

SECTION 23 82 19.01

FAN WALL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, apply to this and other Sections of Division 23.

1.2 SUMMARY

- A. Provide an overall price (“base bid”) for the complete equipment package specified; complete with all accessories and services specified.
- B. This Section includes Specification for Fan Wall (FW) Units and their accessories intended specifically for computer-room applications, in the following arrangements:
 - 1. Floor-mounted, front discharge, rear return chilled water units for Data Hall and Network rooms. Units shall operate in a blow thru configuration.
- C. Equipment Supplier shall be responsible for the following in a coordinated and phased deployment with remobilization as required to support the project:
 - 1. Factory testing: All costs related to travel and lodging for owner, engineer, contractor, and commissioning agent (total four representatives) shall be borne by the individual traveler.
 - 2. Startup and Commissioning: Manufacturer shall provide services associated with start-up of the equipment, installation supervision and technical personnel on site for construction meetings, testing and commissioning. Manufacturer shall support the Commissioning Agent including all commissioning efforts, paperwork and Acceptance/Integrated Systems Testing. Manufacturer will be on-site to support the project as required.
 - 3. Documentation: Full documentation, including interconnect and point-to-point wiring diagrams, nameplate schedule, Operation and Maintenance Manuals.
 - 4. Storage: Equipment shall be stored in spaces with a controlled environment that meets the manufacturer's ambient temperature and humidity tolerances for non-operating equipment.
 - 5. Delivery: Equipment shall be in fully enclosed vehicles after specified environmental conditions have been permanently established in spaces where equipment is to be placed. Units can be shipped on open vehicle if, and only if, manufacturer provides weather and transportation protection of the units and assists with job-site inspection. Delivery of left hand/ right hand units shall be coordinated with install schedule, i.e.. A batch of all right hand units is not acceptable.
 - 6. FOB Delivery: Delivery of the equipment FOB to the Construction Manager's designated location for unloading and installation by the Installing Contractor by air ride truck, including necessary insurance coverage.

7. Tracking: Responsible for tracking all shipments and is expected to provide the Owner and Installing Contractor with a weekly shipping status, at a minimum
 8. Training: Owner/operator training for each system. Provide pricing for eight (8) hours of training with hourly rates for training beyond eight (8) hours.
 9. Damage Repair: At their expense, repair and/or replace all damage due to improper preparation, damage or crating while in transport. If repairs are needed, the entire panel shall be replaced. Touchup painting of exterior panel is allowed only at the Owner's discretion.
- D. Release to manufacture any equipment included in this Specification shall be contingent upon the receipt and approval of submittals and shop drawings as outlined in this Specification.
- E. Installing Contractor shall be responsible for the following:
1. Assuming complete responsibility for equipment upon delivery, perform a level 2 site acceptance check and execute documentation as to the equipment's adherence to the PO, bid package, etc. Where deficiencies exist, the list is to be created and agreed upon as a team. The General Contractor is to own that deficiency list with the OFCI equipment vendor.
 2. Unloading, rigging, and setting in place. If any additional costs for handling, storage, or rigging are incurred due to manufacturer not meeting scheduled dates, or units are shipped prior to contractor being ready to accept them, the manufacturer is responsible for these costs.
 3. Providing support during startup and commissioning of equipment.
 4. Storing all spare parts in a secure space for Owner turnover at the end of the project. Storage location shall be climate-controlled in accordance with manufacturer's requirements.

1.3 DEFINITIONS

- A. Equipment Supplier: The manufacturer of the equipment specified herein, or the manufacturer's agent or representative who shall take responsibility for the preparation of bids, submittals, and delivery of the specified equipment and services to the Owner
- B. Installing Contractor: The person, firm, integrator or other entity contracted by the Owner or Owner's agent to take delivery of the specified equipment, install, and make operational and ready for service
- C. Manufacturer: The Manufacturer, or Manufacturer's representative, of the specific equipment being described
- D. Contractor: The Construction General Contractor or Construction Manager
- E. Engineer: kW Mission Critical Engineering (KWMCE)
- F. Drawings: KWMCE documents for this project
- G. Purchaser: Owner or their purchasing agent (Serverfarm)

- H. FW: Fan Wall unit with rear return and front discharge
- I. Owner: Serverfarm
- J. OFCI: Owner furnished, Contractor Installed
- K. Commission Agent: Independent Testing Party
- L. ASHRAE: American Society of Heating Refrigeration and Air Conditioning Engineers.
- M. BMS: Building Management System—Building heating ventilating and air conditioning system utilizing direct digital control (DDC) hardware and software. The system communicates using one or more digital communication networks.
- N. Hand: The hand shall be defined as standing in front of the unit with the supply airflow hitting you in the back of the head. Connections on FW units to be indicated as left hand or right hand on the equipment schedules. This shall also include condensate piping connections.

1.4 BID DOCUMENTATION REQUIREMENTS

- A. Compliance Review: In addition to the submittal requirements of this section, preorder bidders shall provide a Compliance Review of the Specifications and Addenda. The Compliance Review shall be a paragraph-by-paragraph review of the Specifications with the following information, “C”, “D,” or “E” marked in the margin of the original Specifications and any subsequent Addenda.
 - 1. “C”: Comply with no exceptions.
 - 2. “D”: Comply with deviations. For each and every deviation, provide a numbered footnote with reasons for the proposed deviation and how the intent of the Specification can be satisfied.
 - 3. “E”: Exception, do not comply. For each and every exception, provide a numbered footnote with reasons and possible alternatives.
 - 4. Unless a deviation or exception is specifically noted in the Compliance Review, it is assumed that the Bidder is in complete compliance with the plans and Specifications. Deviations or exceptions taken in cover letters, subsidiary documents, by omission or by contradiction do not release the Bidder from being in complete compliance, unless the exception or deviation has been specifically noted in the Compliance Review submitted with the Bid.
- B. Provide proposed equipment schedule with time durations for product data submittal creation, fabrication, initial delivery to site, follow up deliveries, completion of final delivery, and close out documentation creation (record product data, installation, operation, maintenance, spare parts list, warranty, etc.).

1.5 PROJECT CONDITIONS AND PERFORMANCE REQUIREMENTS

- A. Seismic Restraint Loading Design Criteria: The equipment and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7 and the Structural Engineer’s Design Criteria (listed below for reference):

Parameter	Clarksville, AR
Ambient Temperature Maximum/Minimum	110°F/-2.2°F DB, 84.3°F/-3.0°FWB
Elevation Above Sea Level	500 feet
Relative Humidity	0 to 95%
Seismic Risk Category	II
Seismic Importance Factor	1.00
Seismic Spectral Response Coeff, Sds	0.45
Seismic Spectral Response Coeff, Sd1	0.28
Seismic Design Category	D

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70-2017, by a qualified testing agency, and marked for intended location and application.
- C. ASHRAE Compliance:
 - 1. Applicable requirements in ASHRAE/IES 90.1-2016.

1.6 SUBMITTAL DOCUMENTATION REQUIREMENTS

- A. Equipment Submittal Documentation Requirements:
 - 1. The equipment product data, performance data, shop drawings, installation, operation, maintenance, service, testing and training, and record as-built documentation referred to within shall be submitted to the Owner and Engineer in a searchable .PDF format electronically.
 - 2. Submittals shall be presented in a logical and clear format, contain a cover page and table of content, marked and/or highlighted to identify project specific data. Unedited, general data sheets will not be accepted.
 - 3. The Drawings referenced within shall be submitted in REVIT and AutoCAD format electronically.
- B. Product Data: Include rated capacities, operating characteristics, electrical characteristics, color chart, and furnished specialties and accessories.
- C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components and location and size of each field connection.
 - 1. Wiring Diagrams: Detail wiring for power, signal and control systems and differentiate between Manufacturer installed and field installed wiring.
 - 2. Equipment Support Details: Detail fabrication including anchorages and attachments to structure or floor stands and to supported ductwork or equipment. Document internal fan vibration isolation including vibration isolators, flexible connections, auxiliary motor slides, or rails where applicable.

Provide Manufacturer's product literature for applied equipment like variable frequency drives and auto transfer switches.

3. Document access requirements around other work, including working clearances to mechanical controls and electrical equipment.

D. Coordination Drawings

1. Drawings on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - a. Structural Supports.
 - b. Piping roughing-in requirements.
 - c. Conduit and wiring roughing-in requirements for controls and electrical power, including spaces reserved for controls and electrical equipment.
 - d. Access requirements, including working clearances for controls and electrical equipment, and service clearances. Mark and label clearances.
2. Contractor to provide coordination drawings showing plan, section, and elevation view, drawn to scale. Each view shall include the following:
 - a. Column grids, beams, and columns.
 - b. Room layout with walls, floors, and roofs, including each room name and number.

E. Warranty Information

1. Provide a generic copy of the manufacturer's warranty certificate as part of the initial submittal. Provide the actual warranty certificate as part of the project closeout phase.
2. The Equipment Supplier shall warrant that the equipment supplied is a proven design and can meet the requirements specified. Workmanship shall be of the best quality, free from any defects that might render the equipment unsuitable or inefficient for the purpose for which it is to be used. In the event of problems or malfunctions, the Equipment Supplier shall have qualified technicians capable of affecting all necessary repairs and restoring the system to full operation within eight hours of notification. There shall be no cost to the Owner for corrective repairs or firmware upgrades during the first twelve (12) months following successful substantial completion. Owner and Engineer shall be made aware prior to any firmware flashes after equipment has left the factory.
3. If at any time during the first twelve (12) months following substantial completion, the Owner shall accumulate sufficient evidence to reasonably indicate that the equipment or any part thereof, is not in accordance with the Specifications, the Owner shall so notify the Equipment Supplier in writing, and the Equipment Supplier shall repair or replace the defective components. The cost of removal, reinstallation and complete re-testing of the equipment, and any associated freight charges or service engineering charges, shall be at the Equipment Supplier's expense. The warranty for the repaired or replaced equipment shall be extended for twelve (12) months from the completion of repairs or replacement.
4. If the equipment fails to meet the specific performance guarantees, the Equipment Supplier shall recommend to the Owner adjustments or modification. Upon approval by the Owner, the adjustments or modifications shall be made, and tests shall be rerun. The cost of these adjustments or

modifications and complete re-testing shall be made at the Equipment Supplier's expense. After such adjustments or modifications, should the equipment fail to achieve the guaranteed performance, an equitable settlement shall be made which may, without limitation, include an adjustment of the contract price.

5. Complete re-testing, as referred to in this Section, shall mean site acceptance testing as stipulated in testing portions of this Specification. The conditions, which apply to original testing requirements, shall also apply to the re-testing of any equipment performed under the conditions of this warranty.
6. Commercial operation is defined as commencing on the date on which the equipment covered by these Specifications has successfully completed final site integrated acceptance testing.

1.7 INITIAL SUBMITTAL DATA

- A. The documents detailed in this section shall be submitted with the manufacturer's proposal, at the time of bid submission.
- B. Product Data / Technical Data Sheets: Include rated capacities, electrical load data, physical dimensional data, weights (shipping, installed, and operating), component specifications, sound data, power and control wiring diagrams, furnished specialties, and accessories.
- C. Performance Data Sheet: Provide manufacturers standard performance data sheet showing the performance data for the scheduled conditions.
 1. Performance Data Sheet – Provide manufacturers standard performance data sheet showing performance at the scheduled conditions, along with operating weight, electrical characteristics, etc.
- D. Shop Drawings: Provide project specific dimensional drawings, including required service clearances.
- E. Installation Procedures: Provide step by step descriptions and details for the field installation of the equipment. Include fabrication details for anchorage and attachment to the structure and to support the equipment.
- F. Lead times to manufacture equipment and to deliver equipment to project site.

1.8 CLOSE OUT SUBMITTAL DATA

- A. The close out documentation shall include submittals, shop drawings, installation procedures, operations & maintenance (O&M) manuals as follows.
 1. Close out documentation submissions:
 - a. Initial Submittal: Provide searchable Adobe Acrobat (pdf) format submittal for the Owner and Engineer to review electronically. If desired by the Owner, provide one (1) hard copy for the Owner to review.
 - b. Final Submittal: Upon approval of the initial submittal, provide electronic file to the Owner and Engineer, and provide one (1) hard copy to the Owner.

2. Electronic submittals shall also be provided in portable document format (PDF). Submit a combined PDF document that is word-searchable (not scanned) which shall include bookmarks that match the table of contents of the hard copy submittal. Alternatively, if multiple PDF files are submitted, file names shall match table of contents. Submittals consisting of multiple PDF files with non-descript file names may be disqualified from bid and/or rejected.
 3. Hard copy submittals shall be in bound tabular format, with dividers and tabs clearly indicating relevant sections of the submittal.
 4. Shop drawings shall be submitted in either AutoCAD or REVIT format electronically.
- B. Submit Operations and Maintenance (O&M) Manuals for system and components as specified in the Division 1 specifications:
1. 01 77 00 Closeout Procedures
 2. 01 78 23 Operation and Maintenance Data
- C. Additionally, refer to the Division 1 specification for Commissioning, Warranty, and Record Document requirements:
- D. In addition to requirements included in the Sections referenced above, include the following:
1. Contact information for service work.
 2. List of special tools recommended to be stored at the site for ready access.
 3. Detailed operating instructions.
 4. Copy of approved submittal and shop drawing.
 5. Document indicating the recommended service intervals.
 6. Field Test and Observation Reports: Indicate and interpret test results for compliance with performance requirements.
 7. Complete list of user access credentials, including usernames and passwords for each level of access to which the Owner is entitled.
 8. Where applicable, complete list of relays, meters, etc. with configurations both in native format and tabular format.
- 1.9 SUBMITTALS FOR RELEASE TO MANUFACTURER
- A. In the event there are corrections to be made to the Bid Submittals prior to equipment being manufactured, the Engineer may request the Bid Submittals be resubmitted with corrections included prior to authorizing the manufacture of equipment.
- B. Manufacture lead time shall start upon receipt of either "No Exceptions Taken" or "Make Corrections Noted" submittal response provided by Engineer. If submittal response is "Make Corrections Noted," provide final record copy with the submittal updated to incorporate the review comments.
- C. Submit shop drawings for review and approval as outlined below, prior to proceeding with any fabrication or assembly of equipment.

- D. All drawings and data shall be identified with the Project Name and Specification reference. Drawings shall contain revision boxes to describe all revisions in detail. Indication of items changed in the latest revision shall be made by means such as a triangle enclosed number. Drawings to be submitted in Revit format. The following items shall be included at a minimum:
1. All connection points, rigging points and accoutrements explicitly included (control panel, maintenance clearances, etc.).
 2. Qualification Data: For testing agency and personnel performing the specified tests.
 3. Factory test procedures for approval.
 4. Site acceptance test procedures for approval.
 5. Bill of material for each drawing showing all components, ratings, and catalog numbers.
 6. Warranties.
 7. Recommended preventive maintenance procedures (outline form).
 8. List of all recommended protection settings.
 9. List of all software information and alarm/monitoring points available to interface with BMS/EPMS system in the future.
 10. Recommended alarm set points.

1.10 QUALITY ASSURANCE

- A. Source Limitations: Manufacturer shall be responsible for all components specified herein. Provide a product built from components that have proven reliable and compatible with each other and are coordinated to operate as a unit as evidenced by a minimum of three years of successful operation at end-user sites and successful completion of specified testing.
- B. 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.

1.11 DELIVERY, STORAGE AND HANDLING

- A. The Equipment Supplier shall perform the following to prepare the equipment for shipping from factory to factory, factory to site, and for final assembly at the site:
1. All equipment shall be adequately packed to prevent damage from handling, weather, shock, vibration and corrosion during shipment on a dedicated air ride truck by common carrier. The Equipment Supplier shall be responsible for compliance with local trucking requirements at the Project location and in any states transited.
 2. All metering and equipment shall be protected to ensure cleanliness during shipment, storage and erection.
 3. Each item of equipment shall be clearly marked. All boxes, crates and shipments shall be numbered and identified with the Owner's purchase order number, Owner's name and delivery location, Equipment Supplier's name and address and contents.

4. All equipment shall have provisions for lifting and/or skidding. All lifting points shall be clearly marked.
5. Each shipping unit shall be braced adequately and rigidly, both internally and externally, to prevent damage during transit or in the process of erection.
6. When assemblies are supplied that require disassembly for installation or are shipped disassembled, each piece of the subassembly so affected shall be uniquely identified as to its assembly position. All loose peripheral equipment shall be boxed, crated or otherwise completely enclosed and protected during storage, handling and shipment.
7. Equipment Supplier shall be responsible for the repair, at their expense, of all damage due to improper preparation, crating or damage while in transport. Touch up painting of exterior panels is not allowed. If painting repairs are needed, the entire panel shall be replaced or refinished.
8. Equipment supplier is responsible for tracking all shipments and is expected to inform the Owner, Contractor and Installing Contractor weekly shipping status at a minimum.
9. Installing Contractor shall upon delivery of shipped items, immediately take inventory of all items and confirm completeness of the shipment.
10. Installing Contractor shall store all spare parts in a secure space for Owner turnover at the end of the project. Storage location shall be climate controlled in accordance with manufacturer's requirements.
11. Equipment supplier shall be fully responsible to cover added cost of unit handling, storage, rigging, etc. that is incurred due to the equipment supplier not meeting agreed upon delivery dates. This includes shipping equipment to the job site earlier without write approval from the receiving contractor or equipment arriving onsite past the required delivery date.
12. All pipe connections shall be sealed and protected from debris prior to delivery to the Installing Contractor.
13. Fan Walls shall be shipped with the control wiring factory installed.
14. Fan Walls shall be shipped with firmly attached labels that indicate name of manufacturer, model number, and serial number.

1.12 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranty: A written warranty, executed by the manufacturer and signed by the Contractor, agreeing to replace components that fail in materials or workmanship within the specified warranty period. Fan Wall manufacturer shall provide parts and labor, as required.
 1. Warranty Coverage: Entire Fan Wall Including variable frequency drive, control hardware and motor.
 2. Manufacturer's standard, but not less than one year after date of project substantial completion by the Owner. If the manufacture's standard warranty is

one year from startup or 18 months from shipment, whichever comes first, then the manufacturer must provide extended warranty to cover the time to one year from project substantial completion.

1.13 COMMISSIONING

- A. Commissioning of an equipment or systems specified in this section is part of the construction process. Documentation and testing of these systems, as well as training of the Owner's operation and maintenance personnel, is required in cooperation with the Owner's Construction Manager and the Commissioning Authority.

1.14 FACTORY WITNESS TESTING

- A. Scope: A single machine for the project shall be tested.
- B. Scheduling: Submit a schedule to the Owner, Engineer and Commissioning Agent within 4 weeks of the schedule testing for review and comment by the owner and engineer of record. Submit any safety requirements for attendees in advance (i.e. safety glasses, clothing, shoes). The Owner shall determine the parties who shall be in attendance for the factory witness test.
- C. Travel Expenses: All costs related to travel and lodging for owner, engineer, contractor, and commissioning agent (total four representatives) shall be borne by the individual traveler.
- D. Sensor calibration: Documentation to be present during the testing verifying calibration of the sensors (temperature, pressure, flow, etc.)
- E. A recommended factory test procedure shall be provided by the Equipment Supplier and approved by the Owner's designated representative and Engineer.
 - 1. Testing shall include at a minimum;
 - a. Full load capacity based on scheduled/unit selection data
 - b. Power failure test to document expected restart time and valve operation
 - c. Unit power draw shall be documented with fans running at 100% fan speed.
- F. The manufacturer shall be responsible for providing two separate power sources, full capacity load bank and all meters required to demonstrate the equipment meets the specification requirements.
 - 1. Electrical power quality testing shall demonstrate compliance with this specification and shall including values for kW, KVA, kVAR, THDi, and THDv at load intervals of 0%, 25%, 50%, 75%, and 100% as a minimum.

PART 2 - PRODUCTS

2.1 HORIZONTAL DISCHARGE FAN WALL UNITS

- A. Manufacturers:

1. Stulz-ATS
2. Vertiv
3. Trane
4. Air20

2.2 FAN WALL UNITS

A. General:

1. The units shall be factory assembled, pre-insulated and pre-piped.

B. See equipment schedule for unit size and performance details.

C. Configuration: Fan wall shall be constructed in a blow thru arrangement. The unit shall be constructed with adequate access to all internal components such as valve, coils, dampers, etc. The major sections of the unit shall be:

1. Filters section
2. Fan section
3. Coil section
4. Supply grille
5. Controls

D. Cabinet and Frame: Steel construction. Frame will be fully welded construction with cabinet construction of sufficient quality to mitigate ambient acoustics and mitigate casing deflection.

1. Doors and Access Panels: Galvanized steel with polyurethane gaskets, hinges, and concealed fastening devices. Provide one key per FW unit to lock and unlock the cabinet panel doors when applicable.
2. User interface panel shall be installed on the cabinet door no higher than 5'-6" from finished floor in area of installation.
3. Insulation: Thermally and acoustically insulate cabinet interior with a minimum of R-13. All insulation shall be coded to prevent degradation.
4. Finish of Interior Surfaces: Surfaces in contact with the air stream shall comply with requirements in ASHRAE 62.1-2016.
5. Finish of Exterior Surfaces: With color as selected from Manufacturer's standard colors, provide one of the following:
 - a. Baked-on, textured vinyl enamel.
 - b. 2-ply epoxy finish
 - c. Powder coated.
6. Provide each unit with a factory welded ground lug in an accessible, concealed location.
7. Units to include leveling feet to allow +/- 1". Leveling feet shall be installed on unit at the factory. Ensure leveling feet and any supports thereof are adequately sized for loads incurred during rigging and placement of unit as well as adjustment of final location.

E. Base Rail:

1. Provide a structural base rail along the full perimeter and cross members of the units. Base rail shall be formed from minimum 10-gage galvanized steel channels or aluminum around the perimeter and welded minimum 10-gage galvanized steel or aluminum cross members.
2. Provide base rail and removable lifting lug system that does not require additional support for rigging. Include base rail lifting lugs at unit corners.
3. Base rail height shall be coordinated with the Supply opening in the Gallery Wall.

F. Supply-Air Fan(s):

1. Direct Drive Electronically Commutated Centrifugal Plug Fan: Direct driven with a single-inlet, two-fold backward curved radial fan with an electronically commutated motor. The motor shall include: integrated electronic control board and direct microprocessor control signaling for fan speed control, soft starting capabilities, , and integrated current limitations. Each fan shall be low noise, low vibration manufactured with an anti-corrosive aluminum impeller. Each fan impeller shall be dynamically and statically balanced in two planes to minimize vibration during operation throughout operational speed range. Fans will be set up on manufacturer provided and installed slide rails that will allow easy access on maintenance side of each unit. Bearings shall have L-10 life of 100,000 hours minimum.
2. Fan safety cages shall be provided to restrict access to the rotating equipment on the discharge side of the fan assembly.

G. Chilled Water-Cooling Coil: Seamless copper tubes expanded into aluminum fins, modulating adjustable pressure independent control valve, cooling coil, and test ports across each component. Test ports integral to control valve may be utilized to take credit for required port locations.

1. Mount coil assembly over stainless-steel drain pan.
2. Unit connections will be Victaulic grooved fittings unless otherwise indicated / coordinated.
3. Adjustable Pressure Independent 2-Way Characterized Ball Control Valve
 - a. Control Valve: Belimo (PICCV) Characterized Control valve or approved equal.
 - 1) Valve shall fail to last position if control power or signal is lost.
 - 2) Flow Characteristics: Equal percentage characteristics.
 - 3) Forged brass body rated at no less than 400 psi, chrome plated brass ball and stem, dual EPDM lubricated O-rings and TEFZEL characterizing disc.
 - 4) Accuracy: The control valves shall accurately control the flow from 0 to 100% full rated flow. The flow shall not vary more than +/-5% due to system pressure fluctuations across the valve with a minimum of 5 psid across the valve.
 - 5) Close-Off (Differential) Pressure Rating: 200 psi.
 - 6) Actuator shall be compatible with both the valve and the unit controller.
 - b. Mount cooling coil in the unit cabinet fully accessible for all service activities from the front access panels.

- c. Control signal shall be 4-20ma or 0-10ma for modulating control valve. Input and output single between the valve and unit controller shall be the same.
 4. Modulating control valves shall be capable of providing valve position feed back from the valve to the unit controller.
 5. Test Ports: Manufacturer shall provide test ports between each component in the unitary hydraulic system: upstream of cooling coil inlet, and on both the inlet and outlet from the control valve.
 6. Provide internal isolation valves.
 7. Provide drain valve with hose end at system low point.
 8. Provide bleed valve at the system high point to allow for coil pressure to be released in a control manor upon delivery to the project site as coil will be under pressure. In addition to the bleed valve, a pressure gauge shall be provided on the coil to confirm the coil has held pressure during transit.
 - a. Units to be shipped with pressure less than 50 PSI
- H. Filters: Filter frame shall be fixed to the intake of the air handling unit.
 1. Provide factory fabricated filter section of the same construction and finish as unit casings. Filter sections shall flange to other unit components. Provide filter block-offs as required to prevent air bypass around filters.
 2. Air filter holding frames shall be 16-gauge galvanized steel with filter sealing flange. Shall accommodate 2-inch filters.
 3. ALTERNATE: Provide cost for one additional set of filters for each unit.
- I. Units shall be provided with an air flow switch to allow for fan turn down to 20% of scheduled rate.
- J. Provide integral rope style leak detection. Rope detector will be routed around the unit's base exterior of the unit and wired to the onboard microprocessor controller
- K. Condensate
 1. Provide with condensate pump from factory. Pump shall be capable of removing a 20 GPH at 4' of head pressure. Condensate pump shall be factory wired and powered through the Fan Wall Unit.
 2. Any additional condensate drain pans shall be permitted to drain internally to the lowest drain pan to be pumped by the Condensate Pump.
- L. Control Sensors
 1. Temperature sensors shall be provided for supply air temperature and return air temperature.
- M. Microprocessor Control System:
 1. Owner will be provided with full access to programmed logic and necessary software licenses – no exceptions.
 2. Each control system shall be the Manufacturer's latest version of the microprocessor-based control system with a large graphic front monitor display panel and control keys for user inputs. The unit control shall be factory-set for Intelligent Control which uses "fuzzy logic" and "expert systems" methods.

- a. Provide controller with backlit LCD graphical display front mounted on each unit.
 - a) The user interface to the controller shall be a maximum of 5'-6" above the floor on which the base of the unit sits.
- b. Proportional and Tunable PID shall also be user selectable options for the control of:
 - 1) Supply Air Temperature (unit leaving temperature) – all units shall be configured and tested at the factory for this control approach. Refer to schedule for the initial set point.
 - a) Setpoint adjustment at display and communications interface
 - b) PID loop Adjustment at display and communications interface
 - 2) Return Air Temperature – all units shall be configured and tested at the factory for this control approach. Refer to schedule for the initial setpoint.
 - a) Set point adjustment at display and communications interface
 - b) Sensitivity Adjustment at display and communications interface
3. The controls shall be menu driven. The display shall be organized into several main sections. At a minimum, provide User Menus, Service Menus and Advanced Menus. The system shall display user menus for: active alarms, event log, graphic data, unit view/status overview (including the monitoring of air conditions, operational status in % of each function, date and time), total run hours, various sensors, display setup and service contacts. A password shall be required to make system changes within the service menus. Service menus shall include: setpoints, timers/sleep mode, alarm setup, sensor calibration, maintenance/wellness settings, options setup, system/network setup, auxiliary boards and diagnostics/service mode. A password shall be required to access the advanced menus which include the factory settings and password menus.
4. The Service Menus Shall be Defined as Follows:
 - a. Active Alarms: Unit memory shall hold the 200 most recent alarms with time and date stamp for each alarm.
 - b. Event Log: Unit memory shall hold the 400 most recent events with id number, time and date stamp for each event.
 - c. Graphic Data View: Eight graphic records shall be available: return air temperature, supply air temperature, outdoor temperature, and four custom graphs.
 - d. Unit View - Status Overview: Simple or Graphical "Unit View" summary displays shall include temperature, active functions (and percent of operation) and any alarms of the host unit.
 - e. Total Run Hours: Menu shall display accumulative component operating hours for major components.
 - f. Various Sensors: Menu shall allow setup and display of optional custom sensors. The control shall include four customer accessible analog inputs for sensors provided by others. The analog inputs shall accept a 4 to 20 mA signal. The user shall be able to change the input to 0 to 5VDC or 0 to 10VDC if desired. The gains for each analog input shall be programmable from the front display. The analog inputs shall be able to be monitored from the front display.

- g. Display Setup: Customer shall pre-select the desired grouping of display languages at the time of the order from the following choices: English, French, Italian, Spanish, German, Russian, Greek, Japanese, Chinese, and Arabic.
 - h. Service Contacts: Menu shall allow display of local service contact name and phone number.
5. The Service Menus Shall be Defined as Follows:
- a. Setpoints: Menu shall allow setpoints within the following ranges:
 - 1) Supply Air Temperature Setpoint 50-90°F
 - 2) Minimum Supply Fan Flow (or Speed) 0-100%
 - 3) Return Air Temperature Setpoint 75-105°F
 - 4) Return Air Temperature Sensitivity +1-10°F
 - 5) High Temperature Alarm 35-105°F
 - 6) Low Temperature Alarm 35-90°F
 - b. Timers/Sleep Mode: Menu shall allow various customer settings for turning on/off unit.
 - c. Alarm Setup: Menu shall allow customer settings for alarm notification (audible/local/remote). The following alarms shall be available:
 - 1) High Temperature
 - 2) Low Temperature
 - 3) Fan Failure
 - 4) Change Filter
 - 5) Unit Off
 - 6) Secondary power source
 - d. Audible Alarm: The audible alarm shall annunciate any alarm that is enabled by the operator.
 - e. Common Alarm: A programmable common alarm shall be provided to interface user selected alarms with a remote alarm device
 - f. Remote Monitoring: All alarms shall be communicated to the remote monitoring system with the following information: Date and time of occurrence, unit number and present temperature
 - g. Sensor Calibration: Menu shall allow unit sensors to be calibrated with external sensors.
 - h. Maintenance/Wellness Settings: Menu shall allow reporting of potential component problems before they occur.
 - i. Options Setup: Menu shall provide operation settings for the installed components.
 - j. Auxiliary Boards: Menu shall allow setup of optional expansion boards
 - k. Diagnostics/Service Mode: The control shall be provided with self-diagnostics to aid in troubleshooting. The microcontroller board shall be diagnosed and reported as pass/not pass. Control inputs shall be indicated as on or off at the front display. Control outputs shall be able to be turned on or off from the front display without using jumpers or a service terminal. Each control output shall be indicated by an LED on a circuit board.
6. Advanced Menus Shall be Defined as Follows:

- a. Factory Settings: Configuration settings shall be factory-set based on the pre-defined component operation.
 - b. Change Passwords: Menu shall allow new passwords to be set or changed.
7. In addition, the system shall provide the following controls:
- a. System Auto Restart - The auto restart feature will automatically restart the system after a power failure. Time delay is programmable
 - b. Sequential Load Activation - On initial startup or restart after power failure, each operational load is sequenced with a minimum of one second delay to minimize total inrush current.
 - c. On/Off Status Auxiliary Contact: Provide one normally open, non-powered main fan auxiliary contact. Provide terminals on the unit wire raceway for field wiring to external circuits.
8. BMS Interface
- a. The microprocessor-based communications device shall communicate to the building management system (BMS) utilizing BACnet over IP.
 - b. Environmental Operating Range: 41°F to 104°F, 8 to 75% relative humidity, non-condensing
 - c. Communication:
 - 1) One RS-485 - EIA-485 – selectable baud rate, 9600bps or 19200bps
 - 2) One (1) RS-232 access port (for diagnostics).
 - 3) One (1) RJ-45 access port (for ethernet BACnet)
 - d. Memory: 8 MB flash, 8 MB SDRAM.
 - e. The panel will provide the interface for the BMS system to communicate, as a minimum, the following:
 - 1) Status Points
 - a) Temperature
 - b) Cooling
 - c) % of capacity
 - d) Unit on/off status
 - 2) Alarm Point
 - a) High Temperature
 - b) Low Temperature
 - c) Fan Failure
 - d) Change Filter
 - e) Unit Off
 - f) Smoke alarm
 - g) Water detected by rope sensor
 - h) Secondary power source
 - i) Loss of communications
 - j) Local off
 - k) Remote off
 - l) Loss of airflow
 - m) Main fan overload

- n) Loss of power
- 3) Run Time Hours
 - a) Fan motor
 - b) Chilled water valve
- 4) Setpoints
 - a) Temperature
 - b) Temperature tolerance
 - c) High temp alarm setpoint
 - d) Low temp alarm setpoint
 - e) Minimum fan speed setpoint
- 5) Unit Control Points
 - a) Temperature setpoint
 - b) Temperature tolerance
 - f. The microprocessor shall be programmed to retain its last commanded minimum fan speed setpoint in the event of a communications failure with the BMS. It shall retain this last speed setpoint from the BMS in the event the microprocessor is rebooted due the unit losing power or manually cycled.
 - g. The Unit shall be provided with a super capacitor to provide up to 120 seconds of power for the microprocessor and display.

2.3 ELECTRICAL

- A. All electrical work shall be installed in full compliance with the National Electric Code. All electrical components shall be UL labeled.
- B. The units shall be provided with a UL or ETL label.
- C. Integral Electrical Power Components: Unit-mounted electrical enclosure with piano-hinged door, grounding lug, circuit breakers and cover interlock, and fusible control-circuit transformer. All components shall be fully wired to the utility power terminal identified below.
 - 1. The operating mechanism for the NEMA 1 disconnect switch(es) shall not be higher than 4'-6" above the floor on which service personnel stand. For horizontal discharge units in a non-raised floor environment where units are located on a stand, the mechanism shall be factory installed to meet this operating height requirement assuming the measurement will be made from the floor on which the stand is to be installed.
 - 2. Short Circuit Withstand Rating of the FW electrical enclosure shall be 480V, 65,000 Amps.
 - 3. Input Power Termination: Terminal(s) shall be able to accommodate Aluminum or Copper conductors of scheduled size and quantity as shown on the electrical one-line diagrams.
 - 4. Electrical Connections: Manufacture shall allocate space within the unit for contractor installed raceway from point of entry to the unit to the electrical enclosure. Pathways allocated for electrical raceway shall not be located within the unit plenum. Entrance into the unit shall be able to accommodate entry. At

minimum manufacture shall provide enough space for (1) raceway for each of the following systems: Source 1 electrical service, source 2 electrical service, AC electrical I/O, DC electrical I/O, Communications cabling.

5. Provide each unit with a factory welded (prior to finish painting) ground lug in an accessible, concealed location.
- D. Factory wiring shall be 600v rated, type #12 THHN copper (minimum size). All wiring shall be plenum rated for installation within the units.
- E. Integral Automatic Transfer Switch
1. The UL 1008 transfer switch shall be single throw, double pole actuated by solenoid mechanism, momentarily energized, and connected to the transfer mechanism by a simple over center type linkage.
 2. The Source 1 and Source 2 contacts shall be positively interlocked mechanically and electrically to prevent the unintentional simultaneous closing. Main contacts shall be mechanically locked in both the Source 1 and Source 2 positions without the use of hooks, latches, magnets, or springs, and shall be silver-tungsten alloy. Separate arcing contacts with magnetic blowouts shall be provided on all transfer switches.
 3. The transfer switch shall be capable open-transition and delayed transition operation only. Open-transition transfers between live sources shall incorporate an adjustable time-delay between sources.
 4. Sequence of Operation
 - a. When the voltage on any phase of the Preferred source drops below 80% or increases to 120%, or frequency drops below 90%, or increase to 110%, or 20% voltage differential between phases occurs, after a programmable time delay period of 0-9999 seconds (factory set at 11 seconds) to allow for momentary dips, the transfer switch shall transfer to the Alternate source when the Alternate source has specified voltage and frequency on all phases.
 - b. After restoration of power on all phases of the Preferred Source to a preset value of at least 90% to 110% of rated voltage, and at least 95% to 105% of rated frequency, and voltage differential is below 20%, an adjustable time delay period of 0-9999 seconds (factory set at 300 seconds) shall delay retransfer to allow stabilization of Preferred Source power. If the Alternate Source should fail during this time delay period, the switch shall automatically return to the Preferred Source.
 - c. The transfer switch shall be capable of manual source selection via local selector switch toggle.
 5. The transfer switch shall be furnished with the ability to receive an external input signal that will inhibit the transfer switch from transferring from the preferred to the alternate source. Upon energization of the inhibit signal, the transfer switch shall enter the inhibit state with no delay.
- F. Power Quality:
1. The total Harmonic Voltage Distortion (THVD) shall meet the requirements of Table 10.2 of IEEE std 519 by not exceeding 5% and by limiting the individual harmonic voltage distortion to less than 3%. These limits shall apply while

operating on either utility supply or generator supply and the Point of Common Coupling (PCC) shall be defined as the power input terminals to each unit.

2. Total Demand Distortion (TDD) of the current shall not exceed the limits as defined in Table 10.3 of IEEE std 519 or greater than 5%, whichever is lower. The PCC shall be defined as the power input terminals to each unit.
3. Power Factor: Provide equipment with power factor correction as required to maintain a displacement power factor of 95% (leading or lagging) across all load conditions.
 - a. Where passive harmonic filters are installed, the total capacitive reactive power of the filter(s) shall not exceed 15% of the fundamental KVA, either through inherent design or capacitor switching contactors.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The equipment shall be installed by the Installing Contractor, following the procedures set forth by the Equipment Supplier. The Equipment Supplier shall assist the Installing Contractor as required in interpreting the installation instructions. The Equipment Supplier's representative shall attend on-site construction meetings as required.
- B. The Installing Contractor shall provide all necessary rigging required for unloading and installation of equipment and associated materials. After set in place, remove temporary blocking, lifting eyes and other shipping components from the equipment.
- C. The Installing Contractor shall coordinate with other trade contractors and the owner to ensure work by others that affects the Installing Contractors work is fully coordinated.
- D. If necessary, Installing Contractor shall recommend and review revised locations and layout of equipment and components with Engineer to suit vendor's specific design. Field Verify all installation locations, clearances, conduit layouts, etc. Provide written notice to the Contractor and the Owner of any unacceptable condition.
- E. Installing Contractor shall install all equipment and components in accordance with manufacturer's instructions and anchor to floor with expansion anchors. All units shall be installed plum, level, and true.
- F. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70-2016.
- G. Connections: Inspect all connections to the equipment:
 1. Chilled Water Piping Connections: Verify connections for chilled water comply with the Manufacturer's requirements.
 2. Verify service and maintenance clearances comply with the Manufacturer's requirements.

3. Water and Drainage Connections: Verify connections for condensate drain with the Manufacturer's requirements.
 4. Power: Verify all power connections comply with the Manufacturer's requirements.
 5. Controls and Monitoring: Verify all building controls or monitoring systems connections comply with the Manufacturer's requirements. Coordinate with the building controls and monitoring systems installers to verify all connections operate as specified. Provide all necessary technical support to the building controls and monitoring systems installers for the proper operation of digital communications interfaces to the units.
 6. Piping connections shall be thoroughly cleaned of all scale and foreign matter before the piping is assembled and connected to the unit(s).
 7. Water shall be treated and flushed in accordance with the requirements of Specification Section 23 25 13 prior to being circulated through the unit(s).
- H. Units shall be provided with butyl tape that will be placed on the front of the prior to being installed up against the gallery wall. This will ensure an airtight seal between the unit and the wall.

3.2 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and Fan Wall installation, including piping and electrical connections. Report results in writing.
- B. Manufacturer Provided Start-up
 1. Manufacturer's Supervision: A factory trained service representative of the manufacturer shall supervise the startup of each Fan Wall. Prepare manufacturer's written report/log of the startup signed by the service representative and the Owner.
 2. Representative shall instruct the Owner's operating personnel in the operation and service of the units. This instruction shall be concurrent with startup.
 3. Manufacturer shall supply the following literature:
 - a. Start-up, operation and maintenance instructions.
 - b. Installation instructions.
 - c. Field wiring diagrams.
 - d. One complete set of certified drawings.

3.3 CLEANING

- A. After installation, including outlet fittings and devices, contractor shall inspect unit components, remove dirt and debris and repair damaged finish to match original finish.

3.4 COMMISSIONING ASSISTANCE

- A. A factory-authorized service representative shall be on-site, when requested, during the commissioning process.

- B. A factory-authorized service representative shall correct any deficiencies discovered during the commissioning process. The construction timeline, duration, and schedule shall be dictated by the Owner and Construction Manager.

3.5 DEMONSTRATION

- A. A factory-authorized service representative shall train Owner's maintenance personnel as specified below.
 - 1. Schedule training with Owner, through the Construction Manager with at least 7 days of notice.
 - 2. Provide a minimum of 8-hours of on-site technician-level training. Training to be performed within one year of the substantial completion date.
 - 3. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
 - 4. Review data in the maintenance manuals.
 - 5. Provide the software and hardware necessary to access the system logic for service training.

PART 4 - ALTERNATE BIDS

4.1 EQUIPMENT MAINTENANCE CONTRACT

- A. State the amount to be added to the Base Bid for providing an annually renewable maintenance and service contract, for up to five years. The first year shall only include the preventive maintenance of the equipment, while the remaining four (4) years shall include preventive and corrective maintenance. Include all manufacturer's recommended services and intervals. Assume the contract shall begin after acceptance of the complete system by the Owner.

4.2 EQUIPMENT SPARE PARTS

- A. State the amount to be added to the Base Bid for providing the manufacturer's different levels of recommended Spare Parts Kits to be stored on site. The quantity of Spare Part Kits shall be, at a minimum, one of each equipment size.

END OF SECTION 23 82 19.01

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