstream of each dielectric fitting.
- U. Comply with requirements in Section 23 05 00 "Common Work Results for HVAC" for installation of expansion loops, expansion joints, anchors, and pipe alignment guides.
- V. Comply with requirements in Section 23 05 53 "Identification for HVAC Piping and Equipment" for identifying piping.
- W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 23 05 00 "Common Work Results for HVAC."

3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Soldered Joints: Apply ASTM B813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints in accordance with ASTM B828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B32.
- D. Brazed Joints: Construct joints in accordance with AWS's "Brazing Handbook," "Pipe and Tube" chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.
- E. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

- F. Welded Joints: Construct joints in accordance with AWS D10.12M/D10.12, using qualified processes and welding operators in accordance with "Quality Assurance" Article.
- G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- H. Grooved Joints (for use in boiler room and at equipment connections only): Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

3.4 INSTALLATION OF DIELECTRIC FITTINGS

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric unions.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flanges
- D. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for seismic-restraint devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC."
- B. Comply with requirements in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment" for hangers, supports, and anchor devices.
- C. Install hangers for copper tubing and steel piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Support horizontal piping within 12 inches of each fitting and coupling.
- E. Support vertical runs of copper tubing and steel piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.6 EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections are to be the same as or larger than equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install bypass piping with ball valve around control valve. If parallel control valves are installed, only one bypass is required.
- D. Install ports for pressure gauges and thermometers at coil inlet and outlet connections. Comply with requirements in Section 23 05 00 "Common Work Results for HVAC."

3.7 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 23 05 53 "Identification for HVAC Piping and Equipment."

3.8 SYSTEM STARTUP

- A. Perform the following before operating the system:
 1. Open manual valves fully.
 2. Inspect pumps for proper rotation.
 3. Set makeup pressure-reducing valves for required system pressure.
 4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
 5. Set temperature controls so all coils are calling for full flow.

6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

3.9 FIELD QUALITY CONTROL

- A. Prepare hydronic piping in accordance with ASME B31.9 and as follows:
 1. Leave joints, including welds, uninsulated and exposed for examination during test.
 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure is to be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
 5. Install pressure-relief valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on hydronic piping:
 1. Use ambient-temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
 3. Isolate expansion tanks and determine that hydronic system is full of water.
 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure is not to exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9.
 5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
 6. Prepare written report of testing.

END OF SECTION

SECTION 23 21 16
HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Strainers.
 - 2. Flexible connectors.
- B. Related Requirements:
 - 1. Section 23 05 00 "Common Work Results for HVAC" for expansion fittings and loops.
 - 2. Section 23 05 23.12 "Ball Valves for HVAC Piping" for specification and installation requirements for ball valves common to most piping systems.
 - 3. Section 23 05 23.13 "Butterfly Valves for HVAC Piping" for specification and installation requirements for butterfly valves common to most piping systems.
 - 4. Section 23 05 23.14 "Check Valves for HVAC Piping" for specification and installation requirements for check valves common to most piping systems.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product:
 - 1. Include construction details and material descriptions for hydronic piping specialties.
 - 2. Include rated capacities, operating characteristics, and furnished specialties and accessories.
 - 3. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For hydronic piping specialties to include in emergency, operation, and maintenance manuals.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

1.5 QUALITY ASSURANCE

- A. Pipe Welding: Qualify procedures and operators in accordance with ASME BPVC, Section IX.
- B. Pressure-relief and safety-relief valves and pressure vessels bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME BPVC, Section VIII, Division 1.

PART 2 - PRODUCTS

2.1 STRAINERS

- A. Y-Pattern Strainers:
 - 1. Body: ASTM A126, Class B, cast iron with bolted cover and bottom drain connection.
 - 2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
 - 3. Strainer Screen: Stainless steel, 40mesh strainer, or perforated stainless steel basket.
 - 4. CWP Rating: 125 psig.

2.2 FLEXIBLE CONNECTORS

- A. Stainless Steel Bellows, Flexible Connectors:
 - 1. Body: Stainless steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
 - 2. End Connections: Threaded or flanged to match equipment connected.
 - 3. Performance: Capable of 3/4-inch misalignment.
 - 4. CWP Rating: 150 psig.
 - 5. Maximum Operating Temperature: 250 deg F.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine all piping specialties for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Examine threads on all devices for form and cleanliness.
- C. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- D. Do not attempt to repair defective piping specialties; replace with new devices. Remove defective piping specialties from site.

END OF SECTION

SECTION 23 21 23
HYDRONIC PUMPS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Separately coupled, base-mounted, end-suction centrifugal pumps.

1.2 DEFINITIONS

- A. ECM: Electronically commutated motor.
- B. EPDM: Ethylene propylene diene monomer.
- C. EPR: Ethylene propylene rubber.
- D. FKM: Fluoroelastomer polymer.
- E. HI: Hydraulic Institute.
- F. NBR: Nitrile rubber or Buna-N.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of pump.
 - 1. Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated.
 - 2. Indicate pump's operating point on curves.
- B. Shop Drawings: For each pump.
 - 1. Show pump layout and connections.
 - 2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
 - 3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.
- B. Seismic Qualification Data: Certificates for pumps, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 SEPARATELY COUPLED, BASE-MOUNTED, END-SUCTION CENTRIFUGAL PUMPS

- A. Manufacturers
 - 1. Grundfos – basis of design manufacturer (equipment schedule shall state Grundfos for manufacturer instead of Paco)
 - 2. Bell & Gossett
 - 3. Or approved Equal
- B. Source Limitations: Obtain pumps from single source from single manufacturer.
- C. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, end-suction pump with flexible shaft coupling as defined in HI 1.1-1.2 and HI 1.3; designed for base mounting, with pump and motor shafts horizontal.
- D. Pump Construction:
 - 1. Casing: Radially split, cast iron, with replaceable bronze wear rings, threaded gauge tappings at inlet and outlet, drain plug at bottom and air vent at top of volute, and flanged connections.
 - 2. Impeller: ASTM B584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For pumps that are not frequency-drive controlled, trim impeller to match specified performance.
 - 3. Pump Shaft: Type 304 stainless steel.
 - 4. Seal, Mechanical Type: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless steel spring, and NBR bellows and gasket.
 - 5. Seal, Packing Type: Packing seal consisting of stuffing box with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.
 - 6. Pump Bearings: Grease-lubricated ball bearings in cast-iron housing with grease fittings.
- E. Shaft Coupling: Molded-rubber insert and interlocking spider capable of absorbing vibration. EPDM coupling sleeve for variable-speed applications.
- F. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; steel; removable; attached to mounting frame.
- G. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A36/A36M channels and angles. Fabricate to mount pump casing, coupling guard, and motor.
- H. Motor: Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230500 "Common Work Results for HVAC."
 - 1. Enclosure: Open Drip Proof.
 - 2. NEMA Premium Efficient motors as defined in NEMA MG 1.
 - 3. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 4. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

5. Variable-speed motor.
6. Provide integral pump motor variable-speed controller.

I. Capacities and Characteristics: refer to pump schedule

2.3 PUMP SPECIALTY FITTINGS

A. Suction Diffuser:

1. Angle pattern.
2. 175-psig pressure rating, cast-iron body and end cap, pump-inlet fitting.
3. Fine mesh galvanized steel startup and Type 304 stainless steel permanent strainers with 3/16-inch.
4. Cast iron straightening vanes.
5. Drain plug.

6. Factory-fabricated support.

2.4 INTEGRAL PUMP MOTOR VARIABLE-SPEED CONTROLLERS

A. Provide all pumps with an integral pump motor speed controller.

1. Motor: Operates as variable-speed pump with speed regulated by an integrated variable-speed controls.
2. Integrated Pump Controller: Supports direct communication with the building management system (BMS) with built-in support for the following protocols: BACnet™ MS/TP.
3. Commissioning and pump set up access to pump controls via the following:
 - a. A web interface (data exchange).
 - b. A user interface located on the face of speed controller to adjust modes and mode values.
 - c. An electronic display that reads real-time mode set values, flow, head, speed, and power and that locks out unauthorized adjustment of pump.
4. Provide electronics with "Auto" as factory default but slope of the proportional curve will automatically match the required system curve, and rpm regulation. RPM (speed) regulation can be accomplished by the following:
 - a. Sensorless Control
 - b. Manual (via user interface or HTML).
 - c. Remote via 0 to 10 V dc.
 - d. Data protocol communications with the BMS.
5. Pump Electronics: Standard with multiple digital inputs and two external digital outputs to be available for additional mechanical room control and pump status monitoring.
6. Controller: Mounted on the motor. Provide enclosure rated to UL Type 12.
7. Electronically Protected Pumps: Rated for continuous duty and with built-in startup circuit. Provide overcurrent, line surge and current limit protection, thermal monitoring, heat sink status and over temperature protection.
8. Incorporate DC link reactors for reduction of mains borne harmonic currents and DC link ripple current to increase DC link capacitor lifetime.
9. Fit RFI filters as standard to ensure integrated controls meets low emission and immunity requirements.

10. Pump capable of being monitored continuously via integrated Internet link.
11. Integrated pump controller system to have the following features:
 - a. Controller software shall be capable of sensorless control in variable-volume systems without need for pump-mounted (internal/external) or remotely mounted differential pressure sensor.
 - b. Integrated Pump Controller Sensorless Control: Operates under Quadratic Pressure Control (QPC) to ensure that head reduction with reducing flow conforms to quadratic control curve. Linear or proportional pressure control without sensor is not acceptable.
 - c. Controller:
 - 1) Minimum head of 40 percent of design duty head.
 - 2) User-adjustable control mode settings and minimum/maximum head set points using built-in programming interface.
 - d. Controller Integrated Control Software:
 - 1) Capable of controlling pump performance for non-overloading power at every point of operation.
 - 2) Capable of flow rate display and data output of $\pm 5\%$ accuracy to BAS/BMS.
 - 3) Controls shall display digitally transmit real-time flow & head values.
 - 4) Controls shall be configured for duty/standby operation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
- C. Examine foundations and inertia bases for suitable conditions where pumps will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PUMP INSTALLATION

- A. Comply with HI 1.4 and HI 2.4.
- B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.
- C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
- D. Automatic Condensate Pump Units: Install units for collecting condensate and extend to open drain.
- E. Equipment Mounting:
 1. Install base-mounted pumps on cast-in-place concrete equipment bases.
 2. Comply with requirements for vibration isolation and seismic-control devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC."

3.3 ALIGNMENT

- A. Alignment service is not required on vertical inline pumps. Pumps are factory aligned.

- B. Comply with requirements in HI standards for alignment of pump and motor shaft. Add shims to the motor feet and bolt motor to base frame. Do not use grout between motor feet and base frame.
- C. Comply with pump and coupling manufacturers' written instructions.
- D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.4 PIPING CONNECTIONS

- A. Where installing piping adjacent to pump, allow space for service and maintenance.
- B. Connect piping to pumps. Install valves that are same size as piping connected to pumps.
- C. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- D. Install check, shutoff, and throttling valves on discharge side of pumps.
- E. Install suction diffuser and shutoff valve on suction side of pumps.
 - 1. Use startup strainer for initial system startup. Install permanent strainer element before turnover of system to Owner.
- F. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.
- G. Install pressure gauges on pump suction and discharge or at integral pressure-gauge tapping, or install single gauge with multiple-input selector valve.
- H. Install check valve on each condensate pump unit discharge unless unit has a factory-installed check valve.

3.5 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment in accordance with Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
 - 1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 26 05 53 "Identification for Electrical Systems."
 - 2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.6 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.

3.7 STARTUP SERVICE

- A. Startup service shall be performed by factory authorized technician.
 - 1. Complete installation and startup checks in accordance with manufacturer's written instructions.
 - 2. Check piping connections for tightness.
 - 3. Clean strainers on suction piping. Use startup strainer for initial startup.
 - 4. Perform the following startup checks for each pump before starting:

- a. Verify bearing lubrication.
 - b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
 - c. Verify that pump is rotating in correct direction.
- 5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
 - 6. Start motor.
 - 7. Open discharge valve slowly.

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections with the assistance of a factory-authorized service representative.
- D. Hydronic pumps will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.

END OF SECTION

SECTION 23 64 16
CENTRIFUGAL WATER CHILLERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Centrifugal water chillers.

1.2 DEFINITIONS

- A. COP: Coefficient of performance. The ratio of the rate of heat removal to the rate of energy input, using consistent units for any given set of rating conditions.
- B. DDC: Direct digital control.
- C. EER: Energy-efficiency ratio. The ratio of the cooling capacity given in terms of Btu/h to the total power input given in terms of watts at any given set of rating conditions.
- D. IPLV: Integrated part-load value. A single-number part-load efficiency figure of merit for a single chiller calculated according to the method defined by AHRI 550/590 and referenced to AHRI standard rating conditions.
- E. kVAR: Kilovolt-ampere reactive.
- F. NPLV: Nonstandard part-load value. A single-number part-load efficiency figure of merit for a single chiller calculated according to the method defined by AHRI 550/590 and intended for operating conditions other than the AHRI standard rating conditions.
- G. SCCR: Short-circuit current rating.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include refrigerant, rated capacities, operating characteristics, furnished specialties, and accessories.
2. Performance at AHRI standard conditions and at conditions indicated.
3. Performance at AHRI standard unloading conditions.
4. Minimum evaporator flow rate.
5. Minimum condenser flow rate.
6. Refrigerant capacity of chiller.
7. Oil capacity of chiller.
8. Fluid capacity of evaporator, condenser.

9. Characteristics of safety relief valves.
10. Minimum entering condenser-fluid temperature.
11. Performance at varying capacities with constant design condenser-fluid temperature. Repeat performance at varying capacities for different condenser-fluid temperatures from design to minimum in 5 deg F increments.
12. Force and moment capacity of each piping connection.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, load distribution, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans and elevations, or Building Information Model (BIM), drawn to scale, showing the items described in this Section and coordinated with all building trades.

B. Seismic Qualification Certificates: For chillers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Source Quality-Control Certifications: For chillers.

D. Field quality-control reports.

E. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each chiller to include in emergency, operation, and maintenance manuals.

B. Instructional Videos: Including those that are pre-recorded and those that are recorded during training.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Tool Kit:

1. A tool kit specially designed by chiller manufacturer for use in servicing chiller(s) furnished.

2. Special tools required to service chiller components not readily available to Owner service personnel in performing routine maintenance.
 3. Lockable case with hinged cover, marked with large and permanent text to indicate the special purpose of tool kit, such as "Chiller Tool Kit." Text size must be at least 1 inch high.
 4. A list of each tool furnished. Permanently attach the list to underside of case cover. Text size must be at least 1/2 inch high.
- B. Touch-up Paint: 32-oz. container of paint used for finish coat. Label outside of container with detailed description of paint to allow for procurement of a matching paint in the future.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Ship chillers from the factory fully charged with refrigerant.
- B. Ship each chiller with a full charge of refrigerant. Charge each chiller with nitrogen if refrigerant is shipped in containers separate from chiller.
- C. Ship each oil-lubricated chiller with a full charge of oil.
 1. Ship oil factory installed in chiller.
- D. Package chiller for export shipping in totally enclosed crate with bagging.

1.8 WARRANTY

- A. Manufacturer Warranty: Manufacturer and Installer agree to repair or replace chillers that fail in materials or workmanship within specified warranty period.
- B. Special Warranty: Manufacturer and Installer agree to repair or replace components of chillers that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Complete chiller, including refrigerant and oil charge.
 - b. Complete compressor and drive assembly, including refrigerant and oil charge.
 - c. Refrigerant and oil charge.
 - 1) Loss of refrigerant charge for any reason due to manufacturer product defect and product installation.
 - d. Parts and labor.
 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain centrifugal chillers from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Centrifugal chillers are to withstand the effects of earthquake motions determined according to ASCE/SEI 7. See Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment."
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
- B. Condenser-Fluid Temperature Performance:
 - 1. Startup Condenser-Fluid Temperature: Chiller is to be capable of starting with an entering condenser-fluid temperature of 60 deg F and providing stable operation until the system temperature is elevated to the minimum operating entering condenser-fluid temperature.
 - 2. Minimum Operating Condenser-Fluid Temperature: Chiller is to be capable of continuous operation over the entire capacity range indicated with an entering condenser-fluid temperature of 65 deg F.
 - 3. Make factory modifications to standard chiller design if necessary to comply with performance indicated.
- C. Site Altitude: Chiller is to be suitable for altitude at which installed without affecting performance indicated. Make adjustments to affected chiller components to account for site altitude.
- D. ASHRAE Compliance:
 - 1. ASHRAE 15 for safety code for mechanical refrigeration.
 - 2. ASHRAE 147 for refrigerant leaks, recovery, and handling and storage requirements.
 - 3. ASHRAE/IES 90.1.
- E. ASME Compliance: Fabricate and label chillers to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, as applicable to chiller design. For chillers charged with R-134a, R-513A, or R-1234ze(E) refrigerant, include an ASME U-stamp and nameplate certifying compliance.
- F. 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.
- G. Comply with requirements of Underwriters Laboratories, and include label by a qualified testing agency showing compliance.
- H. Operation Following Loss of Normal Power:

1. Equipment, associated factory- and field-installed controls, and associated electrical equipment and power supply connected to backup power system are to automatically return equipment and associated controls to the operating state occurring immediately before loss of normal power without need for manual intervention by an operator when power is restored either through a backup power source, or through normal power if restored before backup power is brought online.
2. Refer to Drawings for equipment served by back-up power systems.
3. Provide means and methods required to satisfy requirement, even if not explicitly indicated.

2.3 CAPACITIES AND CHARACTERISTICS: See Chiller Schedule for Variable Speed Screw Compressor Chiller on Plans

2.4 CENTRIFUGAL WATER CHILLERS

- A. Manufacturers:
 1. York
 2. Trane
 3. Carrier
 4. Or approved equal
- B. Description: Factory-assembled and -tested chiller complete with compressor, compressor motor, compressor motor controller, lubrication system evaporator, condenser, controls, interconnecting unit piping and wiring, and indicated accessories.
 1. Multi-Piece Assembly: Disassemble chiller into major assemblies as required by the installation after factory testing and before packaging for shipment.
 2. Dual-Compressor Chillers: For chillers with dual compressors, provide each compressor with a dedicated motor and motor controller, and provide for continued operation when either compressor-drive assembly fails.
- C. Fabricate chiller mounting base with reinforcement strong enough to resist chiller movement during a seismic event when chiller is anchored to field support structure.
- D. Compressor-Drive Assembly: Single-stage or multistage, variable- or dynamic-displacement, centrifugal-type compressor driven by an electric motor.
 1. Compressor:
 - a. Compressors: Shall be direct drive, semi hermetic, rotary screw type, including: terminal box, and precision machined cast iron housing. Design working pressure of entire compressor, suction to discharge, shall be 450 psig (31 barg) or higher. Compressor shall be U.L. recognized.
 - b. Compressor Motors: Refrigerant suction-gas cooled accessible hermetic compressor motor, full suction gas flow through 80 mesh screen, with inherent internal thermal protection and external current overload on all three phases.
 - c. Balancing Requirements: All rotating parts shall be statically balanced.
 - d. Lubrication System: External oil separators with no moving parts, 388 psig (26.8 barg) design working pressure, and ETL listing shall be provided on the chiller. Refrigerant system differential pressure shall provide oil flow through service

- replaceable, 0.5 micron, full flow, cartridge type oil filter. Filter bypass, less restrictive media, or oil pump not acceptable.
 - e. Capacity Control: Compressors shall start at minimum load. Provide Microprocessor control to command compressor capacity to balance compressor capacity with cooling load.
- 2. Vibration Balance: Balance chiller compressor and drive assembly to provide a precision balance that is free of noticeable vibration over the entire operating range.
 - a. Overspeed Test: At least 20 percent above design operating speed.
 - b. Vibration Limits: Velocities not to exceed 0.15 inch/s and 0.8 mil peak to peak on all axes.
- 3. Service: Easily accessible for inspection and service.
 - a. Compressor's internal components are to be accessible without having to remove compressor-drive assembly from chiller.
 - b. Provide lifting lugs or eyebolts attached to casing.
- 4. Economizers: For multistage chillers, provide interstage economizers.
- 5. Capacity Control: Modulating, variable-inlet, guide-vane assembly combined with hot-gas bypass, if necessary, to achieve performance indicated.
 - a. Maintain stable operation that is free of surge, cavitation, and vibration throughout range of operation. Configure to achieve most energy-efficient operation possible.
 - b. Operating Range: From 100 to 25 percent of design capacity.
 - c. Condenser-Fluid Unloading Requirements over Operating Range: Constant-design of entering condenser-fluid temperature.
 - d. Chillers with variable-frequency controllers must modulate compressor speed with variable-inlet, guide-vane control to achieve optimum energy efficiency.
 - e. Avoid use of hot-gas bypass if other options are available to achieve performance indicated. Apply hot-gas bypass according to ASHRAE/IES 90.1 and governing codes.
- 6. Oil Lubrication System: Consisting of pump, filtration, cooler, factory-wired power connection, and controls.
 - a. Bearings, gears, and other rotating surfaces are to be lubricated at all operating, startup, coast down, and standby conditions, including power failure.
 - b. Manufacturer's standard method to remove refrigerant from oil.
 - c. Oil filter to be the easily replaceable cartridge type, minimum 0.3-micron efficiency, with means of positive isolation while servicing.
 - d. Refrigerant-cooled oil cooler.
 - e. Factory-installed and pressure-tested piping with isolation valves and accessories.
 - f. Oil compatible with refrigerant and chiller components.
 - g. Positive visual indication of oil level.

E. Refrigeration:

- 1. Refrigerant:

- a. Type: R-513A; ASHRAE 34, Class A1.
 - b. Compatibility: Chiller parts exposed to refrigerants are to be fully compatible with refrigerants, and pressure components are to be rated for refrigerant pressures.
- 2. Refrigerant Flow Control: Manufacturer's standard refrigerant flow-control device satisfying performance requirements indicated.
- 3. Pressure Relief Device:
 - a. Comply with requirements in ASHRAE 15, ASHRAE 147, and applicable portions of ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.
 - b. Select and configure pressure relief devices to protect against corrosion and inadvertent release of refrigerant.
 - c. Where dual pressure relief devices are installed in series, provide a sensor with indicator between devices to indicate refrigerant release past first device.
 - d. For Chillers Using R-134a, R-513A, or R-1234ze(E): ASME-rated, spring-loaded, pressure relief valve; single- or multiple-reseating type. Provide pressure relief valve(s) for each chiller heat exchanger. Provide condenser with dual valves, one being redundant and configured to allow either valve to be replaced without loss of refrigerant.
- 4. Refrigeration Transfer: Provide service valves and other factory-installed accessories required to facilitate transfer of refrigerant from chiller to a remote refrigerant storage and recycling system. Comply with requirements in ASHRAE 15 and ASHRAE 147.
- 5. Refrigerant Isolation for Chillers Using R-134a, R-513A, or R-1234ze(E):
 - a. Factory install positive shutoff, manual isolation valves in the compressor discharge line to the condenser and the refrigerant liquid line leaving the condenser to allow for isolation and storage of full refrigerant charge in the chiller condenser shell.
 - b. Suction side of compressor from evaporator is to have an isolation valve to allow for isolation and storage of full refrigerant charge in the chiller evaporator shell.
- 6. Purge System:
 - a. For chillers operating at sub atmospheric pressures, factory install an automatic purge system for collection and return of refrigerant and lubricating oil and for removal of non-condensables, including, but not limited to, water, water vapor, and non-condensable gases.
 - b. System is to be of thermal purge design, refrigerant or air cooled, and equipped with a carbon filter that includes an automatic regeneration cycle.
 - c. Factory wire to chiller's main power supply and system complete with controls, piping, and refrigerant valves to isolate the purge system from the chiller.
 - d. Construct components of noncorrodible materials.
 - e. Controls are to interface with chiller control panel to indicate modes of operation, set points, data reports, diagnostics, and alarms.
 - f. Efficiency of not more than 0.02 lb of refrigerant per pound of air when rated according to AHRI 580.
 - g. Operation independent of chiller according to ASHRAE 147.
- 7. Positive-Pressure System:

- a. For chillers operating at subatmospheric pressures using refrigerant, factory install an automatic positive-pressure system.
- b. During nonoperational periods, positive-pressure system is to automatically maintain a positive pressure for atmosphere in the refrigerant-pressure vessel of not less than 0.5 psig adjustable up to a pressure that remains within the vessel design pressure limits.
- c. Provide factory-wired system including controller, electric heat, pressure transmitter, or switch.

F. Evaporator:

- 1. Description: Shell-and-tube design, with water in tubes and refrigerant surrounding tubes within shell. Shell is separate from condenser.
- 2. Shell Material: Carbon-steel rolled plates with continuously welded seams or seamless pipe.
- 3. Designed to prevent liquid refrigerant carryover from entering compressor.
- 4. Evaporator must have sight glass or other form of positive visual verification of liquid-refrigerant level.
- 5. Tubes:
 - a. Individually replaceable from either end and without damage to tube sheets and other tubes.
 - b. Mechanically expanded into end sheets and **[physically attached to]** intermediate tube sheets.
 - c. Material: Copper.
 - d. Nominal OD: Manufacturer's choice.
 - e. Minimum Wall Thickness: 0.035 inch.
 - f. External Finish: Manufacturer's standard.
 - g. Internal Finish: Enhanced.
- 6. End Tube Sheets: Continuously welded to each end of shell; drilled and reamed to accommodate tubes, with positive seal between fluid in tubes and refrigerant in shell.
- 7. Intermediate Tube Sheets: Installed in shell and spaced along length of tube at intervals required to eliminate vibration and to avoid contact of tubes resulting in abrasion and wear.
- 8. Water Box:
 - a. Cast-iron or carbon-steel construction; arranged to provide visual inspection and cleaning of tubes from either end without disturbing refrigerant in shell.
 - b. Standard type for water box with piping connections; standard type for water box without piping connections.
 - c. Provide water boxes with lifting lugs or eyebolts.
 - d. Davited water boxes.
 - e. Nozzle Pipe Connections: Grooved with mechanical-joint coupling and flange adapter.
 - f. Thermistor or RTD temperature sensor factory installed in each nozzle.
 - g. Fit each water box with 3/4- or 1-inch drain connection at low point and vent connection at high point, each with threaded plug.
- 9. Additional Corrosion Protection:

- a. Electrolytic corrosion-inhibitor anode, zinc or magnesium.
 - b. Coat wetted surfaces with a corrosion-resistant finish.
 - c. Using same material as tubes, clad surfaces of end tube sheets in contact with fluid. Coat other wetted surfaces, including water boxes, with a corrosion-resistant finish.
10. Flow Sensor: Thermal dispersion type, factory calibrated for Project-specific application.

G. Condenser:

- 1. Description: Shell-and-tube design, with water in tubes and refrigerant surrounding tubes within shell. Shell is to be separate from evaporator.
- 2. Shell Material: Carbon-steel rolled plates with continuously welded seams or seamless pipe.
- 3. Designed to prevent direct impingement of high-velocity hot gas from compressor discharge on tubes.
- 4. Condenser is to have sight glass or other form of positive visual verification of refrigerant charge and condition.
- 5. Tubes:
 - a. Individually replaceable from either end and without damage to tube sheets and other tubes.
 - b. Mechanically expanded into end sheets and physically attached to intermediate tube sheets.
 - c. Material: Copper.
 - d. Nominal OD: Manufacturer's choice.
 - e. Minimum Wall Thickness: 0.035 inch.
 - f. External Finish: Manufacturer's standard.
 - g. Internal Finish: Enhanced.
- 6. End Tube Sheets: Continuously welded to each end of shell; drilled and reamed to accommodate tubes, with positive seal between fluid in tubes and refrigerant in shell.
- 7. Intermediate Tube Sheets: Installed in shell and spaced along length of tube at intervals required to eliminate vibration and to avoid contact of tubes resulting in abrasion and wear, but not more than 4 feet apart.
- 8. Water Box:
 - a. Cast-iron or carbon-steel construction; arranged to provide visual inspection and cleaning of tubes from either end without disturbing refrigerant in shell.
 - b. Standard type for water box with piping connections. Standard type for water box without piping connections.
 - c. Water boxes are to have lifting lugs or eyebolts.
 - d. Davited water boxes.
 - e. Nozzle Pipe Connections: Grooved with mechanical-joint coupling and flange adapter.
 - f. Thermistor or RTD temperature sensor factory installed in each nozzle.
 - g. Fit each water box with 3/4- or 1-inch drain connection at low point and vent connection at high point, each with threaded plug.
- 9. Additional Corrosion Protection:

- a. Electrolytic corrosion-inhibitor anode, zinc or magnesium.
- b. Coat wetted surfaces with a corrosion-resistant finish.
- c. Using same material as tubes, clad surfaces of end tube sheets in contact with fluid. Coat other wetted surfaces, including water boxes, with a corrosion-resistant finish.

10. Flow Sensor: Thermal dispersion type, factory calibrated for Project-specific application.

H. Insulation:

- 1. Closed-cell, flexible elastomeric thermal insulation complying with ASTM C534, Type I for tubular materials and Type II for sheet materials.
 - a. Thickness: 3/4 inch.
- 2. Adhesive: As recommended by insulation manufacturer.
- 3. Factory-applied insulation over all cold surfaces of chiller capable of forming condensation. Components include, but are not limited to, evaporator shell and end tube sheets, evaporator water boxes including nozzles, refrigerant suction pipe from evaporator to compressor, cold surfaces of compressor, refrigerant-cooled motor, and auxiliary piping.
 - a. Apply adhesive to 100 percent of insulation contact surface.
 - b. Before insulating steel surfaces, prepare surfaces for paint, and prime and paint as indicated for other painted components. Do not insulate unpainted steel surfaces.
 - c. Seal seams and joints to provide a vapor barrier.
 - d. After adhesive has fully cured, paint exposed surfaces of insulation to match other painted parts.
 - e. Manufacturer has option to factory or field insulate chiller components installed in multiple pieces to reduce potential for damage during installation.
 - f. Manufacturer has option to factory or field insulate water boxes and nozzles to reduce potential for damage during installation.
- 4. Field-Applied Insulation:
 - a. Components that are not factory insulated are to be field insulated to comply with requirements indicated.
 - b. Manufacturer must be responsible for chiller insulation whether factory or field installed, to ensure manufacturer is the single point of responsibility for chillers.
 - c. Manufacturer factory-authorized service representative is to instruct and supervise installation of field-applied insulation.
 - d. After field-applied insulation is complete, paint insulation to match factory-applied finish.

I. Electrical:

- 1. Factory installed and wired, and functionally tested at factory before shipment.
- 2. Single-point, field-power connection to circuit breaker. Minimum SCCR according to UL 508 is to be as required by electrical power distribution system, but not less than 65,000 A.

- a. Branch power circuit to each motor, electric heater, dedicated electrical load, and control, with circuit breaker having SCCR to match main disconnecting means.
 - 1) NEMA KS 1, heavy-duty fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.
 - 2) NEMA AB 1, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit-trip set point.
 - b. NEMA ICS 2-rated motor controller for auxiliary motors, hand-off-auto switch, and overcurrent protection for each motor. Provide variable-frequency controller for each variable-speed motor furnished.
 - c. Control-circuit transformer with primary and secondary side fuses.
- 3. Terminal blocks with numbered and color-coded wiring to match wiring diagram. Spare wiring terminal block for connection to external controls or equipment.
 - 4. Factory-installed wiring located outside of enclosures is to be installed in metal raceway. Provide terminal connections with not more than a 24-inch length of liquidtight or flexible metallic conduit.
 - 5. Factory install and wire capacitor bank for the purpose of power factor correction to 0.95 at full load.
 - a. If capacitors are mounted in a dedicated enclosure, use same NEMA enclosure type as that for motor controller. Provide enclosure with service entrance knockouts and bushings for conduit.
 - b. Capacitors are to be of non-PCB dielectric fluid, metallized electrode design, with low loss with low-temperature rise. Indicate kVAR ratings and do not exceed the maximum limitations set by NFPA 70. Provide individual cells as required.
 - c. Provide each cell with current-limiting replaceable fuses and carbon-film discharge resistors to reduce residual voltage to less than 50 V within one minute after de-energizing.
 - d. Provide a ground terminal and a terminal block or individual connectors for phase connection.

J. Motor Controller:

- 1. Enclosure: Factory installed, unit mounted,,, with hinged full-front access door with lock and key or padlock and key.
- 2. Control Circuit: Obtained from integral control power transformer with a control power transformer of enough capacity to operate connected control devices.
- 3. Size overload relay in accordance with UL 1995 or provide as integral component of chiller control microprocessor.
- 4. Across-the-Line Controller: NEMA ICS 2, Class A, full voltage, nonreversing; include isolation switch and current-limiting fuses.
- 5. Star-Delta, Reduced-Voltage Controller: NEMA ICS 2, closed transition.
- 6. Autotransformer Reduced-Voltage Controller: NEMA ICS 2, closed transition; include isolation switch and current-limiting fuses.
- 7. Solid-State, Reduced-Voltage Controller: NEMA ICS 2.

- a. Include surge suppressor in solid-state power circuits to provide three-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.
 - b. Visual indication of motor and control status, including the following conditions:
 - 1) Controller on.
 - 2) Overload trip.
 - 3) Loss of phase.
 - 4) Starter fault.
8. Accessories: Factory install devices in controller enclosure unless otherwise indicated.
- a. Externally Operated, Door-Interlocked Disconnect: Circuit breaker. SCCR according to UL 508 is to be as required by electrical power distribution system, but not less than 65,000 A.
 - b. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.
 - c. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.
 - d. Control Relays: Time-delay relays.
 - e. Elapsed-Time Meters: Numerical readout in hours on face of enclosure.
 - f. Number-of-Starts Counter: Numerical readout on face of enclosure.
 - g. Meters: Panel type, 2-1/2 inches with 270-degree scale and 1 percent accuracy. Where indicated, provide transfer device with an off position. Meters indicate the following:
 - 1) Ammeter: Output current for each phase, with current sensors rated to suit application.
 - 2) Voltmeter: Output voltage for each phase.
 - 3) Frequency Meter: Output frequency.
 - 4) Real-time clock with current time and date.
 - 5) Total run time.
 - h. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
 - 1) Selectable, digital display of the following:
 - a) Phase Currents, Each Phase: Plus or minus 1 percent.
 - b) Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
 - c) Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
 - d) Three-Phase Real Power: Plus or minus 2 percent.
 - e) Three-Phase Reactive Power: Plus or minus 2 percent.
 - f) Power Factor: Plus or minus 2 percent.
 - g) Frequency: Plus or minus 0.5 percent.
 - h) Integrated Demand with Demand Interval Selectable from Five to 60 Minutes: Plus or minus 2 percent.
 - i) Accumulated energy, in megawatt hours (joules), plus or minus 2 percent; stored values unaffected by power outages for up to 72 hours.

2) Mounting: Display and control unit flush or semirecessed in instrument compartment door.

- i. Phase-Failure, Phase-Reversal, Undervoltage Relays: Solid-state sensing circuit with adjustable undervoltage setting and isolated output contacts for hardwired connection.
- j. Power Protection: Chiller must shut down within six cycles of power interruption.

K. Variable-Frequency Controller:

1. Motor controller is to be factory mounted and wired on the chiller to provide a single-point, field-power termination to the chiller and its auxiliaries.
2. Description: NEMA ICS 2; listed and labeled according to UL 508 as a complete unit and arranged to provide variable speed by adjusting output voltage and frequency.
3. Enclosure: Unit mounted, NEMA 250, Type 4, with hinged full-front access door with lock and key.
4. Integral Disconnecting Means: Door-interlocked, NEMA AB 1, instantaneous-trip circuit breaker with lockable handle. Minimum SCCR according to UL 508 is to be as required by electrical power distribution system, but not less than 65,000 A.
5. Technology: Pulse width modulated (PWM) output with insulated gate bipolar transistors; suitable for variable torque loads.
6. Controller is to consist of a rectifier converter section, a digital/analog driver regulator section, and an inverter output section.
 - a. Rectifier Section: Full-wave diode bridge that changes fixed-voltage, fixed-frequency, ac line power to a fixed dc voltage. Silicon controller rectifiers, current source inverters, and paralleling of devices are unacceptable. Rectifier is to be insensitive to phase rotation of the ac line.
 - b. Regulator: Full digital control of frequency and voltage.
 - c. Inverter Section: Change fixed dc voltage to variable-frequency, variable ac voltage for application to a squirrel-cage motor. Inverter is to produce a sine-coded, PWM output waveform and conduct no RFI back to the input power supply.
7. Output Rating: Three phase, with voltage proportional to frequency throughout voltage range.
8. Operating Requirements:
 - a. Input AC Voltage Tolerance: 460-V ac, plus 10 percent or 506 V maximum.
 - b. Input frequency tolerance of 60 Hz, plus or minus 2 Hz.
 - c. Capable of driving full load, without derating, under the following conditions:
 - 1) Ambient Temperature: Zero to 50 deg C.
 - 2) Relative Humidity: Up to 90 percent (noncondensing).
 - 3) Altitude: Up to 3300 feet.
 - d. Minimum Efficiency: 96 percent at 60 Hz, full load.
 - e. Minimum Displacement Primary-Side Power Factor: 95 percent without harmonic filter; 98 percent with harmonic filter.
 - f. Overload Capability: 1.05 times the full-load current for seven seconds.
 - g. Starting Torque: As required by compressor-drive assembly.

- h. Speed Regulation: Plus or minus 1 percent.
 - i. Isolated control interface to allow controller to follow control signal over a 10:1 speed range.
 - j. To avoid equipment resonant vibrations, provide critical speed lockout circuitry to allow bands of operating frequency at which controller is to not operate continuously.
 - k. Capable of being restarted into a motor coasting in either the forward or reverse direction without tripping.
9. Internal Adjustability Capabilities: Integral to controller or through chiller control panel.
- a. Minimum Output Frequency: 6 Hz.
 - b. Maximum Output Frequency: 60 Hz.
 - c. Acceleration: Two seconds to a minimum of 60 seconds.
 - d. Deceleration: Two seconds to a minimum of 60 seconds.
 - e. Current Limit: 30 percent to a minimum of 100 percent of maximum rating.
10. Self-Protection and Reliability Features: Subjecting the controller to any of the following conditions must not result in component failure or the need for replacement:
- a. Overtemperature.
 - b. Short circuit at controller output.
 - c. Ground fault at controller output. Variable-frequency controller is to be able to start a grounded motor.
 - d. Open circuit at controller output.
 - e. Input undervoltage.
 - f. Input overvoltage.
 - g. Loss of input phase.
 - h. Reverse phase.
 - i. AC line switching transients.
 - j. Instantaneous overload, line to line or line to ground.
 - k. Sustained overload exceeding 100 percent of controller-rated current.
 - l. Starting a rotating motor.
11. Motor Protection: Controller is to protect motor against overvoltage and undervoltage, phase loss, reverse phase, overcurrent, overtemperature, and ground fault.
12. Automatic Reset and Restart:
- a. Capable of three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction.
 - b. Controller is to be capable of automatic restart on phase-loss and overvoltage and undervoltage trips.
13. Visual Indication: On face of controller enclosure or chiller control enclosure. indicating the following conditions:
- a. Power on.
 - b. Run.
 - c. Overvoltage.
 - d. Line fault.
 - e. Overcurrent.

- f. External fault.
 - g. Motor speed (percent).
 - h. Fault or alarm status (code).
 - i. DC-link voltage.
 - j. Motor output voltage.
 - k. Input kilovolt amperes.
 - l. Total power factor.
 - m. Input kilowatts.
 - n. Input kilowatt-hours.
 - o. Three-phase input voltage.
 - p. Three-phase output voltage.
 - q. Three-phase input current.
 - r. Three-phase output current.
 - s. Three-phase input voltage THD.
 - t. Three-phase input current THD.
 - u. Output frequency (Hertz).
 - v. Elapsed operating time (hours).
 - w. Diagnostic and service parameters.
14. Operator Interface: At controller or chiller control panel; with start-stop and auto-manual selector with manual-speed-control potentiometer.
15. Control Signal Interface:
- a. Electric Input Signal Interface: A minimum of two analog inputs (0 to 10 V or 0/4-20 mA) and six programmable digital inputs.
 - b. Manufacturer has option to incorporate control signal interface into chiller control panel.
16. Active Harmonic Distortion Filter:
- a. Factory mounted and wired to limit total voltage and current distortion to 5 percent.
 - b. Factory mounted and wired to limit total demand distortion (TDD) to 5 percent of unit input.
- L. Accessory Control Relays:
- 1. Control Relays: Auxiliary and adjustable time-delay relays.
 - 2. Devices are to be factory installed in controller enclosure unless otherwise indicated.
- M. Chiller Capacity Control Interface: Equip chiller with adaptive control logic to automatically adjust the compressor motor speed and the compressor pre-rotation inlet vane position independently to achieve maximum part-load efficiency in response to sensor inputs that are integral to the chiller controls.
- N. Controls:
- 1. Description: Standalone and microprocessor based, with all memory stored in nonvolatile memory, so that reprogramming is not required on loss of electrical power.
 - 2. Enclosure: Unit mounted, NEMA 250, Type 4, hinged or lockable, factory wired with a single-point, with field-power connection and a separate control circuit.

3. House factory-installed wiring outside of enclosures in a NFPA 70-approved raceway. Make terminal connections with liquidtight or flexible metallic conduit.
4. Operator Interface: Multiple-character digital or graphic display with dynamic update of information and with keypad or touch-sensitive display located on front of control enclosure. In either imperial or metric units selectable through the interface, display the following information:
 - a. Date and time.
 - b. Operating or alarm status.
 - c. Fault history with not less than last 10 faults displayed.
 - d. Set points of controllable parameters.
 - e. Trend data.
 - f. Operating hours.
 - g. Number of chiller starts.
 - h. Outdoor-air temperature or space temperature if required for chilled-water reset.
 - i. Entering- and leaving-fluid temperatures of evaporator and condenser.
 - j. Difference in fluid temperatures of evaporator and condenser.
 - k. Fluid flow of evaporator and condenser.
 - l. Fluid-pressure drop of evaporator and condenser.
 - m. Refrigerant pressures in evaporator and condenser.
 - n. Refrigerant saturation temperature in evaporator and condenser shell.
 - o. Compressor refrigerant suction and discharge temperature.
 - p. Compressor bearing temperature.
 - q. Motor bearing temperature.
 - r. Motor winding temperature.
 - s. Oil temperature.
 - t. Oil discharge pressure.
 - u. Phase current.
 - v. Percentage of motor-rated load amperage.
 - w. Phase voltage.
 - x. Demand power (kilowatts).
 - y. Energy use (kilowatt-hours).
 - z. Power factor.
 - aa. For chillers equipped with variable-frequency controllers and harmonic filters, include the following:
 - bb. Output voltage and frequency.
 - cc. Voltage THD for each phase.
 - dd. Supply current TDD for each phase.
 - ee. Inlet vane position.
 - ff. Controller internal ambient temperature.
 - gg. Heatsink temperature.
 - hh. Purge suction temperature if purge system is provided.
 - ii. Purge elapsed time if purge system is provided.
5. Control Functions:
 - a. Manual or automatic startup and shutdown time schedule.
 - b. Entering and leaving chilled-water temperatures, control set points, and motor load limits. Evaporator-fluid temperature is to be reset based on return-water temperature.
 - c. Current limit and demand limit.

- d. Condenser-fluid temperature.
 - e. External chiller emergency stop.
 - f. Variable evaporator flow.
 - g. Thermal storage.
6. Manually Reset Safety Controls: The following conditions are to shut down chiller and require manual reset:
- a. Low evaporator pressure; high condenser pressure.
 - b. Low evaporator-fluid temperature.
 - c. Low oil differential pressure.
 - d. High or low oil pressure.
 - e. High oil temperature.
 - f. High compressor-discharge temperature.
 - g. Loss of condenser-fluid flow.
 - h. Loss of evaporator-fluid flow.
 - i. Motor overcurrent.
 - j. Motor overvoltage.
 - k. Motor undervoltage.
 - l. Motor phase reversal.
 - m. Motor phase failure.
 - n. Sensor- or detection-circuit fault.
 - o. Processor communication loss.
 - p. Motor controller fault.
 - q. Extended compressor surge.
7. Trending: Capability to trend analog data of up to five parameters simultaneously over an adjustable period and frequency of polling.
8. Security Access: Provide electronic security access to controls through identification and password, with at least three levels of access: view only; view and operate; and view, operate, and service.
9. Control Authority: At least four conditions: Off, local manual control at chiller, local automatic control at chiller, and automatic control through a remote source.
10. Communication Port: RS-232 port, USB 2.0 port or higher, or equivalent connection capable of connecting a printer and a notebook computer.
11. BAS Interface: Factory install hardware and software to enable system to monitor, control, and display chiller status and alarms.
- a. Communication Interface: ASHRAE 135 (BACnet) communication interface is to enable control system operator to remotely control and monitor the chiller from an operator workstation.
 - 1) Control features and monitoring points displayed locally at chiller control panel are to be available through the control system, including, at a minimum, the following:
 - a) Start-stop command from remote source.
 - b) Unit control source, local, analog, digital or modem.
 - c) Chiller control panel start-stop.
 - d) Accumulated operating hours.
 - e) Accumulated starts.

- f) Compressor motor status.
- g) Unit operation code.
- h) Unit safety fault code.
- i) Unit cycling fault code.
- j) Chilled-water pump status.
- k) Chilled-water flow proof.
- l) Chilled-water entering temperature.
- m) Chilled-water leaving temperature.
- n) Chilled-water leaving temperature set-point adjustment from remote source.
- o) Condenser(s) water entering temperature.
- p) Condenser(s) water leaving temperature.
- q) Evaporator refrigerant pressure.
- r) Condenser(s) refrigerant pressure.
- s) Evaporator refrigerant saturation temperature.
- t) Condenser(s) refrigerant saturation temperature.
- u) Refrigerant discharge temperature.
- v) Refrigerant level.
- w) Refrigerant liquid level set point.
- x) Oil pressure differential.
- y) Oil sump pressure.
- z) Oil pump pressure.
- aa) Oil sump temperature.
- bb) High-speed thrust bearing proximity position.
- cc) High-speed thrust bearing proximity reference.
- dd) Motor current percent of full-load amps.
- ee) Motor current Phase A.
- ff) Motor current Phase B.
- gg) Motor current Phase C.
- hh) Motor current set-point adjustment from remote source.
- ii) Motor bearing shaft end vibration.
- jj) Motor bearing opposite shaft end vibration.
- kk) Motor bearing shaft end temperature.
- ll) Motor bearing opposite shaft end temperature.
- mm) Motor average winding temperature.
- nn) Variable-frequency controller selection, auto or fixed.
- oo) Variable-frequency controller output voltage.
- pp) Variable-frequency controller input power, rate.
- qq) Variable-frequency controller input power, consumption.
- rr) Variable-frequency controller DC bus voltage.
- ss) Variable-frequency controller inverter link current.
- tt) Variable-frequency controller output frequency.
- uu) Variable-frequency controller internal ambient temperature.
- vv) Variable-frequency controller converter heatsink temperature.
- ww) Variable-frequency controller harmonic filter installed, true or false.
- xx) Harmonic Filter THD at maximum voltage, percent.
- yy) Harmonic filter total demand distortion at maximum current, percent.
- zz) Harmonic filter total supply kVA.
- aaa) Anti-recycle time remaining.
- bbb) Liquid line solenoid.
- ccc) Pre-rotation vanes position.

- ddd) Adaptive capacity control valve surge map installed, true or false.
- eee) Adaptive capacity control new surge point, true or false.
- fff) Adaptive capacity control surge type, pressure differential or current.
- ggg) Adaptive capacity control surge count.
- hhh) Adaptive capacity control PRV position.
- iii) Adaptive capacity control output frequency.

12. Quick-Start Feature:

- a. Automatically restore chiller operation up to 100 percent capacity within three minutes after a 15 -second power interruption.
- b. Quick-start feature is to ensure guide vanes remain open following a power interruption event and quick ramp-up speed logic is employed to facilitate shortest time to deliver chilled water at set-point temperature.
- c. Chiller manufacturer is to provide integral UPS unit(s) with chiller controls if required to keep chiller integral controls operational to comply with requirement.
- d. Chiller manufacturer is to demonstrate chiller start time with the quick-start feature enabled while simulating power fault, power service return, restart time, and capacity control, to produce desired chilled-water temperature at load indicated.

O. Finish:

- 1. Paint chiller, using manufacturer's standard procedures, except comply with the following minimum requirements:
 - a. Provide at least one coat of primer with a total dry film thickness of at least 2 mils Insert thickness.
 - b. Provide at least one coat of alkyd-modified, vinyl enamel finish with a total dry film thickness of at least 2 mils.
 - c. Paint surfaces that are to be insulated before applying the insulation.
 - d. Paint installed insulation to match adjacent uninsulated surfaces.
 - e. Color of finish coat is to be manufacturer's standard.

P. Accessories:

1. Flow Switches:

- a. Chiller manufacturer is to furnish a switch for each evaporator and condenser and verify field-mounting location before installation.
- b. Paddle Flow Switches:
 - 1) Vane operated to actuate a double-pole, double-throw switch, with one pole field wired to the chiller control panel and the other pole field wired to the DDC system for HVAC.
 - 2) Contacts: Platinum alloy, silver alloy, or gold-plated switch contacts with a rating of 10 A at 120-V ac.
 - 3) Pressure rating equal to pressure rating of heat exchanger.
 - 4) Construct body and wetted parts of Type 316 stainless steel.
 - 5) House switch in a NEMA 250, Type 4 enclosure constructed of die-cast aluminum.
 - 6) Vane length to suit installation.

c. Pressure-Differential Switches:

- 1) Construction: Wetted parts of body and trim constructed of Type 316 stainless steel.
- 2) Performance: Switch is to withstand, without damage, the full-pressure rating of the heat exchanger applied to either port and exhibit zero set-point shift due to variation in working pressure.
- 3) Set Point: Screw type, field adjustable.
- 4) Electrical Connections: Internally mounted screw-type terminal blocks.
- 5) Switch Enclosure: NEMA 250, Type 4.
- 6) Switch Action: Double-pole, double-throw switch, with one pole field wired to the chiller control panel and the other pole field wired to the DDC system for HVAC.

2. Vibration Isolation:

- a. Chiller manufacturer is to furnish vibration isolation for each chiller.
- b. Neoprene Pad:
 - 1) Two layers of 0.375-inch- thick, ribbed- or waffle-pattern neoprene pads separated by a 16-gauge, stainless steel plate.
 - 2) Fabricate pads from 40- to 60-durometer neoprene.
 - 3) Provide stainless steel square bearing plate to load the pad uniformly between 20 and 40 psig with a 0.12- to 0.16-inch deflection.

3. Sound Barrier:

- a. Provide sound barrier only if required to comply with sound requirements indicated.
- b. Furnish removable and reusable sound-barrier covers over the compressor housing, hermetic motor, compressor suction and discharge piping, and condenser shell.
- c. Provide for repeated installation and removal without use of tape or caulk.
- d. Inner and outer cover is to consist of a PTFE-impregnated fiberglass cloth enclosing heavy-density, needled fiberglass insulation material with a mass-loaded vinyl acoustic barrier.
- e. Covers are to be double sewn and lock stitched, with edges folded and sewn so no raw cut edges are exposed.
- f. Form covers around control devices, gauges, conduit, piping, and supports without degrading sound-barrier performance.
- g. Continuously lap all exposed seams at least 2 inches for better sound containment.
- h. Permanently label each section of cover to indicate its location, description, size, and number sequence.
- i. Randomly place stainless steel quilting pins to prevent covers from shifting and sagging.

2.5 HEAT-EXCHANGER, BRUSH-CLEANING SYSTEM

- A. Description: Factory provided by chiller manufacturer, field-installed, brush-cleaning system on each chiller condenser for tube cleaning and improved heat transfer.

- B. System is to prevent tube fouling at or below design conditions without interrupting normal equipment operation.
- C. System is to consist of a brush inserted into each tube and a catch basket attached to each end of the tube. A four-way valve is to operate to reverse the direction of water flow, to push the brush through the tube while removing tube deposits. Four-way reversing valve's actuator is to be controlled by a preset time cycle that provides regular tube brushing during equipment operation. Frequency of the brushing cycle is to be set up to match Project requirements.
- D. Components:
 - 1. Brush: Each brush is to have nylon bristles, titanium wires, and polypropylene tips. Brush interference fit with the ID of the tube is not to exceed 0.025 inch.
 - 2. Basket: Single-piece polypropylene basket with neck OD to press fit ID of tube. Design is to provide for insertion of eddy current probe or removal of brushes without removing baskets from the valve.
 - 3. Four-Way Valve:
 - a. Construct valve body of carbon steel, with internal sealing parts of hard rubber and Type 304 stainless steel.
 - b. Configure valve with parallel flow connections to minimize field installation of piping.
 - c. Construct to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, at a system working pressure equal to that of condenser.
 - d. Provide flanged pipe connections.
 - e. Valve manufacturer is to test and certify a maximum leakage rate of less than 0.05 percent of the design flow rate at operating conditions of maximum differential pressure.
 - f. Hydrostatically test to 1.5 times the design working pressure.
 - g. Design the valve to cause no more than 0.5-psig pressure drop at design flow conditions.
 - h. Provide valve with valve-mounted indicating/warning light that will light before the valve begins rotation.
 - i. Valve Actuator, Electric: Mount electric actuator to operate valve.
 - j. Valve Actuator, Pneumatic: Mount pneumatic piston-type actuator to operate valve. Actuator is to be suitable for operation using field-supplied air pressure.
 - k. Position Switches: Factory mount microswitches on the valve to indicate the complete turn of valve in both normal and reverse flow.
 - 4. Control Panel: Factory or field mount a control panel on chiller. Control panel is to include the following features:
 - a. NEMA 250, Type 4 enclosure.
 - b. Timer to automatically initiate the cleaning cycle over a 24-hour period.
 - c. Manual override of preset cleaning cycle.
 - d. Visual indication of "Power On," "Diverter Position," "Normal Flow," "Reverse Flow," and "Valve Malfunction," indicating a slow turn or incomplete valve turn.
 - e. For pneumatic actuators, mount four-way solenoid valve for actuator operation in the control panel.
 - f. Flow switch bypass.
 - g. Unloading signal to chiller.

2.6 SOURCE QUALITY CONTROL

- A. AHRI Certification: Certify chiller in accordance with "Water-Cooled Chiller Certification Program."
- B. Perform functional tests of chillers before shipping.
- C. Factory Performance Testing:
 - 1. Factory performance test chillers, before shipping, in accordance with AHRI 550/590.
 - 2. Test the following conditions:
 - a. Design conditions indicated.
 - b. Reduction in capacity from design to minimum load in steps of 25 with condenser fluid at design conditions.
 - c. Reduction in capacity from design to minimum load in steps of 25 with varying entering condenser-fluid temperature from design to minimum conditions in 5 deg F increments.
 - d. At four point(s) of varying part-load performance to be selected by Owner at time of test.
 - 3. Allow Owner access to place where chillers are being tested. Notify Owner in writing at least 30 days in advance of testing.
 - 4. Prepare test report indicating test procedures, instrumentation, test conditions, and results. Submit copy of results within one week of test date.
- D. Factory Sound Testing:
 - 1. For chillers located indoors, rate sound power level in accordance with AHRI 575.
 - 2. Factory sound test chillers, before shipping, in accordance with AHRI 575.
 - 3. Test the following conditions:
 - a. Design conditions indicated.
 - b. Chiller operating at calculated worst-case sound condition.
 - c. At four point(s) of varying part-load performance to be selected by Owner at time of test.
 - 4. Allow Owner access to place where chillers are being tested. Notify Owner in writing at least 30 days in advance of testing.
 - 5. Prepare test report indicating test procedures, instrumentation, test conditions, and results. Submit copy of results within one week of test date.
- E. Factory test and inspect evaporator and condenser according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- F. Factory test and inspect evaporator and condenser according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1. Pressure test fluid side of heat exchangers, including water boxes, to 1.5 times the rated pressure. Pressure proof test refrigerant side of heat exchangers to a minimum of 45 psig. Vacuum and pressure test for leaks.
- G. Eddy Current Testing:

1. Perform factory testing of evaporator and condenser tubes of each chiller to ensure tube quality and longevity.
2. Submit test report, including, at a minimum:
 - a. List of equipment used and equipment settings.
 - b. Test data reports and accompanying strip charts of calibrations.
 - c. Identify tubes with significant defects and typical indications.
 - d. Statistical summary of defect indications.
 - e. Recommendations concerning tube condition, tube replacement, tube removal for evaluation, and future frequency of testing.
 - f. Approval by an American Society for Nondestructive Testing, Level III eddy current technician.

H. Owner Travel Expenses:

1. Include cost associated with Owner travel expenses to witness factory testing. Total value attributed to travel expenses is to be clearly indicated.
2. Expenses are to include roundtrip coach airfare, out-of-town hotel accommodations, out-of-town meals (breakfast, lunch, and dinner), out-of-town ground transportation, and all associated taxes and fees.
3. Exclude other incidental expenses not indicated.
4. Include travel expenses for one Owner representative(s) with origin of San Diego, CA, USA.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine chillers before installation. Reject chillers that are damaged.
- B. Examine roughing-in for equipment support, anchor-bolt sizes and locations, piping, control and electrical connections to verify actual locations, sizes, and other conditions affecting chiller performance, maintenance, and operations before equipment installation.
 1. Chiller locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and control and electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF CENTRIFUGAL WATER CHILLERS

- A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.
- B. Coordinate sizes, locations, and anchoring attachments of structural-steel support structures.
- C. Install chillers on support structure indicated.
- D. Equipment Mounting:

1. Install chillers on cast-in-place concrete equipment bases.
 2. Comply with requirements for vibration isolation and seismic-control devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC."
- E. Maintain manufacturer's recommended clearances for service and maintenance.
- F. Maintain clearances required by governing code.
- G. Chiller manufacturer's factory-trained service personnel are to charge chiller with refrigerant and fill with oil if not factory installed.
- H. Install separate devices furnished by manufacturer and not factory installed.
1. Chillers shipped in multiple major assemblies are to be field assembled by chiller manufacturer's factory-trained service personnel.

3.3 INSTALLATION OF HEAT-EXCHANGER, BRUSH-CLEANING SYSTEM

- A. Install brush-cleaning system control panel adjacent to chiller control panel.
- B. Arrange piping to provide service access to four-way valve assembly without affecting access to chiller. Secure valve to prevent lateral movement and vibration during operation.
- C. Install field electric power, as required, to each system control panel and electric actuated valve.
- D. Install pneumatic piping with pressure regulator and isolation valve to each pneumatic supply connection. Coordinate field source of air with manufacturer to ensure that requirements are satisfied for proper valve operation.
- E. Interconnect brush-cleaning system controls with chiller controls. Coordinate requirements to ensure safe, trouble-free operation.
- F. Functionally test the entire brush-cleaning system, including the valve, actuator, position indicator, and control panel, with chiller in operation.

3.4 PIPING CONNECTIONS

- A. Comply with requirements for piping specified in Section 23 21 13 "Hydronic Piping," and Section 23 21 16 "Hydronic Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to chillers, allow space for service and maintenance.
- C. Evaporator-Fluid Connections:
1. Connect to evaporator inlet with shutoff valve, strainer, flexible connector, thermometer, and plugged tee with pressure gauge.
 2. Connect to evaporator outlet with shutoff valve, balancing valve, flexible connector, thermometer, plugged tee with shutoff valve and pressure gauge, flow meter, and drain connection with valve.

3. Make connections to chiller with a flange or mechanical coupling.

D. Condenser-Fluid Connections:

1. Connect to condenser inlet with shutoff valve, strainer, flexible connector, thermometer, and plugged tee with pressure gauge.
2. Connect to condenser outlet with shutoff valve, balancing valve, flexible connector, thermometer, plugged tee with shutoff valve and pressure gauge, flow meter, and drain connection with valve.
3. Make connections to chiller with a flange or mechanical coupling.

E. Refrigerant-Pressure Relief Device Connections:

1. For chillers installed indoors, extend separate vent piping for each chiller to the outdoors without valves or restrictions.
2. Comply with ASHRAE 15.
3. Connect to chiller pressure relief device with flexible connector and dirt leg with drain valve.

- F. For chillers equipped with a purge system, extend separate purge vent piping for each chiller to the outdoors. Comply with ASHRAE 15 and ASHRAE 147.

- G. Connect each chiller drain connection with a drain valve, which is full size of drain connection. Connect drain pipe to drain valve with union, and extend drain pipe to terminate over floor drain.

- H. Connect each chiller water box vent connection with an automatic vent, which is full size of vent connection.

3.5 ELECTRICAL POWER CONNECTIONS

- A. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- C. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection. Nameplate is to be laminated phenolic layers of black with engraved white letters at least 1/2 inch high. Locate nameplate where easily visible.

3.6 CONTROLS CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring between chillers and other equipment to interlock operation as required to provide a complete and functioning system.
- C. Connect control wiring between chiller control interface and DDC control system for remote monitoring and control of chillers.

- D. Install nameplate on face of chiller control panel indicating the control equipment designation serving chiller and the I/O point designation for each control connection. Nameplate is to be laminated phenolic layers of black with engraved white letters at least 0.5 inch high.

3.7 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Verify that refrigerant charge is sufficient and chiller has been leak tested.
 - 3. Verify that pumps are installed and functional.
 - 4. Verify that thermometers and gauges are installed.
 - 5. Operate chiller for run-in period.
 - 6. Check bearing lubrication and oil levels.
 - 7. Verify that refrigerant pressure relief device is vented outside.
 - 8. Verify proper motor rotation.
 - 9. Verify static deflection of vibration isolators, including deflection during chiller startup and shutdown.
 - 10. Verify and record performance of fluid flow and low-temperature interlocks for evaporator and condenser.
 - 11. Verify and record performance of chiller protection devices.
 - 12. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.
- B. Inspect field-assembled components, equipment installation, piping, controls and electrical connections for proper assembly, installation, and connection.
- C. Visually inspect chiller for damage before starting. Repair or replace damaged components, including insulation. Do not start chiller until damage that is detrimental to operation has been corrected.
- D. Prepare test and inspection startup reports.

3.8 WARRANTY PERIOD TESTING

- A. Within one month(s) of warranty period expiration, perform testing, analysis, and reporting indicated for each chiller.
- B. Eddy Current Testing:
 - 1. Solicit services of a third-party testing agency, specializing in such analysis, to perform testing of evaporator and condenser tubes, to ensure tube quality and longevity.
 - 2. Submit test report to Owner, including, at a minimum:
 - a. List of equipment used and equipment settings.
 - b. Test data reports and accompanying strip charts of calibrations.
 - c. Identify tubes with significant defects and typical indications.
 - d. Statistical summary of defect indications.

- e. Recommendations concerning tube condition, tube replacement, tube removal for evaluation, and future frequency of testing.
- f. Approval by an American Society for Nondestructive Testing, Level III eddy current technician.

C. Oil Analysis:

- 1. Take oil sample and solicit services of a third-party testing agency, specializing in such analysis, to perform oil analysis.
- 2. Submit analysis results and recommendations to Owner.

D. Refrigerant Analysis:

- 1. Take refrigerant sample and solicit services of a third-party testing agency, specializing in such analysis, to perform refrigerant analysis.
- 2. Submit analysis results and recommendations to Owner.

E. Site Access and Scheduling:

- 1. Contact Owner to schedule testing at least 30 days in advance of testing.
- 2. Make mutually agreeable schedule adjustments to accommodate Owner's request for testing.
- 3. Review, with Owner, requirements for visitors in advance of testing.
- 4. Comply with Owner requirements for visitors while on-site.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain chillers. Video record the training sessions and provide electronic copy to Owner.

- 1. Instructor must be factory trained and certified.
- 2. Provide not less than eight hours of training.
- 3. Train personnel in operation and maintenance and to obtain maximum efficiency in plant operation.
- 4. Provide instructional videos showing general operation and maintenance that are coordinated with operation and maintenance manuals.
- 5. Obtain Owner sign-off that training is complete.
- 6. Owner training is to be held at Project site.

END OF SECTION 236416

SECTION 23 65 14.13

OPEN-CIRCUIT, INDUCED-DRAFT, COUNTERFLOW COOLING TOWERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. RFP, City of San Diego Whitebook, City of San Diego General Contract Terms and Provisions, and Drawings apply to this section.

1.2 SUMMARY

- A. Section includes factory-assembled, open-circuit, induced-draft, counterflow cooling towers.

1.3 DEFINITIONS

- A. SCCR: Short-circuit current rating.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, pressure drop, fan performance data, rating at selected points indicated, and furnished specialties and accessories.
 - 2. Maximum flow rate.
 - 3. Minimum flow rate.
 - 4. Pressure required at cooling tower supply piping connections.
 - 5. Pressure required at basin heater supply piping connections.
 - 6. Pressure required at collection basin sweeper supply piping connections.
 - 7. Drift loss as percent of design flow rate.
 - 8. Volume of water in suspension for purposes of sizing remote storage.
 - 9. Sound:
 - a. Sound pressure levels for operation with fan off, fan at minimum speed, and design speed. If sound requirements are indicated at a specific distance, submit performance using same distance for comparative analysis.
 - b. Sound power levels in eight octave bands for operation with fans off, fans at minimum speed, and design speed.
 - 10. Performance curves for the following:
 - a. Varying entering-water temperatures from design to minimum in five-degree temperature increments.
 - b. Varying ambient wet-bulb temperatures from design to minimum in one Insert number-degree temperature increments.

- c. Varying water flow rates from design to minimum in increments of 10 percent of flow rate difference between design and minimum flow rates.
 - d. Varying fan operation from design to minimum speed in 5 Insert number percent speed increments, and with fan off.
 - 11. Fan airflow at design conditions, brake horsepower, and drive losses (indicated in horsepower and percent of brake horsepower).
 - 12. Fan motor electrical characteristics including, but not limited to, speed, voltage, phase, hertz, amperage, efficiency, and power factor at 100, 75, 50, and 25 percent of nameplate horsepower.
 - 13. Electrical power requirements for each cooling tower component requiring power.
- B. Shop Drawings:
- 1. Manufacturer's drawings of assembled cooling towers, control panels, sections, and elevations.
 - 2. Assembled unit dimensions.
 - 3. Diagram showing each separate piece requiring field assembly.
 - 4. Shipped sub-assembly dimensions and weights for field assembly.
 - 5. Assembled unit weight without water.
 - 6. Operating weight and load distribution.
 - 7. Unit vibration isolation and seismic controls.
 - 8. Required clearances for maintenance and operation.
 - 9. Sizes and dimensioned locations of piping and wiring connections.
 - 10. Diagrams for power, signal, and control wiring.
- C. Delegated-Design Submittal: For cooling tower support structure indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- 1. Detail fabrication and assembly of support structure.
 - 2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.
 - 3. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings:

- 1. Drawings on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - a. Structural supports.
 - b. Piping roughing-in requirements.
 - c. Conduit and wiring roughing-in requirements for controls and electrical power, including spaces reserved for controls and electrical equipment.
 - d. Access requirements, including working clearances for controls and electrical equipment, and service clearances. Mark and label clearances.

2. Drawings showing plans, sections, and elevation views, drawn to scale of at least 1/4" = 1'-0".
 3. Each view to show screened background with the following:
 - a. Structural grids.
 - b. Adjacent walls, floors, and roofs.
 - c. Equipment and products of other trades that are located in vicinity of cooling towers and are part of final installation, such as, controls, power, lighting, fire-suppression systems, and plumbing systems.
- B. Seismic Qualification Data: Certificates, for cooling towers, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Product Certificates: For certification required in "Quality Assurance" Article.
- D. Field Test Reports: Include startup service reports.
- E. Source quality-control reports.
- F. Field quality-control reports.
- G. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each cooling tower to include in emergency, operation, and maintenance manuals.
- B. Instructional Videos: Including those that are prerecorded and those that are recorded during training.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Belts:
 1. Furnish one set(s) of matching belts for each unique belt configuration and size furnished.
- B. Tool Kit:
 1. A tool kit specially designed by cooling tower manufacturer for use in servicing cooling tower(s) furnished.
 2. Special tools required to service components not readily available to Owner service personnel in performing routine maintenance.

3. Lockable case with hinged cover, marked with large and permanent text to indicate the special purpose of tool kit, such as "Cooling Tower Tool Kit." Text size shall be at least 1 inch high.
 4. A list of each tool furnished. Permanently attach the list to underside of case cover. Text size shall be at least 1/2 inch high.
- C. Touchup Coating: 32-oz. container of paint coating used. Label outside of container with detailed description of coating to allow for procurement of a matching coating in the future.

1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Certified by CTI.
- B. CTI Certification: Cooling tower thermal performance according to CTI STD 201RS.
- C. FM Global: Approval and listing in the latest edition of FM Global's "Approval Guide."

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Coordinate requirements for multi-piece assembly for shipment. Limit the number of separate pieces for field installation to as few as possible.
- B. If factory assembly of multiple pieces is required for testing or other reasons, disassemble cooling tower into major assemblies as required by installation before packaging for shipment.
 1. Clearly label each separate package with a unique designation and include with assembly instructions for each complete cooling tower.
 2. Install seals on gear-drive assemblies to eliminate oil leakage during shipment if shipped with oil.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace the following components of cooling towers that fail in materials or workmanship within specified warranty period:
 1. All components of cooling tower.
 2. Fan assembly including fan, drive, and motor.
 3. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer's
 1. BAC
 2. Evapco
 3. Or approved equal

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer to design the cooling tower support structure and seismic restraints, including a comprehensive engineering analysis.
- B. Structural Performance: Cooling tower and support structure shall withstand the effects of loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
- C. Seismic Performance: Cooling towers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
- D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1.
- E. 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.
- F. Operation Following Loss of Normal Power:
 - 1. Equipment, associated factory- and field-installed controls, and associated electrical equipment and power supply connected to backup power system shall automatically return equipment and associated controls to the operating state occurring immediately before loss of normal power without need for manual intervention by an operator when power is restored either through a backup power source, or through normal power if restored before backup power is brought on-line.
 - 2. Include means and methods required to satisfy requirement even if not explicitly indicated.
- G. Vibration:
 - 1. Rotating assemblies shall be dynamically balanced to achieve a balance level of "good" while complying with industry-standard requirements for cooling towers.
 - 2. Critical speed shall be at least 115 percent of design speed.

2.3 DESIGN ARRANGEMENT

- A. Counterflow design with airflow from all sides and induced-draft, top-mounted axial fan and pressurized pipe distribution.

2.4 CASING AND FRAME

- A. Casing Material: FRP with UV inhibitors.
- B. Frame Material:] materials to match casing.
- C. Hardware: stainless steel.

- D. Joints and Seams: Sealed watertight.
- E. Welded Connections: Sealed watertight.

2.5 COLLECTION BASIN

- A. Field-Constructed Collection Basin: Configure tower without a factory-assembled collection basin for installation and operation with a field-constructed collection basin.
- B. Factory-Assembled Collection Basin:
 - 1. Material: Stainless steel, Grade 316 .
 - 2. Hardware: Galvanized or stainless steel.
 - 3. Joints and Seams: Sealed watertight.
 - 4. Welded Connections: Sealed watertight.
 - 5. Removable stainless-steel strainer with openings smaller than nozzle orifices.
 - 6. Overflow and drain connections.
 - 7. Makeup-water connection.
 - 8. Outlet Connection: Configured to mate to ASME B16.5, Class 150 flange.
 - 9. Removable equalization flume plate between adjacent cells of multiple-cell towers.
 - 10. Equalizer connection for field-installed equalizer piping configured to mate to ASME B16.5, Class 150 flange.
 - 11. Basin Sweeper Distribution Piping and Nozzles:
 - a. Pipe Material: PVC or CPVC, Schedule 40 or heavier, treated with UV inhibitors and intended for continuous exposure to direct sunlight with degradation.
 - b. Nozzle Material: Plastic.
 - c. Configure piping and nozzles to minimize sediment from collecting in the collection basin.
 - d. Basin penetrations sealed watertight.
 - e. Field Connections: Threaded or flanged depending on pipe size. Thread for sizes through 3" and flanged for larger sizes.

2.6 COLLECTION BASIN MAKEUP-WATER ASSEMBLY

- A. Mechanically Operated, Collection Basin Water-Level Control: Manufacturer's standard adjustable, mechanical float assembly and valve.
- B. Electric/Electronic, Collection Basin Water-Level Controller with Makeup-Water Valve:
 - 1. Enclosures: NEMA 250, Type 4.
 - 2. Sensor: Solid-state controls with multiple electrode probes and relays factory wired to a terminal strip to control makeup-water valve.
 - 3. Electrode Probes: Stainless steel.
 - 4. Water Stilling Chamber: Stainless steel, Grade 316 .
 - 5. Makeup-Water Valve:
 - a. Slow closing.

- b. Valve actuator controlled and powered through level controller in response to water-level set point.
 - c. Actuator Enclosure: NEMA 250, Type 4.
 - d. Fail Position: Last.
 - e. Action: Two position or modulating.
- 6. Electrical Connection Requirements: 120-V ac, single phase, 60 Hz.

2.7 FILL

- A. Materials: PVC, with maximum flame-spread index of 5 according to ASTM E84.
- B. Minimum Thickness: 15 mils, before forming.
- C. Fabrication: Fill-type sheets, fabricated, formed, and bonded together after forming into removable assemblies that are factory installed by manufacturer.
- D. Fill Material Operating Temperature: Suitable for entering-water temperatures up through 120 deg F.
- E. Hardware: stainless steel.

2.8 DRIFT ELIMINATORS

- A. Material: FRP; with maximum flame-spread index of 5 according to ASTM E84.
- B. UV Treatment: Inhibitors to protect against damage caused by UV radiation.
- C. Configuration: Multipass, designed and tested to reduce water carryover to 0.005 percent of design flow rate indicated.
- D. Hardware: stainless steel.

2.9 AIR INLET

- A. Air-Intake Louvers:
 - 1. Material: Matching casing.
 - 2. UV Treatment: Inhibitors to protect against damage caused by UV radiation.
 - 3. Multiple, easily removable sections arranged to uniformly direct air into cooling tower, to minimize air resistance, to block direct sunlight, and to prevent water from splashing out of tower during all modes of operation including operation with fans off.

2.10 FAN AND DRIVE ASSEMBLY

- A. Axial Fan: Balanced at the factory after assembly.
 - 1. Blade Material: Aluminum.

2. Hub Material: Aluminum.
 3. Blade Pitch: Field adjustable.
 4. Fan Shaft: Corrosion resistant.
 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.
- B. Direct Drive: Fan hub directly connected, and properly secured, to motor shaft.
- C. Gear Drive: Right angle, reduced speed, and designed for cooling tower applications according to CTI STD 111. Motor and gear drive shall be aligned before shipment.
1. Gear Drive and Coupling Service Factor: 2.0 based on motor nameplate horsepower.
 2. Housing: Cast iron, with epoxy or polyurethane finish, beveled high-strength steel gears continuously bathed in oil, and with lubrication to other internal parts at all operating speeds.
 3. Mounting: Directly mounted to fan hub and connected to motor so motor shaft is in horizontal position.
 4. Operation: Able to operate both forward and in reverse. Able to operate throughout entire speed range from design speed indicated down to 10 of design speed.
 5. Drive-to-Motor Connection: Close coupled to motor using a flexible coupling.
 6. Drive-to-Motor Connection: Connected to motor located outside of cooling tower casing by a full-floating drive shaft.
 7. Drive Shaft Material: Corrosion resistant, and fitted with flexible couplings on both ends.
 8. Drive Guards: Exposed shaft and couplings shall have guards according to OSHA regulations.
 9. Extend oil fill, drain, and vent to outside of cooling tower casing using galvanized-steel or stainless-steel piping. Include oil-level sight glass.
- D. Fan Motor:
1. Comply with NEMA MG 1 unless otherwise indicated.
 2. Description: NEMA MG 1, Design B, as required to comply with capacity and torque characteristics; medium induction motor.
 3. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
 4. Motor Enclosure: Totally enclosed fan-cooled (TEFC).
 5. Rotor: Random-wound, squirrel cage.
 6. Energy Efficiency: Comply with ASHRAE/IES 90.1.
 7. Service Factor: 1.15.
 8. Temperature Rise: Match insulation rating.
 9. Insulation: Class F.
 10. 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."
 11. Motor Location: Mounted outside of cooling tower casing and cooling tower discharge airstream.
 12. Severe-Duty Rating:

- a. Rotor and stator protected with corrosion-inhibiting epoxy resin.
 - b. Double-shielded, vacuum-degassed bearings lubricated with premium, moisture-resistant grease suitable for temperatures between minus 20 and plus 300 deg F.
 - c. Internal Heater: Automatically energized when motor is de-energized.
 - d. Complying with IEEE 841.
- 13. Motor Base: Adjustable, or other suitable belt-tensioning provisions.
- 14. Motor Shaft Grounding: Motors shall be controlled through variable-frequency controllers with shaft grounding system to protect motor bearings from induced voltage. Drag on motor shaft due to shaft ground system shall be less than 0.5 percent of motor nameplate horsepower.
- E. Hardware: stainless steel.

2.11 AIR DISCHARGE

- A. Low-Profile Fan Discharge Stack:
 - 1. Manufacturer's standard low-profile design.
 - 2. Material: Material to match casing.
 - 3. Stack Termination: Wire-mesh, stainless-steel screens; segmented into multiple removable pie sections and complying with OSHA regulations.
- B. Hardware: stainless steel.

2.12 ELECTRICAL POWER

- A. Factory Furnish for Field Installation: A variable-frequency controller for each fan motor.
- B. Variable-Frequency Controllers:
 - 1. Description: NEMA ICS 2; arranged to achieve motor variable speed by adjusting output voltage and frequency.
 - 2. Enclosure: Unit mounted, NEMA 250, Type 3R, with hinged full-front access door with lock and key.
 - 3. Externally Operated, Door-Interlocked Disconnect: Fused disconnect switch with lockable handle.
 - 4. Minimum SCCR: As required by electrical power distribution system, but not less than 65,000 A.
 - 5. Technology: Pulse-width-modulated (PWM) output with insulated gate bipolar transistors (IGBT); suitable for variable torque loads.
 - 6. Controller shall consist of a rectifier converter section, a digital/analog driver regulator section, and an inverter output section.
 - 7. Output Rating: Three phase; with voltage proportional to frequency throughout voltage range.
 - 8. Output signal shall be programmed to not cause mechanical vibration issues with fan drive assembly.
 - 9. Operating Requirements:

- a. Input AC Voltage Tolerance: 10 percent.
 - b. Input frequency tolerance of 60 Hz, plus or minus 2 Hz.
 - c. Capable of driving full motor load, without derating.
 - d. Minimum Efficiency: 96 percent at 60 Hz, full load.
 - e. Minimum Displacement Primary-Side Power Factor: 95 percent.
 - f. Overload Capability: 1.05 times the full-load current for 7 seconds.
 - g. Starting Torque: As required by fan and motor drive assembly.
 - h. Speed Regulation: 1 percent.
 - i. Speed Range: 10:1 speed range.
 - j. To avoid equipment resonant vibrations, include critical speed lockout circuitry to allow bands of operating frequency at which controller shall not operate continuously.
 - k. Capable of being restarted into a motor coasting in either the forward or reverse direction without tripping.
10. Controller Adjustability Capabilities: Minimum and maximum output frequency, acceleration and deceleration, and current limit.
11. Self-Protection and Reliability Features: Subjecting the controller to any of the following conditions shall not result in component failure or the need for replacement:
- a. Overtemperature.
 - b. Short circuit at controller output.
 - c. Ground fault at controller output. Variable-frequency controller shall be able to start a grounded motor.
 - d. Open circuit at controller output.
 - e. Input undervoltage.
 - f. Input overvoltage.
 - g. Loss of input phase.
 - h. Reverse phase.
 - i. AC line switching transients.
 - j. Instantaneous overload, line to line or line to ground.
 - k. Sustained overload exceeding 100 percent of controller rated current.
 - l. Starting a rotating motor.
12. Motor Protection: Controller shall protect motor against overvoltage and undervoltage, phase loss, reverse phase, overcurrent, overtemperature, and ground fault.
13. Automatic Reset and Restart:
- a. Capable of multiple restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction.
 - b. Capable of automatic restart on phase-loss and overvoltage and undervoltage trips.
14. Visual Indication: On face of controller; indicating the following conditions:
- a. Power on.
 - b. Run.
 - c. Overcurrent and overvoltage.
 - d. Motor speed (percent).
 - e. Various faults with alarm status.
 - f. Input kilovolt amperes.
 - g. Power factor.

- h. Input kilowatts and kilowatt-hours.
 - i. Three-phase input and output voltage.
 - j. Three-phase input and output current.
 - k. Output frequency.
 - l. Elapsed operating time (hours).
 - m. Diagnostic and service parameters.
- 15. Operator Interface: Start-stop and auto-manual selector with manual-speed-control potentiometer.
 - 16. Control Signal Interface: A minimum of two analog inputs (0 to 10 V or 0/4 to 20 mA) and four programmable digital inputs.
 - 17. Bypass Controller:
 - a. Integrated NEMA ICS 2, Class A, full-voltage, non-reversing, motor-rated controller to operate fan motor if variable-frequency controller is not operational.
 - b. Configure power supply to bypass controller and variable-frequency controller to completely isolate power to variable-frequency controller while operating fan motor through bypass controller for safe servicing of variable-frequency controller.
 - c. Include "Bypass/VFC" manual selector switch on face of enclosure for local operator control of preferred controller.
 - d. Include fail-safe control logic to automatically transfer fan motor operation from failed variable-frequency controller to bypass controller.
 - e. Install bypass controller in same enclosure as variable-frequency controller.

2.13 CONTROLS

A. 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. Switch shall have manual-reset button hardwired connection to fan motor electrical circuit.
- 4. Switch shall have field connection to a control system hardwired connection to fan motor electrical circuit.
- 5. Switch shall, on sensing excessive vibration, signal an alarm for connection to control system and shut down the fan.

B. Vibration Transmitter with Switch: For each fan drive.

- 1. Enclosure: NEMA 250, Type 4X.
- 2. Display: Local display of measured value, power, and alarm.
- 3. Vibration Detection: Sensor with a field-adjustable, acceleration-sensitivity set point.
 - a. Cooling tower manufacturer shall select range that is suitable for cooling tower and recommend switch set point for proper operation and protection.
- 4. Transmitter: Continuous vibration level indication through a 4- to 20-mA signal for connection to control system.

5. Switch:
 - a. Relay and switch with manual-reset button for field connection to control system and hardwired connection to fan motor electrical circuit.
 - b. Switch shall, on sensing excessive vibration, signal an alarm to control system and shut down the fan.
 6. Mounting: Locate out of cooling tower discharge airstream and mount in a location that is accessible and where display is easily viewable.
 7. Field Electrical Connection Requirements: 120 V, single phase, 60 Hz.
- C. Gear-Drive, Oil-Level Switch: Low-oil-level warning switch.
1. Switch shall, on reaching a low-oil-level set point recommended by cooling tower manufacturer, signal an alarm.
- D. Control Package:
1. Factory installed and wired, and functionally tested at factory before shipment.
 2. NEMA 250, Type 3R enclosure with removable internally mount backplate.
 3. Control-circuit transformer with primary and secondary side fuses.
 4. Terminal blocks with numbered and color-coded wiring to match wiring diagram. Spare wiring terminal block for connection to external controls or equipment.
 5. Microprocessor-based controller for automatic control of fan based on cooling tower leaving-water temperature with control features to improve operating efficiency based on outdoor ambient wet-bulb temperature by using adaptive logic.
 6. Fan motor sequencer for multiple-cell and two-speed applications with automatic lead stage rotation.
 7. Collection basin level controller complying with requirements in "Electric/Electronic, Collection Basin Water-Level Controller with Makeup-Water Valve" Paragraph in "Collection Basin Makeup-Water Assembly" Article.
 8. Electric basin heaters with temperature control and low-water-level safety switch for each cell, complying with requirements in "Collection Basin Heater" Article.
 9. Vibration switch for each fan, complying with requirements in "Vibration Switch" Paragraph.
 10. Oil-level switch for each fan with a gear drive, complying with requirements in "Gear-Drive, Oil-Level Switch" Paragraph.
 11. Single-point, field-power connection to a fused disconnect switch for each cooling tower cell.
 - a. Branch power circuit to each motor and electric basin heater and to controls with a disconnect switch or circuit breaker.
 - b. NEMA-rated motor controller, hand-off-auto switch, and overcurrent protection for each motor. Include variable-frequency controller with manual bypass and line reactors for each variable-speed motor indicated.
 12. Factory-installed wiring outside of enclosures shall be in metal raceway, except make connections to each motor and electric basin heater with liquidtight conduit.
 13. Visual indication of status and alarm with momentary test push button for each motor.
 14. Audible alarm and silence switch.
 15. Visual indication of elapsed run time, graduated in hours for each motor.

16. Cooling tower shall have hardware to enable control system to remotely monitor and display the following:
 - a. Operational status of each motor.
 - b. Cooling tower leaving-fluid temperature.
 - c. Fan vibration alarm.
 - d. Oil-level alarm.
 - e. Collection basin high- and low-water-level alarms.

2.14 SERVICE ACCESS

A. Doors:

1. Large enough for personnel to access cooling tower internal components.
2. Doors shall be hinged with handles operable from both sides of the door.
3. Door materials shall match casing.
4. Hinges and handles shall be FRP.

B. External Ladders with Safety Cages: Aluminum fixed ladders with ladder extensions to access external platforms and top of cooling tower from adjacent grade without the need for portable ladders. Comply with 29 CFR 1910.27.

C. External Platforms with Handrails: bar grating at cooling tower access doors when cooling towers are elevated and not accessible from grade.

D. External Motor Platforms with Handrails: FRP bar grating.

E. Fan Deck Floor between Cooling Tower Cells:

1. Factory furnish reinforced fan deck floor panels between cooling tower cells for field installation.
2. Floor materials shall match adjacent cooling tower cell fan deck.
3. Fan deck floor shall fasten to and be supported by framing that is attached to cooling tower cells.
4. Frame shall be constructed of same materials as cooling tower frame.

F. Handrail: galvanized steel complete with kneerail and toeboard, around external platforms and top of cooling tower. Comply with 29 CFR 1910.23.

G. Internal Platforms: FRP bar grating.

1. Spanning the collection basin from one end of cooling tower to the other and positioned to form a path between. Platform shall be elevated so that all parts are above the high water level of the collection basin.
2. Elevated internal platforms with handrails accessible from fixed vertical ladders to access the fan drive assembly when out of reach.

H. Hardware: Galvanized steel when connecting galvanized-steel components; stainless steel when connecting other materials.

2.15 HOISTING ASSEMBLY

- A. Hoisting assembly consisting of pedestal base, davit arm, and winch to accommodate lowering and raising cooling tower components from their installed location to the base of cooling tower supports.
 - 1. Cooling tower components serviceable by hoisting assembly shall include, but not be limited to, fan stack, fan, fan drive, and fan motor.
 - 2. Hoisting assembly shall be designed to accommodate heaviest single component plus a safety factor of 1.5.
 - 3. Construct cooling tower structural supports and reinforcing to accommodate lifting heaviest load with safety factor.
- B. Pedestal Base:
 - 1. Equip each cooling tower cell with a pedestal base to accommodate an easily removable davit arm and winch assembly.
 - 2. Position pedestal base at a location on cooling tower for hoisting assembly coverage to fan, fan motor, and fan drive assembly.
 - 3. Pedestal base design shall be open-socket, or comparable, design that is configured to accept and secure an inserted portable davit arm.
 - 4. Fit each pedestal base with an easily removable cap or plug designed to seal the open top of the base when the davit arm is not installed.
 - 5. Fasten pedestal base to cooling tower using threaded hardware.
 - 6. Construct pedestal base of hot-dip galvanized steel or 300L series stainless steel.
- C. Davit Arm:
 - 1. Each cooling tower shall have a davit arm.
 - 2. Davit arm shall be an adjustable telescoping design with angular adjustment to accommodate varying lifting conditions required by the application.
 - 3. Davit arm assembly shall be portable and capable of being relocated to any cooling tower cell pedestal base.
 - 4. Construct davit arm of hot-dip galvanized steel or 300L series stainless steel.
- D. Winch:
 - 1. Each davit arm shall have an electric- or a hand-operated winch.
 - a. Electric winch shall include a power cord and plug for connection to a field-installed, weatherproof, 20-A receptacle with 120-V, single-phase, 60-Hz field power supply.
 - b. Hand-operated winch with gear mechanism to limit force on handle to not more than 80 lb when lifting the heaviest component.
 - 2. Coat winch body and exposed components with corrosion-resistant finish that is rated for outdoor duty in a highly corrosive environment and exposed to direct sunlight.
 - 3. Winch cable shall be stainless steel and terminated with a stainless-steel hook and quick disconnecting mechanism. Cable length shall be at least 1.5 times actual length required for application.

E. Hardware: 304 or 316 series stainless steel.

F. Nameplate:

1. Stamped or engraved aluminum or stainless-steel nameplate with rated load capacity on each davit arm and pedestal.
2. Letter size legible from a distance 60 inches and not less than 1/2 inch.
3. Fasten nameplate at multiple points with stainless-steel rivets or screws.

2.16 CAPACITIES AND CHARACTERISTICS – Per Cooling Tower Schedule

2.17 SOURCE QUALITY CONTROL

A. Performance Test: Factory test and certify cooling tower performance according to CTI STD 201RS, "Standard for the Certification of Water-Cooling Tower Thermal Performance."

1. Allow Owner access to place where cooling towers are being tested. Notify Owner in writing at least 30 days in advance of testing.
2. Prepare test report indicating test procedures, instrumentation, test conditions, and results. Submit copy of results within one week of test date.

B. Seismic Performance Testing: Shake table tested by an independent laboratory to certify performance complies with seismic requirements indicated.

1. Allow Owner access to place where cooling towers are being tested. Notify Owner in writing at least 30 days in advance of testing.
2. Prepare test report indicating test procedures, instrumentation, test conditions, and results. Submit copy of results within one week of test date.

C. Factory Functional Tests:

1. Test collection and distribution basins after assembly, and prove free of leaks.
2. Test factory-installed electric/electronic water-level controls for proper operation.
3. Test factory-installed electric basin heaters for proper operation.
4. Test factory-installed fan and drive assemblies for proper operation.
5. Test factory-installed control package for proper operation.
6. Test access doors to ensure smooth operation and proper fit.
7. Allow Owner access to place where cooling towers are being tested. Notify Owner in writing at least 30 days in advance of testing.
8. Submit report documenting tests performed and results within one week of test date.

D. Owner Travel Expenses:

1. Include cost associated with Owner travel expenses to witness testing. Total value attributed to travel expenses shall be clearly indicated.
2. Expenses shall include round-trip coach airfare, out of town hotel accommodations, out of town meals (breakfast, lunch, and dinner), out of town ground transportation, and all associated taxes and fees.

3. Exclude other incidental expenses not indicated.
4. Include travel expenses for one Owner representative(s) with origin of San Diego, CA, USA.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine cooling towers before installation. Reject cooling towers that are damaged.
- B. Before cooling tower installation, examine roughing-in for tower support, anchor-bolt sizes and locations, piping, controls, and electrical connections to verify actual locations, sizes, and other conditions affecting cooling tower performance, maintenance, and operation.
 1. Cooling tower locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping, controls, and electrical connections.
 2. Verify sizes and locations of concrete bases and support structure with actual equipment.
 3. Verify sizes, locations, and anchoring attachments of structural-steel support structures.
 4. Verify sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install cooling towers on support structure.
- B. Equipment Mounting:
 1. Install cooling towers on cast-in-place concrete equipment bases.
 2. Comply with requirements for vibration isolation and seismic-control devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC."
- C. Install anchor bolts to elevations required for proper attachment to supported equipment.
- D. Maintain manufacturer's recommended clearances for service and maintenance.
- E. Maintain clearances required by governing code.
- F. Loose Components: Install components, devices, and accessories furnished by manufacturer, with cooling tower, that are not factory mounted.
 1. Loose components shall be installed by Contractor under supervision of manufacturer's factory-trained service personnel.

3.3 PIPING CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to cooling towers, allow space for service and maintenance.
- C. Install flexible pipe connectors at pipe connections of cooling towers mounted on vibration isolators.
- D. Install drain piping with valve at cooling tower drain connections and at low points in piping.
- E. Connect cooling tower overflows and drains, and piping drains, to sanitary sewage system.
- F. Makeup-Water Piping:
 - 1. Connect to makeup-water connections with shutoff valve, plugged tee with pressure gage, flow meter, and drain connection with valve and union.
- G. Supply and Return Piping:
 - 1. Comply with applicable requirements in Section 23 21 13 "Hydronic Piping" and Section 23 21 16 "Hydronic Piping Specialties."
 - 2. Connect to entering cooling tower connections with shutoff valve, strainer, balancing valve, thermometer, plugged tee with pressure gage, flow meter, and drain connection with valve.
 - 3. Connect to leaving cooling tower connection with shutoff valve thermometer, plugged tee with full port ball valve for portable field instruments, and drain connection with valve.
 - 4. Make connections to cooling tower with a flange.
- H. Equalizer Piping:
 - 1. Piping requirements to match supply and return piping.
 - 2. Connect an equalizer pipe, full size of cooling tower connection, between tower cells.
 - 3. Connect to cooling tower with shutoff valve and drain connection with valve.
 - 4. Make connections to cooling tower with a flange.
- I. Basin Heater Hot-Water Piping:
 - 1. Comply with applicable requirements in Section 23 21 13 "Hydronic Piping" and Section 23 21 16 "Hydronic Piping Specialties."
 - 2. Connect to supply connections with shutoff valve, strainer, control valve thermometer, plugged tee with pressure gage, flow meter, and drain connection with valve.
 - 3. Connect to return connections with shutoff valve, balancing valve, thermometer, plugged tee with pressure gage, flow meter, and drain connection with valve.
 - 4. Make connections with a flange, union, or mechanical coupling.
- J. Basin Sweeper Piping:
 - 1. Comply with applicable requirements in Section 23 21 13 "Hydronic Piping" and Section 23 21 16 "Hydronic Piping Specialties."

2. Connect to supply connections with shutoff valve, flow meter, and drain connection with valve.
3. Connect to return connections with shutoff valve, balancing valve, flow meter, and drain connection with valve.
4. Make connections with a flange or union.

3.4 ELECTRICAL POWER CONNECTIONS

- A. Connect field electrical power source to each separate electrical device requiring field electrical power. Coordinate termination point and connection type with Installer.
- B. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.
- C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems" for grounding connections.
- D. Install nameplate for each electrical connection indicating electrical equipment designation and circuit number feeding connection. Nameplate shall be laminated phenolic layers of black with engraved white letters at least 1/2 inch high. Locate nameplate where easily visible.

3.5 CONTROLS CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring between cooling towers and other equipment to interlock operation as required to achieve a complete and functioning system.
- C. Connect control wiring between cooling tower control interface and control system for HVAC for remote monitoring and control of cooling towers. Comply with requirements in Section 230923 "Direct Digital Control (DDC) System for HVAC."
- D. Install label at each termination indicating control equipment designation serving cooling tower and the I/O point designation for each control connection. Comply with requirements in Section 260553 "Identification for Electrical Systems" for labeling and identifying products and installations.

3.6 FIELD TESTING PROVISIONS

- A. Include provisions for cooling tower future field-performance testing complying with ASME PTC 23.
- B. Include provisions in field piping for future field-performance testing complying with ASME PTC 23.

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections with the assistance of a factory-authorized service representative.
- E. Tests and Inspections: Comply with ASME PTC 23.
- F. Cooling towers will be considered defective if they do not pass tests and inspections.
- G. Prepare test and inspection reports.

3.8 STARTUP SERVICE

- A. Perform startup service.
- B. Inspect field-assembled components, equipment installation, and piping; controls; 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. Verify proper oil level in gear-drive housing. Fill with oil to proper level.
 - i. Operate variable-speed fans through entire operating range and check for harmonic vibration imbalance. Set motor controller to skip speeds resulting in abnormal vibration.
 - j. Check vibration switch setting. Verify operation.
 - k. Verify water level in tower basin. Fill to proper startup level. Check makeup-water-level control and valve.
 - l. Verify operation of basin heater and control.
 - m. Verify that cooling tower air discharge is not recirculating air into tower or HVAC air intakes. Recommend corrective action.
 - n. 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.

3.9 ADJUSTING

- A. Set and balance water flow to each tower inlet.
- B. Adjust water-level control for proper operating level.
- C. Adjust basin heater control for proper operating set point.

3.10 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain cooling towers.
 - 1. Video record the training sessions.
 - 2. Instructor shall be factory trained and certified.
 - 3. Perform not less than 8 hours of training.
 - 4. Train personnel in operation and maintenance and to obtain maximum efficiency in plant operation.
 - 5. Perform instructional videos showing general operation and maintenance that are coordinated with operation and maintenance manuals.
 - 6. Obtain Owner sign-off that training is complete.
 - 7. Owner training shall be held at Project site.

END OF SECTION 236514.13

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. RFP, City of San Diego Whitebook, City of San Diego General Contract Terms and Provisions, and Drawings apply to this section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Copper building wire rated 600 V or less.
 - 2. Metal-clad cable, Type MC, rated 600 V or less.
 - 3. Connectors, splices, and terminations rated 600 V and less.

1.3 DEFINITIONS

- A. RoHS: Restriction of Hazardous Substances.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: Indicate type, use, location, and termination locations.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA.
 - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Alpha Wire Company.

2. Okonite Company (The).
 3. Service Wire Co.
 4. Southwire Company.
 5. Or approved equal.
- C. Standards:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 2. RoHS compliant.
 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- E. Conductor Insulation:
1. Type THHN and Type THWN-2: Comply with UL 83.
 2. Type XHHW-2: Comply with UL 44.

2.2 METAL-CLAD CABLE, TYPE MC

- A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Alpha Wire Company.
 2. American Bare Conductor.
 3. Okonite Company (The).
 4. Southwire Company.
 5. Or approved equal.
- C. Standards:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 2. Comply with UL 1569.
 3. RoHS compliant.
 4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Circuits:
1. Single circuit and multi circuit with color-coded conductors.
- E. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- F. Ground Conductor: Insulated.
- G. Conductor Insulation:
1. Type TFN/THHN/THWN-2: Comply with UL 83.

- 2. Type XHHW-2: Comply with UL 44.
- H. Armor: Steel, interlocked.
- I. Jacket: PVC applied over armor.

2.3 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. 3M Electrical Products.
 - 2. Hubbell Incorporated, Power Systems.
 - 3. Ideal Industries, Inc.
 - 4. Service Wire Co.
 - 5. TE Connectivity Ltd.
 - 6. Or approved equal.
- C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.
- D. Submersible Splices shall be UL listed cable joints utilizing flexible, flame retardant and water resistant resin and are compatible with EPR, neoprene, Hypalon, PVC, and nitrile sheaths.
- E. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
 - 1. Material: Copper.
 - 2. Type: One hole with standard barrels.
 - 3. Termination: Compression.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN/THWN-2, single conductors in raceway.

- B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- D. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.
- F. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- G. Branch Circuits in Wet Well: Type XHHW-2, multiwire, suitable for submersible .

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 26 05 33 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Support cables according to Section 26 05 29 "Hangers and Supports for Electrical Systems."

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 26 05 53 "Identification for Electrical Systems."

3.6 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
 - 2. Perform each of the following visual and electrical tests:
 - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
 - b. Test bolted connections for high resistance using one of the following:
 - 1) A low-resistance ohmmeter.
 - 2) Calibrated torque wrench.
 - c. Inspect compression-applied connectors for correct cable match and indentation.
 - d. Inspect for correct identification.
 - e. Inspect cable jacket and condition.
 - f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
 - g. Continuity test on each conductor and cable.
 - h. Uniform resistance of parallel conductors.
- C. Cables will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports to record the following:
 - 1. Procedures used.
 - 2. Results that comply with requirements.
 - 3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION

SECTION 26 05 23
CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Category 6A balanced twisted pair cable.
2. Balanced twisted pair cable hardware.
3. Control cable.
4. Control-circuit conductors.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- A. Source quality-control reports.
- B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Flame Travel and Smoke Density for Cables in Non-Riser Applications and Non-Plenum Building Spaces: As determined by testing identical products according to UL 1685.

2.2 CATEGORY 6A BALANCED TWISTED PAIR CABLE

- A. Description: Four-pair, balanced-twisted pair cable with internal spline, certified to meet transmission characteristics of Category 6A cable at frequencies up to 250 MHz.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. 3M.
 2. Belden.
 3. Berk-Tek Leviton; a Nexans/Leviton alliance.
 4. CommScope, Inc.
 5. Mohawk; a division of Belden Networking, Inc.
 6. Superior Essex Inc.

- 7. SYSTIMAX Solutions; a CommScope Inc. brand.
- 8. Or approved equal.
- C. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.
- D. Conductors: 100 ohm, No. 23 AWG solid copper.
- E. Shielding/Screening: Shielded twisted pairs (FTP).
- F. Cable Rating: Riser.
- G. Jacket: Blue thermoplastic.

2.3 BALANCED TWISTED PAIR CABLE HARDWARE

- A. Description: Hardware designed to connect, splice, and terminate balanced twisted pair copper communications cable.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Belden.
 - 2. Berk-Tek Leviton; a Nexans/Leviton alliance.
 - 3. CommScope, Inc.
 - 4. General Cable; Prysmian Group North America.
 - 5. Genesis Cable Products; Honeywell International, Inc.
 - 6. Or approved equal.
- C. General Requirements for Balanced Twisted Pair Cable Hardware:
 - 1. Comply with the performance requirements of Category 6A.
 - 2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
 - 3. Cables must be terminated with connecting hardware of same category or higher.
- D. Source Limitations: Obtain balanced twisted pair cable hardware from same manufacturer as balanced twisted pair cable, from single source.
 - 1. Number of Terminals per Field: One for each conductor in assigned cables.
- E. Patch Cords: Factory-made, four-pair cables in 48 inch (1200 mm) lengths; terminated with an eight-position modular plug at each end.
 - 1. Patch cords must have bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords must have latch guards to protect against snagging.
- F. Plugs and Plug Assemblies:
 - 1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair 100 ohm unshielded or shielded balanced twisted pair cable.

2. Comply with IEC 60603-7-1, IEC 60603-7-2, IEC 60603-7-3, IEC 60603-7-4, and IEC 60603-7.5.
3. Marked to indicate transmission performance.

G. Legend:

1. Machine printed, in the field, using adhesive-tape label.
2. Snap-in, clear-label covers and machine-printed paper inserts.

2.4 CONTROL CABLE

A. Paired Cable: NFPA 70, Type CMG.

1. Multi-pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1685.

2.5 CONTROL-CIRCUIT CONDUCTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Encore Wire Corporation.
2. General Cable; Prysmian Group North America.
3. Service Wire Co.
4. Southwire Company.
5. Or approved equal.

B. Class 1 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.

C. Class 2 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.

D. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.

E. Class 2 Control Circuits and Class 3 Remote-Control and Signal Circuits That Supply Critical Circuits: Circuit Integrity (CI) cable.

1. Smoke control signaling and control circuits.

2.6 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test twisted pair cables according to TIA-568-C.2.

C. Cable will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Test cables on receipt at Project site.
 - 1. Test each pair of twisted pair cable for open and short circuits.

3.2 INSTALLATION OF RACEWAYS AND BOXES

- A. Comply with requirements in Section 26 05 33 "Raceways and Boxes for Electrical Systems" for raceway selection and installation requirements for boxes, conduits, and wireways as supplemented or modified in this Section.
 - 1. Outlet boxes for cables must be no smaller than 4 inch (102 mm) square by 2-1/8 inch (53 mm) deep with extension ring sized to bring edge of ring to within 1/8 inch (3.1 mm) of the finished wall surface.
 - 2. Flexible metal conduit must not be used.
- B. Comply with TIA-569-D for pull-box sizing and length of conduit and number of bends between pull points.
- C. Install manufactured conduit sweeps and long-radius elbows if possible.
- D. Raceway Installation in Equipment Rooms:
 - 1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed, or in the corner of the room if multiple sheets of plywood are installed around perimeter walls of the room.
 - 2. Secure conduits to backboard if entering the room from overhead.
 - 3. Extend conduits 3 inch (75 mm) above finished floor.
 - 4. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- E. Backboards: Install backboards with 96 inch (2440 mm) dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
 - 1. Comply with TIA-568-C Series of standards.
 - 2. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems."
 - 3. Terminate all conductors; cable must not contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
 - 4. Cables may not be spliced and must be continuous from terminal to terminal. Do not splice cable between termination, tap, or junction points.
 - 5. Cables serving a common system may be grouped in a common raceway. Install network cabling and control wiring and cable in separate raceway from power wiring. Do not group conductors from different systems or different voltages.

6. Secure and support cables at intervals not exceeding 30 inch (760 mm) and not more than 6 inch (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Install lacing bars and distribution spools.
8. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.
9. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Monitor cable pull tensions.
10. Support: Do not allow cables to lie on removable ceiling tiles.
11. Secure: Fasten securely in place with hardware specifically designed and installed so as to not damage cables.
12. Provide strain relief.
13. Keep runs short. Allow extra length for connecting to terminals. Do not bend cables in a radius less than 10 times the cable OD. Use sleeves or grommets to protect cables from vibration at points where they pass around sharp corners and through penetrations.
14. Ground wire must be copper, and grounding methods must comply with IEEE C2. Demonstrate ground resistance.

C. Balanced Twisted Pair Cable Installation:

1. Comply with TIA-568-C.2.
2. Install termination hardware as required by equipment manufacturer.
3. Do not untwist balanced twisted pair cables more than 1/2 inch (12 mm) at the point of termination to maintain cable geometry.

D. Installation of Control-Circuit Conductors:

1. Install wiring in raceways.
2. Use insulated spade lugs for wire and cable connection to screw terminals.
3. Comply with requirements specified in Section 26 05 33 "Raceways and Boxes for Electrical Systems."

E. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-D recommendations for separating unshielded copper voice and data communications cable from potential EMI sources including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment must be as follows:
 - a. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 24 inch (600 mm).
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment must be as follows:
 - a. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 12 inch (305 mm).

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures must be as follows:
 - a. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 6 inch (150 mm).
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or 5 HP and Larger: A minimum of 48 inch (1200 mm).

3.4 CONTROL-CIRCUIT CONDUCTORS

A. Minimum Conductor Sizes:

1. Class 1 remote-control and signal circuits; No 14 AWG.
2. Class 2 low-energy, remote-control, and signal circuits; No. 16 AWG.
3. Class 3 low-energy, remote-control, alarm, and signal circuits; No 12 AWG.

3.5 GROUNDING

- #### **A. For control-voltage wiring and cabling, comply with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems."**

3.6 IDENTIFICATION

- #### **A. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."**

3.7 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Visually inspect cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test cabling for direct-current loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination, but not after cross-connection.
 - a. Test instruments must meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in its "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in its "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

- #### **B. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.**

- C. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes grounding and bonding systems and equipment.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans showing dimensioned locations of grounding features specified in "Field Quality Control" Article.
- B. Qualification Data: For testing agency and testing agency's field supervisor.
- C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
 - 1. Include the following:
 - a. Plans showing as-built, dimensioned locations of system.
 - b. Instructions for periodic testing and inspection of grounding features at test wells based on NETA MTS.
 - 1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
 - 2) Include recommended testing intervals.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Certified by NETA.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Burndy; Hubbell Incorporated, Construction and Energy.
 - 2. Fushi Copperweld Inc.
 - 3. Galvan Industries, Inc.; Electrical Products Division, LLC.
 - 4. Or approved equal.

2.3 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B3.
 - 2. Stranded Conductors: ASTM B8.
 - 3. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 4. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches (6.3 by 100 mm) in cross section, with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- C. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

- D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
- E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- F. Conduit Hubs: Mechanical type, terminal with threaded hub.
- G. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- H. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.
- I. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.
- J. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.
- K. Straps: Solid copper, copper lugs. Rated for 600 A.
- L. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.
- M. Water Pipe Clamps:
 - 1. Mechanical type, two pieces with stainless-steel bolts.
 - a. Material: Die-cast zinc alloy.
 - b. Listed for direct burial.
 - 2. U-bolt type with malleable-iron clamp and copper ground connector.

2.5 GROUNDING ELECTRODES

- A. Ground Plates: 1/4 inch (6 mm) thick, hot-dip galvanized.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Grounding Conductors: Green-colored insulation with continuous yellow stripe.
- C. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.

3.2 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.
 - 2. Receptacle circuits.
 - 3. Single-phase motor and appliance branch circuits.
 - 4. Three-phase motor and appliance branch circuits.
 - 5. Flexible raceway runs.
 - 6. Armored and metal-clad cable runs.

3.3 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- C. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- D. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
 - 2. Make connections with clean, bare metal at points of contact.

3. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- D. Grounding system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.
- F. Report measured ground resistances that exceed the following values:
 1. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
- G. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION

SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Steel slotted support systems.
 - 2. Conduit and cable support devices.
 - 3. Structural steel for fabricated supports and restraints.
 - 4. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
 - 5. Fabricated metal equipment support assemblies.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Slotted support systems, hardware, and accessories.
 - b. Clamps.
 - c. Hangers.
 - 2. Include rated capacities and furnished specialties and accessories.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. For fabrication and installation details for electrical hangers and support systems.
 - 1. Hangers. Include product data for components.
 - 2. Slotted support systems.
 - 3. Equipment supports.
 - 4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
- C. Delegated-Design Submittal: For hangers and supports for electrical systems.
 - 1. Include design calculations and details of hangers.
 - 2. Include design calculations for seismic restraints.

1.4 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer to design hanger and support system.
- B. Seismic Performance: Hangers and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the supported equipment and systems will remain in place without separation of any parts when subjected to the seismic forces."

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Stainless steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch- (10-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c. in at least one surface.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Allied Tube & Conduit; a part of Atkore International.
 - b. ERICO International Corporation.
 - c. GS Metals Corp.
 - d. Thomas & Betts Corporation; A Member of the ABB Group.
 - e. Unistrut; Part of Atkore International.
 - f. Or approved equal.
 - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 - 4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 - 5. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
 - 6. Channel Dimensions: Selected for applicable load criteria.
- B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.
- D. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

- a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1) Hilti, Inc.
 - 2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Or approved equal.
- 2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel 316, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) B-line, an Eaton business.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti, Inc.
 - 4) ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - 5) Or approved equal.
- 3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
- 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
- 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325 (Grade A325M).
- 6. Toggle Bolts: Stainless-steel 316 springhead type.
- 7. Hanger Rods: Threaded stainless steel 316.

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
 - 1. NECA 1.
 - 2. NECA 101
- B. Comply with requirements for raceways and boxes specified in Section 26 05 33 "Raceways and Boxes for Electrical Systems."
- C. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

- D. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).
- C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
 - 5. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
 - 6. To Light Steel: Sheet metal screws.
 - 7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.
- D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- B. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive-strength concrete.

- C. Anchor equipment to concrete base as follows:
1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION

SECTION 26 05 33
RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal conduits and fittings.
 - 2. Boxes, enclosures, and cabinets.

1.3 DEFINITIONS

- A. GRC: Galvanized rigid steel conduit.
- B. IMC: Intermediate metal conduit.
- C. EMT: Electrical Metal Tubing

1.4 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

- A. Metal Conduit:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. AFC Cable Systems; a part of Atkore International.
 - b. Allied Tube & Conduit; a part of Atkore International.
 - c. Electri-Flex Company.
 - d. O-Z/Gedney; a brand of Emerson Industrial Automation.
 - e. Western Tube and Conduit Corporation.
 - f. Or approved equal.
 - 2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 3. GRC: Comply with ANSI C80.1 and UL 6.

4. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
 - a. Comply with NEMA RN 1.
 - b. Coating Thickness: 0.040 inch (1 mm), minimum.
 5. EMT: Comply with ANSI C80.3 and UL 797.
 6. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- B. Metal Fittings:
1. Comply with NEMA FB 1 and UL 514B.
 2. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
 3. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: Compression.
 4. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
 5. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.
- C. Joint Compound for GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Adalet.
 2. Appleton - EGS; Emerson Electric Co., Automation Solutions.
 3. Eaton (Crouse-Hinds).
 4. Erickson Electrical Equipment Company.
 5. Hubbell Incorporated.
 6. Kraloy Fittings.
 7. Milbank Manufacturing Co.
 8. Or approved equal.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.
- E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- F. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.
- G. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

- H. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- I. Cabinets:
 - 1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch to match panelboards.
 - 4. Metal barriers to separate wiring of different systems and voltage.
 - 5. Accessory feet where required for freestanding equipment.
 - 6. Provide factory applied or field applied painting of entire equipment with 2-coat marine grade epoxy.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
 - 1. Exposed Conduit: PVC coated GRC.
 - 2. Concealed Conduit, Aboveground: GRC.
 - 3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 - 4. Boxes and Enclosures, Aboveground: Type 4X, stainless steel.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
 - 1. Exposed, Not Subject to Physical Damage: EMT.
 - 2. Exposed and Subject to Severe Physical Damage: GRC.
 - 3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 - 5. Damp or Wet Locations, in Wetwell/Vault, Hazardous Environments: PVC coated GRC.
 - 6. Boxes and Enclosures: NEMA 250, Type 1, except use Explosion proof in wet well locations.
- C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
 - 1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 - 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.

3. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20 and CEC.
- E. Do not install any aluminum conduits, boxes, or fittings.

3.2 INSTALLATION

- A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for hangers and supports.
- B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.
- D. Do not fasten conduits onto the bottom side of a metal deck roof.
- E. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- F. Complete raceway installation before starting conductor installation.
- G. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- H. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.
- I. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.
- J. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- K. Support conduit within 12 inches (300 mm) of enclosures to which attached.
- L. Raceways Embedded in Slabs:
 1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot (3-m) intervals.
 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 3. Arrange raceways to keep a minimum of 2 inches (50 mm) of concrete cover in all directions.
 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.

5. Change from ENT to GRC before rising above floor. Utilize GRC elbow for transition.
- M. Stub-Ups to Above Recessed Ceilings:
1. Use EMT, IMC, or RMC for raceways.
 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- N. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- O. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- P. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- Q. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- R. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- S. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- T. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- U. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- V. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- W. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
1. Where an underground service raceway enters a building or structure.
 2. Where otherwise required by NFPA 70.
- X. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

- Y. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 - 1. Use LFMC in damp or wet locations subject to severe physical damage.
- Z. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- AA. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- BB. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- CC. Locate boxes so that cover or plate will not span different building finishes.
- DD. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- EE. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

3.3 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. RFP, City of San Diego Whitebook, City of San Diego General Contract Terms and Provisions, and Drawings apply to this section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Color and legend requirements for raceways, conductors, and warning labels and signs.
 - 2. Labels.
 - 3. Bands and tubes.
 - 4. Tapes and stencils.
 - 5. Tags.
 - 6. Signs.
 - 7. Cable ties.
 - 8. Fasteners for labels and signs.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1.
- B. Comply with NFPA 70.
- C. Comply with ANSI Z535.4 for safety signs and labels.
- D. Comply with NFPA 70E and Section 26 05 73.19 "Arc-Flash Hazard Analysis" requirements for arc-flash warning labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

2.2 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits at 600 V or Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage and system or service type.

- B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 3. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 4. Color for Neutral: White.
 5. Color for Equipment Grounds: Green.
- C. Equipment Identification Labels:
1. Black letters on a white field.

2.3 LABELS

- A. Self-Adhesive Wraparound Labels: Preprinted, 3-mil- (0.08-mm-) thick, polyester flexible label with acrylic pressure-sensitive adhesive.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Brady Corporation.
 - b. Brother International Corporation.
 - c. Ideal Industries, Inc.
 - d. Marking Services, Inc.
 - e. Panduit Corp.
 - f. Or approved equal.
 2. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.

2.4 BANDS AND TUBES

- A. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at a maximum of 200 deg F (93 deg C). Comply with UL 224.

2.5 TAPES AND STENCILS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide; compounded for outdoor use.
- C. Underground-Line Warning Tape:

1. Tape:
 - a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
 - b. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
 - d. Tape shall be detectable without excavation.
2. Color and Printing:
 - a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
 - b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
 - c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".

2.6 TAGS

- A. Nonmetallic Preprinted Tags: Polyethylene tags, 0.023 inch (0.58 mm) thick, color-coded for phase and voltage level, with factory printed permanent designations; punched for use with self-locking cable tie fastener.

2.7 SIGNS

- A. Baked-Enamel Signs:
 1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
 2. 1/4-inch (6.4-mm) grommets in corners for mounting.
 3. Nominal Size: 7 by 10 inches (180 by 250 mm).

2.8 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
 1. Minimum Width: 3/16 inch (5 mm).
 2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D638: 12,000 psi (82.7 MPa).
 3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
 4. Color: Black, except where used for color-coding.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
 - 1. Secure tight to surface of conductor, cable, or raceway.
- G. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- H. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer.
- I. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
- J. Accessible Fittings for Raceways: Identify the covers of each junction and pull box with voltage and circuit.
- K. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.
- L. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.
- M. Nonmetallic Preprinted Tags:
 - 1. Place in a location with high visibility and accessibility.
 - 2. Secure using general-purpose cable ties.
- N. Baked-Enamel Signs:
 - 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
 - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on minimum 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use signs minimum 2 inches (50 mm) high.

- O. Laminated Acrylic or Melamine Plastic Signs:
 - 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
 - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use labels 2 inches (50 mm) high.
- P. Cable Ties: General purpose, for attaching tags, except as listed below:
 - 1. Outdoors: UV-stabilized nylon.
 - 2. In Spaces Handling Environmental Air: Plenum rated.

3.3 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
- D. Arc Flash Warning Labeling: Self-adhesive labels.
- E. Equipment Identification Labels:
 - 1. Indoor Equipment: Laminated acrylic or melamine plastic sign.
 - 2. Outdoor Equipment: Laminated acrylic or melamine sign.
 - 3. Equipment to Be Labeled:
 - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of an engraved, laminated acrylic or melamine label.
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Switchboards.
 - e. Transformers: Label that includes tag designation indicated on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
 - f. Emergency system boxes and enclosures.
 - g. Motor-control centers.
 - h. Enclosed switches.
 - i. Variable-speed controllers.
 - j. Push-button stations.
 - k. Power-transfer equipment.
 - l. Contactors.
 - m. Battery-inverter units.
 - n. Battery racks.
 - o. Power-generating units.
 - p. Monitoring and control equipment.

END OF SECTION

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. General-use switches.
 - 2. General-grade duplex straight-blade receptacles.
 - 3. Receptacles with ground-fault protective devices.
- B. Related Requirements:
 - 1. Section 260010 "Supplemental Requirements for Electrical" specifies additional coordination, scheduling, sequencing, submittal, and installation requirements applicable to the Work for electrical, communications, and electronic safety and security systems on the Project, including wiring methods.
 - 2. Section 260526 "Grounding and Bonding for Electrical Systems" specifies grounding and bonding referenced by this Section.
 - 3. Section 260533.16 "Boxes and Covers for Electrical Systems" specifies covers and cover plates referenced by this Section.
 - 4. Section 260553 "Identification for Electrical Systems" specifies electrical equipment labels and warning signs referenced by this Section.
 - 5. Section 260923 "Lighting Control Devices" for occupancy sensors, timers, control-voltage switches, and control-voltage dimmers.

1.2 DEFINITIONS

- A. GFCI: Ground-Fault Circuit Interrupter.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Product Listing: Include copy of unexpired approval letter, on letterhead of qualified electrical testing agency, certifying product's compliance with specified listing criteria.
 - a. If listed manufacturer differs from selling manufacturer, indicate relationship between entities on submittal. Clearly indicate which entity warrants product performance and fitness for purpose.
 - b. Listing criteria identified in approval letter must match specified listing criteria. UL label indicating approval of equipment's enclosure is not considered approval of equipment for intended application.
 - c. Product identification in approval letter must match product branding and model numbers in submittal. Approval letters for discontinued or superseded products are not acceptable for submitted product.
 - 2. Include manufacturer's sample extended warranty language.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Products or components listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
- B. General use toggle switches:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - b. Leviton Manufacturing Co., Inc.
 - c. Pass & Seymour; Legrand North America, LLC.
 - d. Or approved equal.
 - 2. Source Limitations: Obtain products from single manufacturer.
 - 3. Listing Criteria: UL CCN WMUZ and UL 20.
 - 4. Standard Features:
 - a. Device Color: White: Normal Branch; Red: Emergency Branch.
 - b. Configuration:
 - 1) General-duty, 120-277 V, 20 A, single pole.
 - 5. Accessories:

- a. Cover Plate: 0.060 inch thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
- b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

2.2 GENERAL-GRADE DUPLEX STRAIGHT-BLADE RECEPTACLES

- A. Duplex Straight-Blade Receptacle:
 - 1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Leviton Manufacturing Co., Inc.
 - b. Pass & Seymour; Legrand North America, LLC.
 - c. Or approved equal.
 - 2. **Listing Criteria:** Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Receptacles for Plugs and Attachment Plugs: UL CCN RTRT and UL 498.
 - b. Surge Protective Devices: UL 1449, Type 3.
 - 3. **Standard Features:**
 - a. Device Color: White: Normal Branch, Red: Emergency Branch.
 - b. Configuration:
 - 1) General-duty, NEMA 5-20R.
 - 4. **Other Available Features Required by the Project:**
 - a. Has factory-terminated connectors on wiring device pigtails for quick installation.
 - 5. **Accessories:**
 - a. Cover Plate: 0.060 inch thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
 - b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

2.3 RECEPTACLES WITH GROUND-FAULT PROTECTIVE DEVICES

- A. General-Grade, Weather-Resistant, Tamper-Resistant Duplex Straight-Blade Receptacle with GFCI Device:
 - 1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - b. Leviton Manufacturing Co., Inc.
 - c. Pass & Seymour; Legrand North America, LLC.
 - d. Or approved equal.
 - 2. **Listing Criteria:** Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Receptacle GFCIs: UL CCN KCXS, UL 498, and UL 943.
 - 3. **Standard Features:**
 - a. Device Color: White: Normal Branch; Red: Emergency Branch.
 - b. Configuration: Heavy-duty, NEMA 5-20R.
 - 4. **Other Available Features Required by the Project:**
 - a. Has factory-terminated connectors on wiring device pigtails for quick installation.
 - 5. **Accessories:**
 - a. Cover Plate: 0.060 inch thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
 - b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receptacles:
 - 1. Verify that receptacles to be procured and installed for Owner-furnished equipment are compatible with mating attachment plugs on equipment.

3.2 SELECTION OF GFCI RECEPTACLES

- A. Healthcare Facilities: Unless protection of downstream branch-circuit wiring, cord sets, and power-supply cords is required by NFPA 70 or NFPA 99, provide non-feed-through GFCI receptacles.

3.3 INSTALLATION OF SWITCHES

- A. Comply with manufacturer's published instructions.

- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in the Contract Documents or manufacturer's published instructions, comply with the following:
 - 1. Electrical Construction: ICC IBC, ICC IFB, NFPA 1, NFPA 70, and NECA NEIS 1.
 - 2. Electrical Safety: NFPA 70E.
 - 3. Life Safety and Means of Egress Work: NFPA 101.
 - 4. Wiring Devices: NECA NEIS 130.
 - 5. Mounting Heights: NECA NEIS 1.
 - 6. Consult Architect for resolution of conflicting requirements.
- C. Interfaces with Other Work:
 - 1. Identification:
 - a. Identify cover or cover plate for device with panelboard identification and circuit number.
 - b. Mark cover or cover plate using hot, stamped, or engraved machine printing with black-filled lettering, and provide durable wire markers or tags inside device box or outlet box.
 - c. Provide warning signs and arc-flash hazard warning labels for electrical equipment.
 - d. Healthcare Facilities: Distinctively identify covers or cover plates of device boxes and outlet boxes that are supplied from life safety and critical branch power supplies following facility's standard practice.

3.4 INSTALLATION OF STRAIGHT-BLADE RECEPTACLES

- A. Comply with manufacturer's published instructions.
- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in the Contract Documents or manufacturer's published instructions, comply with the following:
 - 1. Electrical Construction: ICC IBC, ICC IFB, NFPA 1, NFPA 70, and NECA NEIS 1.
 - 2. Electrical Safety: NFPA 70E.
 - 3. Grounding and Bonding: NECA NEIS 331 and Article 250 of NFPA 70.
 - 4. Installing and Maintaining Wiring Devices: NECA NEIS 130.
 - 5. Mounting Heights: Unless otherwise indicated in the Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
 - 6. Receptacle Orientation: Unless otherwise indicated in the Contract Documents, orient receptacle to match configuration diagram in NEMA WD 6.
 - a. Hospital-Grade Receptacle Orientation: Orient receptacle with ground pin or neutral pin at top.
 - 7. Consult Architect for resolution of conflicting requirements.
- C. Interfaces with Other Work:
 - 1. Identification: Provide labels for receptacles and associated electrical equipment.
 - a. Identify field-installed conductors, interconnecting wiring, and components.
 - b. Label each enclosure with engraved metal or laminated-plastic nameplate.
 - 1) Identify cover or cover plate for device with panelboard identification and circuit number.
 - 2) Mark cover or cover plate using hot, stamped, or engraved machine printing with black-filled lettering, and provide durable wire markers or tags inside device box or outlet box.
 - c. Provide warning signs and arc-flash hazard warning labels for electrical equipment.
 - d. Healthcare Facilities: Distinctively identify covers or cover plates of device boxes and outlet boxes that are supplied from life safety and critical branch power supplies following facility's standard practice.
 - 2. Do not install Type 3 SPD, including surge-protected relocatable taps and power strips, on branch circuit downstream of GFCI device.

3.5 PROTECTION

- A. Devices:
 - 1. Schedule and sequence installation to minimize risk of contamination of wires and cables, devices, device boxes, outlet boxes, covers, and cover plates by plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other materials.
 - 2. After installation, protect wires and cables, devices, device boxes, outlet boxes, covers, and cover plates from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION

SECTION 26 28 13

FUSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nonrenewable cartridge fuses.
2. Spare-fuse cabinets.

B. Related Requirements:

1. Section 26 00 10 "Supplemental Requirements for Electrical" specifies additional requirements applicable to coordinating, scheduling, and sequencing of the Work specified in this Section.
2. Section 260553 "Identification for Electrical Systems" specifies electrical equipment labels and warning signs referenced by this Section.
3. Section 260573 "Power System Studies" specifies coordination studies, arc-flash hazard analysis, warning labels, and circuit-breaker trip ranges referenced by this Section.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
 - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
3. Current-limitation curves for fuses with current-limiting characteristics.
4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit in electronic format suitable for use in coordination software in PDF format.
5. Coordination charts and tables and related data.
6. Fuse sizes for elevator feeders and elevator disconnect switches.

1.3 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra stock material.

1.4 FIELD CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Products or components listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.2 NONRENEWABLE CARTRIDGE FUSES

- A. Class J Nonrenewable Cartridge Fuse:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Bussmann, an Eaton business.
 - b. Or approved equal.
 - 2. Source Limitations: Obtain products from single manufacturer.
 - 3. Listing Criteria: Investigated, labeled, and marked by a qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Cartridge Fuses, Nonrenewable: UL CCN JDDZ, including UL 248-1 and UL 248-8 (Class J).
 - 4. Standard Features:
 - a. NEMA FU 1, Class J, 200 kA(sym) interrupt rating, current limiting, sizes up to 600 A, 600 V(ac), non-time-delay, with rejection feature.
- B. Class L Nonrenewable Cartridge Fuse:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Bussmann, an Eaton business.
 - b. Or approved equal.
 - 2. Source Limitations: Obtain products from single manufacturer.

3. Listing Criteria: Investigated, labeled, and marked by a qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Cartridge Fuses, Nonrenewable: UL CCN JDDZ, including UL 248-1 and UL 248-10 (Class L).
4. Standard Features:
 - a. NEMA FU 1, Class L, 300 kA(sym) interrupt rating, current limiting, sizes 100 to 6000 A, 600 V(ac), non-time-delay, with rejection feature, with bolt-on terminals.

C. Class RK1 Nonrenewable Cartridge Fuse:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Bussmann, an Eaton business.
 - b. Or approved equal.
2. Source Limitations: Obtain products from single manufacturer.
3. Listing Criteria: Investigated, labeled, and marked by a qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Cartridge Fuses, Nonrenewable: UL CCN JDDZ, including UL 248-1 and UL 248-12 (Class R).
4. Standard Features:
 - a. NEMA FU 1, Class RK1, 200 kA(sym) interrupt rating, current limiting, sizes up to 600 A, 600 V(ac), non-time-delay, with rejection feature.
 - 1) Select ferrule terminals or knife blade terminals to match equipment where fuse is installed.

D. Class RK5 Nonrenewable Cartridge Fuse:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Bussmann, an Eaton business.
 - b. Or approved equal.
2. Source Limitations: Obtain products from single manufacturer.
3. Listing Criteria: Investigated, labeled, and marked by a qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Cartridge Fuses, Nonrenewable: UL CCN JDDZ, including UL 248-1 and UL 248-12 (Class R).

4. Standard Features:

- a. NEMA FU 1, Class RK5, 200 kA(sym) interrupt rating, current limiting, sizes up to 600 A, 600 V(ac), non-time-delay, with rejection feature.
 - 1) Select ferrule terminals or knife blade terminals to match equipment where fuse is installed.

2.3 SPARE-FUSE CABINET

- A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
 - 1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
 - 2. Finish: Gray, baked enamel.
 - 3. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

2.4 MAINTENANCE MATERIAL ITEMS

- A. Extra Stock Material: Furnish to Owner extra materials, from same production run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Include the following:
 - 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF FUSES

- A. Comply with manufacturer's published instructions.
- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in the Contract Documents or manufacturer's published instructions, comply with the following:

1. Electrical Construction: ICC IBC, ICC IFC, NFPA 1, NFPA 70, and NECA NEIS 1.
 2. Electrical Maintenance: NFPA 70B.
 3. Electrical Safety: NFPA 70E.
 4. Work in Confined Spaces: NFPA 350.
 5. Work in Basements and Other Developed Subterranean Spaces: NFPA 520.
 6. Fuse Applications: NECA NEIS 420.
 7. Work with Fuses in Motor Control Centers: NECA NEIS 402.
- C. Provide open-fuse indicator fuses or fuse covers with open fuse indication.
- D. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- E. Install spare-fuse cabinet(s) in location indicated on the Drawings or as indicated in the field by Construction Manager.
- F. Interfaces with Other Work:
1. Identification: Provide labels for spare fuse cabinet.
 - a. Legend: "SPARE FUSES" in 1-1/2 inch high letters on exterior of door.
 2. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with results of coordination study and arc-flash hazard analysis.

END OF SECTION

SECTION 26 28 16

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Molded-case circuit breakers (MCCBs).
4. Enclosures.

B. Related Requirements:

1. Section 26 00 10 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 DEFINITIONS

- A. GFEP: Ground-fault circuit-interrupter for equipment protection.
- B. GFLS: Ground-fault circuit-interrupter for life safety.
- C. SPDT: Single pole, double throw.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
2. Enclosure types and details for types other than UL 50E, Type 1.
3. Current and voltage ratings.
4. Short-circuit current ratings (interrupting and withstand, as appropriate).
5. Include evidence of qualified electrical testing laboratory listing for series rating of installed devices.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
7. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.

B. Shop Drawings: For enclosed switches and circuit breakers.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include wiring diagrams for power, signal, and control wiring.

C. Field Quality-Control Submittals:

1. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Warranty documentation.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Spare Parts: Furnish to Owner spare parts, for repairing enclosed switches and circuit breakers, that are packaged with protective covering for storage on-site and identified with labels describing contents. Include the following:
 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 2. Fuse Pullers: Two for each size and type.

1.7 WARRANTY

- A. Special Installer Extended Warranty: Installer warrants that fabricated and installed enclosed switches and circuit breakers perform in accordance with specified requirements and agrees to repair or replace components or products that fail to perform as specified within extended-warranty period.
- B. Special Manufacturer Extended Warranty: Manufacturer warrants that enclosed switches and circuit breakers perform in accordance with specified requirements and agrees to provide repair or replacement of components or products that fail to perform as specified within extended-warranty period.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain products from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.2 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Eaton.

2. Square D; Schneider Electric USA.
3. Or approved equal.

B. Type HD, Heavy Duty:

1. Double throw.
2. Three pole.
3. 600 V(ac).
4. 1200 A and smaller.
5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses.
6. Lockable handle with capability to accept three padlocks and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Service-Rated Switches: Labeled for use as service equipment.
6. Hookstick Handle: Allows use of hookstick to operate handle.
7. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 24 V.
8. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Eaton.
2. Square D; Schneider Electric USA.
3. Or approved equal.

B. Type GD, General Duty, Three Pole, Single Throw, 240 V(ac), 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Three Pole, Single Throw, 600 V(ac), 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Type HD, Heavy Duty, Three Pole, Double Throw, 600 V(ac), 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

E. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Service-Rated Switches: Labeled for use as service equipment.
6. Hookstick Handle: Allows use of hookstick to operate handle.
7. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 24 V.
8. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.4 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Eaton.
 2. Square D; Schneider Electric USA.
 3. Or approved equal.
- B. Circuit breakers must be constructed using glass-reinforced insulating material. Current carrying components must be completely isolated from handle and accessory mounting area.
- C. Circuit breakers must have toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. Circuit-breaker handle must be over center, be trip free, and reside in tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon must be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with push-to-trip button, located on face of circuit breaker to mechanically operate circuit-breaker tripping mechanism for maintenance and testing purposes.
- D. Maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings must be clearly marked on face of circuit breaker. Circuit breakers must be 100 percent rated. Circuit breaker/circuit breaker combinations for series connected interrupting ratings must be listed by UL as recognized component combinations. Series rated combination used must be marked on end-use equipment along with statement "Caution - Series Rated System. _____ Amps Available. Identical Replacement Component Required."
- E. MCCBs must be equipped with device for locking in isolated position.
- F. Lugs must be suitable for 75 deg C rated wire.
- G. Standard: Comply with UL 489 with required interrupting capacity for available fault currents.
- H. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- I. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- J. Electronic Trip Circuit Breakers: Field-replaceable rating plug, RMS sensing, with the following field-adjustable settings:

1. Instantaneous trip.
 2. Long- and short-time pickup levels.
 3. Long- and short-time time adjustments.
 4. Ground-fault pickup level, time delay, and I-squared t response.
- K. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
- L. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.
- M. GFLS Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6 mA trip).
- N. GFEP Circuit Breakers: With Class B ground-fault protection (30 mA trip).
- O. Features and Accessories:
1. Standard frame sizes, trip ratings, and number of poles.
 2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
 3. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
 4. Alarm Switch: One NC contact that operates only when circuit breaker has tripped.
 5. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
 6. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
 7. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
 8. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system, specified in Section 26 09 13 "Electrical Power Monitoring and Control."
 9. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
 10. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key must be removable only when circuit breaker is in off position.
 11. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
 12. Electrical Operator: Provide remote control for on, off, and reset operations.
 13. Accessory Control Power: Integrally mounted, self-powered; 24 V.

2.5 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, UL 50E, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish: Enclosure must be gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (UL 50E Type 1).
- C. Conduit Entry: UL 50E Types 4, 4X, and 12 enclosures may not contain knockouts. UL 50E Types 7 and 9 enclosures must be provided with threaded conduit openings in both endwalls.

- D. Operating Mechanism: Circuit-breaker operating handle must be directly operable through front cover of enclosure (UL 50E Type 1). Cover interlock mechanism must have externally operated override. Override may not permanently disable interlock mechanism, which must return to locked position once override is released. Tool used to override cover interlock mechanism must not be required to enter enclosure in order to override interlock.
- E. Enclosures designated as UL 50E Type 4, 4X stainless steel, 12, or 12K must have dual cover interlock mechanism to prevent unintentional opening of enclosure cover when circuit breaker is ON and to prevent turning circuit breaker ON when enclosure cover is open.
- F. UL 50E Type 7/9 enclosures must be furnished with breather and drain kit to allow their use in outdoor and wet location applications.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Commencement of work will indicate Installer's acceptance of areas and conditions as satisfactory.

3.2 SELECTION OF ENCLOSURES

- A. Indoor, Dry and Clean Locations: UL 50E, Type 1.
- B. Outdoor Locations: UL 50E, Type 3R.
- C. Other Wet or Damp, Indoor Locations: UL 50E, Type 4.
- D. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: UL 50E, Type 12.

3.3 INSTALLATION

- A. Comply with manufacturer's published instructions.
- B. Special Techniques:
 - 1. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
 - 2. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
 - 3. Comply with mounting and anchoring requirements specified by the manufacturer.
 - 4. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
 - 5. Install fuses in fusible devices.

3.4 IDENTIFICATION

- A. Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.5 FIELD QUALITY CONTROL

- A. Field tests and inspections must be witnessed by authorities having jurisdiction.
- B. Tests and Inspections for Switches:
 - 1. Visual and Mechanical Inspection:
 - a. Inspect physical and mechanical condition.
 - b. Inspect anchorage, alignment, grounding, and clearances.
 - c. Verify that unit is clean.
 - d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
 - e. Verify that fuse sizes and types match the Specifications and Drawings.
 - f. Verify that each fuse has adequate mechanical support and contact integrity.
 - g. Inspect bolted electrical connections for high resistance using one of the following methods:
 - 1) Use low-resistance ohmmeter.
 - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels must be in accordance with manufacturer's published data. In absence of manufacturer's published data, use NETA ATS Table 100.12.
 - h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on Drawings.
 - i. Verify correct phase barrier installation.
 - j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
 - 2. Electrical Tests:
 - a. Perform resistance measurements through bolted connections with low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.
 - b. Measure contact resistance across each switchblade fuseholder. Drop values may not exceed high level of manufacturer's published data. If

manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.

- c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In absence of manufacturer's published data, use Table 100.1 from NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
- d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
- e. Perform ground fault test in accordance with NETA ATS Section 7.14 "Ground Fault Protection Systems, Low-Voltage."

C. Tests and Inspections for Molded-Case Circuit Breakers:

1. Visual and Mechanical Inspection:

- a. Verify that equipment nameplate data are as described in the Specifications and shown on Drawings.
- b. Inspect physical and mechanical condition.
- c. Inspect anchorage, alignment, grounding, and clearances.
- d. Verify that unit is clean.
- e. Operate circuit breaker to ensure smooth operation.
- f. Inspect bolted electrical connections for high resistance using one of the following methods:
 - 1) Use low-resistance ohmmeter.
 - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels must be in accordance with manufacturer's published data. In absence of manufacturer's published data, use NETA ATS Table 100.12.
- g. Inspect operating mechanism, contacts, and chutes in unsealed units.
- h. Perform adjustments for final protective device settings in accordance with coordination study.

2. Electrical Tests:

- a. Perform resistance measurements through bolted connections with low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.

- b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In absence of manufacturer's published data, use Table 100.1 from NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
- c. Perform contact/pole resistance test. Drop values may not exceed high level of manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.
- d. Perform insulation resistance tests on control wiring with respect to ground. Applied potential must be 500 V(dc) for 300 V rated cable and 1000 V(dc) for 600 V rated cable. Test duration must be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values may be no less than 2 M Ω .
- e. Determine the following by primary current injection:
 - 1) Long-time pickup and delay. Pickup values must be as specified. Trip characteristics may not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 2) Short-time pickup and delay. Short-time pickup values must be as specified. Trip characteristics may not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 3) Ground-fault pickup and time delay. Ground-fault pickup values must be as specified. Trip characteristics may not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 4) Instantaneous pickup. Instantaneous pickup values must be as specified and within manufacturer's published tolerances.
- f. Test functionality of trip unit by means of primary current injection. Pickup values and trip characteristics must be as specified and within manufacturer's published tolerances.
- g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of shunt trip and close coils must be as indicated by manufacturer.
- h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset trip logs and indicators. Investigate units that do not function as designed.
- i. Verify operation of charging mechanism. Investigate units that do not function as designed.

3. Test and adjust controls, remote monitoring, and safeties.

D. Nonconforming Work:

- 1. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- 2. Remove and replace defective units and retest.

- E. Collect, assemble, and submit test and inspection reports.
 - 1. Test procedures used.
 - 2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
 - 3. List deficiencies detected, remedial action taken, and observations after remedial action.
- F. Manufacturer Services:
 - 1. Engage factory-authorized service representative to support field tests and inspections.

3.6 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges to values indicated on Drawings.

3.7 PROTECTION

- A. After installation, protect enclosed switches and circuit breakers from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

3.8 MAINTENANCE

- A. Infrared Scanning of Enclosed Switches and Breakers: Two months after Substantial Completion, perform infrared scan of joints and connections. Remove covers so joints and connections are accessible to portable scanner. Take visible light photographs at same locations and orientations as infrared scans for documentation to ensure follow-on scans match same conditions for valid comparison.
 - 1. Instruments and Equipment: Use infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 2. Follow-up Infrared Scanning: Perform two follow-up infrared scans of enclosed switches and breakers, one at four months and another at 11 months after Substantial Completion.
 - 3. Instrument: Use infrared-scanning device designed to measure temperature or to detect significant deviations from normal values. Provide documentation of device calibration.
 - 4. Report: Prepare certified report that identifies units checked and that describes scanning results. Include notation of deficiencies detected, remedial actions taken, and scanning observations after remedial action.

END OF SECTION

Bid Results

Bidder Details

Vendor Name		HPS Mechanical, Inc.
Address		3100 E. Belle Terrace Bakersfield, California 93307 United States
Respondee		Alma Martinez
Respondee Title		Estimating/Preconstruction Coordinator
Phone		661-397-2121
Email		alma@hpsmechanical.com
Vendor Type		CADIR
License #		793014
CADIR		1000001107

Bid Detail

Bid Format		Electronic
Submitted		12/04/2025 1:37 PM (PST)
Delivery Method		
Bid Responsive		
Bid Status		Submitted
Confirmation #		459713

Respondee Comment

Buyer Comment

Attachments

File Title	File Name	File Type
Contractors Certification of Pending Actions.pdf	Contractors Certification of Pending Actions.pdf	Contractor's Certification of Pending Actions
Mandatory Disclosure of Business Interests Form.pdf	Mandatory Disclosure of Business Interests Form.pdf	Mandatory Disclosure of Business Interests
Debarment and Suspension Certification.pdf	Debarment and Suspension Certification.pdf	Prime - Debarment and Suspension Certification
Subcontractors Debarment and Suspension Certification.pdf	Subcontractors Debarment and Suspension Certification.pdf	Subcontractors - Debarment and Suspension Certification
Bid Bond.pdf	Bid Bond.pdf	Bid Bond

Subcontractors

Showing 3 Subcontractors

Name & Address	Desc	License Num	CADIR	Amount	Type
Karcher Insulation, Inc. 2300 E. Orangewood Ave. Anaheim, California 92806	Insulation	309141	1000006996	\$32,850.00	
Performance Automation Solutions 10633 Roselle Street Suite G San Diego, California 92121-1551	Controls	946532	1000025467	\$174,020.00	WBE, CAU, WOSB, FEM, CADIR, Local
Saturn Electric, Inc. 7552 Trade St. San Diego, California 92121	Electrical	219097	1000007128	\$146,400.00	Local

Line Items

Discount Terms No Discount

Item #	Item Code	Type	Item Description	UOM	QTY	Unit Price	Line Total	Response	Comment
Main Bid							\$2,575,000.00		
1	524126		Bonds (Payment and Performance)	LS	1	\$25,495.00	\$25,495.00	Yes	
2	236220		San Diego Fire Department Hazardous Materials Permit (EOC Type I)	AL	1	\$15,000.00	\$15,000.00	Yes	
3	236220		Construction of Chillers and Cooling Towers	LS	1	\$2,254,505.00	\$2,254,505.00	Yes	
4	238910		Mobilization	LS	1	\$100,000.00	\$100,000.00	Yes	
5	238210		Distributed Control System (DCS) Hardware (EOC Type I)	AL	1	\$50,000.00	\$50,000.00	Yes	
6			Field Orders (EOC Type II)	AL	1	\$130,000.00	\$130,000.00	Yes	

Line Item Subtotals

Section Title	Line Total
Main Bid	\$2,575,000.00
Grand Total	\$2,575,000.00

SUBCONTRACTOR LISTING (OTHER THAN FIRST TIER)

Pursuant to California Senate Bill 96 and in accordance with the requirements of Labor Code sections 1771.1 and 1725.5, by submitting a bid or proposal to the City, Contractor is certifying that he or she has verified that all subcontractors used on this public work project are registered with the California Department of Industrial Relations (DIR). **The Bidder is to list below the name, address, license number, DIR registration number of any (known tiered subcontractor)** - who will perform work, labor, render services or specially fabricate and install a portion [type] of the work or improvement pursuant to the contract. **If none are known at this time, mark the table below with non-applicable (N/A).**

Prime Contractor Name: HPS Mechanical

NAME, ADDRESS AND TELEPHONE NUMBER OF SUBCONTRACTOR	CONSTRUCTOR OR DESIGNER	DIR REGISTRATION NUMBER	SUBCONTRACTOR LICENSE NUMBER	TYPE OF WORK
Name: <u>N/A</u> Address: _____ City: _____ State: _____ Zip: _____ Phone: _____ Email: _____				
Name: <u>N/A</u> Address: _____ City: _____ State: _____ Zip: _____ Phone: _____ Email: _____				
Name: <u>NA</u> Address: _____ City: _____ State: _____ Zip: _____ Phone: _____ Email: _____				
Name: <u>N/A</u> Address: _____ City: _____ State: _____ Zip: _____ Phone: _____ Email: _____				

**** USE ADDITIONAL FORMS AS NECESSARY ****