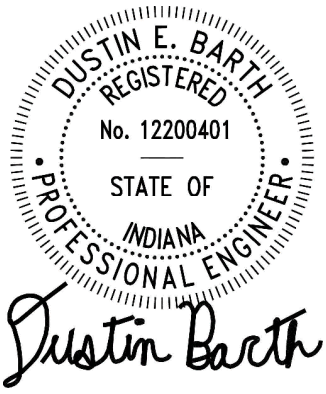
ADDENDUM NO. ONE

JOB NAME: **Rosa Parks Boiler & Chiller Replacement**

PROJECT NUMBER: **23-800-359-1**

DATE OF ADDENDUM: **04/18/2024**



Dustin Barth, P.E.
Indiana Registration No. 12200401

THIS ADDENDUM FORMS A PART OF THE CONTRACT DOCUMENTS AND IS ISSUED IN ACCORDANCE WITH THE INSTRUCTIONS TO BIDDERS. ACKNOWLEGE RECEIPT OF THIS ADDENDUM BY SIGNING THE ADDENDUM ACKNOWLEDGEMENT SECTION OF YOUR PROPOSAL.

GENERAL:

1. Added Pre-Bid Meeting Attendance Sheet.

RFI's:

1. Is Victualic acceptable on the piping for hot and chilled water piping?
    a. This is acceptable.

SPECIFICATION'S:

1. Added 26 29 23 – Variable Frequency Motor Specification.

END OF ADDENDUM 1

RQAW
ARCHITECTURE

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Meeting Attendance:

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SECTION 262923
VARIABLE FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 DEFINITIONS

A. BMS: Building management system.

B. IGBT: Integrated gate bipolar transistor.

C. LAN: Local area network.

D. PID: Control action, proportional plus integral plus derivative.

E. PWM: Pulse-width modulated.

F. VFC: Variable frequency controller.

1.4 SUBMITTALS

A. Product Data: For each type of VFC. Include dimensions, mounting arrangements, location for conduit entries, shipping and operating weights, and manufacturer's technical data on features, performance, electrical ratings, characteristics, and finishes.

1. Include verification of sizing requirement defined in this Section.
2. Include verification of communication requirement with building management system provided within this building as defined in this Section.

B. Shop Drawings: For each VFC.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Each installed unit's type and details.
b. Nameplate legends.
c. Fully rated, short-circuit current rating of integrated unit.

2. Wiring diagrams: Power, signal, and control wiring for VFC's. Provide schematic wiring diagram for each type of VFC.

C. Manufacturer Seismic Qualification Certification: Submit certification that VFC's, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned outline drawings of equipment unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For VFC's, all installed devices, and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:

1. Routine maintenance requirements for VFC's and all installed components.
2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

F. Compliance to IEEE 519 – Harmonic analysis for particular jobsite including total harmonic voltage distortion and total harmonic current distortion (TDD).

1. The VFC manufacturer shall provide calculations, specific to this installation, showing total harmonic voltage distortion is less than 8 percent at the point of common coupling. Input line filters shall be sized and provided as required by the VFC manufacturer to ensure compliance with IEEE Standard 519 latest version.

G. Warranty: Special warranty as specified in this Section.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles (160 km) of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.

B. Source Limitations: Obtain VFC's of a single type through one source from a single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with NFPA 70.

E. VFC's associated with the stairwell pressurization system and the smoke purge/removal system shall be listed and labeled according to UL864 and UUKL.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver VFC's in shipping splits of lengths that can be moved past obstructions in delivery path as indicated.

B. Store VFC's indoors in clean, dry space with uniform temperature to prevent condensation. Protect VFC's from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation, capable of driving full load without derating, under the following conditions, unless otherwise indicated:

1. Ambient temperature: 0 to 40 deg C.
2. Humidity: Less than 90 percent (non-condensing).
3. Altitude: Not exceeding 3300 feet (1005 m).

1.8 COORDINATION

A. Coordinate layout and installation of VFC's with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate features of VFC's, installed units, and accessory devices with pilot devices and control circuits to which they connect.

C. Coordinate features, accessories, and functions of each VFC and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of controllers and associated components that fail in materials or workmanship within specified warranty period.

1. Warranty period: Two (2) years from date of project Substantial Completion.

1.10 COMMISSIONING

A. Commissioning of components, equipment and/or system specified in this division is part of the construction process. Project closeout is dependent on successful completion of all commissioning procedures, documentation and issue closure. See Section 01 91 13 for detailed commissioning requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. ABB Power Distribution, Inc.; ABB Control, Inc. Subsidiary.
2. Danfoss Electronic Devices, Inc.
3. Siemens
4. Trane

2.2 VARIABLE FREQUENCY CONTROLLERS

A. Description: NEMA ICS 2, IGBT, PWM, VFC; UL listed and labeled as a complete unit and arranged to provide variable speed of an NEMA MG 1, Design B, 3-phase induction motor by adjusting output voltage and frequency.

B. Design and Rating: Match load type such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

C. Output Rating: 3-phase; 6 to 60 Hz, with voltage proportional to frequency throughout voltage range.

D. Unit Operating Requirements:

1. Input ac voltage tolerance of plus or minus 10 percent.
2. Input frequency tolerance of 50/60 Hz, plus or minus 5 percent.
3. Minimum efficiency: 96 percent at 60 Hz, full load.
4. Minimum displacement primary side power factor: 96 percent.
5. Overload capability: 1.1 times the base load current for 60 seconds; 1.3 times the base load current for 3 seconds.
6. Starting torque: 100 percent of rated torque or as indicated.
7. Speed regulation: Plus or minus 1 percent.
8. Isolated control interface to allow controller to follow control signal over a 10:1 speed range.
9. Power loss ride through of 2 seconds.

10. The drive shall include password protection against parameter changes.

E. Isolated control interface to allow controller to follow control signal over an 11:1 speed range.

1. Electrical signal: 4 to 20 mA at 24 V.

F. Internal Adjustability Capabilities:

1. Minimum speed: 5 to 25 percent of maximum rpm.
2. Maximum speed: 80 to 100 percent of maximum rpm.
3. Acceleration: 0.1 to a minimum of 999 seconds.
4. Deceleration: 0.1 to a minimum of 999 seconds.
5. Current limit: 50 to a minimum of 110 percent of maximum rating.

G. Self-Protection and Reliability Features:

1. Input transient protection by means of surge suppressors. Surge suppression shall consist of 4-120 Joule rated MOV (phase to phase and phase to ground) and capacitor clamping. Include snubber network to protect against malfunction.
2. Under- and overvoltage trips; inverter over-temperature, overload, and overcurrent trips.
3. Motor overload relay: Solid state, adjustable and capable of NEMA ICS 2, Class 20 performance.
4. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination. Include minimum of three (3) settings.
5. Instantaneous line-to-line and line-to-ground overcurrent trips.
6. Loss-of-phase protection.
7. Reverse-phase protection.
8. Short-circuit protection.
9. Motor over-temperature fault.
10. Drive over-temperature/overload.
11. Ground fault.
12. CPU error.

H. Automatic Reset/Restart: Attempts three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Bidirectional auto-speed search shall be capable of starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.

I. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.

J. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.

K. Input Line Conditioning: 5 percent line reactor to reduce the harmonics to the power line and to add protection from AC line transient.

L. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual speed control potentiometer.

M. LCD display with key pad (HMI): Back lit LCD display; time clock with battery backup, selector switch, mounted flush in controller door and connected to indicate and control of the following controller parameters:

1. Output frequency (Hz).
2. Motor speed (rpm).
3. Motor status (running, stop, fault).
4. Motor current (amperes).
5. Motor torque (percent).
6. Fault or alarming status (code).
7. PID feedback signal (percent).
8. DC-link voltage (VDC).
9. Set-point frequency (Hz).
10. Motor output voltage (V).
11. Power on, operating condition.
12. Run or operating hours.
13. Control location (local/remote/hand/auto).
14. Real-time clock with current time and date.
15. Running log of total power versus time.
16. Total run time.
17. Fault log, maintaining last four faults with time and date stamp for each.

N. Control Signal Interface:

1. Electric input signal interface: A minimum of 2 analog inputs (0 to 10 V or 0/4-20 mA) and 6 programmable digital inputs.
2. Remote signal inputs: Capability to accept any of the following speed-setting input signals from the BMS or other control systems:

a. 0 to 10-V dc.
b. 0-20 or 4-20 mA.
c. Digital programmable input – minimum of 6.
d. Fixed frequencies using digital inputs.
e. RS485.
f. Keypad display for local hand operation.
g. Analog programmable input – minimum of 2.

3. Output signal interface:

a. A minimum of 1 analog output signal (4-20 mA), which can be programmed to any of the following:

1) Output frequency (Hz).
2) Output current (load).
3) DC-link voltage (VDC).
4) Motor torque (percent).
5) Motor speed (rpm).

6) Set-point frequency (Hz).

4. Remote indication interface: A minimum of 2 dry circuit relay outputs (120-V ac, 1 A) for remote indication of the following:

   a. Motor running.
   b. Set-point speed reached.
   c. Fault and warning indication (over-temperature or overcurrent).
   d. PID high- or low-speed limits reached.

O. Communications:

1. Communication compatibility: Refer to Division 23 Section "Environmental Control System" for communication requirements. Coordinate communication protocol with provided manufacturer.
2. Each variable frequency controller shall be supplied with an integral solid state card compatible with RS-485 and echelon protocol to transmit all operating, alarm and maintenance data in BACnet or Lon language to BAS LAN to allow monitoring at the master OWS. (Points to be mapped into BAS OWS to be selected by A/E and Owner).
3. Serial communication capabilities shall include, but not be limited to, run-stop control, speed set adjustment, proportional/integral/derivative PID control adjustments, current limit, accel/decal time adjustments, and lock and unlock the keypad. All diagnostic warning and fault information shall be transmitted over the serial communications bus.
4. The VFC shall allow the DDC to control the drive's digital and analog outputs via the serial interface. This control shall be independent of any VFC function. The VFC's digital and analog inputs shall be capable of being monitored by the DDC system.

P. EMI/RFI Filters:

1. All VFC's shall include EMI/RFI filters. The onboard filters shall allow the VFC assemble to be CE marked and the VFC shall meet product standard EN 61800-3 for the First Environment restricted level.
2. Output filter: VFDs with 10 HP or larger size and more than 90 ft. distance to the motor shall be provided with an integral factory mounted and wired LC filter network (Dv/Dt filter) designed to limit the output voltage to values outlined in NEMA MG1, Part 30. The output filters shall be designed to fallow for a maximum wire run of 500 ft. between the VFD and motor. Externally mounted filters in a separate enclosure is not acceptable.

Q. Bypass: Arrange magnetic contactor to safely transfer motor between controller output and bypass controller circuit when motor is at zero speed. Unit shall be capable of stable operation (starting, stopping, and running), with motor completely disconnected from controller, and allowing the controller to be completely disconnected from the power. Three-contactor bypass scheme. The bypass scheme shall totally isolate the controller.

1. The drive/bypass shall include the following:

   a. Bypass hand-off-auto, drive mode selector, bypass mode selector and bypass fault reset.
   b. Indicator (LED) for power-on, bypass mode selector, bypass fault, safety open and automatic transfer to bypass.

c. Form C relay output(s) for system started, system running bypass, override enabled and bypass fault.
d. Bypass controller: Bypass controller shall be either a full voltage, non-reversing controller, a solid state reduced voltage controller or a second variable frequency controller. Provide per schedule on the drawings. Refer to Division 26 Section "Enclosed Controllers" for requirements where applicable.

R. Integral Disconnecting Means: NEMA AB 1, molded-case circuit breaker with lockable handle satisfying the requirement for lock-out/tag-out procedures.

S. The VFC shall include a "run permissive circuit" that will provide a normally open contact whenever a run command is provided (local or remote start command in VFC or bypass mode). When the VFC system safety interlock (fire detector, freezestat, high static pressure switch, etc.) opens, the motor shall coast to a stop and the run permissive contact shall open, closing the damper or valve. Internal switch to select manual or automatic bypass. An adjustable current sensing circuit for the bypass to provide loss of load indication (broken belt) when in the bypass mode.

T. Drive short circuit withstand rating shall be minimum of 65 KAIC unless noted otherwise.

2.3 ENCLOSURES

A. Surface mounted cabinets rated for the environmental conditions at the installed locations.

1. Dry and clean locations: NEMA 250, Type 1 with drip proof plate.

2.4 ACCESSORIES

A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.

B. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.

2.5 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and tested VFC's before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, surfaces, and substrates to receive VFC's for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Select features of each VFC to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; and duty cycle of motor, controller, and load.

B. Select horsepower rating of controllers to suit motor controlled.

3.3 INSTALLATION

A. Anchor each VFC assembly to steel-channel sills arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and grout sills flush with mounting surface.

3.4 IDENTIFICATION

A. Identify VFC's, components, and control wiring according to Division 26 Section "Electrical Identification of Electrical System." Shall include the following information:

1. Designation.
2. Equipment served.
3. Fed from, circuit number.
4. Voltage, phase, wire.
5. Feeder size.

B. Arc Flash Labels: Comply with Division 26 Section "Electrical System Fault Analysis, Coordination and Arc Flash Study" for arc flash labeling requirements.

3.5 CONTROL WIRING INSTALLATION

A. Install wiring between VFC's and remote devices according to Division 26 Section "Low Voltage Electrical Power Conductors and Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect hand-off-automatic switch and other control devices where applicable.

1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.
2. Connect selector switches with control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.
3. Provide control wiring between variable frequency controller and remote safety switch (disconnect). VFC control circuit shall be routed in series with disconnect auxiliary

contact. Contact shall open prior to disconnect opening to safely stop VFC operation. All control wiring shall be routed in conduit, separate from power wiring.

3.6 CONNECTIONS

A. Conduit installation requirements are specified in other Division 26 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.

B. Ground equipment according to Division 26 "Grounding and Bonding for Electrical Systems" and per manufacturers' recommendations.

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.7 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each enclosed controller element, bus, components, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:

1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
2. Assist in field testing of equipment including pretesting and adjusting of solid-state controllers.
3. Report results in writing.

C. Perform the following field tests and inspections and prepare test reports:

1. Perform each electrical test and visual and mechanical inspection, as follows. Certify compliance with test parameters.

    a. Compare equipment nameplate data with drawings and specifications.
    b. Inspect physical and mechanical condition.
    c. Inspect anchorage, alignment, and grounding.
    d. Verify the unit is clean.
    e. Ensure vent path openings are free from debris and that heat transfer surfaces are clean.
    f. Verify correct connections of circuit boards, wiring, disconnects and ribbon cables.
    g. Motor running protection:

        1) Verify drive overcurrent setpoints are correct for their application.

2) If drive is used to operate multiple motors, verify individual overload element ratings are correct for their application.
3) Apply minimum and maximum speed setpoints. Verify setpoints are within limitations of the load coupled to the motor

h. Inspect bolted electrical connections for high resistance using calibrated torque wrench method.
i. Test for the following parameters as recommended by the manufacturer:

1) Input phase loss protection.
2) Input overvoltage protection.
3) Output phase rotation.
4) Over-temperature protection.
5) DC overvoltage protection.
6) Over-frequency protection.
7) Drive overload protection.
8) Fault alarm outputs.

j. Perform startup of drive in accordance with manufacturer's published data. Calibrate drive to the system's minimum and maximum speed control signals.
k. Perform operational tests by initiating control devices:

1) Slowly vary drive speed between minimum and maximum. Observe motor and load for unusual noise or vibration.
2) Verify operation of drive from remote start/stop and speed control signals.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

D. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

3.8 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.9 CLEANING

A. Clean VFC's internally, on completion of installation, according to manufacturer's written instructions. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

3.10 WARRANTY

A. Warranty shall be 24 months from the date of project Substantial Completion. The warranty shall include all parts, labor, travel time, and expenses.

3.11 STARTUP/DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain variable frequency controllers. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION 26 29 23