

5/08/2023

To: All Potential Respondents  
From: Construction Procurement  
Subject: RFQ930200-01 DOC ICIW Unit 9 Chiller Replacement

### Request for Quote

The State of Iowa is conducting a Request for Quote for a contractor to remove existing air cooled chiller, piping, and concrete pad. Replace with Owner provided air cooled chiller. Replace chiller pad, extend existing piping to new chiller, and reconnect electrical and BAS controls. See Exhibit B Scope of Work for additional detail.

All work must be done on-site at the Iowa Correctional Institution for Women (ICIW) and all personnel may be required to pass a background check. Information required for the background check includes full name, birthdate, state driver's license # or State id#, and social security number.

All work shall be completed no later than 4/19/2024.

The Project is located at DOC ICIW, 420 Mill St. SW Mitchellville, Iowa 50169

**Please email your quote using the Exhibit A pricing form to [construction.procurement@iowa.gov](mailto:construction.procurement@iowa.gov) prior to 5/31/23 at 2:00 PM (CT).**

**A pre-quote onsite meeting will be held on May 17, 2023 @ 2:00 pm at DOC ICIW Maintenance Shop Conference Room, 420 Mill St. SW Mitchellville, Iowa 50169. There will also be a Teams virtual meeting. Invites will be sent out to respondents.**



**All questions regarding this solicitation must be received by email by 2:00 PM (CT) on 5/24/23.**

### **Contract Terms and Conditions**

This procurement will result in a Consensus 802 Agreement. By submitting a quote, respondent agrees to the contract terms and conditions available at:

<https://das.iowa.gov/sites/default/files/procurement/pdf/ConsensusDoc802.pdf>

### **Performance Bond**

Respondent must provide a Performance and Payment Bond in accordance with Section 10.8 of Consensus 802 Agreement.

### **Insurance Requirements**

See sample Certificate of Insurance attached as Exhibit D for required limits, additional insured requirements, and waiver of subrogation.

### **Attachments:**

**Exhibit A Pricing Form**

**Exhibit B Scope of Work**

**Exhibit C Facility Work Requirements**

**Exhibit D Certificate of insurance**

**Exhibit E Drawings**

**Exhibit F Specifications**

**Exhibit G Equipment Controls Scope of Work**

**Exhibit A Pricing Form**  
DOC ICIW Unit 9 Chiller Replacement  
Iowa Correctional Institution for Women  
Request for Quote RFQ930200-01

**Due Wednesday, 5/31/2023 at 2:00 PM(CT)**

Please submit this completed form with your Quote to:  
Attention: Jeff Just  
Iowa Department of Administrative Services - Central Procurement  
[construction.procurement@iowa.gov](mailto:construction.procurement@iowa.gov)

This form is to be completed in ink or typewritten.  
Only pricing on this form or an exact copy of this form will be accepted.  
Pricing Form shall be signed by an officer of the firm with authority to bind Respondent to Contract.

Respondent acknowledges receipt of the following Addenda (if issued) which are part of the RFQ documents:

Addendum No. \_\_\_\_\_ Date \_\_\_\_\_

Addendum No. \_\_\_\_\_ Date \_\_\_\_\_

Freight Terms: FOB Destination, Freight Pre-Paid

The State reserves the right to reject any or all quotes without penalty and to waive minor deficiencies and informalities if, in the judgement of the State, it's best interests will be served.

Respondents must submit pricing for all scope of work items indicated per the attached Exhibit B. The State reserves the right to evaluate pricing. The State intends to make one Award for this project.

**Lump Sum Price For ICIW Unit 9 Chiller Replacement.**

Base Bid: Unit 9 Chiller Replacement. Include an allowance of \$13,590.09 for equipment controls.

Labor and Material(s) Lump Sum: Total \$ \_\_\_\_\_

\*Please note all pricing is to be delivered price. That is why we are stating FOB Destination, Freight Pre-Paid.\*

**Signature** \_\_\_\_\_

**Name (Print)** \_\_\_\_\_

**Title** \_\_\_\_\_

**Company** \_\_\_\_\_

**Address** \_\_\_\_\_

**City, St., Zip** \_\_\_\_\_

**Phone #** \_\_\_\_\_ **Fax #** \_\_\_\_\_

**E-mail** \_\_\_\_\_

## **Exhibit B Scope of Work**

DOC ICIW Unit 9 Chiller Replacement  
Iowa Correctional Institution for Women  
Request for Quote RFQ930200-01

**Due Wednesday, 5/31/2023 at 2:00 PM(CT)**

### **ICIW Unit 9 Chiller Replacement Scope of Work**

All drawings in Exhibit E

All specifications in Exhibit F

Entire scope of work in Exhibit G

Replace the existing air cooled chiller and concrete pad and provide all associated piping, insulation, electrical and controls work. The new chiller will be owner provided, contractor installed. This includes an allowance for material, termination, and programming for the equipment controls as detailed in Exhibit G (wiring and conduit to be provided in the base quote). The system will require additional ethylene glycol. Equipment startup and BAS controls verification are also included.

#### **Additional Requirements:**

- The Contractor's Work includes all labor, supervision, materials, equipment, services, supplies, tools, facilities, transportation, hoisting, storage, receiving, licenses, inspections, certifications, overhead, profit, or other items required or reasonably inferable to properly and timely perform and complete all work and services to be performed by the Contractor pursuant to this Agreement. Unless specifically stated otherwise, incidental work required to accomplish the work of this Bid Package shall be included the bid. This would include, but not be limited to, temporary facilities, protection of the work, security of equipment, materials, and work in progress, etc. Contractor's Work shall be performed in accordance with the Drawings and Specifications.
- Contractor is responsible for all labor and equipment to unload, account for all material delivered, stock, and delivery for this scope of work. Storage and delivery of materials and equipment at the Site shall be permitted only to the extent approved in advance by the Construction Manager, and if anything so stored obstructs the progress of any portion of the work, it shall be promptly removed or relocated by the Contractor without reimbursement.
- On site supervision by Prime Contractor at all times work by that contractor or their subcontractors/suppliers is taking place.
- Provide all temporary facilities required for this scope of work including trailer, trailer power, telephone, secured storage, temporary power for work, temporary and task lighting for work, etc. as determined necessary by Contractor. Coordinate location of trailers, material storage and utility lines with Construction Manager. Limited space is available, and permission to bring any such facility or excess materials on to the site shall be approved by the Construction Manager.
- Contractor shall provide all equipment and tools for Contractor's own cleanup. Clean up shall be done at end of every shift or more frequently if required for the Contractor to perform their work, for other Contractors to perform their work, as required by the Owner's operations, and at the discretion of the Construction Manager.
- All turf, landscaping, and subgrade disturbances caused by equipment traffic or other activities related to the Contractor's scope shall be repaired or restored to proper conditions by the owner, but the contractor is responsible to minimize any damage caused to the facility's landscaping.
- Protect adjacent existing building elements from damage from Scope of work. Repair existing building elements damaged during Contractor's Scope of work.

- Contractor shall maintain an accurate set of As-Built Drawings throughout the duration of the project and submit to the Construction Manager at the completion of the project.

## **Exhibit C Facility Work Requirements**

DOC ICIW Unit 9 Chiller Replacement  
Iowa Correctional Institution for Women  
Request for Quote RFQ930200-01

**Due Wednesday, 5/31/2023 at 2:00 PM(CT)**

- All contractors will be directly escorted and supervised by the ICIW Maintenance and Security staff
- The site operates from 7am to 3pm. All contractors shall abide by these work hours unless arrangements are made in advance.
- ICIW accounts for all tools that are removed from the contractor's truck, van, trailer etc, at the project site within the secure perimeter. Any unnecessary tools not needed for the project should be removed prior to entering the secure perimeter. There can not be any unsecured tools in the back of a truck or trailer that will not be used for the project. All ladders must be secured to the vehicle, ladder rack or trailer. A list of the main tools and equipment needed daily for the project will expedite the process.
- Staging each morning and having all necessary equipment, tools and supplies will eliminate having to exit the secure perimeter causing unnecessary delays to the project
- State of Iowa including ICIW is Smoke Free including smokeless tobacco & electronic smoking devices. Contractors are allowed to smoke in their vehicles outside of the secure perimeter.
- The site foreman(s) are allowed to have a cell phone inside the secure perimeter. All other contractor employees must leave their cell phones in their vehicle outside of the secure perimeter.
- Restrooms are provided by ICIW and contractors will be escorted to the restroom.
- Pat down searches of visitors, contractors, and outside vendors will take place daily
- Vehicle searches will take place for visitors, contractors, and outside vendors

**Exhibit D Sample Certification of Insurance**

DOC ICIW Unit 9 Chiller Replacement  
Iowa Correctional Institution for Women  
Request for Quote RFQ930200-01

**Due Wednesday, 5/31/2023 at 2:00 PM(CT)**



**Exhibit E Drawings**

DOC ICIW Unit 9 Chiller Replacement  
Iowa Correctional Institution for Women  
Request for Quote RFQ930200-01

**Due Wednesday, 5/31/2023 at 2:00 PM(CT)**

# DOC - ICIW - UNIT 9 CHILLER REPLACEMENT

MITCHELLVILLE,  
IOWA

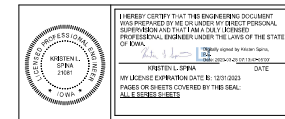
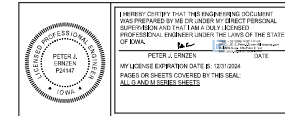
DAS PROJECT #9302.00  
RFQ#930200-01

ISSUED FOR BID  
03/24/2023



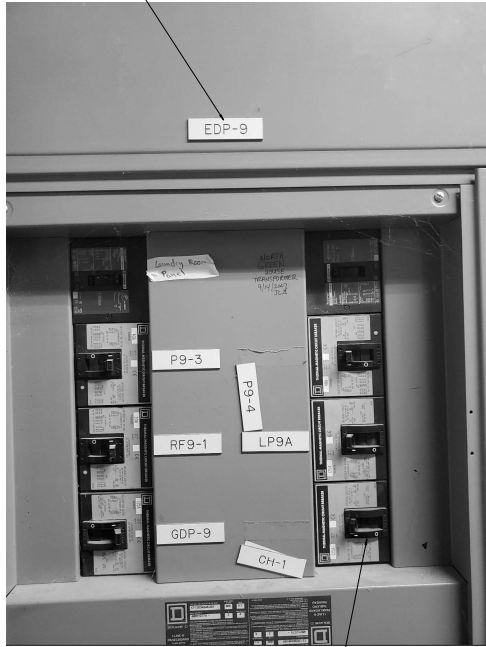
SHEET LIST					
Number	Name	Sub-Order/In	SHEET ORDER	DRAWING SET	
GENERAL					
0100	PROJECT COVER SHEET	00 GENERAL	0	GENERAL	
0100	UNIT 9 CHILLER REPLACEMENT	00 GENERAL	1	GENERAL	
MECHANICAL					
0100	MECHANICAL COVER SHEET	01 MECHANICAL	0	MECHANICAL	
0101	FIRST FLOOR PLANS - MECHANICAL	01 MECHANICAL	01	MECHANICAL	
0102	MECHANICAL EQUIPMENT	01 MECHANICAL	02	MECHANICAL	
0103	MECHANICAL EQUIPMENT	01 MECHANICAL	03	MECHANICAL	
0104	MECHANICAL EQUIPMENT	01 MECHANICAL	04	MECHANICAL	
0105	MECHANICAL EQUIPMENT	01 MECHANICAL	05	MECHANICAL	
ELECTRICAL					
0100	ELECTRICAL COVER SHEET	01 ELECTRICAL	0	ELECTRICAL	
0101	FIRST FLOOR PLANS - POWER	01 ELECTRICAL	01	ELECTRICAL	

PROJECT LOCATION





EXISTING PANEL ED9A LOCATED IN EXISTING ELECTRICAL ROOM.



EXISTING CHILLER BREAKER



EXISTING CONCRETE PAD

EXISTING CHILLED WATER SUPPLY AND RETURN PIPING ROUTED UNDERGROUND.

NOTES:  
 1. ALL WORK SHALL BE IN ACCORDANCE WITH THE IOWA ELECTRICAL CODE AND THE IOWA MECHANICAL CODE.  
 2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ALL NECESSARY PERMITS.  
 3. ALL MATERIALS AND WORKMANSHIP SHALL BE SUBJECT TO INSPECTION AND APPROVAL BY THE IOWA DEPARTMENT OF PUBLIC SAFETY.

REVISIONS

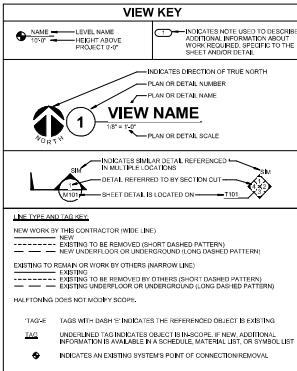
NO. DATE REVISION

DATE: \_\_\_\_\_  
 DRAWN BY: \_\_\_\_\_  
 CHECKED BY: \_\_\_\_\_  
 APPROVED BY: \_\_\_\_\_  
 PROJECT NO.: 2207302.00  
 SHEET NO.: \_\_\_\_\_  
 TOTAL SHEETS: \_\_\_\_\_

EXISTING CONDITION PHOTOS

SCALE: \_\_\_\_\_

SHEET NUMBER



### APPLICABLE CODES

CONTRACTOR SHALL COMPLY WITH APPLICABLE CODES AND LOCAL AMENDMENTS.

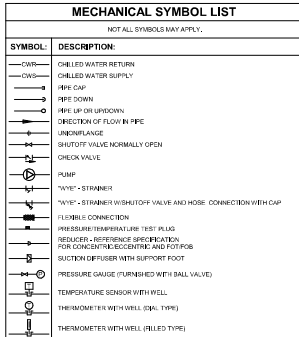
BUILDING CODE:	IRC 2015 EDITION
FIRE CODE:	IFC 2015 EDITION
PLUMBING CODE:	UPC 2021 EDITION
MECHANICAL CODE:	IMC 2021 EDITION
ELECTRICAL CODE:	NFPA 70 (NEC) 2020 EDITION
ENERGY CONSERVATION CODE:	IECC 2012

### CONTRACTOR ABBREVIATION KEY

ABBR.	DESCRIPTION:
E.C.	ELECTRICAL CONTRACTOR
M.C.	MECHANICAL CONTRACTOR
T.C.C.	TEMPERATURE CONTROLS CONTRACTOR

### CONTACT PERSONS:

DESCRIPTION:	PERSON:
PROJECT MANAGER:	PETER ERNSEN
MECHANICAL:	PETER ERNSEN
ELECTRICAL:	KIRITEN SENA



### MECHANICAL RENOVATION NOTES:

THESE NOTES APPLY TO ALL MECHANICAL SHEETS AND TRADES.

- EXISTING CONDITIONS ARE SHOWN BASED ON INFORMATION OBTAINED FROM FIELD SURVEYS, EXISTING BUILDING DOCUMENTS, AND STAFF. VERIFY EXISTING CONDITIONS AND REPORT ANY CORRECTIONS IMMEDIATELY.
- NOT ALL EXISTING DUCTWORK AND PIPING IS SHOWN. VERIFY EXISTING CONDITIONS BEFORE EXISTING WORK. NOTIFY ENGINEER OF ANY CONDITIONS NOT SHOWN.
- WHERE EXISTING MECHANICAL SYSTEMS ARE LOCATED IN AREAS THAT CONFLICT WITH NEW EQUIPMENT, PIPING, OR DUCTWORK TO BE INSTALLED, EACH CONTRACTOR SHALL NOTIFY ENGINEER IMMEDIATELY. CONTRACTORS SHALL BE RESPONSIBLE FOR OBTAINING ALL NECESSARY PERMITS. CONTRACTORS DOES NOT COMPLY WITH EXISTING SYSTEMS OR REMOVE EXISTING MECHANICAL SYSTEMS TO BE INSTALLED IN AREAS OF EQUIPMENT, PIPING, OR DUCTWORK.
- OBTAIN PERMISSION FROM OWNER BEFORE SHUTTING DOWN ANY SYSTEM FOR ANY REASON. MAINTAIN RECORD OF ALL COMPONENTS THAT ARE TO REMAIN. ALL NEW SYSTEMS ARE INSTALLED.

### MECHANICAL GENERAL NOTES:

THESE NOTES APPLY TO ALL MECHANICAL SHEETS AND TRADES.

- DRAWINGS SHOWING LOCATIONS OF EQUIPMENT, DUCTWORK, PIPING, ETC. ARE DIMENSIONAL AND MAY NOT ALWAYS REFLECT EXACT INSTALLATION CONDITIONS. DIMENSIONS SHOWN ARE GENERAL APPROXIMATIONS OR GUIDELINES. DIMENSIONS, ETC. AND MAY NOT INCLUDE ALL OFFSETS AND FITTINGS REQUIRED FOR COMPLETE INSTALLATION. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ALL ACTUAL BUILDING CONDITIONS AND VERIFY ALL DIMENSIONS AND CLEARANCES FROM DIMENSIONS ON PAPER. VERIFY ALL DIMENSIONS AND CLEARANCES FROM DIMENSIONS ON PAPER. VERIFY ALL DIMENSIONS AND CLEARANCES FROM DIMENSIONS ON PAPER. VERIFY ALL DIMENSIONS AND CLEARANCES FROM DIMENSIONS ON PAPER. VERIFY ALL DIMENSIONS AND CLEARANCES FROM DIMENSIONS ON PAPER.
- COORDINATE ALL WORK WITH ALL OTHER TRADES PRIOR TO INSTALLATION TO PREVENT CLEARANCES REQUIRED FOR OPERATIONAL MAINTENANCE, CODE COMPLIANCE, AND TO VERIFY DIMENSIONS AND CLEARANCES FOR ALL TRADES. NOTIFY ALL INTERFERENCES IMMEDIATELY TO THE SYSTEMS ENGINEER AND ARCHITECT BEFORE BEGINNING WORK.
- REVIEW SPACE REQUIREMENTS OF EQUIPMENT SPECIFIED OR SUBSTITUTED AND MAKE RESPONSIBLE ACCORDING TO ALL APPLICABLE CODES AND REGULATIONS TO PROVIDE PROPER ACCESS.
- ANY CHANGES REQUIRED TO ELIMINATE CONFLICTS OR THAT RESULT FROM A FAILURE TO COORDINATE SHALL BE MADE BY THE CONTRACTOR WITHOUT ADDITIONAL COST OR DELAY TO THE PROJECT.
- THE CONTRACTOR IS RESPONSIBLE FOR ALL COSTS ASSOCIATED WITH ELECTRICAL CHANGES REQUIRED FOR EQUIPMENT PROPOSED THAT DEVIATES FROM THE BASIS OF DESIGN.
- EACH CONTRACTOR IS RESPONSIBLE FOR DAMAGE CAUSED BY THEIR ACTIONS TO WALLS, FLOORS, CEILING, AND ROOFS. THE CONTRACTOR IN WISE WORKS DAMAGE IS RESPONSIBLE FOR PATCHING TO MATCH ORIGINAL CONSTRUCTION, FINISH, AND COLOR.
- DO NOT BLOCK THE PATH OF EQUIPMENT SERVICE CLEARANCES.
- Maintain a minimum working clearance of 3'-6" in front of all electrical equipment requiring maintenance, inspection, and testing including but not limited to panels, distribution panels, switchboards, motor control centers, transformers, elevators, disconnects, and starters.
- Maintain the dedicated electrical equipment space defined by the width, depth, and height of the equipment. Clear the equipment from the floor to a height of 1'-0" above the equipment to the structural ceiling. Where floor clearance is not provided to the electrical distribution system are not allowed in the dedicated electrical space including ductwork, piping, etc.

### TEMPERATURE CONTROL GENERAL NOTES:

- TEMPERATURE CONTROL CONTRACTOR SCOPE SHALL BE COVERED UNDER ALLOWANCE. VERIFY TO SEE IF WORK IS IN SCOPE UNDER CONTRACT. CONTRACTOR SHALL BE RESPONSIBLE FOR ALL OTHER POINTS EXCEPT AS SPECIFICALLY NOTED.
- EACH CONTRACTOR SHALL BE RESPONSIBLE FOR ALL CONTROL DEVICES INCLUDING BUT NOT LIMITED TO: THERMOSTATS, THERMISTORS, THERMOCOUPLES, AND THERMISTORS.
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### MECHANICAL SHEET INDEX

NO.	DESCRIPTION:
ME01	MECHANICAL COVER SHEET
ME02	FRESH FLOOR TRAY/MECHANICAL
ME03	MECHANICAL FLOW SCHEDULES
ME04	MECHANICAL CONTROL DEVICES
ME05	MECHANICAL DETAILS AND SCHEDULES
ME06	MECHANICAL DETAILS AND SCHEDULES

### PIPE INSULATION SCHEDULE (HVAC)

DESIGN NOTES:  
1. REFER TO THE SPECIFICATIONS FOR THE DESCRIPTIONS AND JACKING REQUIREMENTS. VALUES LISTED BELOW ARE BASED ON ASHRAE 90.1 REQUIREMENTS.  
2. THE INSULATION THICKNESS FOR 1" THROUGH 6" SHALL BE NOTED IN ORIGINAL DRAWINGS OR 3" OR 4" IF NOT SPECIFIED OTHERWISE.

PIPE SYSTEM	INSULATION TYPE	INSULATION THICKNESS PER NOMINAL PIPE OR TUBE SIZE				NOTES
		1/2"	1"	1 1/2"	2"	
STANDARD COOLING		0.5"	1"	1 1/2"	2"	
CITY-COOLING WATER RETURN	5 (Fiberglass)	0.5"	1"	1 1/2"	2"	
CITY-COOLING WATER SUPPLY	5 (Fiberglass)	0.5"	1"	1 1/2"	2"	

DAS#09302-00  
RFQ#0930200-01



REVISIONS

NO.	DATE	REVISION

SCALE: As Indicated

SHEET NUMBER: MECHANICAL COVER SHEET

M000

**SHEET NOTES**  
 1. DRAWING SHALL BE PREPARED BY OWNER. CONTACT CHAD HANSEN AT 515-234-0600 FOR MECHANICAL SALES AND INFORMATION FOR ADDITIONAL INFORMATION.

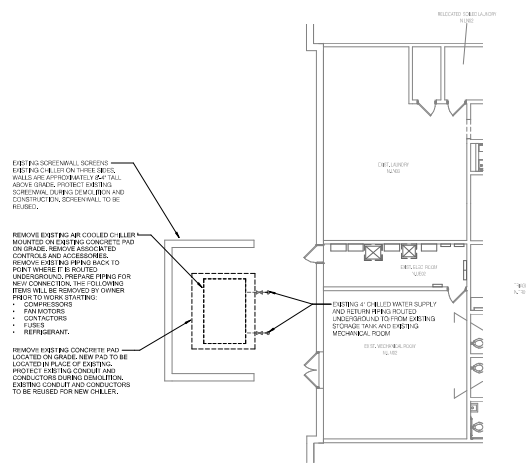
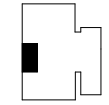
**IDAS - DOC - ICW - UNIT 9 CHILLER REPLACEMENT**  
 MITCHELLVILLE, IOWA  
 IOWA IDAS

DAS#9302.00  
 RFG#930200-01

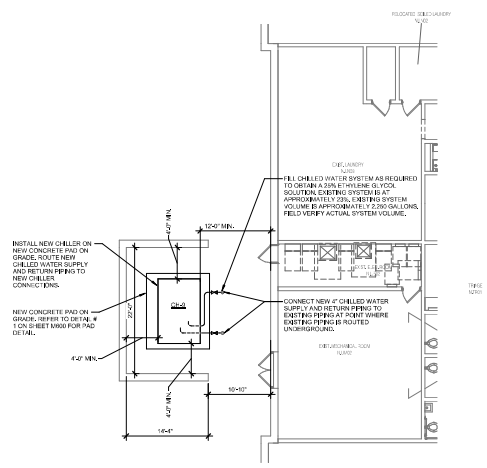


2867 NORTH STABLET  
 515-234-0600  
 50322  
 PH: 515-234-0600  
 FAX: 515-234-0608  
 www.imegcorp.com

REF PLAN



**1 FIRST FLOOR DEMOLITION PLAN - MECHANICAL**



**2 FIRST FLOOR PLAN - MECHANICAL**

THIS DRAWING IS THE PROPERTY OF IMEG CORPORATION. IT IS TO BE USED ONLY FOR THE PROJECT AND SITE SPECIFICALLY IDENTIFIED HEREON. ANY REUSE OR REPRODUCTION OF THIS DRAWING WITHOUT THE WRITTEN PERMISSION OF IMEG CORPORATION IS STRICTLY PROHIBITED.

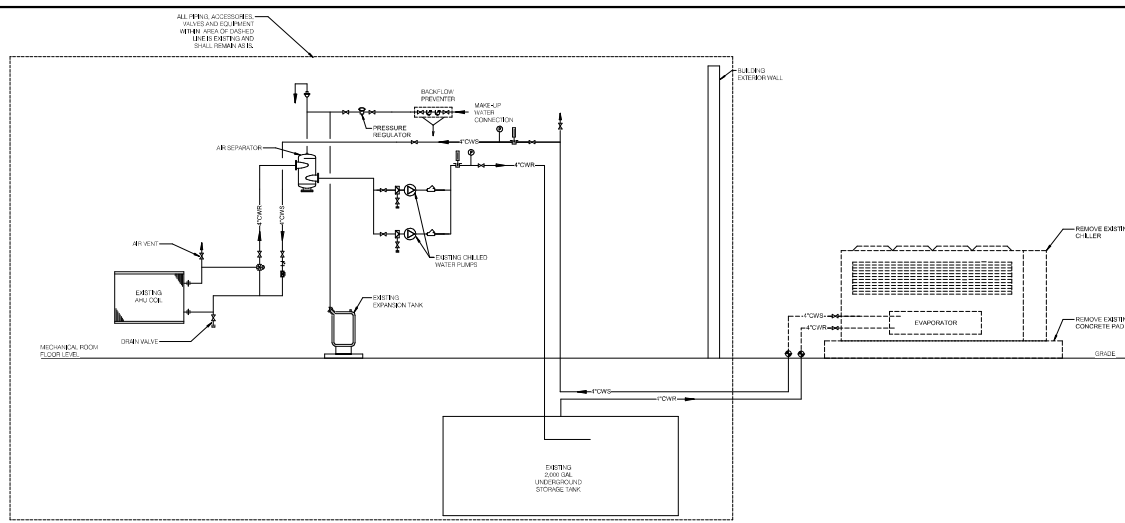


DATE: 03/24/2025  
 DESIGNED BY: CHAD HANSEN  
 CHECKED BY: CHAD HANSEN

NO.	DATE	REVISION

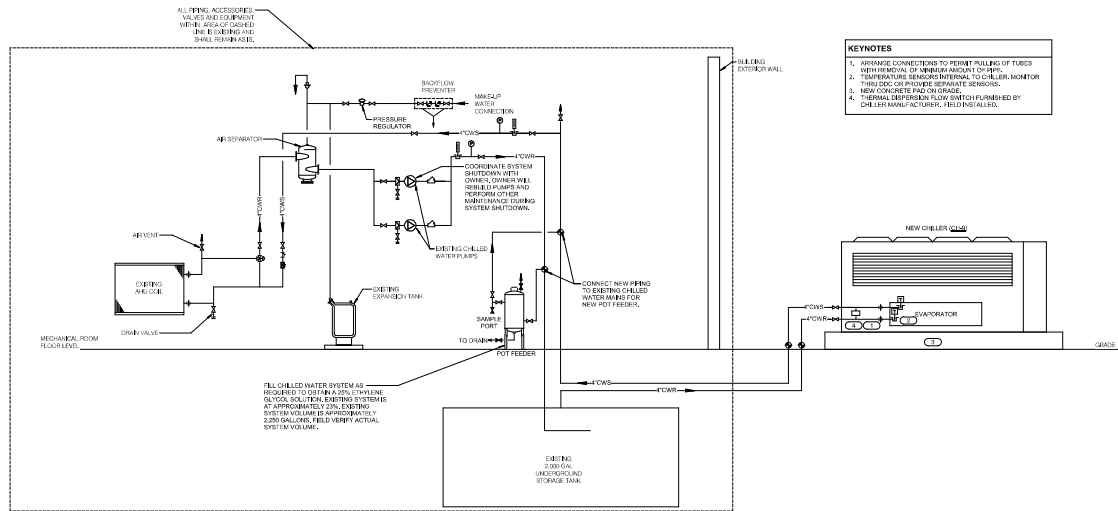
PROJECT: UNIT 9 CHILLER REPLACEMENT  
 SHEET: FIRST FLOOR PLANS - MECHANICAL

SCALE: 1/8" = 1'-0"



1 CHILLED WATER FLOW DIAGRAM - DEMOLITION

NO SCALE  
W/CR 103



2 CHILLED WATER FLOW DIAGRAM - NEW WORK

NO SCALE  
W/CR 103

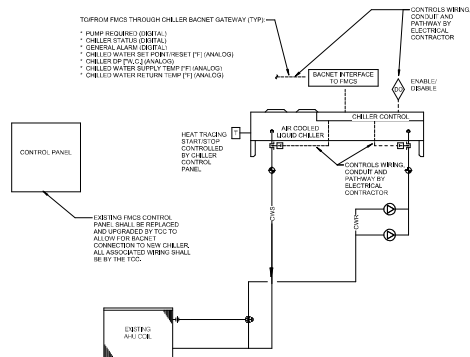
KEYNOTES

1. ADVANCE CONNECTIONS TO PERMIT PULLING OF TUBES WITH REMOVAL OF MINIMUM AMOUNT OF RPS.
2. TEMPERATURE SENSORS INTERNAL TO CHILLER MONITOR THRU DOC OR PROVIDE SEPARATE SENSORS.
3. NEW CONCRETE PAD ON GRADE.
4. THERMAL LEAKS FROM FLOW TRENDS FINISHED BY CHILLER MANUFACTURER, FIELD NOTIFIED.

REVISIONS  
NO. DATE REVISION  
1 03/24/2023

SCALE  
1" = 1'-0"

SHEET NO. 002  
PROJECT NO. 2207302.00  
DATE 03/24/2023  
DRAWN BY PETERN  
CHECKED BY PETERN  
APPROVED BY PETERN



**CHILLER PLANT REPORT GENERATION**

PLANT STATUS MONITOR FOR THE FOLLOWING POINTS ON 15 MINUTE (ADD) INTERVALS WITHIN A SINGLE TENDR. THE TENDR SHALL RUN FOR A 24 HOUR CYCLE. AT WHICH POINT THE NEWEST VALUES SHALL COVER/WRITE THE OLDEST VALUES:

- \* DATE
- \* TIME
- \* GENERAL OUTSIDE AIR TEMPERATURE (T)
- \* GENERAL OUTSIDE AIR DOWNDRA (T)
- \* AVERAGE CHILLED WATER SUPPLY TEMPERATURE (T)
- \* AVERAGE CHILLED WATER RETURN TEMPERATURE (T)
- \* TOTAL CHILLED WATER FLOW (GPM) (FMS)
- \* CURRENT LOAD FROM THE FAN COILS

THIS INFORMATION SHALL BE ACCESSIBLE TO VIEW BY EITHER TABLE OR GRAPHICAL FORM ON THE FAN COIL OPERATOR WORKSTATION.

**CHILLER PLANT REPORT GENERATION**

**SEQUENCE OF OPERATION**

THE CHILLER MANUFACTURER SHALL PROVIDE A FACTORY MOUNTED CHILLER CONTROL PANEL. ALL AVAILABLE DATA PROVIDED/CONTROLLED BY THE CHILLER CONTROL PANEL SHALL BE AVAILABLE TO AND MONITORED BY THE FAN COIL SYSTEM. CHILLER OPERATION SHALL BE CONTROLLED BY THE CHILLER CONTROL PANEL AND SHALL BE ENABLED WHEN THE OUTSIDE AIR TEMPERATURE RISES ABOVE 50°F (ADD) FOR 15 MINUTES AND/OR WHEN OUTSIDE AIR TEMPERATURE DROPS BELOW 40°F (ADD) FOR 15 MINUTES (ADD) CHILLER OPERATION SHALL BE DISABLED. CHILLER SHALL NOT OPERATE UNTIL A CHILLED WATER VALVE IN THE SYSTEM IS A CALL FOR COOLING AND BEING TO OPEN.

**CHILLER STARTING**

WHEN THE FAN COIL MAKES THE CHILLER TO RUN THE FOLLOWING SHALL OCCUR:

- \* THE FAN COIL SHALL TURN ON THE CHILLED WATER PUMP PER THE EXISTING PUMP CONTROL SEQUENCE.
- \* UPON PROOF OF FLOW IN THE FAN COIL OR BARREL, THE CHILLER CONTROL PANEL SHALL INSTRUCT CHILLER TO START.
- \* CHILLER SHALL START AFTER ALL INTERNAL SAFETIES ARE SATISFIED AND SHALL MAINTAIN CHILLED WATER SUPPLY TEMPERATURES OF 40°F (ADD) MINIMUM CONTROLS.

**CHILLER STOPPING**

WHEN THE FAN COIL MAKES THE CHILLER TO STOP THE FOLLOWING SHALL OCCUR:

- \* THE CHILLER CONTROL PANEL SHALL INSTRUCT CHILLER TO STOP.
- \* THE CHILLER CONTROL PANEL SHALL SEND A SIGNAL TO THE FAN COIL TO SHUT DOWN THE CHILLED WATER PUMP PER THE EXISTING PUMP CONTROL SEQUENCE.

**CHILLER MINIMUM/MAINTENANCE**

WHEN THE OUTSIDE AIR TEMPERATURE DROPS BELOW 30°F (ADD), THE CHILLED WATER PUMP SHALL BE ENABLED. THIS IS INTENDED TO ALLOW WATER TO FLOW THROUGH THE SYSTEM AS AN ADDITIONAL FREEZE PREVENTION CONTROL MEASURE.

**CHILLER HEAT TRACE**

THE CHILLER CONTROL PANEL SHALL CONTROL THE HEAT TRACE OF THE HEAT EXCHANGER.

**CHILLER SAFETIES**

TCC SHALL COORDINATE ALL SAFETY AND INTERLOCK REQUIREMENTS WITH CHILLER MANUFACTURER. TCC SHALL PROVIDE THE NECESSARY I/O AND WIRING TO CHILLED WATER FLOW SWITCHES, AND OTHER COMPONENTS PROVIDED WITH CHILLER AS REQUIRED FOR PROPER OPERATION.

**ALARMING INTERLOCKS AND SAFETIES**

CHILLER SHALL INTERLOCK WITH THE FAN COIL WHEN THE FOLLOWING OCCUR:

- \* AN ALARM IS INDICATED AT THE CHILLER CONTROL PANEL.

ALL EXISTING CHILLED WATER SYSTEM ALARMS, INTERLOCKS AND SAFETIES SHALL REMAIN AFTER NEW CHILLER IS INSTALLED.

**1 CHILLED WATER PLANT CONTROL**

NO SCALE  
N/A (SCALE)

NOTE:  
ALL WIRING, CONTROL COMPONENTS, SERVICES AND PROGRAMMING SHOWN ON THESE CONTROL DRAWINGS SHALL BE PROVIDED BY THE ELECTRICAL CONTRACTOR UNLESS SPECIFICALLY NOTED OTHERWISE.

REVISIONS

NO.	DATE	REVISION

PROJECT NO. 22071902.00

DATE: 03/24/2023

APP. DATE: 2/20/23

APP. NAME: PETERN

APP. TITLE: ENGINEER

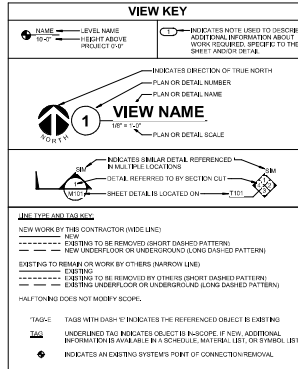
APP. SIGNATURE: PETERN

DATE: 03/24/23

SCALE: 12" = 1'-0"

SHEET NUMBER: M500





### CONTRACTOR ABBREVIATION KEY

ABBR:	DESCRIPTION:
E.C.	ELECTRICAL CONTRACTOR
M.C.	MECHANICAL CONTRACTOR
T.C.C.	TEMPERATURE CONTROLS CONTRACTOR

### CONTACT PERSONS:

DESCRIPTION:	PERSON:
PROJECT MANAGER	PETER ERINZEN
MECHANICAL	PETER ERINZEN
ELECTRICAL	KRISTEN SPIVA

- ### ELECTRICAL RENOVATION NOTES:
- THESE NOTES APPLY TO ALL ELECTRICAL SHEETS AND TRADES, INCLUDING BUT NOT LIMITED TO EXISTING POWER AND SYSTEMS.
- EXISTING CONDITIONS ARE SHOWN BASED ON INFORMATION OBTAINED FROM FIELD SURVEYS, FIELD MEASUREMENTS, AND DRAWINGS. VERIFY EXISTING CONDITIONS AND REPORT ANY CONFLICTS BEFORE PROCEEDING.
  - CONTRACTOR SHALL VERIFY ANY CONDITIONS BEFORE STARTING WORK. VERIFY EXISTING FIELD MEASUREMENTS AND CONDITIONS FOR CABLE TRAY, BULWARK AND CONDUITS BEFORE FIELD INSTALLATION AND REPORT ANY CONFLICTS BEFORE STARTING WORK.
  - EACH CONTRACTOR SHALL FIELD VERIFY ACCESSIBILITY TO THE AREA OF THEIR WORK AND SHALL NOTIFY THE CONTRACTOR MANAGER PRIOR TO BEING IN OTHER UTILITIES ARE REQUIRED TO BE REMOVED OR RELOCATED TO ALLOW ACCESS TO THEIR AREA OF WORK.
  - VERIFY THE FIELD ELECTRICAL SYSTEMS AND LOCATED AREAS THAT CONFLICT WITH NEW EQUIPMENT, PIPES, OR OUTWORK TO BE INSTALLED. EACH CONTRACTOR SHALL NOTIFY THE CONTRACTOR MANAGER PRIOR TO CONSTRUCTION. VERIFY ALL FIELD CONDITIONS NOT COVERED WITH CONTRACT SYSTEMS, OR FIELDWORK EXISTING ELECTRICAL SYSTEMS TO ALLOW FOR INSTALLATION OF NEW EQUIPMENT, PIPES, OR OUTWORK.

- ### ELECTRICAL INSTALLATION NOTES:
- ALL MATERIALS USED TO SEAL PENETRATIONS OF FIRE RATED WALLS AND FLOORS SHALL BE TESTED AND CERTIFIED AS A SYSTEM FOR ASTM E119 STANDARDS FOR FIRE TESTS OF THROUGH PENETRATIONS IN WALLS.
  - CONTRACTOR SHALL BE RESPONSIBLE FOR ALL OPENINGS REQUIRED IN WALLS. ALL OPENINGS SHALL BE REFERRED TO MATCH EXISTING BY A QUALIFIED CONTRACTOR AT THE EXPENSE OF THE CONTRACTOR. ALL CONDUITS THROUGH WALLS SHALL BE GROUNDED OR SEALED INTO OPENINGS.
  - ALL WELDING SHALL BE ACCORDING TO AMERICAN WELDING SOCIETY STANDARDS. CONTRACTOR SHALL SUBMIT TO THE ARCHITECT FOR REVIEW ALL WELDING AND SIGHT FIELDS. PRIOR TO START OF WORK, THE ARCHITECT ENGINEER RESERVES THE RIGHT TO SECURE QUALIFYING EDUCATION/EXPERIENCE AT THE CONTRACTOR'S EXPENSE, OF ANY WELDER APPROVED TO THE JOB.
  - EACH CONTRACTOR IS RESPONSIBLE FOR DAMAGE CAUSED BY THEIR ACTIONS TO THE WALLS, FLOORS, CEILING, AND ROOFS. THE CONTRACTOR IN WHOSE WORK CAUSED DAMAGE IS RESPONSIBLE FOR PATCHING TO MATCH ORIGINAL CONSTRUCTION, FIRE RATINGS, AND FINISH.

### ELECTRICAL ABBREVIATION KEY

ABBR:	DESCRIPTION:
AFP	ABOVE FINISHED FLOOR
C	CORNER
GF1	GROUND FAULT INTERRUPTER
NC	NORMALLY CLOSED
NC	NOT IN CONTRACT
NO	NORMALLY OPEN
SV	SOLENOID VALVE
TYP	TYPICAL
UON	UNLESS OTHERWISE NOTED

### ELECTRICAL SYMBOL LIST

SYMBOL:	TAG:	SPEC SECTION:	DESCRIPTION:
	28 55 33	28 55 33	ELECTRICAL CONNECTION
	PANEL W/P	EX-210	PANELBOARD - SURFACE MOUNT
	TRANS-F	EX-210	TRANSFORMER, REFER TO TRANSFORMER SCHEDULE

### ELECTRICAL SHEET INDEX

NO.	DESCRIPTION:
000	ELECTRICAL COVER SHEET
001	FIRST FLOOR PLANS - POWER
GRAND TOTAL: 2	

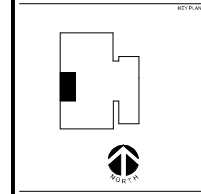
**IDAS - DOC - ICIV - UNIT 9 CHILLER REPLACEMENT**

MITCHELLVILLE, IOWA  
IOWA IDAS

**IDAS#9302.00**  
**RFQ#930200-01**

2867 NORTH STREET  
DRAFTING, IOWA  
50222

PH: 515.234.6666  
FAX: 515.234.6666  
www.pmgcorp.com



### ELECTRICAL COVER SHEET

NO.	DESCRIPTION:
000	ELECTRICAL COVER SHEET
001	FIRST FLOOR PLANS - POWER
GRAND TOTAL: 2	

SCALE: **As Indicated**

SHEET NUMBER: **E000**

DATE: **03/24/2023**

PROJECT: **22078322.00**

DRAWN BY: **KRISTEN SPIVA**

CHECKED BY: **PETER ERINZEN**

APPROVED BY: **PETER ERINZEN**

DATE: **03/24/2023**

SCALE: **As Indicated**

SHEET NUMBER: **E000**





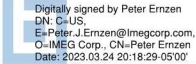
**Exhibit F Specifications**



DOC ICIW Unit 9 Chiller Replacement  
Iowa Correctional Institution for Women  
Request for Quote RFQ930200-01

**Due Wednesday, 5/31/2023 at 2:00 PM(CT)**

SECTION 00 01 07

SEALS PAGE

	<p>I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.</p>
	<p> </p>
	<p>_____ (signature) _____ (date)</p>
	<p>Printed or typed name <u>Peter J. Ernzen</u></p>
	<p>License number <u>P24147</u></p>
	<p>My license renewal date is <u>December 31, 2024</u></p>
<p>Pages or sheets covered by this seal: <u>Division 23</u> _____ _____</p>	

	<p>I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.</p>
	<p> <u>3/24/23</u></p>
	<p>_____ (signature) _____ (date)</p>
	<p>Printed or typed name <u>Kristen L. Spina</u></p>
	<p>License number <u>P21081</u></p>
	<p>My license renewal date is <u>December 31, 2023</u></p>
<p>Pages or sheets covered by this seal: <u>Division 26</u> _____ _____</p>	

END OF SECTION

## TABLE OF CONTENTS

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SECTION 23 05 05 - HVAC DEMOLITION FOR REMODELING  
SECTION 23 05 29 - HVAC SUPPORTS AND ANCHORS  
SECTION 23 05 53 - HVAC IDENTIFICATION  
SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING  
SECTION 23 07 19 - HVAC PIPING INSULATION  
SECTION 23 09 00 - CONTROLS  
SECTION 23 21 00 - HYDRONIC PIPING  
SECTION 23 21 16 - HYDRONIC SPECIALTIES  
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**END OF SECTION**

## SECTION 23 05 00

### BASIC HVAC REQUIREMENTS

#### PART 1 - GENERAL

##### 1.1 SECTION INCLUDES

- A. Requirements applicable to all Division 23 Sections. Also refer to Division 01 - General Requirements.
- B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced herein and within each specification section.

##### 1.2 SCOPE OF WORK

- A. This Specification and the associated drawings govern the furnishing, installing, testing and placing into satisfactory operation the Mechanical Systems.
- B. Each Contractor shall provide all new materials indicated on the drawings and/or in these specifications, and all items required to make the portion of the Mechanical Work a finished and working system.
- C. All work will be awarded under a single General Contract. The division of work listed below is for the Contractor's convenience and lists normal breakdown of the work.
- D. Scope of Work:
  - 1. Mechanical Work shall include, but is not necessarily limited to:
    - a. Remove existing chiller and disconnect existing piping.
    - b. Install new air cooled chiller. Equipment pre-purchased by owner.
    - c. Remove existing chiller pad and replace with new pad.
    - d. Extend existing chilled water system. Make final connections at new chillers.
    - e. Provide and install new pot feeder.
    - f. Provide and install new glycol solution for existing system as required to obtain the noted glycol solution percentage.
    - g. Extend existing temperature control system to new chiller. Scope is part of an allowance.
    - h. Complete all applicable tests, certifications, forms, and matrices.
  - 2. Testing, Adjusting, and Balancing Work shall include, but is not necessarily limited to:
    - a. Furnish complete testing, adjusting, and balancing as specified in Section 23 05 93, including, but not limited to, air systems, hydronic systems, plumbing systems, and verification of control systems.
    - b. Complete all applicable tests, certifications, forms, and matrices.

### 1.3 OWNER FURNISHED PRODUCTS

- A. The Owner will supply the following items for installation and/or connection by this Contractor:
  - 1. Air Cooled Chiller - Daikin AGZ091E. Contact Chad Raymer - Mechanical Sales Inc.
- B. The Owner will supply manufacturer's installation data for Owner-purchased equipment for this project.
- C. This Contractor shall make all mechanical system connections shown on the drawings or as required for fully functional units.
- D. This Contractor is responsible for all damage to Owner furnished equipment caused during installation.

### 1.4 WORK SEQUENCE

- A. All work that will produce excessive noise or interference with normal building operations, as determined by the Owner, shall be scheduled with the Owner. It may be necessary to schedule such work during unoccupied hours. The Owner reserves the right to determine when restricted construction hours will be required.

### 1.5 DIVISION OF WORK BETWEEN MECHANICAL, ELECTRICAL & CONTROL CONTRACTORS

- A. Definitions:
  - 1. "Mechanical Contractors" refers to the following:
    - a. Plumbing Contractor.
    - b. Heating Contractor.
    - c. Air Conditioning and Ventilating Contractor.
    - d. Temperature Control Contractor.
    - e. Fire Protection Contractor.
    - f. Testing, Adjusting, and Balancing Contractor.
  - 2. Motor Control Wiring: The wiring associated with the remote operation of the magnetic coils of magnetic motor starters or relays, or the wiring that permits direct cycling of motors by means of devices in series with the motor power wiring. In the latter case the devices are usually single phase and are usually connected to the motor power wiring through a manual motor starter having "Manual-Off-Auto" provisions.
  - 3. Control devices such as start-stop push buttons, thermostats, pressure switches, flow switches, relays, etc., generally represent the types of equipment associated with motor control wiring.
  - 4. Motor control wiring is single phase and usually 120 volts. In some instances, the voltage will be the same as the motor power wiring. Generally, where the motor power wiring exceeds 120 volts, a control transformer is used to give a control voltage of 120 volts.
  - 5. Temperature Control Wiring: The wiring associated with the operation of a motorized damper, solenoid valve or motorized valve, etc., either modulating or two-position, as opposed to wiring which directly powers or controls a motor used to drive equipment such as fans, pumps, etc.
    - a. This wiring will be from a 120 volt source and may continue as 120 volt, or be reduced in voltage (24 volt) in which case a control transformer shall be furnished as part of the temperature control wiring.

6. Control Motor: An electric device used to operate dampers, valves, etc. It may be two-position or modulating. Conventional characteristics of such a motor are 24 volts, 60 cycles, 1 phase, although other voltages may be encountered.
7. Voltage is generally specified and scheduled as distribution voltage. Motor submittals may be based on utilization voltage if it corresponds to the correct distribution voltage.

Distribution/Nominal Voltage	Utilization Voltage
120	115
208	200
240	230
277	265
480	460

B. General:

1. The purpose of these Specifications is to outline the Electrical and Mechanical Contractor's responsibilities related to electrical work required for items such as temperature controls, mechanical equipment, fans, chillers, compressors and the like. The exact wiring requirements for much of the equipment cannot be determined until the systems have been selected and submittals reviewed. Therefore, the electrical drawings show only known wiring related to such items. All wiring not shown on the electrical drawings, but required for mechanical systems, is the responsibility of the Mechanical Contractor.
2. Where the drawings require the Electrical Contractor to wire between equipment furnished by the Mechanical Contractor, such wiring shall terminate at terminals provided in the equipment. The Mechanical Contractor shall provide complete electrical power/controls wiring diagrams and supervision to the Electrical Contractor and designate the terminal numbers for correct wiring.
3. All electrical work shall conform to the National Electrical Code. All provisions of the Electrical Specifications concerning wiring, protection, etc., apply to wiring provided by the Mechanical Contractor unless noted otherwise.
4. Control low (24V) and control line (120V) voltage wiring, conduit, and related switches and relays required for the automatic control and/or interlock of motors and equipment, including final connection, are to be furnished and installed under Divisions 21, 22 and 23. Materials and installation to conform to Class 1 or 2 requirements.

C. Mechanical Contractor's Responsibility:

1. Assumes responsibility for internal wiring of all equipment provided by the Mechanical Contractor, for example:
  - a. Chillers.
2. Assumes all responsibility for the Temperature Control wiring, when the Temperature Control Contractor is a Subcontractor to the Mechanical Contractor.
3. Shall verify all existing equipment sizes and capacities where units are to be modified, moved or replaced. Contractor shall notify Engineer of any discrepancies prior to ordering new units or replacement parts, including replacements of equipment motors.
4. Temperature Control Subcontractor's Responsibility:
  - a. Wiring of all devices needed to make the Temperature Control System functional.
  - b. Verifying any control wiring on the electrical drawings as being by the Electrical Contractor. All wiring required for the Control System, but not shown on the electrical drawings, is the responsibility of the Temperature Control Subcontractor.

- c. Coordinating equipment locations (such as relays, transformers, etc.) with the Electrical Contractor, where wiring of the equipment is by the Electrical Contractor.
5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

D. Electrical Contractor's Responsibility:

1. Provides all combination starters, manual starters and disconnect devices shown on the Electrical Drawings or indicated to be by the Electrical Contractor on the Mechanical Drawings or Specifications.
2. Installs and wires all remote control devices furnished by the Mechanical Contractor or Temperature Control Subcontractor when so noted on the Electrical Drawings.
3. Provides motor control and temperature control wiring, where so noted on the drawings.
4. Coordinate with the Mechanical Contractor for size of motors and/or other electrical devices involved with repair or replacement of existing equipment.
5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

1.6 QUALITY ASSURANCE

A. Contractor's Responsibility Prior to Submitting Pricing Data:

1. The Contractor is responsible for constructing complete and operating systems. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of a three-dimensional object, subject to human interpretation. This representation may include imperfect data, interpreted codes, utility guidelines, three-dimensional conflicts, and required field coordination items. Such deficiencies can be corrected when identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the Design Team any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.
2. The Contractor shall resolve all reported deficiencies with the Engineer prior to awarding any subcontracts, ordering material, or starting any work with the Contractor's own employees. Any work performed prior to receipt of instructions from the Design Team will be done at the Contractor's risk.

B. Compliance with Codes, Laws, Ordinances:

1. Conform to all requirements of the State of Iowa's Codes, Laws, Ordinances and other regulations having jurisdiction.
2. Conform to all published standards of the Iowa Department of Corrections.
3. If there is a discrepancy between the codes and regulations and these specifications, the Engineer shall determine the method or equipment used.
4. If the Contractor notes, at the time of bidding, that any parts of the drawings or specifications do not comply with the codes or regulations, Contractor shall inform the Engineer in writing, requesting a clarification. If there is insufficient time for this procedure, Contractor shall submit with the proposal a separate price to make the system comply with the codes and regulations.
5. All changes to the system made after letting of the contract, to comply with codes or requirements of Inspectors, shall be made by the Contractor without cost to the Owner.

6. If there is a discrepancy between manufacturer's recommendations and these specifications, the manufacturer's recommendations shall govern.
7. All rotating shafts and/or equipment shall be completely guarded from all contact. Partial guards and/or guards that do not meet all applicable OSHA standards are not acceptable. Contractor is responsible for providing this guarding if it is not provided with the equipment supplied.

C. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.
2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where the work is done, or as required by any duly constituted public authority.
3. Pay all charges for permits or licenses.
4. Pay all fees and taxes imposed by the State, Municipal and/or other regulatory bodies.
5. Pay all charges arising out of required inspections by an authorized body.
6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized agency/consultant.
7. Where applicable, all fixtures, equipment and materials shall be approved or listed by Underwriter's Laboratories, Inc.

D. Examination of Drawings:

1. The drawings for the mechanical work are completely diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment, outlets, etc., and the approximate sizes of equipment.
2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of pipes and ducts to best fit the layout of the job.
3. Scaling of the drawings is not sufficient or accurate for determining these locations.
4. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.
5. Because of the scale of the drawings, certain basic items, such as fittings, boxes, valves, unions, etc., may not be shown, but where required by other sections of the specifications or required for proper installation of the work, such items shall be furnished and installed.
6. If an item is either on the drawings or in the specifications, it shall be included in this contract.
7. Determination of quantities of material and equipment required shall be made by the Contractor from the documents. Where discrepancies arise between drawings, schedules and/or specifications, the greater number shall govern.
8. Where used in mechanical documents, the word "furnish" shall mean supply for use, the word "install" shall mean connect complete and ready for operation, and the word "provide" shall mean to supply for use and connect complete and ready for operation.
  - a. Any item listed as furnished shall also be installed, unless otherwise noted.
  - b. Any item listed as installed shall also be furnished, unless otherwise noted.

E. Field Measurements:

1. Verify all pertinent dimensions at the job site before ordering any materials or fabricating any supports, pipes or ducts.

F. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing Revit.
2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.
3. Upon request for electronic media, the Contractor shall complete and return a signed "Electronic File Transmittal" form provided by IMEG.
4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.
5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.
6. The drawings prepared by IMEG for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.
7. The use of these CAD documents by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.
8. The information is provided to expedite the project and assist the Contractor with no guarantee by IMEG as to the accuracy or correctness of the information provided. IMEG accepts no responsibility or liability for the Contractor's use of these documents.

1.7 SUBMITTALS

- A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.

1. Submittals List:

Referenced Specification Section	Submittal Item
23 05 00	Owner Training Agenda
23 05 93	Testing, Adjusting, and Balancing
23 07 19	HVAC Pipe Insulation
23 09 00	Controls
23 21 00	Hydronic Piping Systems and Valves
23 21 16	Hydronic Specialties

- B. General Submittal Procedures: In addition to the provisions of Division 01, the following are required:

1. Transmittal: Each transmittal shall include the following:
  - a. Date
  - b. Project title and number
  - c. Contractor's name and address
  - d. Division of work (e.g., plumbing, heating, ventilating, etc.)
  - e. Description of items submitted and relevant specification number
  - f. Notations of deviations from the contract documents
  - g. Other pertinent data

2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:
  - a. Date
  - b. Project title and number
  - c. Engineer
  - d. Contractor and subcontractors' names and addresses
  - e. Supplier and manufacturer's names and addresses
  - f. Division of work (e.g., plumbing, heating, ventilating, etc.)
  - g. Description of item submitted (using project nomenclature) and relevant specification number
  - h. Notations of deviations from the contract documents
  - i. Other pertinent data
  - j. Provide space for Contractor's review stamps
  
3. Composition:
  - a. Submittals shall be submitted using specification sections and the project nomenclature for each item.
  - b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).
  - c. All sets shall contain an index of the items enclosed with a general topic description on the cover.
  
4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; electrical power criteria (e.g., voltage, phase, amps, horsepower, kW, etc.) wiring and control diagrams; Short Circuit Current Rating (SCCR); dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.
  
5. Contractor's Approval Stamp:
  - a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.
  - b. Unstamped submittals will be rejected.
  - c. The Contractor's review shall include, but not be limited to, verification of the following:
    - 1) Only approved manufacturers are used.
    - 2) Addenda items have been incorporated.
    - 3) Catalog numbers and options match those specified.
    - 4) Performance data matches that specified.
    - 5) Electrical characteristics and loads match those specified.
    - 6) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
    - 7) Dimensions and service clearances are suitable for the intended location.
    - 8) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
    - 9) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).

- d. The Contractor shall review, stamp and approve all subcontractors' submittals as described above.
  - e. The Contractor's approval stamp is required on all submittals. Approval will indicate the Contractor's review of all material and a complete understanding of exactly what is to be furnished. Contractor shall clearly mark all deviations from the contract documents on all submittals. If deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.
6. Submittal Identification and Markings:
- a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.
  - b. The Contractor shall clearly indicate the size, finish, material, etc.
  - c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.
  - d. All marks and identifications on the submittals shall be unambiguous.
7. Schedule submittals to expedite the project. Coordinate submission of related items.
8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.
9. Reproduction of contract documents alone is not acceptable for submittals.
10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Engineer.
11. Submittals not required by the contract documents may be returned without review.
12. The Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Engineer to recheck and handle the additional shop drawing submittals.
13. Submittals shall be reviewed and approved by the Engineer before releasing any equipment for manufacture or shipment.
14. Contractor's responsibility for errors, omissions, or deviation from the contract documents in submittals is not relieved by the Engineer's approval.
15. Schedule shall allow for adequate time to perform orderly and proper review of submittals, including time for consultants and Owner if required, and resubmittals by Contractor if necessary, and to cause no delay in Work or in activities of Owner or other contractors.
- a. Allow two weeks for Engineer's review and processing of each submittal.
16. Engineer reserves the right to withhold action on a submittal which, in the Engineer's opinion, requires coordination with other submittals until related submittals are received. The Engineer will notify the Contractor, in writing, when they exercise this right.
- C. Electronic Submittal Procedures:
1. Distribution: Email submittals as attachments to all parties designated by the Engineer, unless a web-based submittal program is used.
  2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
  3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.

4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
  - a. Submittal file name: 23 XX XX.description.YYYYMMDD
  - b. Transmittal file name: 23 XX XX.description.YYYYMMDD
5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.

#### 1.8 SCHEDULE OF VALUES

- A. The requirements herein are in addition to the provisions of Division 01.
- B. Format:
  1. Use AIA Document Continuation Sheets G703 or another similar form approved by the Owner and Engineer.
  2. Submit in Excel format.
  3. Support values given with substantiating data.
- C. Preparation:
  1. Itemize work required by each specification section and list all providers. All work provided by subcontractors and major suppliers shall be listed on the Schedule of Values. List each subcontractor and supplier by company name.
  2. Break down all costs into:
    - a. Material: Delivered cost of product with taxes paid.
    - b. Labor: Labor cost, excluding overhead and profit.
- D. Update Schedule of Values when:
  1. Indicated by Engineer.
  2. Change of subcontractor or supplier occurs.
  3. Change of product or equipment occurs.

#### 1.9 CHANGE ORDERS

- A. A detailed material and labor takeoff shall be prepared for each change order, along with labor rates and markup percentages. Change orders shall be broken down by sheet or associated individual line item indicated in the change associated narrative, whichever provides the most detailed breakdown. Change orders with inadequate breakdown will be rejected.
- B. Itemized pricing with unit cost shall be provided from all distributors and associated subcontractors.
- C. Change order work shall not proceed until authorized.

#### 1.10 EQUIPMENT SUPPLIERS' INSPECTION

- A. The following equipment shall not be placed in operation until a competent installation and service representative of the manufacturer has inspected the installation and certified that the equipment is properly installed, adjusted and lubricated; that preliminary operating instructions have been given; and that the equipment is ready for operation:
  - 1. Air Cooled Chillers
- B. Contractor shall arrange for and obtain supplier's on-site inspection(s) at proper time(s) to assure each phase of equipment installation and/or connection is in accordance with the manufacturer's instructions.
- C. Submit copies of start-up reports to the Engineer and include copies of Owner's Operation and Maintenance Manuals.

#### 1.11 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE

- A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage. Keep materials clean, dry and free from harmful conditions. Immediately remove any materials that become wet or that are suspected of becoming contaminated with mold or other organisms.
- B. Keep all bearings properly lubricated and all belts properly tensioned and aligned.
- C. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the Mechanical Contractor does not have prior documented experience in rigging and lifting similar equipment, he/she shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.
- D. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate the work with other trades.

#### 1.12 NETWORK / INTERNET CONNECTED EQUIPMENT

- A. These specifications may require certain equipment or systems to have network, Internet and/or remote access capability ("Network Capability"). Any requirement for Network Capability shall be interpreted only as a functional capability and is not to be construed as authority to connect or enable any Network Capability. Network Capability may only be connected or enabled with the express written consent of the Owner.

#### 1.13 WARRANTY

- A. Provide one-year warranty, unless otherwise noted, to the Owner for all fixtures, equipment, materials, and workmanship.
- B. The warranty period for all work in this Division of the specifications shall commence on the date of final acceptance, unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner.

- C. Warranty requirements shall extend to correction, without cost to the Owner, of all Work found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from defects or nonconformance with contract documents.

#### 1.14 INSURANCE

- A. Contractor shall maintain insurance coverage as set forth in Division 0 of these specifications.

#### 1.15 MATERIAL SUBSTITUTION

- A. Where several manufacturers' names are given, the scheduled manufacturer is the basis for job design and establishes the quality required.
- B. Equivalent equipment manufactured by the other listed manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meet all requirements of the drawings and specifications and fits in the allocated space. When using other listed manufacturers, the Contractor shall assume responsibility for any and all modifications necessary (including, but not limited to structural supports, electrical connections, piping and ductwork connections and arrangement, plumbing connections and rough-in, and regulatory agency approval, etc.) and coordinate such with other contractors.
- C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Engineer not later than ten days prior to the bid opening.
- D. This Contractor assumes all costs incurred as a result of using the offered material, article or equipment, on the Contractors part or on the part of other Contractors whose work is affected.
- E. This Contractor may list voluntary add or deduct prices for alternate materials on the bid form. These items will not be used in determining the low bidder.
- F. All material substitutions requested later than ten (10) days prior to bid opening must be listed as voluntary changes on the bid form.

### PART 2 - PRODUCTS (Not Used)

### PART 3 - EXECUTION

#### 3.1 JOBSITE SAFETY

- A. Neither the professional activities of the Engineer, nor the presence of the Engineer or the employees and subconsultants at a construction site, shall relieve the Contractor and other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Engineer and personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Engineer and the Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

### 3.2 EXCAVATION, FILL, BACKFILL, COMPACTION

#### A. General:

1. Prior to the commencement of any excavation or digging, the Contractor shall verify all underground utilities with the regional utility locator. Provide prior notice to the locator before excavations. Contact information for most regional utility locaters can be found at the following website (<https://call811.com/>) or by calling 811.
2. The Contractor shall do all excavating, filling, backfilling and compacting associated with the work.

#### B. Excavation:

1. Make all excavations to accurate, solid, undisturbed earth, and to proper dimensions.
2. Where excavations are made in error below foundations, concrete of same strength as specified for the foundations or thoroughly compacted sand-gravel fill, as determined by the Engineer, shall be placed in such excess excavations. Place thoroughly compacted, clean, stable fill in excess excavations under slabs on grade, at the Contractor's expense.
3. Trim bottom and sides of excavations to grades required for foundations.
4. Protect excavations against frost and freezing.
5. Take care in excavating not to damage surrounding structures, equipment, or buried pipe. Do not undermine footing or foundation.
6. Perform all trenching in a manner to prevent cave-ins and risk to workers.
7. Where original surface is pavement or concrete, the surface shall be saw cut to provide clean edges and assist in the surface restoration.
8. Where satisfactory bearing soil for foundations is not found at the indicated levels, the Engineer or their representative shall be notified immediately, and no further work shall be done until further instructions are given by the Engineer or their representative.

#### C. Dewatering:

1. Contractor shall furnish, install, operate, and remove all dewatering pumps and pipes needed to keep trenches and pits free of water.

#### D. Underground Obstructions:

1. Known underground piping, foundations, and other obstructions in the vicinity of construction are shown on the drawings. Use great care in making installations near underground obstruction.
2. If objects not shown on the drawings are encountered, remove, relocate, or perform extra work as directed by the Engineer.

#### E. Fill and Backfilling:

1. Dispose of excess excavated earth as directed.
2. Backfill all trenches and excavations immediately after installing utilities or removal of forms, unless other protection is provided.
3. Around piers and isolated foundations and structures, backfill and fill shall be placed and consolidated simultaneously on all sides to prevent wedge action and displacement. Fill and backfill materials shall be spread in 6 inch uniform horizontal layers with each layer compacted separately to required density.

F. Surface Restoration:

1. Where trenches are cut through existing graded, planted, or landscaped areas, the areas shall be restored to the original condition. Replace all planting removed or damaged to its original condition. A minimum of 6 inches of topsoil shall be applied where disturbed areas are to be seeded or sodded.
2. Concrete or asphalt type pavement, seal coat, rock, gravel or earth surfaces removed or damaged shall be replaced with comparable materials and restored to original condition.

3.3 ENGINEER OBSERVATION OF WORK

- A. The Engineer will have the opportunity to review the installation and provide a written report noting deficiencies requiring correction. The Contractor's schedule shall account for these reviews and show them as line items in the approved schedule.

3.4 PROJECT CLOSEOUT

- A. The following paragraphs supplement the requirements of Division 01.

B. Final Jobsite Observation:

1. In order to prevent the Final Jobsite Observation from occurring too early, the Contractor is required to review the completion status of the project and certify that the job is ready for the final jobsite observation.
2. Attached to the end of this section is a typical list of items that represent the degree of job completeness expected prior to requesting a review.
3. Upon Contractor certification that the project is complete and ready for a final observation, the Contractor shall sign the attached certification and return it to the Engineer so that the final observation can be scheduled.
4. It is understood that if the Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Engineer's additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

- C. Before final payment is authorized, this Contractor must submit the following:

1. Operation and maintenance manuals with copies of approved shop drawings.
2. Record documents including marked-up or reproducible drawings and specifications.
3. A report documenting the instructions given to the Owner's representatives complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of This Contractor and shall be signed by the Owner's representatives.
4. Start-up reports on all equipment requiring a factory installation inspection or start-up.
5. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to project site and place in location as directed; receipt by Engineer required prior to final payment approval.

3.5 OPERATION AND MAINTENANCE MANUALS

A. General:

1. Provide an electronic copy of the O&M manuals as described below for Engineer's review and approval. The electronic copy shall be corrected as required to address the Engineer's comments. Once corrected, electronic copies and paper copies shall be distributed as directed by the Engineer.

2. Approved O&M manuals shall be completed and in the Owner's possession prior to Owner's acceptance and at least 10 days prior to instruction of operating personnel.

B. Electronic Submittal Procedures:

1. Distribution: Email the O&M manual as attachments to all parties designated by the Engineer.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
  - a. O&M file name: O&M.div23.contractor.YYYYMMDD
  - b. Transmittal file name: O&Mtransmittal.div23.contractor.YYYYMMDD
5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.
6. Provide the Owner with an approved copy of the O&M manual on compact discs (CD), digital video discs (DVD), or flash drives with a permanently affixed label, printed with the title "Operation and Maintenance Instructions", title of the project and subject matter of disc/flash drive when multiple disc/flash drives are required.
7. All text shall be searchable.
8. Bookmarks shall be used, dividing information first by specification section, then systems, major equipment and finally individual items. All bookmark titles shall include the nomenclature used in the construction documents and shall be an active link to the first page of the section being referenced.

C. Operation and Maintenance Instructions shall include:

1. Title Page: Include title page with project title, Engineer, Contractor, all subcontractors, and major equipment suppliers, with addresses, telephone numbers, website addresses, email addresses and point of contacts. Website URLs and email addresses shall be active links in the electronic submittal.
2. Table of Contents: Include a table of contents describing specification section, systems, major equipment, and individual items.
3. Copies of all final approved shop drawings and submittals. Include Engineer's shop drawing review comments. Insert the individual shop drawing directly after the Operation and Maintenance information for the item(s) in the review form.
4. Refer to Section 23 09 00 for additional requirements for Temperature Control submittals.
5. Copy of final approved test and balance reports.
6. Copies of all factory inspections and/or equipment startup reports.
7. Copies of warranties.
8. Schematic electrical power/controls wiring diagrams of the equipment that have been updated for field conditions. Field wiring shall have label numbers to match drawings.
9. Dimensional drawings of equipment.
10. Capacities and utility consumption of equipment.
11. Detailed parts lists with lists of suppliers.
12. Operating procedures for each system.
13. Maintenance schedule and procedures. Include a chart listing maintenance requirements and frequency.

14. Repair procedures for major components.
15. List of lubricants in all equipment and recommended frequency of lubrication.
16. Instruction books, cards, and manuals furnished with the equipment.

### 3.6 INSTRUCTING THE OWNER'S REPRESENTATIVES

- A. Adequately instruct the Owner's designated representatives in the maintenance, care, and operation of all systems installed under this contract.
- B. Provide verbal and written instructions to the Owner's representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.
- C. The Owner has the option to make a video recording of all instructions. Coordinate schedule of instructions to facilitate this recording.
- D. The instructions shall include:
  1. Explanation of all system flow diagrams.
  2. Temperature control system operation including calibration, adjustment and proper operating conditions of all sensors.
  3. Maintenance of equipment.
  4. Start-up procedures for all major equipment.
  5. Explanation of seasonal system changes.
- E. Notify the Engineer of the time and place for the verbal instructions to be given to the Owner's representative so a representative can attend if desired.
- F. Minimum hours of instruction for each item shall be:
  1. Chilled Water System - 2 hours.
  2. Temperature Controls - As defined in Section 23 09 00.
- G. The Contractor shall prepare a detailed, written training agenda and submit it to the Engineer a minimum of two weeks prior to the formal training for approval. The written agenda shall include specific training points within the items described above. For example: how to adjust setpoints, troubleshooting, proper start-up, proper shut-down, seasonal changes, draining, venting, changing filters, changing belts, etc. Failure to provide and follow an approved training agenda may result in additional training required at the expense of the Contractor.
- H. Operating Instructions:
  1. Contractor is responsible for all instructions to the Owner's representatives for the mechanical and control systems.
  2. If the Contractor does not have staff that can adequately provide the required instructions the Contractor shall include in the bid an adequate amount to reimburse the Owner for the Engineer to perform these services.

### 3.7 SYSTEM STARTING AND ADJUSTING

- A. The mechanical systems shall be complete and operating. System startup, testing, adjusting, and balancing to obtain satisfactory system performance is the responsibility of the Contractor. This includes calibration and adjustments of all controls, noise level adjustments and final comfort adjustments as required.

- B. Complete all manufacturer-recommended startup procedures and checklists to verify proper motor rotation, electrical power voltage is within equipment limitations, equipment controls maintain pressures and temperatures within acceptable ranges, all filters and protective guards are in-place, acceptable access is provided for maintenance and servicing, and equipment operation does not pose a danger to personnel or property.
- C. Contractor shall adjust the mechanical systems and controls at season changes during the one year warranty period, as required, to provide satisfactory operation and to prove performance of all systems in all seasons.
- D. All operating conditions and control sequences shall be tested during the start-up period. Test all interlocks, safety shutdowns, controls, and alarms.
- E. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all systems perform properly. If the Engineer is requested to visit the job site for trouble shooting, assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period, through no fault of the design; the Contractor shall reimburse the Owner on a time and materials basis for services rendered at the Engineer's standard hourly rates in effect when the services are requested. The Contractor shall pay the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

### 3.8 RECORD DOCUMENTS

- A. The following paragraphs supplement Division 01 requirements.
- B. Maintain at the job site a separate and complete set of mechanical drawings and specifications with all changes made to the systems clearly and permanently marked in complete detail.
- C. Mark drawings to indicate revisions to piping and ductwork, size and location, both exterior and interior; including locations of coils, dampers, other control devices, filters, and other units requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned from column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (e.g., traps, strainers, expansion compensators, tanks, etc.); Change Orders; concealed control system devices.
- D. Refer to Section 23 09 00 for additional requirements for Temperature Control documents.
- E. Mark specifications to show approved substitutions; Change Orders, and actual equipment and materials used.
- F. Record changes daily and keep the marked drawings available for the Engineer's examination at any normal work time.
- G. Upon completing the job, and before final payment is made, give the marked-up drawings to the Engineer.

### 3.9 PAINTING

- A. Paint all equipment that is marred or damaged prior to the Owner's acceptance. Paint and color shall match original equipment paint and shall be obtained from the equipment supplier if available.

3.10 ADJUST AND CLEAN

- A. Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project. Clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from all equipment.
- B. Clean all drain pans and areas where moisture is present. Immediately report any mold, biological growth, or water damage.
- C. Remove all rust, scale, dirt, oils, stickers and thoroughly clean exterior of all exposed bare metal ductwork, piping, hangers, and accessories.
- D. Remove all rubbish, debris, etc., accumulated during construction from the premises.

3.11 SPECIAL REQUIREMENTS

- A. Contractor shall coordinate the installation of all equipment, valves, dampers, operators, etc., with other trades to maintain clear access area for servicing.
- B. All equipment shall be installed in such a way to maximize access to parts needing service or maintenance. Review the final field location, placement, and orientation of equipment with the Owner's designated representative prior to setting equipment.
- C. Installation of equipment or devices without regard to coordination of access requirements and confirmation with the Owner's designated representative will result in removal and reinstallation of the equipment at the Contractor's expense.

3.12 IAQ MAINTENANCE FOR OCCUPIED FACILITIES UNDER CONSTRUCTION

- A. Contractors shall make all reasonable efforts to prevent construction activities from affecting the air quality of the occupied areas of the building or outdoor areas near the building. These measures shall include, but not be limited to:
  - 1. All contractors shall endeavor to minimize the amount of contaminants generated during construction. Methods to be employed shall include, but not be limited to:
    - a. Minimizing the amount of dust generated.
    - b. Reducing solvent fumes and VOC emissions.
    - c. Maintain good housekeeping practices, including sweeping and periodic dust and debris removal. There should be no visible haze in the air.
    - d. Protect stored on-site and installed absorptive materials from moisture damage.
  - 2. Request that the Owner designate an IAQ representative.
  - 3. Review and receive approval from the Owner's IAQ representative for all IAQ-related construction activities and negative pressure containment plans.
  - 4. Inform the IAQ representative of all conditions that could adversely impact IAQ, including operations that will produce higher than normal dust production or odors.
  - 5. Schedule activities that may cause IAQ conditions that are not acceptable to the Owner's IAQ representative during unoccupied periods.
  - 6. Request copies of and follow all of the Owner's IAQ and infection control policies.
  - 7. Unless no other access is possible, the entrance to construction site shall not be through the existing facility.
  - 8. To minimize growth of infectious organisms, do not permit damp areas in or near the construction area to remain for over 24 hours.

9. In addition to the criteria above, provide measures as recommended in the SMACNA "IAQ Guidelines for Occupied Buildings Under Construction".
10. If permanently installed air handlers are used to serve both construction and occupied areas, all return grilles throughout construction areas shall be sealed to prevent air from construction areas being supplied to occupied areas.
11. If permanently installed air handlers are used during construction to serve only construction areas and do not supply air to adjacent occupied areas, MERV 8 filtration media shall be used to protect each return air grille or opening. The intent of this will be to prevent construction dust and debris from entering any return or supply air ductwork in the facility. All filtration media shall be replaced immediately prior to occupancy.

**READINESS CERTIFICATION PRIOR TO FINAL JOBSITE OBSERVATION**

To prevent the final job observation from occurring too early, we require that the Contractor review the completion status of the project and, by copy of this document, certify that the job is indeed ready for the final job observation. The following is a typical list of items that represent the degree of job completeness expected prior to your requesting a final job observation.

1. Chiller operating and balanced.
2. All temperature control systems operating, programmed and calibrated.
3. Pipe insulation complete, pipes labeled and valves tagged.

Accepted by:

Prime Contractor \_\_\_\_\_

By \_\_\_\_\_ Date \_\_\_\_\_

Upon Contractor certification that the project is complete and ready for a final job observation, we require the Contractor to sign this agreement and return it to the Engineer so that the final observation can be scheduled.

It is understood that if the Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Engineers for additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

**END OF SECTION**

## SECTION 23 05 05

### HVAC DEMOLITION FOR REMODELING

#### PART 1 - GENERAL

##### 1.1 SECTION INCLUDES

- A. Mechanical demolition.
- B. Cutting and Patching.

#### PART 2 - PRODUCTS

##### 2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment shall be as specified in individual Sections.

#### PART 3 - EXECUTION

##### 3.1 EXAMINATION

- A. THE DRAWINGS ARE INTENDED TO INDICATE THE GENERAL SCOPE OF WORK AND DO NOT SHOW EVERY PIPE, DUCT, OR PIECE OF EQUIPMENT THAT MUST BE REMOVED. THE CONTRACTOR SHALL VISIT THE SITE AND VERIFY CONDITIONS PRIOR TO SUBMITTING A BID.
- B. Verify that abandoned utilities serve only abandoned equipment or facilities. Extend services to facilities or equipment that shall remain in operation following demolition.
- C. Coordinate work with all other Contractors and the Owner. Schedule removal of equipment to avoid conflicts.
- D. This Contractor shall verify all existing equipment sizes and capacities where equipment is scheduled to be replaced or modified, prior to ordering new equipment.
- E. Bid submittal shall mean the Contractor has visited the project site and verified existing conditions and scope of work.

##### 3.2 PREPARATION

- A. Provide temporary connections to maintain existing systems in service during construction. When work must be performed on operating equipment, use personnel experienced in such operations.

##### 3.3 DEMOLITION AND EXTENSION OF EXISTING MECHANICAL WORK

- A. Demolish and extend existing mechanical work under provisions of Division 2 and this Section.
- B. Remove, relocate, and extend existing installations to accommodate new construction.

- C. Remove abandoned ducts and piping to source of supply and/or main lines.
- D. Disconnect and remove mechanical devices and equipment serving equipment that has been removed.
- E. Repair adjacent construction and finishes damaged during demolition and extension work.
- F. Maintain access to existing mechanical installations which remain. Modify installation or provide access panels as appropriate.
- G. Extend existing installations using materials and methods compatible with existing installations, or as specified.

3.4 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment which remain or are to be reused.
- B. Clean all systems adjacent to project which are affected by the dust and debris caused by this construction.
- C. MECHANICAL ITEMS REMOVED AND NOT RELOCATED REMAIN THE PROPERTY OF THE OWNER. CONTRACTOR SHALL PLACE ITEMS RETAINED BY THE OWNER IN A LOCATION COORDINATED WITH THE OWNER. THE CONTRACTOR SHALL DISPOSE OF MATERIAL THE OWNER DOES NOT WANT TO REUSE OR RETAIN FOR MAINTENANCE PURPOSES.

**END OF SECTION**

## SECTION 23 05 29

### HVAC SUPPORTS AND ANCHORS

#### PART 1 - GENERAL

##### 1.1 SECTION INCLUDES

- A. Equipment Bases and Supports.
- B. Flashing and Sealing of Equipment and Pipe Stacks.

#### PART 2 - PRODUCTS

##### 2.1 FOUNDATIONS, BASES, AND SUPPORTS

###### A. Basic Requirements:

- 1. Furnish and install foundations, bases, and supports (not specifically indicated on the Drawings or in the Specifications of either the General Construction or Mechanical work as provided by another Contractor) for mechanical equipment.
- 2. All concrete foundations, bases and supports, shall be reinforced. All steel bases and supports shall receive a prime coat of zinc chromate or red metal primer. After completion of work, give steel supports a final coat of gray enamel.

###### B. Supports:

- 1. Provide sufficient clips, inserts, hangers, racks, rods, and auxiliary steel to securely support all suspended material, equipment and conduit without sag.

###### C. Grout:

- 1. Grout shall be non-shrinking premixed (Master Builders Company "Embecco"), unless otherwise indicated on the drawings or approved by the Engineer.
- 2. Use Mix No. 1 for clearances of 1" or less, and Mix No. 2 for all larger clearances.
- 3. Grout under equipment bases, around pipes, at pipe sleeves, etc., and where shown on the drawings.

#### PART 3 - EXECUTION

##### 3.1 HVAC SUPPORTS AND ANCHORS

###### A. General Installation Requirements:

- 1. Install all items per manufacturer's instructions.
- 2. Coordinate the location and method of support of piping systems with all installations under other Divisions and Sections of the Specifications.
- 3. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

B. Supports Requirements:

1. Set all concrete inserts in place before pouring concrete.
2. Furnish, install and prime all auxiliary structural steel for support of piping systems that are not shown on the Drawings as being by others.

C. Pipe Requirements:

1. Support all piping and equipment, including valves, strainers, traps and other specialties and accessories to avoid objectionable or excessive stress, deflection, swaying, sagging or vibration in the piping or building structure during erection, cleaning, testing and normal operation of the systems.
2. Do not, however, restrain piping to cause it to snake or buckle between supports or to prevent proper movement due to expansion and contraction.
3. Piping shall not introduce strains or distortion to connected equipment.

D. Do not exceed the manufacturer's recommended maximum load for any hanger or support.

E. Steel/Concrete Structure: Spacing of hangers shall not exceed the compressive strength of the insulation inserts, and in no case shall exceed the following:

1. Steel and Fiberglass (Std. Weight or Heavier - Liquid Service):
  - a. Maximum Spacing:
    - 1) 1-1/4" & under: 7'-0"
    - 2) 1-1/2": 9'-0"
    - 3) 2": 10'-0"
    - 4) 2-1/2": 11'-0"
    - 5) 3": 12'-0"
    - 6) 4" & larger: 12'-0"

**END OF SECTION**

**SECTION 23 05 53**  
**HVAC IDENTIFICATION**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Identification of products installed under Division 23.

**1.2 REFERENCES**

- A. ANSI/ASME A13.1 - Scheme for the Identification of Piping Systems.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. 3M
- B. Bunting
- C. Calpico
- D. Craftmark
- E. Emedco
- F. Kolbi Industries
- G. Seton
- H. W. H. Brady
- I. Marking Services
- J. Or engineer pre-approved equal

**2.2 MATERIALS**

- A. All pipe markers (purchased or stenciled) shall conform to ANSI A13.1. Marker lengths and letter sizes shall be at least the following:

OD of Pipe or Insulation	Marker Length	Size of Letters
Up to and including 1-1/4" (32mm)	8" (200 mm)	1/2" (12 mm)
1-1/2" (40 mm) to 2" (50 mm)	8" (200 mm)	3/4" (20 mm)
2-1/2" (65 mm) to 6" (150 mm)	12" (300 mm)	1-1/4" (32 mm)
8" (200 mm) to 10" (250 mm)	24" (600 mm)	2-1/2" (65 mm)
Over 10" (250 mm)	32" (800 mm)	3-1/2" (90 mm)

Plastic tags may be used for outside diameters under 3/4" (20 mm)

- B. Aluminum Nameplates: Black enamel background with natural aluminum border and engraved letters furnished with two mounting holes and screws.
- C. Plastic Pipe Markers: Semi-rigid plastic, preformed to fit around pipe or pipe covering; indicating flow direction and fluid conveyed.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install all products per manufacturer's recommendations.
- B. Degrease and clean surfaces to receive adhesive for identification materials.
- C. Pipe Markers:
  - 1. Adhesive Backed Markers: Use Brady Style 1, 2, or 3 on pipes 3" diameter and larger. Use Brady Style 4, 6, or 8 on pipes under 3" diameter. Similar styles by other listed manufacturers are acceptable. Secure all markers at both ends with a wrap of pressure sensitive tape completely around the pipe.
  - 2. Snap-on Markers: Use Seton "Setmark" on pipes up to 5-7/8" OD. Use Seton "Setmark" with nylon or Velcro ties for pipes 6" OD and over. Similar styles by other listed manufacturers are acceptable if pre-approved by engineer.
  - 3. Apply markers and arrows in the following locations where clearly visible:
    - a. At each valve.
    - b. On both sides of walls that pipes penetrate.
    - c. At least every 20 feet along all pipes.
    - d. On each riser and each leg of each "T" joint.
    - e. At least once in every room and each story traversed.
- D. Equipment:
  - 1. All equipment not easily identifiable such as controls, relays, gauges, etc.; and all equipment in an area remote from its function such as air handling units, exhaust fans, filters, reheat coils, dampers, etc.; shall have nameplates or plastic tags listing name, function, and drawing symbol. Do not label exposed equipment in public areas.
  - 2. Fasten nameplates or plastic tags with stainless steel self-tapping screws or permanently bonding cement.
  - 3. Mechanical equipment that is not covered by the U.S. National Appliance Energy Conservation Act (NAECA) of 1987 shall carry a permanent label installed by the manufacturer stating that the equipment complies with the requirements of ASHRAE 90.1.

#### 3.2 SCHEDULE

- A. Pipes to be marked shall be labeled with text as follows, regardless of which method or material is used:
  - 1. CHILLED WATER SUPPLY: White lettering; green background
  - 2. CHILLED WATER RETURN: White lettering; green background

### END OF SECTION

## SECTION 23 05 93

### TESTING, ADJUSTING, AND BALANCING

#### PART 1 - GENERAL

##### 1.1 SECTION INCLUDES

- A. Testing, adjusting, and balancing of cooling systems.
- B. Measurement of final operating condition of HVAC systems.

##### 1.2 QUALITY ASSURANCE

- A. Work shall be performed in accordance with the requirements of the references listed at the start of this section.

##### 1.3 REFERENCES

- A. AABC - National Standards for Total System Balance, Seventh Edition.
- B. ADC - Test Code for Grilles, Registers, and Diffusers.
- C. AMCA - Publication 203-90; Field Performance Measurement of Fan Systems.
- D. ASHRAE - 2019 HVAC Applications Handbook; Chapter 39, Testing, Adjusting and Balancing.
- E. ASHRAE/ANSI - Standard 111-2008; Practices for Measurement, Testing, Adjusting and Balancing of Building HVAC&R Systems.
- F. NEBB - Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems, Ninth Edition, 2019.
- G. SMACNA - HVAC Systems; Testing, Adjusting and Balancing, Third Edition, 2002.
- H. TABB - International Standards for Environmental Systems Balance.

##### 1.4 SUBMITTALS

- A. Submit copies of report forms, balancing procedures, and the name and qualifications of testing and balancing agency for approval within 30 days after award of Contract.
- B. Electronic Copies:
  - 1. Submit a certified copy of test reports to the Engineer for approval. Electronic copies shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Copies that are not legible will be returned to the Contractor for resubmittal. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
  - 2. Electronic file size shall be limited to a maximum of 10MB. Larger files shall be divided into files that are clearly labeled as "1 of 2", "2 of 2", etc.

3. All text shall be searchable.
4. Bookmarks shall be used. All bookmark titles shall be an active link to the index page and index tabs.

#### 1.5 REPORT FORMS

- A. Submit reports on AABC, SMACNA or NEBB forms. Use custom forms approved by the Engineer when needed to supply specified information.
- B. Include in the final report a schematic drawing showing each system component, including balancing devices, for each system. Each drawing shall be included with the test reports required for that system. The schematic drawings shall identify all testing points and cross-reference these points to the report forms and procedures.
- C. Refer to PART 4 for required reports.

#### 1.6 WARRANTY/GUARANTEE

- A. The TAB Contractor shall include an extended warranty of 90 days after owner receipt of a completed balancing report, during which time the Owner may request a recheck of terminals, or resetting of any outlet, coil, or device listed in the test report. This warranty shall provide a minimum of 8 manhours of onsite service time. If it is determined that the new test results are not within the design criteria, the balancer shall rebalance the system according to design criteria.
- B. Warranty/Guarantee must meet one of the following programs: TABB International Quality Assurance Program, AABC National Project Performance Guarantee, NEBB's Conformance Certification.

#### 1.7 SCHEDULING

- A. Coordinate schedule with other trades. Provide a minimum of seven days' notice to all trades and the Engineer prior to performing each test.

### PART 2 - PRODUCTS (Not Used)

### PART 3 - EXECUTION

#### 3.1 GENERAL REQUIREMENTS

- A. All procedures must conform to a published standard listed in the References article of this section. All equipment shall be adjusted in accordance with the manufacturer's recommendations. Any system not listed in this specification but installed under the contract documents shall be balanced using a procedure from a published standard listed in the References article.
- B. The Balancing Contractor shall incorporate all pertinent documented construction changes (e.g. submittals/shop drawings, change orders, RFIs, ASIs, etc.) and include in the balancing report.
- C. Recorded data shall represent actual measured or observed conditions.

- D. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing is complete, close probe holes and patch insulation with new materials as specified. Restore vapor barrier and finish as specified.
- E. Permanently mark setting of valves, dampers, and other adjustment devices allowing for settings to be restored. Set and lock memory stops.
- F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, plugging test holes, and restoring thermostats to specified settings.
- G. Installations with systems consisting of multiple components shall be balanced with all system components operating.

### 3.2 EXAMINATION

- A. Before beginning work, verify that systems are complete and operable. Ensure the following:
  - 1. General Equipment Requirements:
    - a. Equipment is safe to operate and in normal condition.
    - b. Equipment with moving parts is properly lubricated.
    - c. Temperature control systems are complete and operable.
    - d. Proper thermal overload protection is in place for electrical equipment.
    - e. Direction of rotation of all fans and pumps is correct.
    - f. Access doors are closed and end caps are in place.
  - 2. Pipe System Requirements:
    - a. Coil fins have been cleaned and combed.
    - b. Hydronic systems have been cleaned, filled, and vented.
    - c. Strainer screens are clean and in place.
    - d. Shutoff, throttling and balancing valves are open.

- B. Report any defects or deficiencies to Engineer.
- C. Promptly report items that are abnormal or prevent proper balancing.
- D. If, for design reasons, system cannot be properly balanced, report as soon as observed.
- E. Beginning of work means acceptance of existing conditions.

### 3.3 PREPARATION

- A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to the Engineer for spot checks during testing.
- B. Instruments shall be calibrated within six months of testing performed for project, or more recently if recommended by the instrument manufacturer.

### 3.4 INSTALLATION TOLERANCES

- A.  $\pm 10\%$  of scheduled values:
  - 1. Adjust piping systems to  $\pm 10\%$  of design values.

### 3.5 ADJUSTING

- A. After adjustment, take measurements to verify balance has not been disrupted or that disruption has been rectified.
- B. After testing, adjusting and balancing are complete, operate each system and randomly check measurements to verify system is operating as reported in the report. Document any discrepancies.

### 3.6 SUBMISSION OF REPORTS

- A. Fill in test results on appropriate forms.

## PART 4 - SYSTEMS TO BE TESTED, ADJUSTED AND BALANCED

### 4.1 VERIFICATION OF EXISTING SYSTEMS.

- A. Perform a pre-balance of systems serving the area of construction prior to the start of any other work. Do not make adjustments to the systems. If the systems are not operating at maximum capacity, temporarily drive system to maximum and take readings for the system. Return the system to its original state when measurements are complete.
- B. Air Cooled Chillers:
  - 1. General Requirements:
    - a. Drawing symbol.
    - b. Manufacturer and model.
    - c. Refrigerant type and capacity.
    - d. Starter type, size, and thermal protection.
    - e. Capacity: specified and actual.
  - 2. Temperature:
    - a. Evaporator entering water temperature: specified and actual.
    - b. Evaporator leaving water temperature: specified and actual.
    - c. Condenser entering air temperature.
    - d. Condenser leaving air temperature.
  - 3. Pressure Drop and Pressure:
    - a. Evaporator pressure drop: specified and actual.
  - 4. Flow Rate:
    - a. Evaporator water flow rate: specified and actual.

- C. Report findings to Engineer on standard forms. Provide one (1) copies of report.

#### 4.2 GENERAL REQUIREMENTS

##### A. Title Page:

1. Project name.
2. Project location.
3. Project Engineer (IMEG Corp.).
4. Project General Contractor.
5. TAB Company name, address, phone number.
6. TAB Supervisor's name and certification number.
7. TAB Supervisor's signature and date.
8. Report date.

##### B. Report Index

##### C. General Information:

1. Test conditions.
2. Nomenclature used throughout report.
3. Notable system characteristics/discrepancies from design.
4. Test standards followed.
5. Any deficiencies noted.
6. Quality assurance statement.

##### D. Instrument List:

1. Instrument.
2. Manufacturer, model, and serial number.
3. Range.
4. Calibration date.

#### 4.3 COOLING SYSTEMS

##### A. Air Cooled Chillers:

###### 1. General Requirements:

- a. Drawing symbol.
- b. Manufacturer and model.
- c. Refrigerant type and capacity.
- d. Starter type, size, and thermal protection.
- e. Capacity: specified and actual.

###### 2. Temperature:

- a. Evaporator entering water temperature: specified and actual.
- b. Evaporator leaving water temperature: specified and actual.
- c. Condenser entering air temperature.
- d. Condenser leaving air temperature.

3. Pressure Drop and Pressure:
  - a. Evaporator pressure drop: specified and actual.
4. Flow Rate:
  - a. Evaporator water flow rate: specified and actual.

**END OF SECTION**

## SECTION 23 07 19

### HVAC PIPING INSULATION

#### PART 1 - GENERAL

##### 1.1 SECTION INCLUDES

- A. Piping Insulation.
- B. Insulation Jackets.

##### 1.2 QUALITY ASSURANCE

- A. Materials: Listed and labeled for flame spread/smoke developed rating of no more than 25/50 when tested per ASTM E84 or UL 723 as required by code. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

##### 1.3 REFERENCES

- A. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- B. ANSI/ASTM C534 - Elastomeric Foam Insulation.
- C. ASTM C1729 - Standard Specification for Aluminum Jacketing for Insulation.
- D. ASTM E84 - Surface Burning Characteristics of Building Materials.
- E. NFPA 255 - Surface Burning Characteristics of Building Materials.
- F. UL 723 - Surface Burning Characteristics of Building Materials.
- G. National Commercial & Industrial Insulation Standards - 1999 Edition - as published by Midwest Insulation Contractors Association and endorsed by National Insulation Contractors Association.

##### 1.4 SUBMITTALS

- A. Submit shop drawings per Section 23 05 00. Include product description, list of materials and thickness for each service, and locations.

## PART 2 - PRODUCTS

### 2.1 INSULATION

- A. Type B: Flexible elastomeric foam insulation; closed-cell, sponge or expanded rubber (polyethylene type is not permitted); ANSI/ASTM C534, Grade 1 Type I for tubular materials; flexible plastic; 0.25 maximum 'K' value at 75°F, listed and labeled at more than 25/50 when tested per ASTM E84 or UL 723 as required by code. Maximum 1" thick per layer where multiple layers are specified.

### 2.2 VAPOR BARRIER JACKETS

- A. All-purpose polymer or polypropylene service jacket vapor barrier with self-sealing adhesive joints. Beach puncture resistance ratio of at least 50 units. Tensile strength: 35 psi minimum. Single, self-seal acrylic adhesive on longitudinal jacket laps and butt strips.

### 2.3 JACKET COVERINGS

- A. Aluminum Jackets: ASTM C1729; 0.016" thick (thicker where required by ASTM C1729); stucco embossed finish with Z edge seams and aluminum bands for outdoor use. Where colored jacket covers are called for, provide factory-applied hard film acrylic paint in color selected by Owner.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Install insulation after piping has been tested. Pipe shall be clean, dry and free of rust before applying insulation.
- B. Patch and repair torn insulation. Paint to match adjacent insulation surface.

### 3.2 INSTALLATION

- A. General Installation Requirements:
  1. Install materials per manufacturer's instructions, building codes and industry standards.
  2. Continue insulation with vapor barrier through penetrations. This applies to all insulated piping. Maintain fire rating of all penetrations.
  3. All piping and insulation that does not meet 25/50 that is in an air plenum shall have written approval from the Authority Having Jurisdiction and the local fire department for authorization and materials approval. If approval has been allowed, the non-rated material shall be wrapped with a product that has been listed and labeled having a flame spread index of not more than 25 and a smoke-developed index of not more than 50 when tested as a composite in accordance with ASTM E84 or UL 723.
  4. On 1" and smaller piping routed through metal wall studs, provide a plastic grommet to protect the piping. The piping shall be insulated between the wall studs, and the insulation shall butt up to each stud.

B. Insulated Piping Operating Below 60°F:

1. Insulate fittings, valves, unions, flanges, flexible connections, flexible hoses, and expansion joints. Seal all penetrations of vapor barrier.
2. All balance valves and strainers with fluid operating below 60°F shall be insulated with a removable plug wrapped with vapor barrier tape to allow access for reading and adjusting of the balancing valve and cleaning and servicing of the balancing valve.

C. Exposed Piping:

1. Locate and cover seams in least visible locations.
2. Where exposed insulated piping extends above the floor, provide a sheet metal guard around the insulation extending 12" above the floor. Guard shall be 0.016" cylindrical smooth or stucco aluminum and shall fit tightly to the insulation.

### 3.3 INSULATION

A. Type B Insulation:

1. Install per manufacturer's instructions or ASTM C1710.
2. Elastomeric Cellular Foam: Where possible, slip insulation over the open end of pipe without slitting. Seal all butt ends, longitudinal seams, and fittings with adhesive. At elbows and tees, use mitered connections. Do not compress or crush insulation at cemented joints. Joints shall be sealed completely and not pucker or wrinkle.
3. Insulation Installation on Straight Pipes and Tubes:
  - 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 must be installed in compression to allow for expansion and contraction. Insulation shall be pushed onto the pipe, never pulled. Stretching of insulation may result in open seams and joints.
4. Insulation Installation on Valves and Pipe Specialties:
  - a. Install preformed sections of same material as straight segments of pipe insulation when available.
  - b. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
  - c. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

### 3.4 JACKET COVER INSTALLATION

A. Metal Covering:

1. Provide vapor barrier as specified for insulation type. Cover with aluminum jacket covering with seams located on the bottom of horizontal piping. Include fittings, joints and valves.
2. Seal all interior and exterior butt joints with metal draw bands and sealant. Seal all exterior joints watertight.
3. Interior joints do not need to be sealed.
4. Use metal covering on the following pipes:
  - a. All exterior piping.

3.5 SCHEDULE

- A. Refer to drawings for insulation schedule.

**END OF SECTION**

**SECTION 23 09 00**

**CONTROLS**  
**(Refer to Allowance)**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Complete System of Automatic Controls.
- B. Control Devices, Components, Wiring and Material.
- C. Instructions for Owners.
- D. Remodeling.

**1.2 REFERENCES**

- A. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.
- B. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- C. ANSI/ASHRAE Standard 135-2001: BACnet® - A Data Communication Protocol for Building Automation and Control Networks, including all amendments.
- D. ANSI/NEMA 250 - Enclosures for Electrical Equipment (1000 volts Maximum).
- E. ANSI/NFPA 70 - National Electrical Code.
- F. ANSI/NFPA 90A - Installation of Air-Conditioning and Ventilation Systems.
- G. ASHRAE 62.1 - Ventilation for Acceptable Indoor Air Quality.
- H. ASHRAE 85 - Automatic Control Terminology for Heating, Ventilating, Air Conditioning.

**1.3 SUBMITTALS**

- A. Equipment Coordination:
  - 1. The Controls Contractor shall obtain approved equipment submittals from other contractors to determine equipment wiring connections, to choose appropriate controllers, and to provide programming.
  - 2. Coordinate the control interface of all equipment with the equipment manufacturers prior to submittal submission.
- B. Shop Drawings:
  - 1. Submit shop drawings per Section 23 05 00. In addition, submit an electronic copy of the shop drawings in Adobe Acrobat (.pdf) format to the Owner for review.

2. Cross-reference all control components and point names in a single table located at the beginning of the submittal with the identical nomenclature used in this section.
3. Submittal shall also include a trunk cable schematic diagram depicting operator workstations, control panel locations and a description of the communication type, media and protocol.
4. System Architecture: Provide riser diagrams of wiring between central control unit and all control panels. This shall include specific protocols associated with each level within the architecture. Identify all interface equipment between CPU and control panels. The architecture shall include interface requirements with other systems including, but not limited to, security systems, lighting control, fire alarm, elevator status, and power monitoring system.
5. Diagrams shall include:
  - a. Wiring diagrams and layouts for each control panel showing all termination numbers.
  - b. Schematic diagrams for all control, communication, and power wiring. Provide a schematic drawing of the central system installation. Label all cables and ports with computer manufacturers' model numbers and functions. Show all interface wiring to the control system.
  - c. Identification of all control components connected to emergency power.
  - d. Schematic diagrams for all field sensors and controllers.
  - e. A schematic diagram of each controlled system. The schematics shall have all control points labeled. The schematics shall graphically show the location of all control elements in the system.
  - f. A schematic wiring diagram for each controlled system. Each schematic shall have all elements labeled. Where a control element is the same as that shown on the control system schematic, label it with the same name. Label all terminals.
  - g. A tabular instrumentation list for each controlled system. The table shall show element name, type of device, manufacturer, model number and product data sheet number.
  - h. All installation details and any other details required to demonstrate that the system will function properly.
  - i. All interface requirements with other systems.
6. The network infrastructure shall conform to the published guidelines for wire type, length, number of nodes per channel, termination, and other relevant wiring and infrastructure criteria as published. The number of nodes per channel shall be no more than 80% of the defined segment (logical or physical) limit in order to provide future system enhancement with minimal infrastructure modifications.
7. Sequences: Submit a complete description of the operation of the control system, including sequences of operation. The description shall include and reference a schematic diagram of the controlled system. The wording of the control sequences in the submittal shall match verbatim that included in the construction documents to ensure there are no sequence deviations from that intended by the Engineer. Clearly highlight any deviations from the specified sequences on the submittals.
8. Points List Schedule: Submit a complete points list of all points to be connected to the TCS and FMCS. The points list for each system controller shall include both inputs and outputs (I/O), point number, the controlled device associated with the I/O point, the location of the I/O device, and reference drawings. Where a control point is the same as that shown on the control system schematic, label it with the same name. Points list shall specifically identify alarms, trends, event history, archive, totalization, graphic points, and all mapped points from other systems (security systems, lighting control, fire alarm, etc.). Provide points lists, point naming convention, and factory support information for systems provided and integrated into the FMCS.

9. Product Data Sheets: Required for each component that includes: unique identification tag that is consistent throughout the submittal, manufacturer's description, technical data, performance curves, installation/maintenance instructions, and other relevant items. When manufacturer's literature applies to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawings shall clearly reference the specification and/or drawing that the submittal is to cover. General catalogs shall not be accepted as cutsheets to fulfill submittal requirements.
10. Provide PICS files indicating the BACnet functionality and configuration of each device.
11. Provide documentation of submitted products that have been tested and listed by the BACnet Testing Laboratory (BTL), or provide a letter on the manufacturer's company letterhead indicating the anticipated date by which testing is expected to be completed. If, for any reason, BTL testing and listing has not been completed, a written commitment to upgrade installed controls to a version that meets BTL testing and listing requirements if problems are found during BTL testing is required.
12. Graphic Display: Include a sample graphic of each system and component identified in the points list with a flowchart (site map) indicating how the graphics are to be linked to each other for system navigation.
13. Control System Demonstration and Acceptance: Provide a description of the proposed process, along with all reports and checklists to be used.
14. Clearly identify work by others in the submittal.
15. Quantities of items submitted may be reviewed but are the responsibility of the Contractor to verify.

C. Operation and Maintenance Manual:

1. In addition to the requirements of Section 23 05 00, submit an electronic copy of the O&M manuals in PDF format.
2. Each O&M manual shall include:
  - a. Table of contents with indexed tabs dividing information as outlined below.
  - b. Definitions: List of all abbreviations and technical terms with definitions.
  - c. Warranty Contacts: Names, addresses, and 24-hour telephone numbers of contractors installing equipment and controls and service representatives of each.
  - d. Licenses, Guarantees, and Warranties: Provide documentation for all equipment and systems.
  - e. System Components: Alphabetical list of all system components, with the name, address, and telephone number of the vendor.
  - f. Operating Procedures: Include procedures for operating the control systems; logging on/off; enabling, assigning, and reporting alarms; generating reports; collection, displaying, and archiving of trended data; overriding computer control; event scheduling; backing up software and data files; and changing setpoints and other variables.
  - g. Programming: Description of the programming language (including syntax), statement descriptions (including algorithms and calculations used), point database creation and modification, program creation and modification, and use of the editor.
  - h. Engineering, Installation, and Maintenance: Explain how to design and install new points, panels, and other hardware; recommended preventive maintenance procedures for all system components, including a schedule of tasks (inspection, cleaning, calibration, etc.), time between tasks, and task descriptions; how to debug hardware problems; and how to repair or replace hardware. A list of recommended spare parts.
  - i. Software: One set of CDs containing an executable copy of all custom software created using the programming language, including the setpoints, tuning parameters, and object database.

- j. Graphics: A glossary or icon symbol library detailing the function of each graphic icon and graphics creation and modification. One set of CDs containing files of all color graphic screens created for the project.

D. Training Manual:

- 1. Provide a course outline and training manuals for each training class.

E. Record Documents:

- 1. Submit record documentation per Section 23 05 00.
- 2. Provide a complete set of "as-built" drawings and application software on CDs. Provide drawings as AutoCAD or Visio compatible files. Provide two copies of the "as-built" drawings with revisions clearly indicated in addition to the documents on compact disk. All as-built drawings shall also be installed on the FMCS server in a dedicated directory. Provide all product data sheets in PDF format.
- 3. Submit two hard copies and one electronic copy of as-built versions of the shop drawings, including product data and record drawings with revisions clearly indicated. Provide floor plans showing actual locations of control components including panels, thermostats, sensors, and hardware.
- 4. Provide all completed testing and commissioning reports and checklists, along with all trend logs for each system identified in the points lists.
- 5. Submit printouts of all graphic screens with current values (temperatures, pressures, etc.) to the A/E verifying completion and proper operation of all points.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons through shipping, storage, and handling as required to prevent equipment damage. Store equipment and materials inside and protected from weather.
- B. Factory-Mounted Components: Where control devices specified in this section are indicated to be factory mounted on equipment, arrange for shipping control devices to unit manufacturer.

1.5 AGENCY AND CODE APPROVALS

- A. All products shall have the following agency approvals. Provide verification that the approvals exist for all submitted products with the submittal package.
  - 1. UL-916; Energy Management Systems.
  - 2. C-UL listed to Canadian Standards Association C22.2 No. 205-M1983 "Signal Equipment."
  - 3. EMC Directive 89/336/EEC (European CE Mark).
  - 4. FCC, Part 15, Subpart J, Class A Computing Devices.

1.6 ACRONYMS

- A. Acronyms used in this specification are as follows:
  - 1. B-AAC BACnet Advanced Application Controller
  - 2. B-ASC BACnet Application Specific Controller
  - 3. BTL BACnet Testing Laboratories
  - 4. DDC Direct Digital Controls
  - 5. FMCS Facility Management and Control System
  - 6. GUI Graphic User Interface

7. IBC Interoperable BACnet Controller
8. IDC Interoperable Digital Controller
9. LAN Local Area Network
10. NAC Network Area Controller
11. ODBC Open DataBase Connectivity
12. OOT Object Oriented Technology
13. OPC Open Connectivity via Open Standards
14. PICS Product Interoperability Compliance Statement
15. PMI Power Measurement Interface
16. POT Portable Operator's Terminal
17. TCC Temperature Control Contractor
18. TCS Temperature Control System
19. WAN Wide Area Network
20. WBI Web Browser Interface

## 1.7 SUMMARY

### A. Extend Existing System:

1. Extend the existing FMCS for this project.
2. Replace existing controller as required to accommodate new chiller BACnet connection.
3. All controllers and accessories shall interface with the existing FMCS.

### B. TCC shall furnish all labor, materials, equipment, and service necessary for a complete and operating Temperature Control System (TCS) and Facility Management and Control System (FMCS) using Direct Digital Controls as shown on the drawings and as described herein.

### C. All labor, material, equipment and software not specifically referred to herein or on the plans that is required to meet the intent of this specification shall be provided without additional cost to the Owner.

### D. The Owner shall be the named license holder of all software associated with any and all incremental work on the project.

## 1.8 JOB CONDITIONS

### A. Cooperation with Other Trades: Coordinate the Work of this section with that of other sections to ensure that the Work will be carried out in an orderly fashion. It is this Contractor's responsibility to check the Contract Documents for possible conflicts between the Work of this section and that of other crafts in equipment location; pipe, duct and conduit runs; electrical outlets and fixtures; air diffusers; and structural and architectural features.

## 1.9 WARRANTY

### A. Refer to Section 23 05 00 for warranty requirements.

### B. Within the warranty period, any defects in the work provided under this section due to faulty materials, methods of installation or workmanship shall be promptly (within 48 hours after receipt of notice) repaired or replaced by this Contractor at no expense to the Owner.

### C. Warranty requirements include furnishing and installing all FMCS software upgrades issued by the manufacturer during the one-year warranty period.

### D. Update all software and back-ups during warranty period and all user documentation on the Owner's archived software disks.

1.10 WARRANTY ACCESS

- A. The Owner shall grant to this Contractor reasonable access to the TCS and FMCS during the warranty period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. BACnet Protocol:
1. Siemens Industry, Inc. - Apogee System

2.2 SYSTEM ARCHITECTURE

- A. General:
1. The Temperature Control System (TCS) and Facility Management Control System (FMCS) shall consist of a network of interoperable, standalone digital controllers, a computer system, graphic user interface software, printers, network devices, valves, dampers, sensors, and other devices as specified herein.
  2. The installed system shall provide secure password access to all features, functions and data contained in the overall FMCS.
- B. Open, Interoperable, Integrated Architectures:
1. All components and controllers supplied under this Division shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data are not acceptable.
  2. The supplied system must be able to access all data using standard Web browsers without requiring proprietary operator interface and configuration programs. An Open DataBase Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on a supplier-installed server for all database access. Systems requiring proprietary database and user interface programs are not acceptable.
  3. Hierarchical or "flat" topologies are required to have system response times as indicated below and to manage the flow and sharing of data without unduly burdening the customer's internal intranet network.
    - a. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.
    - b. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

2.3 NETWORKS

- A. The Local Area Network (LAN) shall be a 100 megabits/sec Ethernet network supporting BACnet, Java, XML, HTTP, and SOAP. Provide support for multiple Network Area Controllers (NACs), user workstations and, if specified, a local server.

- B. Local area network minimum physical and media access requirements:
  - 1. Ethernet; IEEE Standard 802.3.
  - 2. Cable; 100 Base-T, UTP-8 wire, Category 6.
  - 3. Minimum throughput; 100 Mbps.
- C. Communication conduits shall not be installed closer than six feet from 110VAC or higher transformers or run parallel within six feet of electrical high-power cables. Route the cable as far from interference generating devices as possible. Where communication wire must cross 110VAC or higher wire, it must do so at right angles.
- D. Ground all shields (earth ground) at one point only to eliminate ground loops. Provide all shield grounding at the controller location, with the shield at the sensor/device end of the applicable wire being left long and "safed" off in an appropriate manner.
- E. There shall be no power wiring more than 30 VAC rms run in conduit with communications wiring. In cases where signal wiring is run in conduit with communication wiring, run all communication wiring and signal wiring using separate twisted pairs (24awg) in accordance with the manufacturer's wiring practices.

#### 2.4 BACNET FMCS

- A. The intent of this specification is to provide a peer-to-peer networked, standalone, distributed control system with the capability to integrate ANSI/ASHRAE Standard 135-2001 BACnet, MODBUS, OPC, and other open and proprietary communication protocols in one open, interoperable system.
- B. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices in the system. Adherence to industry standards including the latest ANSI/ASHRAE Standard 135 (BACnet) to assure interoperability between all system components is required. For each BACnet device, the device supplier must provide a PICS document showing the installed device's compliance level. Minimum compliance is Level 3; with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet (BACnet Ethernet/IP) and/or RS-485 (BACnet MSTP).
- C. Interoperable BACnet Controller (IBC):
  - 1. Controls shall be microprocessor based Interoperable BACnet Controllers (IBC) in accordance with the latest ANSI/ASHRAE Standard 135. Provide IBCs for unit ventilators, fan coils, heat pumps, terminal air boxes (TAB) and other applications. The application control program shall reside in the same enclosure as the input/output circuitry that translates the sensor signals. Provide a PICS document showing the installed system's compliance level to ANSI/ASHRAE Standard 135. Minimum compliance is Level 3.
  - 2. The IBCs shall be listed by the BACnet Testing Laboratory (BTL) as follows:
    - a. BACnet Building Controller(s) (B-BC).
    - b. BACnet Advanced Application Controller(s) (B-ACC).
    - c. BACnet Application Specific Controller(s) (B-ASC).
  - 3. The IBCs shall communicate with the NAC via an Ethernet connection at a baud rate of not less than 10 Mbps.

4. Each IBC sensor shall connect directly to the IBC and shall not use any of the I/O points of the controller. The IBC Sensor shall provide a two-wire connection to the controller that is polarity and wire type insensitive. The IBC sensor shall provide a communications jack for connection to the BACnet communication trunk to which the IBC controller is connected. The IBC sensor, the connected controller, and all other devices on the BACnet bus shall be accessible by the POT.
5. All IBCs shall be fully application programmable and shall at all times maintain their BACnet Level 3 compliance. Controllers offering application selection only (non-programmable) require a 10% spare point capacity to be provided for all applications. Store all control sequences within or programmed into the IBC in non-volatile memory that does not depend on a battery to be retained.
6. The Contractor supplying the IBCs shall provide documentation for each device, with the following information at a minimum:
  - a. BACnet Device; MAC address, name, type and instance number.
  - b. BACnet Objects; name, type and instance number.
7. It is the responsibility of the Contractor to ensure that the proper BACnet objects are provided in each IBC.

D. Object Libraries:

1. A standard library of objects shall be included for development and setup of application logic, user interface displays, system services, and communication networks.
2. The objects in this library shall be capable of being copied and pasted into the user's database and shall be organized according to their function. In addition, the user shall have the capability to group objects created in their application and store the new instances of these objects in a user-defined library.
3. In addition to the standard libraries specified here, the system supplier shall maintain an on-line accessible (over the Internet) library, available to all registered users, to provide new or updated objects and applications as they are developed.
4. All control objects shall conform to the control objects specified in the BACnet specification.
5. The library shall include applications or objects for the following functions, at a minimum:
  - a. Scheduling Object: The schedule must conform to the schedule object as defined in the BACnet specification, providing seven-day plus holiday and temporary scheduling features and a minimum of 10 on/off events per day. Data entry to be by graphic sliders to speed creation and selection of on-off events.
  - b. Calendar Object: The calendar must conform to the calendar object as defined in the BACnet specification, providing 12-month calendar features to allow for holiday or special event data entry. Data entry to be by graphic "point-and-click" selection. This object must be "linkable" to any or all scheduling objects for effective event control.
  - c. Override Object: Provide override object that is capable of restarting equipment turned off by other energy saving programs to maintain occupant comfort or for equipment protection.
  - d. Start-Stop Time Optimization Object: Provide a start-stop time optimization object to start equipment just early enough to bring space conditions to desired conditions by the scheduled occupancy time. Also, allow equipment to be stopped before the scheduled unoccupied time just far enough ahead to take advantage of the building's "flywheel" effect for energy savings. Provide automatic tuning of all start-stop time object properties based on historical performance.

- e. Demand Limiting Object: Provide a demand-limiting object that is capable of controlling demand for any selected energy utility (electric, oil, gas, etc.). The object shall be able to monitor a demand value and predict (using a sliding window prediction algorithm) the demand at the end of the user-defined interval period (1 to 60 minutes). This object shall also accommodate a utility meter time sync pulse for fixed interval demand control. Upon a prediction that will exceed the user-defined demand limit (supply a minimum of 6 per day), the demand limiting object shall issue shed commands to either turn off user specified loads or modify equipment setpoints to provide the desired energy reduction. If the list of sheddable equipment is not enough to reduce the demand to below the setpoint, display a message on the user's screen (as an alarm) instructing the user to take manual actions to maintain the desired demand. The shed lists are specified by the user and shall be selectable to be shed in either a fixed or rotating order to control which equipment is shed the most often. Upon suitable reductions in demand, the demand-limiting object shall restore the equipment that was shed in the reverse order in which it was shed. Each sheddable object shall have a minimum and maximum shed time property to provide both equipment protection and occupant comfort.
6. The library shall include control objects for the following functions:
- a. Analog Input Object: Minimum requirement is to comply with the BACnet standard for data sharing. Allow high, low and failure limits to be assigned for alarming. Also, provide a time delay filter property to prevent nuisance alarms caused by temporary excursions above or below the user defined alarm limits.
  - b. Analog Output Object: Minimum requirement is to comply with the BACnet standard for data sharing.
  - c. Binary Input Object: Minimum requirement is to comply with the BACnet standard for data sharing. The user must be able to specify either input condition for alarming. This object must also include the capability to record equipment runtime by counting the amount of time the hardware input is in an "on" condition. The user must be able to specify either input condition as the "on" condition.
  - d. Binary Output Object: Minimum requirement is to comply with the BACnet standard for data sharing. Properties to enable minimum on and off times for equipment protection as well as start-to-start delay must be provided. Incorporate the BACnet Command Prioritization priority scheme to allow multiple control applications to execute commands on this object with the highest priority command being invoked. Provide 16 levels of priority as a minimum. Systems not employing the BACnet method of contention resolution are not acceptable.
  - e. PID Control Loop Object: Minimum requirement is to comply with the BACnet standard for data sharing. Each individual property must be adjustable to allow proportional control only, or proportional with integral control, or proportional, integral and derivative control.
  - f. Comparison Object: Allow a minimum of two analog objects to be compared to select either the highest, lowest, or equality between the two linked inputs. Also, allow limits to be applied to the output value for alarm generation.
  - g. Math Object: Allow a minimum of four analog objects to be tested for the minimum or maximum, or the sum, difference, or average of linked objects. Also, allow limits to be applied to the output value for alarm generation.
  - h. Custom Programming Objects: Provide a blank object template for the creation of new custom objects to meet specific user application requirements. This object must provide a simple BASIC-like programming language that is used to define object behavior. Provide a library of functions including, but not limited to, math and logic functions and string manipulation. Also, provide a comprehensive on-line debug tool to allow complete testing of the new object. Allow new objects to be stored in the library for reuse.

- i. Interlock Object: Provide an interlock object that provides a means of coordination of objects within a piece of equipment, such as an air handler or other similar types of equipment. An example is to link the return fan to the supply fan such that, when the supply fan is started, the return fan object is also started automatically without the user having to issue separate commands or to link each object to a schedule object. In addition, the control loops, damper objects, and alarm monitoring (such as return air, supply air, and mixed air temperature objects) will be inhibited from alarming during a user-defined period after startup to allow for stabilization. When the air handler is stopped, the interlocked return fan is also stopped, the outside air damper is closed, and other related objects within the air handler unit are inhibited from alarming, thereby eliminating nuisance alarms during the off period.
  - j. Temperature Override Object: Provide an object whose purpose is to override a binary output to an "on" state in the event a user-specified high or low limit value is exceeded. Link this object to the desired binary output object as well as to an analog object for temperature monitoring to cause the override to be enabled. This object will execute a start command at the Temperature Override level of start/stop command priority, unless changed by the user.
  - k. Composite Object: Provide a container object that allows a collection of objects representing an application to be encapsulated to protect the application from tampering or to more easily represent large applications. This object must have the ability to allow the user to select the appropriate parameters of the "contained" application that are represented on the graphic shell of this container.
7. The object library shall include objects to support the integration of devices connected to the Network Area Controller (NAC). Provide the following as part of the standard library included with the programming software:
- a. LonMark/LonWorks Devices: These devices shall include, but not be limited to, devices for control of HVAC, lighting, access, and metering. Provide LonMark manufacturer-specific objects to facilitate simple integration of these devices. Support all network variables defined in the LonMark profile. The device manufacturer shall provide information (type and function) regarding network variables not defined in the LonMark profile.
  - b. For devices not conforming to the LonMark standard, provide a dynamic object that can be assigned to the device based on network variable information provided by the device manufacturer. Device manufacturer shall provide an XIF file, resource file, and documentation for the device to facilitate device integration.
  - c. For BACnet devices, provide the following objects:
    - 1) Analog In.
    - 2) Analog Out.
    - 3) Analog Value.
    - 4) Binary.
    - 5) Binary In.
    - 6) Binary Out.
    - 7) Binary Value.
    - 8) Multi-State In.
    - 9) Multi-State Out.
    - 10) Multi-State Value.
    - 11) Schedule Export.
    - 12) Calendar Export.
    - 13) Trend Export.
    - 14) Device.

- d. For each BACnet object, provide the ability to assign the object a BACnet device and object instance number.
- e. For BACnet devices, provide the following support at a minimum:
  - 1) Segmentation.
  - 2) Segmented Request.
  - 3) Segmented Response.
  - 4) Application Services.
  - 5) Read Property.
  - 6) Read Property Multiple.
  - 7) Write Property.
  - 8) Write Property Multiple.
  - 9) Confirmed Event Notification.
  - 10) Unconfirmed Event Notification.
  - 11) Acknowledge Alarm.
  - 12) Get Alarm Summary.
  - 13) Who-has.
  - 14) I-have.
  - 15) Who-is.
  - 16) I-am.
  - 17) Subscribe COV.
  - 18) Confirmed COV notification.
  - 19) Unconfirmed COV notification.
  - 20) Media Types.
  - 21) Ethernet.
  - 22) BACnet IP Annex J.
  - 23) MSTP.
  - 24) BACnet Broadcast Management Device (BBMD) function.
  - 25) Routing.

## 2.5 SYSTEM PROGRAMMING

- A. The GUI software shall perform system programming and graphic display engineering. Access to the GUI software shall be through password access as assigned by the system administrator.
- B. Provide a library of control, application, and graphic objects to enable creation of all applications and user interface screens. Applications shall be created by selecting the control objects from the library, dragging or pasting them on the screen, and linking them together using a built-in graphic connection tool. Completed applications may be stored in the library for future use. GUI screens shall be created in the same fashion. Data for the user displays shall be obtained by graphically linking the user display objects to the application objects to provide "real-time" data updates. Any real-time data value or object property may be connected to display its current value on a user display. Provide all software tools or processes to create applications and user interface displays.
- C. Programming Methods:
  - 1. Provide the capability to copy objects from the supplied libraries or from a user-defined library to the user's application. Link objects with a graphic linking scheme by dragging a link from one object to another. Object links will support one-to-one, many-to-one, or one-to-many relationships. Linked objects shall maintain their connections to other objects regardless of where they are positioned on the page and shall show link identification for links to objects on other pages for easy identification. Links will vary in color depending on the type of link; e.g., internal, external, hardware, etc.

2. Configuration of each object shall be done through the object's property sheet using fill-in-the-blank fields, list boxes, and selection buttons. Use of custom programming, scripting language, or a manufacturer-specific procedural language for configuration is not acceptable.
3. The software shall provide the ability to view the logic in a monitor mode. When on-line, the monitor mode shall provide the ability to view the logic in real time for easy diagnosis of the logic execution. When off-line (debug), the monitor mode shall allow the user to set values to inputs and monitor the logic for diagnosing execution before it is applied to the system.
4. All programming shall be done in real time. Systems requiring the uploading, editing, and downloading of database objects are not allowed.
5. The system shall support object duplication in a customer's database. An application, once configured, can be copied and pasted for easy reuse and duplication. All links, other than to the hardware, shall be maintained during duplication.

## 2.6 DDE DEVICE INTEGRATION

- A. The NAC shall support the integration of device data via Dynamic Data Exchange (DDE) over the Ethernet network. The NAC shall act as a DDE client to another software application that functions as a DDE server.
- B. Provide the required objects in the library included with the Graphic User Interface programming software to support the integration of these devices into the FMCS. Objects provided shall include, at a minimum:
  1. DDE Generic AI Object.
  2. DDE Generic AO Object.
  3. DDE Generic BO Object.
  4. DDE Generic BI Object.

## 2.7 MODBUS SYSTEM INTEGRATION

- A. The NAC shall support integration of device data from Modbus RTU, ASCII, and TCP control system devices. Connect to the Modbus system via an RS-232, RS485, or Ethernet IP as required by the device.
- B. Provide the required objects in the library included with the GUI programming software to support the integration of the Modbus system data into the FMCS. Objects provided shall include, at a minimum:
  1. Read/Write Modbus AI Registers.
  2. Read/Write Modbus AO Registers.
  3. Read/Write Modbus BI Registers.
  4. Read/Write Modbus BO Registers.
- C. The NAC shall perform all scheduling, alarming, logging and global supervisory control functions of the Modbus system devices.
- D. The FMCS supplier shall provide a Modbus system communications driver. The equipment system vendor that provided the equipment using Modbus shall provide documentation of the system's Modbus interface and shall provide factory support at no charge during system commissioning.

## 2.8 CONDUIT AND BOXES

- A. Conduit and Boxes: Refer to Electrical Section 26 05 33 for materials, sizing, and other requirements
- B. Conduit and Box Identification (Color and Labeling):
  - 1. Refer to the Temperature Control Contractor notes located on the mechanical cover sheet for raceway and box color requirements.

## 2.9 WIRE AND CABLE

- A. Wire and Cable: Refer to Electrical Section 26 05 13 for wire and cable materials.
  - 1. Wire and Cable Color: Refer to the Temperature Control Contractor notes located on the mechanical cover sheet for wire and cable color requirements.

## PART 3 - EXECUTION

### 3.1 GENERAL INSTALLATION

- A. Verify that systems are ready to receive work. Beginning of installation means installer accepts existing conditions.
- B. Install system and materials in accordance with manufacturer's instructions.
- C. Drawings of the TCS and FMCS network are diagrammatic only. Any apparatus not shown but required to meet the intent of the project documents shall be furnished and installed without additional cost.
- D. Install all operators, sensors, and control devices where accessible for service, adjustment, calibration, and repair. Do not install devices where blocked by piping or ductwork. Devices with manual reset or limit adjustments shall be installed below 6'-0" if practical to allow inspection without using a ladder.
- E. Mount control panels adjacent to associated equipment on vibration-free walls or freestanding angle iron supports. One cabinet may accommodate more than one system in same equipment room.
- F. After completion of installation, test and adjust control equipment.
- G. Check calibration of instruments. Recalibrate or replace.
- H. Furnish and install conduit, wire, and cable per the National Electric Code, unless noted otherwise in this section.
- I. All hardware, software, equipment, accessories, wiring (power and sensor), piping, relays, sensors, power supplies, transformers, and instrumentation required for a complete and operational FMCS system, but not shown on the electrical drawings, are the responsibility of the TCC.

J. Labels For Control Devices:

1. Provide labels indicating service of all control devices in panels and other locations.
2. Labels may be made with permanent marking pen in the control panels if clearly legible.
3. Use engraved labels for items outside panel such as outside air thermostats.
4. Labels are not required for room thermostats, damper actuators and other items where their function is obvious.

3.2 GRAPHIC DISPLAY

A. Create a customized graphic for each piece of equipment indicated on the itemized points list.

B. Components shall be arranged on graphic as installed in the field.

C. Include each graphic point listed in the itemized points list using real time data.

D. Provide a graphic representation of the following:

1. Where there are multiple buildings, color code the campus map by the systems serving that building. The building graphic shall be linked to the graphic for that building's systems.
2. Where there are multiple floors, provide color codes/designations for the areas served by each AHU and TAB by floor.
3. Where multiple AHUs serve one floor, color code the areas served by each AHU. The area shall be linked to the graphic for that area's AHU.
4. Provide an overall floor plan of each floor of the building color coded by zone linked to the TAB for that zone. The zone shall be linked to the graphic for that zone's TAB graphic.
5. Show the location of each thermostat on the floor plan.
6. Provide separate graphics showing the chilled and heating water system flow diagram. Show temperatures and flows on the flow diagram. Each piece of equipment shown on the flow diagram shall be linked to the graphic for that piece of equipment.
7. Provide a graphic showing the steam system flow diagram. Show pressures and flows on the flow diagram. Each piece of equipment shown on the flow diagram shall be linked to the graphic for that piece of equipment.

E. The FMCS shall include full graphic operator interface to display the following graphics as a minimum:

1. Home page to include a minimum of six critical points: Outside Air Temperature, Outside Air Relative Humidity, Enthalpy, KWH, KW, etc.
2. Graphic floor plans accurately depicting rooms, walls, hallways, and showing accurate locations of space sensors and major mechanical equipment.
3. Detailed graphics for each mechanical system including AHUs, ERUs, EFs, chillers, and boilers, as a minimum.
4. Access corresponding system drawings, technical literature, and sequences of operations directly from each system graphic.

F. The FMCS shall include individual graphical buttons to access the following data stored in PDF format:

1. Project control as-built documentation including all TCS drawings, diagrams and sequences of operation.
2. TCS Bill of Material for each system, e.g. AHU, RTU, FCU, boiler, etc.
3. Technical literature specification data sheets for all components listed in the TCS Bill of Material.

### 3.3 CONDUIT AND BOXES INSTALLATION

- A. Conduit and Box Installation: Refer to Electrical Section 26 05 33 for execution and installation.
- B. Conduit and Box Identification (color and labeling) installation. Refer to Electrical Section 26 05 53 for raceway and box identification installation.
- C. Outlet Box Schedule: Thermostat/temperature sensor:
  - 1. Dry Interior Locations: Provide 4" square galvanized steel with raised cover to fit flush with finished wall line. When located in concrete block walls, provide square edge title cover of sufficient depth to extend out to face of block or masonry boxes.
  - 2. Other Conditions: Refer to Electrical Section 26 05 33 for requirements.

### 3.4 WIRE AND CABLE INSTALLATION

- A. Wire and Cable Installation: Refer to Electrical Section 26 05 13 for execution and installation.
- B. Field Quality Control:
  - 1. Inspect wire and cable for physical damage and proper connection.
  - 2. Torque test conductor connections and terminations to manufacturer's recommended values.
  - 3. Perform continuity test on all conductors.
  - 4. Protection of cable from foreign materials:
    - a. It is the Contractor's responsibility to provide adequate physical protection to prevent foreign material application or contact with any cable type. Foreign material is defined as any material that would negatively impact the validity of the manufacturer's performance warranty. This includes, but is not limited, to overspray of paint (accidental or otherwise), drywall compound, or any other surface chemical, liquid or compound that could come in contact with the cable, cable jacket or cable termination components.
    - b. Overspray of paint on any cable, cable jacket or cable termination component will not be accepted. It shall be the Contractor's responsibility to replace any component containing overspray, in its entirety, at no additional cost to the project. Cleaning of the cables with harsh chemicals is not allowed. This requirement is regardless of the PASS/FAIL test results of the cable containing overspray. Should the manufacturer and warrantor of the structured cabling system desire to physically inspect the installed condition and certify the validity of the structured cabling system (via a signed and dated statement by an authorized representative of the structured cabling manufacturer), the Owner may, at their sole discretion, agree to accept said warranty in lieu of having the affected cables replaced. In the case of plenum cabling, in addition to the statement from the manufacturer, the Contractor shall also present to the Owner a letter from the local Authority Having Jurisdiction stating that they consider the plenum rating of the cable to be intact and acceptable.
- C. Installation Schedule:
  - 1. Conduit terminations to all devices installed in applications with rotating equipment, expansion/contraction or vibration shall be made with flexible metallic conduit, unless noted otherwise. Final terminations to exterior devices installed in damp or wet locations shall be made with liquidtight flexible metallic conduit. Terminations in hazardous areas,

as defined in the National Electrical Code, shall be made with flexible conduit rated for the environment.

### 3.5 COMMISSIONING

- A. Upon completion of the installation, this Contractor shall load all system software and start up the system. This Contractor shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to ensure that the system is functioning in full accordance with these specifications.
- B. This Contractor shall perform tests to verify proper performance of components, routines, and points. Repeat tests until proper performance results. This testing shall include a point-by-point log to validate 100% of the input and output points of the FMCS system operation.
- C. This Contractor shall prove that the controls network is functioning correctly and within acceptable bandwidth criteria and shall test the system with an approved protocol analysis tool. Provide a log and statistics summary showing that each channel is within acceptable parameters.
- D. Upon completion of the performance tests described above, repeat these tests, point by point, as described in the validation log above in the presence of Owner's Representative, as required. Properly schedule these tests so testing is complete at a time directed by the Owner's Representative. Do not delay tests so as to prevent delay of occupancy permits or building occupancy.
- E. System Acceptance: Satisfactory completion is when this Contractor has performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Owner's Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

### 3.6 PREPARATION FOR BALANCING

- A. Verify that all dampers are in the position indicated by the controller (e.g., open, closed or modulating).
- B. Verify the operation of all interlock systems.

### 3.7 TEST AND BALANCE COORDINATION

- A. The Contractor shall furnish a single set of all tools necessary to interface to the control system for test and balance purposes.
- B. The Contractor shall provide a minimum of four (4) hours training for the Balancing Contractor in the use of these tools.
- C. The tools used during the test and balance process shall be returned at the completion of the testing and balancing.

### 3.8 DEMONSTRATION AND ACCEPTANCE

- A. At completion of installation, provide two days minimum instruction for operators. Demonstrate operation of all controls and systems. Describe the normal operation of all equipment.

### 3.9 TRAINING

#### A. On-Site:

1. After completion of commissioning, the manufacturer shall provide 2 hours of training for 4 Owner's representatives. The training course shall enable the Owner's representatives to perform Day-to-Day Operations as defined herein. A factory-trained instructor with experience in presenting the training material and the system programmer for this project shall perform the training.

#### B. Day-to-Day Operations - Training Description:

1. Proficiently operate the system.
2. Understand control system architecture and configuration.
3. Understand FMCS systems components.
4. Understand system operation, including FMCS system control and optimizing routines (algorithms).
5. Operate the workstation and peripherals.
6. Log-on and off the system.
7. Access graphics, point reports, and logs.
8. Adjust and change system setpoints, time schedules, and holiday schedules.
9. Recognize malfunctions of the system by observation of the printed copy and graphic visual signals.
10. Understand system drawings and Operation and Maintenance manual.
11. Understand the job layout and location of control components.
12. Access data from FMCS controllers and ASCs.
13. Operate portable operator's terminals.

- #### C.
- Provide course outline and materials in accordance with the "SUBMITTALS" article in Part 1 of this section. The instructor(s) shall provide one copy of training material per student.

**END OF SECTION**

## SECTION 23 21 00

### HYDRONIC PIPING

#### PART 1 - GENERAL

##### 1.1 SECTION INCLUDES

- A. Pipe and Pipe Fittings
- B. Valves
- C. System Piping Schedule

##### 1.2 QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body. Remanufactured valves are not acceptable.
- B. Welding Materials, Procedures, and Operators: Conform to ASME Section 9, ANSI/AWS D1.1, and applicable state labor regulations.

##### 1.3 REFERENCES

- A. ASME - Boiler and Pressure Vessel Code.
- B. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.
- C. ASME B16.3 - Malleable Iron Threaded Fittings Class 150 and 300.
- D. ASME B16.4 - Cast Iron Threaded Fittings, Class 125 and 250.
- E. ASME B16.5 - Pipe Flanges and Flanged Fittings.
- F. ASME B16.9 - Factory-Made Wrought Steel Butt Welding Fittings.
- G. ASME B16.12 - Cast Iron Threaded Drainage Fittings.
- H. ASME B16.21 - Nonmetallic Flat Gaskets for Pipes Flanges.
- I. ASME B18.2.1 - Square and Hex Bolts and Screws, Inch Series.
- J. ASME B18.2.2 - Square and Hex Nuts, Inch Series.
- K. ASME Section 9 - Welding and Brazing Qualifications.
- L. ASTM A126 - Gray Cast Iron Castings for Valves, Flanges, and Pipe Fittings.
- M. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
- N. ASTM A181 - Forgings, Carbon Steel for General Purpose Piping.

- O. ASTM A234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
- P. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

#### 1.4 SUBMITTALS

- A. Submit product data under provisions of Section 23 05 00. Include data on pipe materials, fittings, valves, and accessories. Include manufacturers' support spacing requirements for plastic piping.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store and protect piping to prevent entrance of foreign matter into pipe and to prevent exterior corrosion.
- B. Deliver and store valves in shipping containers with labeling in place.

### PART 2 - PRODUCTS

#### 2.1 STEEL PIPE (ABOVE GRADE)

- A. Design Pressure 125 psig, Maximum Design Temperature 225°F (230°F for grooved couplings).
- B. Black Steel; Standard Weight; Threaded Joints:
  - 1. Pipe: Standard weight black steel, threaded and coupled, ASTM A53; Type E, F, or S; Grade B.
  - 2. Joints: Screwed.
  - 3. Fittings: Class 125 cast iron, ASTM A126, ASME B16.4; or Class 150 malleable iron, ASTM A197, ASME B16.3.
  - 4. Unions: Class 150 malleable iron, ANSI B16.39, ground joint with copper or copper alloy-to-iron seat.
- C. Black Steel; Standard Weight; Welded or Flanged Joints:
  - 1. Pipe: Standard weight black steel, beveled ends, ASTM A53, Type E or S, Grade B.
  - 2. Joints: Butt-welded or flanged.
  - 3. Fittings: Standard weight wrought steel, butt-welding type, ASTM A234, ASME B16.9.
  - 4. Flanges: Class 150 forged steel, welding neck or slip-on, ASTM A181 or A105, Class 60, ASME B16.5 up to 24" and B16.47 above 24". ASME B16.1 for flanges mating with flat face equipment flanges. Flange face seal weld (backweld) is required for slip-on flanges.

#### 2.2 VALVES

- A. Shutoff Valves:
  - 1. For pipe systems where mechanical press connections are allowed, shutoff valves with mechanical press connections are acceptable subject to the requirements in the paragraphs below.

2. Butterfly Valves:

a. BF-1:

- 1) 2-1/2" thru 6", 175 psi CWP, elastomers rated for 20°F to 225°F continuous and 250°F intermittent at 125 psig, fully lugged or grooved end, ductile or cast iron body (not in contact with fluid); bronze, aluminum-bronze or EPDM coated ductile iron disc; EPDM seat, stainless steel stem, extended neck, 175 psi bubble-tight, bi-directional dead-end shutoff without backing flange or nuts and with cap screws extending to centerline of valve body (for pipe extension without draining system), 10 position locking operator up to 6" size. Cv of at least 1580 in 6" size.
- 2) Manufacturers:
  - a) Center Line Series 200
  - b) Keystone #222
  - c) Watts #DBF-03-121-1P
  - d) Nibco N200 Series or LD2000 Series
  - e) Milwaukee CL series
  - f) Hammond 5200 series
  - g) Or engineer pre-approved equal.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends, remove burrs, bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Remove all scale, rust, dirt, oils, stickers and thoroughly clean exterior of all bare metal exposed piping, hangers, and accessories in preparation to be painted.
- D. Connect to all equipment with flanges or unions.
- E. After completion, fill, clean, and treat systems. Refer to Section 23 25 00 for treatment.

3.2 SYSTEMS, PIPING, AND VALVE SCHEDULE

- A. Chilled Water (Above Grade):
  1. Black Steel; Standard Weight; Threaded Joints: 2" and Under
  2. Black Steel; Standard Weight; Welded or Flanged Joints: 2-1/2" and Over
  3. Shutoff Valves: BF-1

3.3 TESTING PIPING

- A. Complete testing before insulation is applied. If insulation is applied before pipe is tested and a leak ruins the insulation, replace all damaged insulation.
- B. Test the pipe with water at 1.5 times the design pressure but not less than 125 psig pressure. Hold pressure for at least two hours.
- C. Test to be witnessed by the Engineer or their representative, if requested by the Engineer.

### 3.4 CLEANING PIPING

#### A. Assembly:

1. Prior to assembly of pipe and piping components, remove all loose dirt, scale, oil and other foreign matter on internal or external surfaces by means consistent with good piping practice subject to approval of the Engineer. Blow chips and burrs out of pipe before assembly. Wipe cutting oil from internal and external surfaces.
2. During fabrication and assembly, remove slag and weld spatter from both internal and external joints by peening, chipping and wire brushing to the degree consistent with good piping practices.
3. Notify the Engineer prior to starting any post erection cleaning operation in time to allow witnessing the operation. Properly dispose of cleaning and flushing fluids.
4. Prior to blowing or flushing erected piping systems, disconnect all instrumentation and equipment, open wide all valves, control valves, and balance valves, and verify all strainer screens are in place.

#### B. Chemical Cleaning:

1. Flush pipe and components with clean water until all discharge from system is clean. Maintain minimum velocities at all points of 5 feet/second for 30 minutes. Flow shall be in same direction as when system is in normal operation. Discharge shall be from low points of pipes, ends of headers and as otherwise needed to flush entire system. After flushing, all residual water shall be drained and/or blown out.
2. Add 2 pounds of trisodium phosphate per 100 gallons of system capacity. Use an alternate chemical if discharge of trisodium phosphate is not permitted. Maintain 150°F in the system if possible. If heat is not available, use 3 pounds per 100 gallons.
3. Drain the system after circulating the chemical cleaner for six hours at 150°F, or 12 hours at a lower temperature. Refill. Test a water sample. Drain and fill again if excessive cleaning chemicals remain and until water appears clear.
4. After each system has been cleaned and thoroughly flushed of pretreatment chemicals, it shall be immediately refilled with water and treated with chemical treatment as specified in Section 23 25 00. The system shall not be allowed to sit empty for any length of time.
5. When system water is clear, remove, clean and replace all strainers.
6. Water samples may be taken by the Engineer to verify a clean system. If system is not clean, the entire process, including chemical treatment specified in Section 23 25 00, shall be repeated at the Contractor's expense.
7. Chemical cleaning applies to the following systems:
  - a. Chilled Water

### 3.5 INSTALLATION

#### A. General Installation Requirements:

1. Route piping in orderly manner, straight, plumb, with consistent pitch, parallel to building structure, with minimum use of offsets and couplings. Provide only offsets required for needed headroom or clearance and needed flexibility in pipe system.
2. Install piping to conserve building space, and not interfere with other work.
3. Group piping whenever practical at common elevations.
4. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

5. Reducers are generally not shown. Where pipe sizes change at tee, the tee shall be the size of the largest pipe shown connecting to it. Where pipe sizes are not shown, the larger size in either direction shall continue through the fitting nearest to the indication of a smaller pipe size.
6. Install bell and spigot pipe with bells upstream.
7. Seal pipes passing through exterior walls with a wall seal per Section 23 05 29. Provide Schedule 40 galvanized sleeve at least 2 pipe sizes larger than the pipe.
8. Branch takeoffs shall be from the top side (if branch is two sizes smaller than main), or any angle from the horizontal plane to the top of piping.

B. Installation Requirements in Electrical Rooms:

1. Do not install piping or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the equipment plus its required clearance space.

C. Valves/Fittings and Accessories:

1. Provide chain operators for all valves over 2" size that are over 10'-0" above finished floor. Extend to 7'-0" above finished floor.
2. Provide valve position indicator on all valves 10'-0" or greater above finish floor and not located above ceiling.
3. Provide clearance for installation of insulation, and access to valves and fittings.
4. Prepare pipe, fittings, supports, and accessories for finish painting.
5. Install valves with stems upright or horizontal, not inverted, except install manual quarter turn valves in radiation cabinets and all butterfly valves with stems horizontal.
6. Provide shutoff valves and flanges or unions at all connections to equipment, traps, and items that require servicing.
7. Provide flanges or unions at all final connections to equipment, traps and valves.
8. Arrange piping and piping connections so equipment may be serviced or totally removed without disturbing piping beyond final connections and associated shutoff valves.

### 3.6 PIPE ERECTION AND LAYING

- A. Carefully inspect all pipe, fittings, valves, equipment and accessories prior to installation. Immediately reject and remove from the job any items which are unsuitable, cracked or otherwise defective.
- B. All pipe, fittings, valves, equipment and accessories shall have factory-applied markings, stampings, or nameplates sufficient to determine their conformance with specified requirements.
- C. Exercise care at every stage of storage, handling, laying and erecting to prevent entry of foreign matter into piping, fittings, valves, equipment and accessories. Do not erect or install any unclean item.
- D. During construction, until system is fully operational, keep all openings in piping and equipment closed at all times except when actual work is being performed on that item. Closures shall be plugs, caps, blind flanges or other items designed for this purpose.
- E. Change direction of pipes only with fittings or pipe bends. Change size only with fittings. Do not use miter fittings, face or flush bushings, or street elbows. 2-1/2" and larger fittings shall be long radius type, unless otherwise shown on the drawings or specified. Construct welded elbows of angles not available as standard fittings by cutting and welding standard elbows to form smooth, long radius fittings.

- F. Use full and double lengths of pipe wherever possible.
- G. Unless otherwise indicated, install all inlet and outlet piping, including shutoff valves and strainers to coils, pumps and other equipment at line size with reduction in size being made only at control valve or pump.
- H. Cut all pipe to exact measurement and install without springing or forcing except in the case of expansion loops where cold springing is indicated on the drawings.
- I. Do not create, even temporarily, undue loads, forces or strains on valves, equipment or building elements.

### 3.7 DRAINING AND VENTING

- A. Unless otherwise indicated on the drawings, all horizontal pipes, including branches, shall pitch 1" in 40 feet to low points for complete drainage, removal of condensate, and venting.
- B. Provide drain valves at all low points of water piping systems or where indicated on drawings for complete or sectionalized draining. Drain valves are defined above.
- C. Use eccentric reducing fittings on horizontal runs when changing size for proper drainage and venting. Install all liquid lines with top of pipe and eccentric reducers in a continuous line.
- D. Provide air vents at all high points and wherever else required for elimination of air in all water piping systems. Do not use automatic air vents in glycol systems unless they are piped to the fill tank.
- E. Air vents shall be in accessible locations. If needed to trap and vent air in a remote location, a 1/8" pipe shall connect the tapping location to a venting device in an accessible location.
- F. All vent and drain piping shall be of same materials and construction as the service involved.

### 3.8 BRANCH CONNECTIONS

- A. Make branch connections with standard tee or cross fittings of the type required for the service unless otherwise specified herein or detailed on the drawings.
- B. At the option of the Contractor, branch connections from headers and mains may be cut into black steel pipe using forged weld-on fittings.
- C. Use of forged weld-on fittings is also limited as follows:
  - 1. Must have at least same pressure rating as the main.
  - 2. Header or main must be 2-1/2" or over.
  - 3. Branch line is at least two pipe sizes under header or main size.

### 3.9 JOINING OF PIPE

- A. Threaded Joints (Steel Pipe):
  - 1. Ream pipe ends and remove all burrs and chips.
  - 2. Protect plated pipe and valve bodies from wrench marks when making up joints.
  - 3. Apply Teflon tape to male threads.

B. Flanged Joints (Steel Pipe):

1. Bronze flanges shall conform to B16.24 and ductile iron flanges to B16.42. Steel flanges shall be raised face except when bolted to flat face cast iron flange.
2. Bolting shall be ASTM A307 Grade B with bolts and heavy hexagonal nuts conforming to ASME B18.2.1 and B18.2.2.
3. Torque bolts in at least three passes, tightening to 1/3, 2/3, and final torque in a cross pattern with an indicating torque wrench for equal tension in all bolts.
4. Gaskets for flat face flanges shall be full-face type. Gaskets for raised faced flanges shall conform to requirements for "Group I gaskets" in ASME B16.5. All gaskets shall conform to ASME B16.21. Unless otherwise specified, gaskets shall meet the following requirements:
  - a. Gasket material and thickness approved by manufacturer for intended service, chemical compatibility, pipe system test pressure, and operating temperature range.
  - b. Maximum pressure rating of at least 250 psig.
  - c. Minimum temperature rating: -10°F.
  - d. Maximum temperature rating of at least 170°F for water and glycol solution systems operating 140°F and less.
  - e. Maximum temperature rating of at least 250°F for water and glycol solution systems operating above 140°F and up to 180°F.

C. Welded Joints (Steel Pipe):

1. Welding of all pipe joints, both as to procedures and qualification of welders, shall be in accordance with Section IX, ASME "Boiler & Pressure Vessel Code" unless local codes take precedence.
2. Furnish certificates qualifying each welder to the Owner's Representative prior to start of work.
3. The Owner's Representative reserves the right to require qualifying demonstration, at the Contractor's expense, of any welders assigned to the job.
4. Ends of pipe and fittings to be joined by butt-welding shall be beveled, cleaned to bare metal and internal diameters aligned before tack welding.

**END OF SECTION**

**SECTION 23 21 16**  
**HYDRONIC SPECIALTIES**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Drain Valves and Blowdown Valves
- B. Glycol

**1.2 QUALITY ASSURANCE**

- A. Welding Materials, Procedures, and Operators: Conform to ASME Section 9, ANSI/AWS D1.1, and applicable state labor regulations.

**1.3 SUBMITTALS**

- A. Submit product data under provisions of Section 23 05 00. Include data on pipe materials, fittings, valves, and accessories. Include manufacturers' support spacing requirements for plastic piping.

**1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Store and protect piping to prevent entrance of foreign matter into pipe and to prevent exterior corrosion.
- B. Deliver and store valves in shipping containers with labeling in place.

**PART 2 - PRODUCTS**

**2.1 DRAIN VALVES AND BLOWDOWN VALVES**

- A. Drain valve and blowdown valve shall mean a shutoff valve as specified for the intended service with added 3/4" male hose thread outlet, cap, and retaining chain.

**2.2 CONNECTIONS BETWEEN DISSIMILAR METALS**

- A. Connections between dissimilar metals shall be insulating dielectric types that provide a water gap between the connected metals, and that either allow no metal path for electron transfer or that provide a wide water gap lined with a non-conductive material to impede electron transfer through the water path.
- B. Joints shall be rated for the temperature, pressure, and other characteristics of the service in which they are used, including testing procedure.

- C. Aluminum, iron, steel, brass, copper, bronze, galvanized steel, and stainless steel are commonly used and require isolation from each other with the following exceptions:
1. Iron and steel connected to each other.
  2. Brass, copper, and bronze connected to each other.
  3. Brass or bronze valves and specialties connected in closed systems with steel, iron, or stainless steel on both sides of the brass or bronze valves and specialties. Where two or more brass or bronze items occur together, they shall be connected with brass nipples. Brass or bronze valves and specialties cannot be used as a dielectric separation between pipe materials.
- D. Dielectric protection is required at connections to equipment of a material different than the piping.
- E. Screwed Joints (acceptable up to 2" size):
1. Dielectric waterway rated for 300 psi CWP and 225°F.
  2. Manufacturers:
    - a. Elster Group ClearFlow fittings
    - b. Victaulic Series 647
    - c. Grinnell Series 407
    - d. Matco-Norca
    - e. Engineer pre-approved equal
- F. Flanged Joints (any size):
1. Use 1/8" minimum thickness, non-conductive, full-face gaskets.
  2. Employ one-piece molded sleeve-washer combinations to break the electrical path through the bolts.
  3. Sleeve-washers are required on one side only, with sleeves minimum 1/32" thick and washers minimum 1/8" thick.
  4. Install steel washers on both sides of flanges to prevent damage to the sleeve-washer.
  5. Separate sleeves and washers may be used only if the sleeves are manufactured to exact lengths and installed carefully so the sleeves must extend partially past each steel washer when tightened.
  6. Manufacturers:
    - a. EPCO
    - b. Central Plastics
    - c. Pipeline Seal and Insulator
    - d. F.H. Maloney
    - e. Calpico
    - f. Engineer pre-approved equal

## 2.3 ETHYLENE GLYCOL

- A. Fill glycol systems with a mixture of water and ethylene glycol based low temperature industrial heat transfer fluid with an expected life of at least 12 years in normal use. *Water shall meet the glycol manufacturer's recommendations (generally less than 25ppm chloride, sulfite, and hardness). Distilled, deionized, or reverse osmosis water is acceptable, as are pre-diluted solutions from the manufacturer. Solution shall contain a fluorescent dye to facilitate leak detection.*
- B. Fluid suitable for use from -60°F to 250°F.

- C. Glycol shall *pass ASTM D1384 (less than 0.5 mils annual penetration of all system metals)*. Glycol supplier shall provide a certificate of assurance.
- D. A 50% solution by weight shall depress the freezing point to at least -29°F. At 40°F the solution shall have viscosity of not over 6 centipoise, thermal conductivity of at least 0.21 Btu/hr\*ft\*°F, specific heat of at least 0.79 Btu/lbm\*°F, and specific gravity of at least 1.08.
- E. The glycol manufacturer shall analyze the fluid two times during the 1 year warranty period to ensure the corrosion protection properties continue to meet industry standards. This shall be at no cost to the Owner. No chemical additions shall be made to the glycol solution until an analysis is completed.
- F. Automotive glycol containing sodium silicate is not acceptable.
- G. Manufacturers:
  - 1. Dow Chemical "Dowtherm SR-1"
  - 2. Interstate Chemical "Intercool NFE"
  - 3. Houghton Chemical "Wintrex"
  - 4. Texaco
  - 5. Or engineer pre-approved equal

**END OF SECTION**

## SECTION 23 25 00

### CHEMICAL (WATER) TREATMENT

#### PART 1 - GENERAL

##### 1.1 SECTION INCLUDES

- A. Treatment for Closed Systems (Glycol).

##### 1.2 REFERENCES

- A. ASTM D 859-00: Test Method for Silica in Water
- B. ASTM D 1066-97: Practice for Sampling Steam
- C. ASTM D 1067-92: Test Methods for Acidity or Alkalinity in Water
- D. ASTM D 1068-03: Test Methods for Iron in Water
- E. ASTM D 1126-02: Test Method for Hardness in Water
- F. ASTM D 1129-03a: Terminology Relating to Water
- G. ASTM D 3370-95a: Practices for Sampling Water from Closed Conduits

##### 1.3 REGULATORY REQUIREMENTS

- A. Conform to all applicable codes and regulations for addition of non-potable chemicals to building mechanical systems, and for discharge to public sewage systems.
- B. Provide only chemicals approved for use and disposal by local authorities. Contact the Engineer if any specified chemicals are prohibited.

##### 1.4 WATER ANALYSIS

- A. Sample feedwater to determine appropriate chemical treatment. Contact the Engineer if test indicates treatment required is different than that specified.

#### PART 2 - PRODUCTS

##### 2.1 MATERIALS

- A. Closed System Treatment (with Glycol):
  - 1. The specified glycols contain initial charge of corrosion inhibitors, however, the pH after installation must be checked and adjusted to maintain between 8.0 and 10.0 using inhibitors recommended by the manufacturer (normally dipotassium phosphate).

2.2 EQUIPMENT

- A. Bypass (Pot) Feeder: 5.0 gal; quick-opening cap with 3-1/2" minimum diameter opening and opening wrench, legs to raise fill cap to 30" to 36", drain valve, air cock, working pressure of 200 psig at 200°F.
  - 1. Acceptable Manufacturers:
    - a. Griswold
    - b. Vector Industries
    - c. J. L. Wingert
    - d. Neptune

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install bypass (pot) feeder with top approximately 36" above the floor.
- C. Coordinate with Contractor to provide temporary metering capabilities during system fill to determine overall system volume.
- D. For systems containing glycol, carefully review the glycol manufacturer's water requirements and coordinate to provide system cleaning, flushing, and initial fill with the proper quality of water conforming to the manufacturer's and these specifications.

3.2 CLOSED-LOOP HYDRONIC SYSTEM WATER QUALITY STANDARDS

- A. Review equipment manufacturer's water quality standard to ensure water quality is sufficient to meet their warranty requirements as well as to ensure peak heat transfer efficiency. Contractor shall maintain hydronic systems within the more stringent of either the equipment manufacturer's requirements or those listed below:

Measured Value	Multi-Metal Systems with Aluminum	Multi-Metal Systems with Stainless Steel	Multi-Metal Systems with Copper
pH Range	8.5	8.5	9.0
Alkalinity as CaCO <sub>3</sub>	100 - 500 mg/l	100 - 500 mg/l	100 - 500 mg/l
Hardness as CaCO <sub>3</sub> *	100 - 500 mg/l	100 - 500 mg/l	100 - 500 mg/l
Suspended Solids	less than 10 mg/l	less than 10 mg/l	less than 10 mg/l
Dissolved Solids	less than 1,000 mg/l	less than 1,000 mg/l	less than 1,000 mg/l
Chlorides	less than 150 mg/l	less than 150 mg/l	less than 150 mg/l
Iron	less than 5.0 mg/l	less than 5.0 mg/l	less than 5.0 mg/l
Manganese	less than 0.4 mg/l	less than 0.4 mg/l	less than 0.4 mg/l
Nitrate	less than 100 mg/l	less than 100 mg/l	less than 100 mg/l
Sulfate	less than 200 mg/l	less than 200 mg/l	less than 200 mg/l
Ammonia	less than 5.0 mg/l	less than 5.0 mg/l	less than 5.0 mg/l
Free Copper	less than 0.10 mg/l	less than 0.10 mg/l	less than 0.10 mg/l

- B. Submit an independent third-party test report for each chemically treated closed-loop system showing compliance with all measured values shown in the above table as part of project closeout documentation.

**END OF SECTION**

**SECTION 23 64 30**

**AIR COOLED WATER CHILLERS**

**(EQUIPMENT PRE-PURCHASED BY OWNER)**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Chiller Package.
- B. Charge of Refrigerant and Oil.
- C. Controls and Control Connections.
- D. Connections.
- E. Starters.

**1.2 REFERENCES**

- A. ANSI/AHRI 590 - Standard for Water Chilling Packages using the Vapor Compression Cycle.
- B. ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration.
- C. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- D. ANSI/ASME SEC 8 - Boiler and Pressure Vessel Code
- E. ANSI/NEMA MG 1 - Motors and Generators.
- F. ANSI/UL 1995 - Heating and Cooling Equipment.
- G. ANSI/UL 984 - Safety Standard for Hermetic Motor Compressors.
- H. ANSI/AFBMA 9 - Load ratings and Fatigue Life for Ball Bearings.
- I. AHRI 370 - Sound Rating of Large Outdoor Refrigerating and Air Conditioning Equipment.
- J. AHRI 550 - Centrifugal or Rotary Water - Chilling Packages.
- K. ARI-700-99 - Specification for Fluorocarbon Refrigerants.

**1.3 DELIVERY, STORAGE, AND HANDLING (FOR REFERENCE)**

- A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- B. Protect units from physical damage. Leave factory shipping covers in place until installation. Protect insulation from dust, debris, and/or damage.

- C. Unit controls shall be capable of withstanding 150°F storage temperatures for an indefinite period of time.

#### 1.4 REGULATORY REQUIREMENTS (FOR REFERENCE)

- A. Conform to ANSI/AHRI 590, ANSI/UL 1995, ANSI/ASME SEC 8 Boiler and Pressure Vessel Code, ANSI/UL 984, and ANSI/ASHRAE 15.
- B. Conform to ASHRAE 90.1.

#### 1.5 WARRANTY (FOR REFERENCE)

- A. Provide five year compressor warranty covering materials and labor cost for repair or replacement at the Owner's option.
- B. Provide one year warranty on the entire unit covering materials and labor cost for repair or replacement of defective components at the Owner's option.

### PART 2 - PRODUCTS (FOR REFERENCE)

#### 2.1 MANUFACTURERS

- A. Daikin.

#### 2.2 AIR COOLED WATER CHILLERS

- A. Provide factory assembled and tested outdoor air cooled liquid chillers consisting of compressors, condenser, fans, evaporator, thermal expansion valve, refrigeration accessories, and control panel.
- B. Evaporator tubes are designed to operate under constant water flow conditions. Chiller manufacturer shall determine the minimum flow rates and maximum rate of water flow rate change.
- C. Units shall have efficiency meeting ASHRAE 90.1.
- D. Charge unit with refrigerant at the factory and provide field charging if required after installation.

#### 2.3 COMPRESSORS

- A. Hermetic direct drive scroll compressor(s) with suction strainer, crankcase oil heater, and suction and discharge valves.
- B. Statically and dynamically balance rotating parts. Mount on internal vibration isolators.
- C. Provide oil charging valve, oil level sight glass, oil filter, and magnetic plug on strainer, arranged to ensure adequate lubrication during starting, stopping, and normal operation.
- D. Provide compressor motor, suction gas cooled with solid state sensor and electronic winding overheating protection.
- E. Provide compressor heater to evaporate refrigerant returning to compressor during shut down. Energize heater when compressor is not operating.

## 2.4 EVAPORATOR

- A. Provide shell and tube evaporator, seamless or welded steel construction with cast iron or fabricated steel heads, seamless copper or red brass tubes with integral fins, rolled or silver brazed into tube sheets. Provide multiple refrigerant circuits on multiple compressor units.
- B. Design, test, and stamp refrigerant side for the applicable refrigerant working pressure and water side for 150 psi working pressure, in accordance with ANSI/ASME SEC 8.
- C. Insulate with 0.75" thick flexible plastic or rubber elastomeric cellular foam insulation with maximum K value of 0.28.
- D. Provide heat tape to protect evaporator to -20°F.
- E. Provide water drain and vent connection and thermometer wells for temperature controller and low temperature cutout.
- F. The evaporator shall be a dual circuit, brazed plate-to-plate heat exchanger consisting of parallel stainless steel plates with copper as the braze material.
- G. Evaporator shall be UL listed.
- H. Design, test, and stamp refrigerant side for the applicable refrigerant working pressure and water side for 300 psi working pressure in accordance with ANSI/ASME SEC 8.
- I. Evaporator shall be insulated with closed cell insulation with a minimum R-value of 3.0.
- J. Provide thermostatically controlled heaters to protect to -20°F ambient in off-cycle.
- K. Evaporator shall have ANSI/AWWA C-606 grooved 150 psi flange water inlet and outlet connections.
- L. Provide valved differential pressure gauge between supply and return at evaporator.
- M. Provide differential pressure flow switch or thermal dispersion flow switch in evaporator piping with connection to chiller control panel to provide proof of flow. Flow switch shall be factory installed and wired for internal evaporators.

## 2.5 CONDENSERS

- A. Condenser shall provide design capacity between the minimum and maximum ambient conditions scheduled on the drawings.
- B. Condenser Coil:
  - 1. Microchannel: All aluminum brazed fin construction. The maximum allowable working pressure of the condenser is 450 psig. Air test underwater to 450 psig.
- C. Condenser Fans: Provide vertical discharge propeller condenser fans with fan guard on discharge and factory mounted, louvered, galvanized steel coil guard panels to completely protect condenser coils. Wire mesh coil protection is not acceptable.

- D. Condenser Motors: Provide low sound, direct drive, high efficiency fan motors with Class F insulation, permanently lubricated ball bearings, and built-in current and overload protection.
- E. Entire fan assembly shall be statically and dynamically balanced.

## 2.6 ENCLOSURES

- A. House components in welded steel frame with galvanized steel panels with weather resistant, baked enamel finish.

## 2.7 REFRIGERANT CIRCUIT

- A. Provide refrigerant circuits, factory supplied and piped.
- B. Provide for each refrigerant circuit:
  - 1. Liquid line solenoid and shutoff valves.
  - 2. Filter dryer (replaceable core type).
  - 3. Liquid line sight glass and moisture indicator.
  - 4. Electronic or thermal expansion valve.
  - 5. Charging valve.
  - 6. Insulated suction line.
  - 7. Discharge check valves.
  - 8. Compressor suction and discharge service valves.
  - 9. Condenser pressure relief valve.
  - 10. Refrigerant.
- C. Refrigerant may be new or reclaimed. Reclaimed refrigerant shall meet the ARI-700-99 Specification for Fluorocarbon Refrigerants.
- D. The use of chlorofluorocarbon (CFC)-based refrigerants is prohibited.

## 2.8 CONTROLS

- A. On chiller, mount lockable weatherproof steel control panel, containing starters, power and control wiring, non-fused disconnect switch, factory wired with single point power connection. Provide mechanical interlock to disconnect power when door is open.
- B. For each compressor, provide across-the-line starter, non-recycling compressor overload, starter relay, and control power transformer or terminal for control power. Provide manual reset current overload protection.
- C. Provide the following safety controls with 40-character English display, arranged so any one will shut down machine and require manual reset:
  - 1. Low chilled water temperature switch.
  - 2. High discharge pressure switch for each compressor.
  - 3. Low suction pressure switch for each compressor.
  - 4. Flow switch in chilled water line.
  - 5. Motor current overload.
  - 6. Phase reversal/unbalance/single-phasing.
  - 7. Over/under voltage.
  - 8. Failure of water temperature sensor used by chiller controller.
  - 9. Relay for remote mounted emergency shut-down switch.
  - 10. Low ambient/high ambient.

- D. Provide the following operating controls:
1. Chilled water temperature controller that modulates capacity control device(s).
  2. Timer to prevent compressor short cycling.
  3. Anti-coincidental timer.
  4. Load limit thermostat to limit compressor loading on high return water temperature.
  5. Low ambient control for operation down to 32°F(0.
  6. High ambient controls for operation over 115°F.
- E. Microprocessor control panel with digital readout. Display shall be multiple character LCD or lighted display with keypad.
1. User interface shall display at a minimum the following:
    - a. Operating/alarm condition.
    - b. Leaving chilled water temperature set point (with adjustment at the panel and via DDC).
    - c. Entering and leaving chilled water temperature.
    - d. Percent rated load amps output for each compressor.
    - e. Condenser pressure for each circuit.
    - f. Evaporator pressure for each circuit.
    - g. Outside air temperature.
    - h. Voltage.
  2. Control panel shall communicate the following points to the DDC system via a Lon, Modbus or BACnet interface:
    - a. Inputs:
      - 1) Chiller enable.
      - 2) Leaving chilled water temperature set point.
      - 3) Chiller mode.
      - 4) Current limit set point.
    - b. Outputs:
      - 1) Chiller status.
      - 2) Active chilled water set point.
      - 3) Leaving chilled water temperature.
      - 4) Entering chilled water temperature.
      - 5) Alarm descriptor.
      - 6) Average percent Run Load Amps (actual capacity).
      - 7) Active current limit set point.
- F. Chiller manufacturer shall provide a BACnet interface with the building automation system in accordance with ASHRAE/ANSI Standard 135/2001. This may be accomplished through a system integration panel, or "gateway". Integration shall be through an RS-232 connection. Integration panels shall be provided as part of the chiller package. Wiring between the chiller control panel(s) and the integration panel shall be the responsibility of the chiller manufacturer.

## 2.9 BEARINGS

- A. All bearings shall have a L10 life of not less than 200,000 hours per ANSI/AFBMA 9.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

##### A. General Installation Requirements:

1. Install in accordance with manufacturer's instructions.
2. Align chiller package on steel or concrete foundations.
3. Comb all condenser coils to repair bent fins.

##### B. Piping Requirements:

1. Connect to chilled water piping. On inlet, provide well for temperature controller, flexible connector and shutoff valve. On outlet, provide well for thermometer, flexible connector.
2. Arrange piping for easy dismantling for tube cleaning.

##### C. Paint Requirements:

1. Paint chiller completely (including insulation) including two coats of paint to insulation or PVC jacketing. Provide one pint of additional paint for touch-up after installation. Color selection by Owner.

#### 3.2 MANUFACTURER'S FIELD SERVICES (FOR REFERENCE)

- A. Provide factory trained representation for a period of one day to perform testing, start up, and instruction on operating and maintenance to Owner.

**END OF SECTION**

## SECTION 26 05 00

### BASIC ELECTRICAL REQUIREMENTS

#### PART 1 - GENERAL

##### 1.1 SECTION INCLUDES

- A. Requirements applicable to all Division 26 Sections. Also refer to Division 1 - General Requirements. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced herein and within each specification section.

##### 1.2 REFERENCES

- A. NFPA 70 - National Electrical Code (NEC)

##### 1.3 SCOPE OF WORK

- A. This Specification and the associated drawings govern furnishing, installing, testing and placing into satisfactory operation the Electrical Systems.
- B. The Contractor shall furnish and install all new materials as indicated on the drawings, and/or in these specifications, and all items required to make the portion of the Electrical Work a finished and working system.
- C. All work will be awarded under a single General Contract. The division of work listed below is for the Contractor's convenience and lists normal breakdown of the work.
- D. Description of Systems shall be as follows:
  - 1. Electrical power system to and including equipment, motors, devices, etc.
  - 2. Wiring system for temperature control system as shown on the drawings.
  - 3. Wiring of equipment furnished by others.
  - 4. Removal work and/or relocation and reuse of existing systems and equipment.
  - 5. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.

##### 1.4 WORK SEQUENCE

- A. All work that will produce excessive noise or interference with normal building operations, as determined by the Owner, shall be scheduled with the Owner. It may be necessary to schedule such work during unoccupied hours. The Owner reserves the right to determine when restricted construction hours are required.

##### 1.5 DIVISION OF WORK BETWEEN MECHANICAL, ELECTRICAL, and CONTROL CONTRACTORS

- A. Division of work is the responsibility of the Prime Contractor. Any scope of work described at any location on the contract document shall be sufficient for including said requirement in the project. The Prime Contractor shall be solely responsible for determining the appropriate subcontractor for the described scope. In no case shall the project be assessed an additional cost for scope that is described on the contract documents on bid day. The following division of responsibility is a guideline based on typical industry practice.

B. Definitions:

1. "Mechanical Contractors" refers to the Contractors listed in Division 21/22/23 of this Specification.
2. "Technology Contractors" refers to the Contractors furnishing and installing systems listed in Division 27/28 of this Specification.
3. Motor Power Wiring: The single phase or 3 phase wiring extending from the power source (transformer, panelboard, feeder circuits, etc.) through disconnect switches and motor controllers to, and including the connections to the terminals of the motor.
4. Motor Control Wiring: The wiring associated with the remote operation of the magnetic coils of magnetic motor starters or relays, or the wiring that permits direct cycling of motors by means of devices in series with the motor power wiring. In the latter case, the devices are usually single phase, have "Manual-Off-Auto" provisions, and are usually connected into the motor power wiring through a manual motor starter.
5. Control devices such as start-stop push buttons, thermostats, pressure switches, flow switches, relays, etc., generally represent the types of equipment associated with motor control wiring.
6. Motor control wiring is single phase and usually 120 volts. In some instances, the voltage will be the same as the motor power wiring. When the motor power wiring exceeds 120 volts, a control transformer is usually used to give a control voltage of 120 volts.
7. Temperature Control Wiring: The wiring associated with the operation of a motorized damper, solenoid valve or motorized valve, etc., either modulating or two-position, as opposed to wiring that directly powers or controls a motor used to drive equipment such as fans, pumps, etc. This wiring will be from a 120-volt source and may continue as 120 volt, or be reduced in voltage (24 volt), in which case a control transformer shall be furnished as part of the temperature control wiring.
8. Control Motor: An electric device used to operate dampers, valves, etc. It may be two-position or modulating. Conventional characteristics of such a motor are 24 volts, 60 cycles, 1 phase, although other voltages may be encountered.

C. General:

1. The purpose of these Specifications is to outline the Electrical and Mechanical Contractors' responsibilities related to electrical work required for items such as temperature controls, mechanical equipment, fans, chillers, compressors, etc. The exact wiring requirements for much of the equipment cannot be determined until the systems have been selected and submittals approved. Therefore, the electrical drawings show only known wiring related to such items. All wiring not shown on the electrical drawings, but required for mechanical systems, is the responsibility of the Mechanical Contractor.
2. Where the drawings require the Electrical Contractor to wire between equipment furnished by the Mechanical Contractor, such wiring shall terminate at terminals provided in the equipment. The Mechanical Contractor shall furnish complete wiring diagrams and supervision to the Electrical Contractor and designate the terminal numbers for correct wiring.
3. Control low (24V) and control line (120V) voltage wiring, conduit, and related switches and relays required for the automatic control and/or interlock of motors and equipment, including final connection, are to be furnished and installed under Divisions 21, 22 and 23. Materials and installation to conform to Class 1 or 2 requirements.
4. The Electrical Contractor shall establish electrical utility elevations prior to fabrication and installation. The Electrical Contractor shall coordinate utility elevations with other trades. When a conflict arises, priority shall be as follows:
  - a. Luminaires.
  - b. Gravity flow piping, including steam and condensate.
  - c. Electrical bus duct.

- d. Sheet metal.
- e. Cable trays, including access space.
- f. Other piping.
- g. Conduits and wireway.

D. Mechanical Contractor's Responsibility:

- 1. Assumes responsibility for internal wiring of all equipment furnished by the Mechanical Contractor.
- 2. Assumes all responsibility for miscellaneous items furnished by the Mechanical Contractor that require wiring but are not shown on the electrical drawings or specified in the Electrical Specification. If items such as relays, flow switches, or interlocks are required to make the mechanical system function correctly or are required by the manufacturer, they are the responsibility of the Mechanical Contractor.
- 3. Assumes all responsibility for Temperature Control wiring, if the Temperature Control Contractor is a Subcontractor to the Mechanical Contractor.
- 4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

E. Temperature Control Contractor's or Subcontractor's Responsibility:

- 1. Wiring of all devices needed to make the Temperature Control System functional.
- 2. Verifying any control wiring on the electrical drawings as being by the Electrical Contractor. All wiring required for the Control System, but not shown on the electrical drawings, is the responsibility of the Temperature Control Contractor or Subcontractor.
- 3. Coordinating equipment locations (such as PE's, EP's, relays, transformers, etc.) with the Electrical Contractor, where wiring of the equipment is by the Electrical Contractor.

F. Electrical Contractor's Responsibility:

- 1. Furnishes and installs all combination starters, manual starters and disconnect devices shown on the Electrical Drawings or indicated to be by the Electrical Contractor in the Mechanical Drawings or Specifications.
- 2. Installs and wires all remote-control devices furnished by the Mechanical Contractor or Temperature Control Contractor when so noted on the Electrical Drawings.
- 3. Furnishes and installs motor control and temperature control wiring, when noted on the drawings.
- 4. Furnishes, installs, and connects all relays, etc., for automatic shutdown of certain mechanical equipment (supply fans, exhaust fans, etc.) upon actuation of the Fire Alarm System.
- 5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

## 1.6 QUALITY ASSURANCE

### A. Contractor's Responsibility Prior to Submitting Pricing/Bid Data:

1. The Contractor is responsible for constructing complete and operating systems. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of a three-dimensional object, subject to human interpretation. This representation may include imperfect data, interpreted codes, utility guides, three-dimensional conflicts, and required field coordination items. Such deficiencies can be corrected when identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the Architect/Engineer any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.
2. The Contractor shall resolve all reported deficiencies with the Architect/Engineer prior to awarding any subcontracts, ordering material, or starting any work with the Contractor's own employees. Any work performed prior to receipt of instructions from the Architect/Engineer will be done at the Contractor's risk.

### B. Qualifications:

1. Only products of reputable manufacturers as determined by the Architect/Engineer are acceptable.
2. All Contractors and subcontractors shall employ only workmen who are skilled in their trades. At all times, the number of apprentices at the job site shall be less than or equal to the number of journeymen at the job site.

### C. Compliance with Codes, Laws, Ordinances:

1. Conform to all requirements of the State of Iowa Codes, Laws, Ordinances and other regulations having jurisdiction.
2. If there is a discrepancy between the codes and regulations and these specifications, the Architect/Engineer shall determine the method or equipment used.
3. If the Contractor notes, at the time of bidding, that any parts of the drawings or specifications do not comply with the codes or regulations, Contractor shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time for this procedure, Contractor shall submit with the proposal a separate price to make the system comply with the codes and regulations.
4. All changes to the system made after the letting of the contract to comply with codes or the requirements of the Inspector, shall be made by the Contractor without cost to the Owner.
5. If there is a discrepancy between manufacturer's recommendations and these specifications, the manufacturer's recommendations shall govern.
6. If there are no local codes having jurisdiction, the current issue of the National Electrical Code shall be followed.

### D. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.
2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where the work is done, or as required by any duly constituted public authority.
3. Pay all charges for permits or licenses.
4. Pay all fees and taxes imposed by State, Municipal, and other regulatory bodies.
5. Pay all charges arising out of required inspections by an authorized body.

6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized agency/consultant.
7. Where applicable, all fixtures, equipment and materials shall be listed by Underwriter's Laboratories, Inc. or a nationally recognized testing organization.
8. Pay all telephone company charges related to the service or change in service.

E. Examination of Drawings:

1. The drawings for the electrical work are completely diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment, outlets, etc., and the approximate sizes of equipment.
2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of raceways to best fit the layout of the job. Conduit entry points for electrical equipment including, but not limited to, panelboards, switchboards, switchgear and unit substations, shall be determined by the Contractor unless noted in the contract documents.
3. Scaling of the drawings will not be sufficient or accurate for determining these locations.
4. Where job conditions require reasonable changes in arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.
5. Because of the scale of the drawings, certain basic items, such as junction boxes, pull boxes, conduit fittings, etc., may not be shown, but where required by other sections of the specifications or required for proper installation of the work, such items shall be furnished and installed.
6. If an item is either shown on the drawings or called for in the specifications, it shall be included in this contract.
7. The Contractor shall determine quantities and quality of material and equipment required from the documents. Where discrepancies arise between drawings, schedules and/or specifications, the greater and better-quality number shall govern.
8. Where used in electrical documents the word "furnish" shall mean supply for use, the word "install" shall mean connect up complete and ready for operation, and the word "provide" shall mean to supply for use and connect up complete and ready for operation.
9. Any item listed as furnished shall also be installed unless otherwise noted.
10. Any item listed as installed shall also be furnished unless otherwise noted.

F. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing Revit.
2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.
3. Upon request for electronic media, the Contractor shall complete and return a signed "Electronic File Transmittal" form provided by IMEG.
4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.
5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.
6. The drawings prepared by IMEG for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.
7. The use of these CAD documents by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.

8. The information is provided to expedite the project and assist the Contractor with no guarantee by IMEG as to the accuracy or correctness of the information provided. IMEG accepts no responsibility or liability for the Contractor's use of these documents.

G. Field Measurements:

1. Verify all pertinent dimensions at the job site before ordering any conduit, conductors, wireways, bus duct, fittings, etc.

1.7 SCHEDULE OF VALUES

A. The requirements herein are in addition to the provisions of Division 1.

B. Format:

1. Use AIA Document Continuation Sheets G703 or another similar form approved by the Owner and Architect/Engineer.
2. Submit in Excel format.
3. Support values given with substantiating data.

C. Preparation:

1. Itemize work required by each specification section and list all providers. All work provided by subcontractors and major suppliers shall be listed on the Schedule of Values. List each subcontractor and supplier by company name.
2. Break down all costs into:
  - a. Material: Delivered cost of product with taxes paid.
  - b. Labor: Labor cost, excluding overhead and profit.
3. Itemize the cost for each of the following:
  - a. Overhead and profit.
  - b. Bonds.
  - c. Insurance.
  - d. General Requirements: Itemize all requirements.
4. For each line item having an installed cost of more than \$5,000, break down costs to list major products or operations under each item. At a minimum, provide material and labor cost line items for the following:
  - a. Each piece of equipment requiring shop drawings. Use the equipment nomenclature (SB-1, PANEL P-1, etc.) on the Schedule of Values.
  - b. Each type of small unitary equipment (e.g., FDS, FCS, CS, etc.). Multiple units of the same type can be listed together provided quantities are also listed so unit costs can be determined.
  - c. Each conduit system (medium voltage, normal, emergency, low voltage systems, etc.). In addition, for larger projects breakdown the material and labor for each conduit system based on geography (building, floor, and/or wing).
  - d. Site utilities (5' beyond building)
  - e. Seismic design
  - f. Testing
  - g. Commissioning
  - h. Record drawings
  - i. Punchlist and closeout

- D. Update Schedule of Values when:
1. Indicated by Architect/Engineer.
  2. Change of subcontractor or supplier occurs.
  3. Change of product or equipment occurs.

#### 1.8 CHANGE ORDERS

- A. A detailed material and labor takeoff shall be prepared for each change order, along with labor rates and markup percentages. Change orders shall be broken down by sheet or associated individual line item indicated in the change associated narrative, whichever provides the most detailed breakdown. Change orders with inadequate breakdown will be rejected.
- B. Itemized pricing with unit cost shall be provided from all distributors and associated subcontractors.
- C. Change order work shall not proceed until authorized.

#### 1.9 PRODUCT DELIVERY, STORAGE, HANDLING and MAINTENANCE

- A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage.
- B. Keep all materials clean, dry and free from damaging environments.
- C. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the Electrical Contractor does not have prior documented experience in rigging and lifting similar equipment, he/she shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.
- D. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate the work with other trades.

#### 1.10 NETWORK / INTERNET CONNECTED EQUIPMENT

- A. These specifications may require certain equipment or systems to have network, Internet and/or remote access capability ("Network Capability"). Any requirement for Network Capability shall be interpreted only as a functional capability and is not to be construed as authority to connect or enable any Network Capability. Network Capability may only be connected or enabled with the express written consent of the Owner.

#### 1.11 WARRANTY

- A. Provide one-year warranty for all fixtures, equipment, materials, and workmanship.
- B. The warranty period for all work in this specification Division shall commence on the date of Substantial Completion or successful system performance whichever occurs later. The warranty may also commence if a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization of the Owner. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner.

- C. Warranty requirements extend to correction, without cost to the Owner, of all work found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage due to defects or nonconformance with contract documents excluding repairs required as a result of improper maintenance or operation, or of normal wear as determined by the Architect/Engineer.

#### 1.12 INSURANCE

- A. This Contractor shall maintain insurance coverage as set forth in Division 1 of these specifications.

#### 1.13 MATERIAL SUBSTITUTION

- A. Where several manufacturers' names are given, the manufacturer for which a catalog number is given is the basis for job design and establishes the quality.
- B. Equivalent equipment manufactured by the other listed manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meet all requirements of the drawings and specifications and fits in the allocated space. When using other listed manufacturers, the Contractor shall assume responsibility for any and all modifications necessary (including, but not limited to structural supports, electrical connections and rough-in, and regulatory agency approval, etc.) and coordinate such with other contractors. The Architect/Engineer shall make the final determination of whether a product is equivalent.
- C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Architect/Engineer via addendum. The Contractor assumes all costs incurred as a result of using the offered material, article or equipment, on the Contractors part or on the part of other Contractors whose work is affected.
- D. Voluntary add or deduct prices for alternate materials may be listed on the bid form. These items will not be used in determining the low bidder. This Contractor assumes all costs incurred as a result of using the offered material or equipment on the Contractors part or on the part of other Contractors whose work is affected.
- E. All material substitutions requested after the final addendum must be listed as voluntary changes on the bid form.

### PART 2 - PRODUCTS

#### 2.1 GENERAL

- A. All items of material having a similar function (e.g., safety switches, panelboards, switchboards, contactors, motor starters, dry type transformers) shall be of the same manufacturer unless specifically stated otherwise on drawings or elsewhere in specifications.

## PART 3 - EXECUTION

### 3.1 JOBSITE SAFETY

- A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or the employees and subconsultants at a construction site, shall relieve the Contractor and any other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

### 3.2 ARCHITECT/ENGINEER OBSERVATION OF WORK

- A. The contractor shall provide seven (7) calendar days' notice to the Architect/Engineer prior to:
  - 1. Placing fill over underground and underslab utilities.
- B. The Architect/Engineer will review the installation and provide a written report noting deficiencies requiring correction. The contractor's schedule shall account for these reviews and show them as line items in the approved schedule.

### 3.3 PROJECT CLOSEOUT

- A. The following paragraphs supplement the requirements of Division 1.
- B. Final Jobsite Observation:
  - 1. To prevent the Final Jobsite Observation from occurring too early, the Contractor shall review the completion status of the project and certify that the job is ready for the final jobsite observation.
  - 2. Attached to the end of this section is a typical list of items that represent the degree of job completeness expected prior to requesting a review. The Contractor shall sign the attached certification and return it to the Architect/Engineer so that the final observation can be scheduled.
  - 3. It is understood that if the Architect/Engineer finds the job not ready for the final observation and additional trips and observations are required to bring the project to completion, the cost of the additional time and expenses incurred by the Architect/Engineer will be deducted from the Contractor's final payment.
  - 4. Contractor shall notify Architect/Engineer 48 hours prior to installation of ceilings or lay-in ceiling tiles.
- C. The following must be submitted before Architect/Engineer recommends final payment:
  - 1. Operation and maintenance manuals with copies of approved shop drawings.
  - 2. Record documents including marked-up drawings and specifications.
  - 3. A report documenting the instructions given to the Owner's representatives complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of this Contractor and shall be signed by the Owner's representatives.

4. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to project site and place in location as directed and submit receipt to Architect/Engineer.
5. Inspection and testing report by the fire alarm system manufacturer.
6. Start-up reports on all equipment requiring a factory installation or start-up.

D. Circuit Directories:

1. Provide custom typed circuit directory for each branch circuit panelboard. Provide updated custom typed circuit directory for each existing branch circuit panelboard with new or revised circuits per the scope of work. Label shall include equipment name or final approved room name, room number, and load type for each circuit (examples: SUMP SP-1 or ROOM 101 RECEIPT). Revise directory to reflect circuit changes required to balance phase loads. Printed copies of the bid document panel schedules are not acceptable as circuit directories.

3.4 OPERATION AND MAINTENANCE MANUALS

A. General:

1. Provide an electronic copy of the O&M manuals as described below for Architect/Engineer's review and approval. The electronic copy shall be corrected as required to address the Architect/Engineer's comments. Once corrected, electronic copies and paper copies shall be distributed as directed by the Architect/Engineer.
2. Approved O&M manuals shall be completed and in the Owner's possession prior to Owner's acceptance and at least 10 days prior to instruction of operating personnel.

B. Electronic Submittal Procedures:

1. Distribution: Email the O&M manual as attachments to all parties designated by the Architect/Engineer.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
  - a. O&M file name: O&M.div26.contractor.YYYYMMDD
  - b. Transmittal file name: O&Mtransmittal.div26.contractor.YYYYMMDD
5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.
6. Provide the Owner with an approved copy of the O&M manual on compact discs (CD), digital video discs (DVD), or flash drives with a permanently affixed label, printed with the title "Operation and Maintenance Instructions", title of the project and subject matter of disc/flash drive when multiple disc/flash drives are required.
7. All text shall be searchable.
8. Bookmarks shall be used, dividing information first by specification section, then systems, major equipment and finally individual items. All bookmark titles shall include the nomenclature used in the construction documents and shall be an active link to the first page of the section being referenced.

C. Operation and Maintenance Instructions shall include:

1. Title Page: Include title page with project title, Architect, Engineer, Contractor, all subcontractors, and major equipment suppliers, with addresses, telephone numbers, website addresses, email addresses and point of contacts. Website URLs and email addresses shall be active links in the electronic submittal.
2. Table of Contents: Include a table of contents describing specification section, systems, major equipment, and individual items.
3. Copies of all final approved shop drawings and submittals. Include Architect's/Engineer's shop drawing review comments. Insert the individual shop drawing directly after the Operation and Maintenance information for the item(s) in the review form.
4. Copies of all factory inspections and/or equipment startup reports.
5. Copies of warranties.
6. Schematic wiring diagrams of the equipment that have been updated for field conditions. Field wiring shall have label numbers to match drawings.
7. Dimensional drawings of equipment.
8. Detailed parts lists with lists of suppliers.
9. Operating procedures for each system.
10. Maintenance schedule and procedures. Include a chart listing maintenance requirements and frequency.
11. Repair procedures for major components.
12. Replacement parts and service material requirements for each system and the frequency of service required.
13. Instruction books, cards, and manuals furnished with the equipment.
14. Include record drawings of the one-line diagrams for each major system. The graphic for each piece of equipment shown on the one-line diagram shall be an active link to its associated Operation & Maintenance data.
15. Copies of all panel schedules in electronic Microsoft Excel spreadsheet (.xlsx) file. Each panelboard shall be a separate tab in the workbook.

3.5 INSTRUCTING THE OWNER'S REPRESENTATIVE

- A. Adequately instruct the Owner's designated representatives in the maintenance, care, and operation of the complete systems installed under this contract.
- B. Provide verbal and written instructions to the Owner's representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.
- C. The instructions shall include:
  1. Maintenance of equipment.
  2. Start-up procedures for all major equipment.
- D. Notify the Architect/Engineer of the time and place for the verbal instructions to be given to the Owner's representative so a representative can be present if desired.
- E. Minimum hours of instruction time for each item and/or system shall be as indicated in each individual specification section.
- F. Operating Instructions:
  1. Contractor is responsible for all instructions to the Owner's representatives for the electrical and specialized systems.

2. If the Contractor does not have staff that can adequately provide the required instructions, the Contractor shall include in the bid an adequate amount to reimburse the Owner for the Architect/Engineer to perform these services.

### 3.6 RECORD DOCUMENTS

- A. The following paragraphs supplement Division 1 requirements.
- B. Maintain at the job site a separate and complete set of electrical drawings and specifications with all changes made to the systems clearly and permanently marked in complete detail.
- C. Mark drawings and specifications to indicate approved substitutions; Change Orders, and actual equipment and materials used. All Change Orders, RFI responses, Clarifications and other supplemental instructions shall be marked on the documents. Record documents that merely reference the existence of the above items are not acceptable. Should this Contractor fail to complete Record Documents as required by this contract, this Contractor shall reimburse Architect/Engineer for all costs to develop record documents that comply with this requirement. Reimbursement shall be made at the Architect/Engineer's hourly rates in effect at the time of work.
- D. Record changes daily and keep the marked drawings available for the Architect/Engineer's examination at any normal work time.
- E. Upon completing the job, and before final payment is made, give the marked-up drawings to the Architect/Engineer.
- F. Record actual routing of conduits exceeding 2 inches.

### 3.7 ADJUST AND CLEAN

- A. Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project.
- B. Clean all foreign paint, grease, oil, dirt, labels, stickers, etc. from all equipment.
- C. Remove all rubbish, debris, etc., accumulated during construction from the premises.

### 3.8 SPECIAL REQUIREMENTS

- A. Coordinate the installation of all equipment, controls, devices, etc., with other trades to maintain clear access area for servicing.
- B. Install all equipment to maximize access to parts needing service or maintenance. Review the final location, placement, and orientation of equipment with the Owner's representative prior to setting equipment.
- C. Installation of equipment or devices without regard to coordination of access requirements and confirmation with the Owner's representative will result in removal and reinstallation of the equipment at the Contractor's expense.

### 3.9 SYSTEM STARTING AND ADJUSTING

- A. The electrical systems shall be complete and operating. System startup, testing, adjusting, and balancing to obtain satisfactory system performance is the responsibility of the Contractor. This includes all calibration and adjustment of electrical controls, balancing of loads, troubleshooting and verification of software, and final adjustments that may be needed.
- B. Complete all manufacturer-recommended startup procedures and checklists to verify proper equipment operation and does not pose a danger to personnel or property.
- C. All operating conditions and control sequences shall be tested during the start-up period. Testing all interlocks, safety shut-downs, controls, and alarms.
- D. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all systems perform properly. If the Architect/Engineer is requested to visit the job site for trouble shooting, assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period, through no fault of the design; the Contractor shall reimburse the Owner on a time and materials basis for services rendered at the Architect/Engineer's standard hourly rates in effect when the services are requested. The Contractor shall pay the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

### 3.10 FIELD QUALITY CONTROL

- A. General:
  - 1. Conduct all tests required during and after construction. Submit test results in NETA format, or equivalent form, that shows the test equipment used, calibration date, tester's name, ambient test conditions, humidity, conductor length, and results corrected to 40°C.
  - 2. Supply necessary instruments, meters, etc., for the tests. Supply competent technicians with training in the proper testing techniques.
  - 3. All cables and wires shall be tested for shorts and grounds following installation and connection to devices. Replace shorted or grounded wires and cables.
  - 4. Any wiring device, electrical apparatus or luminaire, if grounded or shorted on any integral "live" part, shall have all defective parts or materials replaced.
  - 5. Test cable insulation of service and panel feeder conductors for proper insulation values. Tests shall include the cable, all splices, and all terminations. Each conductor shall be tested and shall test free of short circuits and grounds and have an insulation value not less than Electrical Code Standards. Take readings between conductors, and between conductors and ground.
  - 6. If the results obtained in the tests are not satisfactory, make adjustments, replacements, and changes as needed. Then repeat the tests, and make additional tests, as the Architect/Engineer or authority having jurisdiction deems necessary.
- B. If any test results are not satisfactory, make adjustments, replacements and changes as needed and repeat the tests and make additional tests as the Architect/Engineer or authority having jurisdiction deem necessary.

### READINESS CERTIFICATION PRIOR TO FINAL JOBSITE OBSERVATION

To prevent the final job observation from occurring too early, we require that the Contractor review the completion status of the project and, by copying of this document, certify that the job is indeed ready for the final job observation. The following is a typical list of items that represent the degree of job completeness expected prior to your requesting a final job observation.

1. Penetrations of fire-rated construction fire sealed in accordance with specifications.
2. Electrical panels have typed circuit identification.
3. Operation and Maintenance manuals have been submitted as per Section 26 05 00.
4. Bound copies of approved shop drawings have been submitted as per Section 26 05 00.
5. Report of instruction of Owner's representative has been submitted as per Section 26 05 00.

Accepted by:

Prime Contractor \_\_\_\_\_

By \_\_\_\_\_ Date \_\_\_\_\_

Upon Contractor certification that the project is complete and ready for a final job observation, we require the Contractor to sign this agreement and return it to the Architect/Engineer so that the final observation can be scheduled.

It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineers for additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

**END OF SECTION**

## SECTION 26 05 05

### ELECTRICAL DEMOLITION FOR REMODELING

#### PART 1 - GENERAL

##### 1.1 SECTION INCLUDES

- A. Electrical demolition

#### PART 2 - PRODUCTS

##### 2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment for patching and extending work shall be as specified in individual Sections.

#### PART 3 - EXECUTION

##### 3.1 EXAMINATION

- A. THE DRAWINGS ARE INTENDED TO INDICATE THE SCOPE OF WORK REQUIRED AND DO NOT INDICATE EVERY BOX, CONDUIT, OR WIRE THAT MUST BE REMOVED. THE CONTRACTOR SHALL VISIT THE SITE PRIOR TO SUBMITTING A BID AND VERIFY EXISTING CONDITIONS.
- B. Where walls, ceilings, structures, etc., are indicated as being removed on general or electrical drawings, the Contractor shall be responsible for the removal of all electrical equipment, devices, fixtures, raceways, wiring, systems, etc., from the removed area.
- C. Where ceilings, walls, structures, etc., are temporarily removed and replaced by others, this Contractor shall be responsible for the removal, storage, and replacement of equipment, devices, fixtures, raceways, wiring, systems, etc.
- D. Where mechanical or technology equipment is indicated as being removed on electrical, mechanical, or technology drawings, the Contractor shall be responsible for disconnecting the equipment and removing all starters, VFD, controllers, electrical equipment, raceways, wiring, etc. associated with the device.
- E. Verify that abandoned wiring and equipment serve only abandoned equipment or facilities. Extend conduit and wire to facilities and equipment that will remain in operation following demolition. Extension of conduit and wire to equipment shall be compatible with the surrounding area. Extended conduit and conductors to match existing size and material.
- F. Coordinate scope of work with all other Contractors and the Owner at the project site. Schedule removal of equipment and electrical service to avoid conflicts.
- G. Bid submittal shall mean the Contractor has visited the project site and has verified existing conditions and scope of work.

### 3.2 PREPARATION

- A. The Contractor shall obtain approval from the Owner before turning off power to circuits, feeders, panels, etc. Coordinate all outages with Owner.
- B. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations. Assume all equipment and systems must remain operational unless specifically noted otherwise on drawings.
- C. Existing Electrical Service: Maintain existing system in service . Disable system only to make switchovers and connections. Obtain permission from Owner at least 48 hours before partially or completely disabling system. Minimize outage duration.

### 3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Demolish and extend existing electrical work under provisions of Division 1 of Specifications and this Section.
- B. Remove, relocate, and extend existing installations to accommodate new construction.
- C. Remove abandoned wiring and raceway to source of supply. Existing conduit in good condition may be reused in place by including an equipment ground conductor in reused conduit. Reused conduit and boxes shall have supports revised to meet current codes. Relocating conduit shall not be allowed.
- D. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces. Remove all associated clamps, hangers, supports, etc. associated with raceway removal.
- E. Disconnect and remove outlets and devices that are to be demolished. Remove outlet or devices' associated back box, supports, and conduit and conductors back to source. Patch opening created from removal of device to match surrounding finishes.
- F. Disconnect and remove abandoned panelboards and distribution equipment.
- G. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- H. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories. Ballasts in light fixtures installed prior to 1980 shall be incinerated in EPA approved incinerator or disposed of in EPA certified containers and deposited in an EPA landfill certified for PCB disposal or recycled by permitted ballast recycler. Punctured or leaking ballasts must be disposed of according to Federal Regulations under the Toxic Substance Control Act. Provide Owner and Architect/Engineer with a Certificate of Destruction to verify proper disposal.
- I. Repair adjacent construction and finishes damaged during demolition and extension work. Patch openings to match existing surrounding finishes.
- J. Maintain access to existing electrical installations that remain active. Modify installation or provide junction boxes and access panel as appropriate.

- K. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified. Extended conduit and conductors to match existing size and material.
- L. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- M. Floor slabs may contain conduit systems. This Contractor is responsible for taking any measures required to ensure no conduits or other services are damaged. This includes x-ray or similar non-destructive means. Where conduit is in concrete slab, cut conduit flush with floor, pull out conductors, and plug conduit ends.
- N. This Contractor is responsible for all costs incurred in repair, relocations, or replacement of any cables, conduits, or other services if damaged without proper investigation.

#### 3.4 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment that remain or are to be reused.
- B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.
- C. ELECTRICAL ITEMS (E.G., LIGHTING FIXTURES, RECEPTACLES, SWITCHES, CONDUIT, WIRE, ETC.) REMOVED AND NOT RELOCATED REMAIN THE PROPERTY OF THE OWNER. CONTRACTOR SHALL PLACE ITEMS RETAINED BY THE OWNER IN A LOCATION COORDINATED WITH THE OWNER. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE DISPOSAL OF MATERIAL THE OWNER DOES NOT WANT.

#### 3.5 INSTALLATION

- A. Install relocated materials and equipment under the provisions of Division 1 of Specifications.

**END OF SECTION**

## SECTION 26 05 13

### WIRE AND CABLE

#### PART 1 - GENERAL

##### 1.1 SECTION INCLUDES

- A. Building wire
- B. Cabling for remote control, signal, and power limited circuits

##### 1.2 RELATED WORK

- A. Section 26 05 53 - Electrical Identification: Refer to electrical identification for color and identification labeling requirements.

##### 1.3 REFERENCES

- A. NFPA 70 - National Electrical Code (NEC)
- B. UL 44 - Thermoset-Insulated Wires and Cables
- C. UL 83 - Thermoplastic-Insulated Wires and Cables
- D. UL 1581 - Standard for Electrical Wires, Cables, and Flexible Cords
- E. UL 2196 - Fire Resistive, Fire Resistant and Circuit Integrity Cables

#### PART 2 - PRODUCTS

##### 2.1 BUILDING WIRE

- A. Feeders and Branch Circuits 8 AWG and larger: Copper, stranded conductor, 600-volt insulation, THHN/THWN or XHHW-2.
- B. Feeders and Branch Circuits 8 AWG and larger in Underground Conduit: Copper, stranded conductor, 600-volt insulation, THWN or XHHW-2.
- C. Feeders and Branch Circuits 10 AWG and Smaller: Copper, solid or stranded conductor, 600-volt insulation, THHN/THWN, unless otherwise noted on the drawings.
- D. Motor Feeder from Variable Frequency Drives: Copper conductor, 600-volt XHHW-2 insulation, stranded conductor, unless otherwise noted on the drawings.
- E. Control Circuits: Copper, stranded conductor 600-volt insulation, THHN/THWN.
- F. Aluminum conductors are not to be used for feeds to motor loads.
- G. Each 120 and 277-volt branch circuit shall have a dedicated neutral conductor. Neutral conductors shall be considered current-carrying conductors for wire derating.

## 2.2 CABLING FOR REMOTE CONTROL, SIGNAL, AND POWER LIMITED CIRCUITS

- A. Wire for the following specialized systems shall be as designated on the drawings, or elsewhere in these specifications. If not designated on the drawings or specifications, the system manufacturer's recommendations shall be followed.
  - 1. Other specialized cabling, signal, and power limited cabling. Refer to the appropriate Division 23, 27, or 28 requirements; including, but not limited, to the following:
    - a. Building Automation Systems and Controls, Division 23.
- B. Control Cable for Class 1 Remote Control and Signal Circuits: Copper conductor, 600-volt insulation, rated 60°C, individual conductors twisted together, shielded, and covered with a PVC jacket.
- C. Control Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300-volt insulation, rated 60°C, individual conductors twisted together, shielded, and covered with a PVC jacket; UL listed.
- D. Plenum Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300-volt insulation, rated 60°C, individual conductors twisted together, shielded, and covered with a nonmetallic jacket; UL listed for use in air handling ducts, hollow spaces used as ducts, and plenums.

## PART 3 - EXECUTION

### 3.1 WIRE AND CABLE INSTALLATION SCHEDULE

- A. All Other Locations: Building wire in raceway.
- B. Above Grade: All conductors installed above grade shall be type "THHN".
- C. Underground or In Slab: All conductors shall be type "THWN".
- D. Low Voltage Cable (less than 100 volts): Low voltage cable shall be installed in raceway.

### 3.2 CONTRACTOR CHANGES

- A. The Contractor shall be responsible for derating and sizing conductors and conduits to equal or exceed the ampacity of the basis of design circuits, if he/she chooses to use methods or materials other than the basis of design.
- B. Record drawing shall include the calculations and sketches.

### 3.3 GENERAL WIRING METHODS

- A. Use no wire smaller than 18 AWG for low voltage control wiring below 100 volts.
- B. Splice only in junction or outlet boxes.
- C. All conductors shall be continuous in conduit from last outlet to their termination.
- D. Cables or wires shall not be laid out on the ground before pulling.

- E. Cables or wires shall not be dragged over earth or paving.
- F. Care shall be taken so as not to subject the cable or wire to high mechanical stresses that would cause damage to the wire and cable.
- G. At least six (6)-inch loops or ends shall be left at each outlet for installation connection of luminaires or other devices.
- H. All wires in outlet boxes not connected to fixtures or other devices shall be rolled up, spliced if continuity of circuit is required, and insulated.

### 3.4 WIRING INSTALLATION IN RACEWAYS

- A. Pull all conductors into a raceway at the same time. Use UL listed wire pulling lubricant for pulling 4 AWG and larger wires.
- B. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.
- C. Pulling shall be continuous without unnecessary stops and starts with wire or cable only partially through raceway.
- D. Where reels of cable or wire are used, they shall be set up on jacks close to the point where the wire or cable enters the conduit or duct so that the cable or wire may be unreeled and run into the conduit or duct with a minimum of change in the direction of the bend.
- E. Conductors shall not be pulled through conduits until plastering or masonry work is completed and conduits are free from moisture. Care shall be taken so that long pulls of wire or pulls around several bends are not made where the wire may be permanently stretched and the insulation damaged.
- F. Only nylon rope shall be permitted to pull cables into conduit and ducts.
- G. Completely and thoroughly swab raceway system before installing conductors.
- H. Conductor Supports in Vertical Raceways:
  - 1. Support conductors in vertical raceways in accordance with the Electrical Code Spacing of Conductors Supports.
  - 2. Supports shall be of insulated wedge type (OZ Gedney Type S, or equal) and installed in a tapered insulated bushing fitting or a metal woven mesh with a support ring that fits inside conduit fitting installed in an accessible junction box (Hubbell Kellems support grip or equal).

### 3.5 WIRING CONNECTIONS AND TERMINATIONS

- A. Splice and tap only in accessible junction boxes.
- B. Use solderless, tin-plated copper, compression terminals (lugs) applied with circumferential crimp for conductor terminations, 8 AWG and larger.
- C. Use solderless, tin-plated, compression terminals (lugs) applied with indenter crimp for copper conductor terminations, 10 AWG and smaller.

- D. Use solderless pressure connectors with insulating covers for copper wire splices and taps, 8 AWG and smaller. For 10 AWG and smaller, use insulated spring wire connectors with plastic caps.
- E. Thoroughly clean wires before installing lugs and connectors.
- F. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.

### 3.6 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Division 1.
- B. Inspect wire and cable for physical damage and proper connection.
- C. Protection of wire and cable from foreign materials:
  - 1. It is the Contractor's responsibility to provide adequate physical protection to prevent foreign material application or contact with any wire or cable type. Foreign material is defined as any material that would negatively impact the validity of the manufacturer's performance warranty. This includes, but is not limited to, overspray of paint (accidental or otherwise), drywall compound, or any other surface chemical, liquid, or compound that could come in contact with the cable, cable jacket, or cable termination components.
- D. Overspray of paint on any wire or cable will not be accepted. It shall be the Contractor's responsibility to replace any component containing overspray, in its entirety, at no additional cost to the project. Cleaning of the cables with harsh chemicals is not allowed.

**END OF SECTION**

**SECTION 26 05 26**  
**GROUNDING AND BONDING**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Equipment grounding system
- B. Bonding system

**1.2 QUALITY ASSURANCE**

- A. Comply with UL 467 Grounding and Bonding Equipment.

**1.3 REFERENCES**

- A. NFPA 70 - National Electrical Code (NEC)

**1.4 SUMMARY**

- A. This section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

**PART 2 - PRODUCTS**

**2.1 GROUNDING CONDUCTORS**

- A. For insulated conductors, comply with Division 26 Section 26 05 13 "Wire and Cable".
- B. Material: Copper.
- C. Equipment Grounding Conductors: Insulated. Refer to Section 26 05 53 for insulation color.
- D. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.
- E. Copper Bonding Conductors: As follows:
  - 1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch in diameter.
  - 2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
  - 3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
  - 4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

## 2.2 CONNECTOR PRODUCTS

- A. Comply with UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
- B. Connectors: Hydraulic compression type, in kit form, and selected per manufacturer's written instructions.
- C. Bolted Connectors: Bolted-pressure-type connectors.

## PART 3 - EXECUTION

### 3.1 CONNECTIONS

- A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
  - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
  - 2. Make connections with clean, bare metal at points of contact.
  - 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
  - 4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
  - 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
- C. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
- D. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
- E. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically non-continuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
- F. Underground Connections: Exothermic-welded connections. Use for underground connections, except those at test wells.

- G. Connections at back boxes, junction boxes, pull boxes, and equipment terminations: The equipment grounding conductor(s) associated with all circuits in the box shall be connected together and to the box using a suitable grounding screw. The removal of the respective receptacle, luminaire, or other device served by the box shall not interrupt the grounding continuity. The connection to the non-metallic boxes shall be made to any metallic fitting or device requiring grounding.
- H. Tighten screws and bolts for grounding and bonding 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.
- I. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

### 3.2 INSTALLATION

- A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.
- B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage. Each grounding conductor that passes through a below grade wall must be provided with a waterstop.
- C. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then use a bolted clamp. Bond straps directly to the basic structure, taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.
- D. In raceways, use insulated equipment grounding conductors.
- E. Underground Grounding Conductors: Use copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches below grade or bury 12 inches above duct bank when installed as part of the duct bank.

### 3.3 EQUIPMENT GROUNDING SYSTEM

- A. Comply with Electrical Code, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by Electrical Code are indicated.
- B. Install equipment grounding conductors in all feeders and circuits. Terminate each end on a grounding lug or bus.
- C. Install insulated equipment grounding conductor with circuit conductors for the following items, in addition to those required by Electrical Code:
  - 1. Lighting and receptacle circuits. Terminate each end on a grounding lug or bus.
  - 2. Single-phase and three-phase motor and appliance branch circuits.
  - 3. Flexible raceway runs, including FMC and LFMC.
  - 4. Armored and metal-clad cable runs.

- D. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.

#### 3.4 BONDING SYSTEM

- A. At building expansion joints, provide flexible bonding jumpers to connect to columns or beams on each side of the expansion joint.
- B. Exterior Metallic Pull and Junction Box Covers, Metallic Hand Rails: Bond to grounding system using flexible grounding conductors.
- C. Equipment Circuits: Install a bonding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, dampers, and heaters. Bond conductor to each unit and to air duct. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps or copper conductor sized equal to the equipment grounding conductor.
- D. Water Heater, Heat-Tracing, Metal Well Casing, and Heating Cables: Install a separate equipment grounding conductor to each electric water heater, heat-tracing, and anti-frost heating cable. Bond conductor to heater units, piping, well casing, connected equipment, and components.
- E. Connect bonding conductors to metal water pipe using a suitable ground clamp. Make connections to flanged piping at street side of flange. Provide bonding jumper around water meter.

#### 3.5 FIELD QUALITY CONTROL

- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

**END OF SECTION**

**SECTION 26 05 33**  
**CONDUIT AND BOXES**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Electrical connection
- B. Pull and junction boxes

**1.2 RELATED WORK**

- A. Section 26 05 53 - Electrical Identification: Refer to electrical identification for color and identification labeling requirements.

**1.3 REFERENCES**

- A. American National Standards Institute (ANSI):
  - 1. ANSI C80.1 - Rigid Steel Conduit, Zinc-Coated
  - 2. ANSI C80.3 - Electrical Metallic Tubing, Zinc-Coated and Fittings
  - 3. ANSI C80.4 - Fittings for Rigid Metal Conduit and Electrical Metallic Tubing
  - 4. ANSI/NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports
  - 5. ANSI/NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports
- B. Federal Specifications (FS):
  - 1. A-A-50553A - Fittings for Conduit, Metal, Rigid, (Thick-Wall and Thin-Wall (EMT) Type
  - 2. A-A-55810 - Specification for Flexible Metal Conduit
- C. NECA "Standards of Installation"
- D. National Electrical Manufacturers Association (NEMA):
  - 1. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable
  - 2. RN 1 - Polyvinyl chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit, Rigid Aluminum Conduit, and Intermediate Metal Conduit
  - 3. TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit
  - 4. TC 9 - Fittings for PVC Plastic Utilities Duct for Underground Installation
- E. NFPA 70 - National Electrical Code (NEC)
- F. Definitions:
  - 1. Fittings: Conduit connection or coupling.
  - 2. Body: Enlarged fittings with opening allowing access to the conductors for pulling purposes only.

3. Mechanical Spaces: Enclosed areas, usually kept separated from the general public, where the primary use is to house service equipment and to route services. These spaces generally have exposed structures, bare concrete and non-architecturally emphasized finishes.
4. Finished Spaces: Enclosed areas where the primary use is to house personnel and the general public. These spaces generally have architecturally emphasized finishes, ceilings and/or floors.
5. Concealed: Not visible by the general public. Often indicates a location either above the ceiling, in the walls, in or beneath the floor slab, in column coverings, or in the ceiling construction.
6. Above Grade: Not directly in contact with the earth. For example, an interior wall located at an elevation below the finished grade shall be considered above grade but a wall retaining earth shall be considered below grade.
7. Slab: Horizontal pour of concrete used for a floor or sub-floor.

## PART 2 - PRODUCTS

### 2.1 ECONN; ELECTRICAL CONNECTION

- A. Electrical connection to equipment and motors, sized per Electrical Code. Coordinate requirements with contractor furnishing equipment or motor. Refer to specifications and general installation notes for terminations to motors.

### 2.2 JB; PULL AND JUNCTION BOXES

- A. Sheet Metal Boxes: ANSI/NEMA OS 1; galvanized steel.
- B. Sheet metal boxes larger than 12 inches in any dimension that contain terminations or components: Continuous hinged enclosure with 1/4 turn latch and white back panel for mounting terminal blocks and electrical components.
- C. Cast Metal Boxes for Outdoor and Wet Location Installations: NEMA 250; Type 4 and Type 6, flat-flanged, surface-mounted junction box, UL listed as raintight. Galvanized cast iron box and cover with ground flange, neoprene gasket, and stainless steel cover screws.
- D. Cast Metal Boxes for Underground Installations: NEMA 250; Type 4, inside flanged, recessed cover box for flush mounting, UL listed as raintight. Galvanized cast iron box and plain cover with neoprene gasket and stainless steel cover screws.
- E. Flanged type boxes shall be used where installed flush in wall.

## PART 3 - EXECUTION

### 3.1 BOX INSTALLATION SCHEDULE

- A. Galvanized steel boxes may be used in:
  1. Concealed interior locations above ceilings and in hollow studded partitions.
  2. Exposed interior locations in mechanical rooms and in rooms without ceilings; higher than 8' above the highest platform level.
  3. Direct contact with concrete except slab on grade.
  4. Recessed in stud wall of kitchens and laundries.

- B. Cast boxes shall be used in:
  - 1. Exterior locations.
  - 2. Hazardous locations.
  - 3. Exposed interior locations within 8' of the highest platform level.
  - 4. Direct contact with earth.
  - 5. Direct contact with concrete in slab on grade.
  - 6. Wet locations.
  - 7. Kitchens and laundries when exposed on wall surface.

### 3.2 COORDINATION OF BOX LOCATIONS

- A. Provide electrical boxes as shown on the drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance.
- B. Electrical box locations shown on the Contract Drawings are approximate, unless dimensioned. Verify location of floor boxes and outlets in offices and work areas prior to rough-in.
- C. Locate and install boxes to allow access. Avoid interferences with ductwork, piping, structure, equipment, etc. Recessed luminaires shall not be used as access to outlet, pull, and junction boxes. Where installation is inaccessible, provide access doors. Coordinate locations and sizes of required access doors with the Architect/Engineer and General Contractor.
- D. Locate and install to maintain headroom and to present a neat appearance.

### 3.3 EXPOSED BOX INSTALLATION

- A. Boxes shall be secured to the building structure with proper size screws, bolts, hanger rods, or structural steel elements.
- B. On brick, block and concrete walls or ceilings, exposed boxes shall be supported with no less than two (2) Ackerman-Johnson, Paine, Phillips, or approved equal screw anchors or expansion shields and round head machine screws. Cast boxes shall not be drilled.
- C. On steel structures, exposed boxes shall be supported to the steel member by drilling and tapping the member and fastening the boxes by means of round head machine screws.
- D. Boxes may be supported on steel members by APPROVED beam clamps if conduit is supported by beam clamps.
- E. Boxes shall be fastened to wood structures by means of a minimum of two (2) wood screws adequately large and long to properly support. (Quantity depends on size of box.)
- F. Wood, plastic, or fiber plugs shall not be used for fastenings.
- G. Explosive devices shall not be used unless specifically allowed.

**END OF SECTION**

## SECTION 26 05 53

### ELECTRICAL IDENTIFICATION

#### PART 1 - GENERAL

##### 1.1 SECTION INCLUDES

- A. Nameplates and Signs

##### 1.2 REFERENCES

- A. NFPA 70E - National Electrical Safety Code
- B. NFPA 70 - National Electrical Code (NEC)
- C. ANSI A13.1 - Standard for Pipe Identification
- D. ANSI Z535.4 - Standard for Product Safety Signs and Labels

#### PART 2 - PRODUCTS

##### 2.1 NAMEPLATES AND SIGNS

- A. Engraved, Plastic-Laminated Labels, Signs and Instruction Plates: Engraving stock melamine plastic laminate, 1/16-inch minimum thick for signs up to 20 square inches, or 8 inches in length; 1/8 inch thick for larger sizes. Labels shall be punched for mechanical fasteners.
- B. Text Sizes:
  - 1. The following information shall be used for text heights, fonts, and size, unless otherwise noted.
    - a. Text Height: 3/8 inch minimum
- C. Baked-Enamel Signs for interior Use: Preprinted aluminum signs, punched, or drilled for fasteners, with colors, legend, and size required for application. Mounting 1/4" grommets in corners.
- D. Exterior, Metal-Backed, Butyrate Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396 inch galvanized-steel backing: and with colors, legend, and size required for application. Mounting 1/4" grommets in corners.
- E. Safety Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145.
- F. Fasteners for Plastic-Laminated Signs; Self-tapping stainless steel screws or number 10/32 stainless steel machine screws with nuts and flat and lock washers.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as required by code.
- B. Install identification devices in accordance with manufacturer's written instruction and requirements of Electrical Code.
- C. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work. All mounting surfaces shall be cleaned and degreased prior to identification installation.
- D. Circuit Identification: Tag or label conductors as follows:
  - 1. Multiple Power or Lighting Circuits in Same Enclosure: Where multiple branch circuits are terminated or spliced in a box or enclosure, label each conductor with source and circuit number.
  - 2. Multiple Control Wiring and Communication/Signal Circuits in Same Enclosure: For control and communications/signal wiring, use wire/cable marking tape at terminations in wiring boxes, troughs, and control cabinets. Use consistent letter/number conductor designations throughout on wire/cable marking tape.
  - 3. Match identification markings with designations used in panelboards shop drawings, Contract Documents, and similar previously established identification schemes for the facility's electrical installations.
- E. Apply warning, caution and instruction signs as follows:
  - 1. Install warning, caution or instruction signs where required by Electrical Code, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.
- F. Apply circuit/control/item designation labels of engraved plastic laminate for pushbuttons, pilot lights, alarm/signal components, and similar items, except where labeling is specified elsewhere.
- G. Install labels parallel to equipment lines at locations as required and at locations for best convenience of viewing without interference with operation and maintenance of equipment.
- H. Underground Electrical Lines: For exterior underground power, control, signal, and communication lines, install continuous underground plastic line marker located directly above line at 6 (150mm) to 8 (205mm) inches below grade. A single plastic line marker is permitted when the width of the common trench does not exceed 16 inches; provide a second plastic line marker to mark each edge of the trench when 16 inches of width is exceeded. Install line marker for underground wiring, both direct-buried cables and cables in raceway.

### 3.2 CONDUIT AND EXPOSED CABLE LABELING

- A. Product:
  - 1. Adhesive labels and field markings
- B. Conduit Identification: Pre-printed, flexible, self-adhesive vinyl labels with legend at 20 foot (6 meter) intervals to identify all conduits run exposed or located above accessible ceilings. Conduits located above non-accessible ceiling or in floors and walls shall be labeled within 3 feet of becoming accessible, or separated by enclosures, walls, partitions, ceilings, and floors. Labels for multiple conduits shall be aligned. Refer to color requirements in Part 2 when applicable in addition to the following:
  - 1. 1000 Volt or less Normal/Emergency Power: Indicate feeder identification and voltage.
  - 2. Grounding: Indicate "GROUND" and equipment and designation.
- C. Blank conduit ends or outlet boxes for future extension of system shall have permanent identification marker indicating purpose of conduit or box and where the raceway originated.

### 3.3 CONDUCTOR COLOR CODING

- A. Products:
  - 1. All wire and cables shall be color coded by the manufacturer.
- B. Color coding shall be applied at all panels, switches, junction boxes, pull boxes, vaults, manholes etc., where the wires and cables are visible and terminations are made. The same color coding shall be used throughout the entire electrical system, therefore maintaining proper phasing throughout the entire project.
- C. Where more than one nominal voltage system exists in a building or facility, each ungrounded conductor of a multi-wire branch circuit, where accessible, shall be identified by phase and system.
- D. Conductors shall be color coded as follows:
  - 1. 208Y/120 Volt, 4-Wire:
    - a. A-Phase - Black
    - b. B-Phase - Red
    - c. C-Phase - Blue
    - d. Neutral - White
    - e. Ground Bond - Green
  - 2. 480Y/277 Volt, 4-Wire:
    - a. A-Phase - Brown
    - b. B-Phase - Orange
    - c. C-Phase - Yellow
    - d. Neutral - Gray
    - e. Ground Bond - Green

3. Grounding Conductors:
  - a. Equipment grounding conductors, main/system/supply-side bonding jumpers: Green.
  - b. Isolated Equipment Ground Conductors: Green with colored distinctive yellow stripe along the entire length of the conductor. Isolated ground for feeders, use colored tape with alternating bands of green and yellow to provide a minimum of three bands of green and two bands of yellow.
4. Cabling for Remote Control, Signal, and Power Limited Circuits:
  - a. Building Automation Systems and Control: Refer to the Temperature Control Contactor notes located on the mechanical cover sheet.

### 3.4 EQUIPMENT CONNECTION IDENTIFICATION

- A. Products:
  1. Nameplates and signs
- B. Provide identification for hard wired electrical connections to equipment such as disconnects switches, starters, etc. Plug and cord type connections do not require this specific label.
- C. Identification shall be provided for all connections to equipment furnished by this Contractor, other contractors, or the Owner. The following list of equipment is specifically being listed to receive an equipment connection label; this list does not limit the equipment that shall receive a label:
  1. Mechanical heating, ventilation, and air conditioning equipment; chillers, boilers, pumps, air handling ventilation units, condensing units, unit heaters, and similar equipment
  2. Plumbing equipment
- D. Labeling shall include:
  1. Equipment type and contract documents designation of equipment being served
  2. Location of equipment being served if it is not located within sight.
  3. Voltage and rating of the equipment.
  4. Panel and circuit numbers(s) serving the equipment
  5. Available fault current
  6. Date of fault current study
  7. Sample Label:

UNIT HEATER UH-1 ("LOCATED IN STORAGE ROOM 200")  
480V: 3-PHASE  
FED FROM "1HA1-1"  
22,000 AMPS AVAILABLE FAULT CURRENT  
DATE OF STUDY: 1 JAN 2017

**END OF SECTION**

**Exhibit G Equipment Controls Scope of Work**

DOC ICIW Unit 9 Chiller Replacement  
Iowa Correctional Institution for Women  
Request for Quote RFQ930200-01

**Due Wednesday, 5/31/2023 at 2:00 PM(CT)**