

DIVISION 2: SPECIFICATIONS FOR THE CONSTRUCTION OF THE PROJECT

A) SCOPE OF WORK:

- 1) The Scope of Work under this contract includes mechanical contractor services for the addition, removal, and replacement of various mechanical (HVAC) components, and mechanical, electrical, and plumbing auxiliaries made necessary, for the Municipal Water District of Orange County (henceforth; 'MWDOC') at:
 - a. The Administrative Building ('Admin Building') at 18700 Ward Street, Fountain Valley CA
- 2) Demolition and removal of existing equipment is included. Re-connection of new equipment to existing utilities is included. Detailed descriptions of the scope of work are included in the Specifications, and are part and parcel to this contract, whether by direct description, implied or necessary to provide a complete replacement of the existing system.

B) CONTRACTORS QUALIFICATIONS

- 1) Mechanical Contractor shall act as the Prime Contractor for the project.
- 2) Contractor is required to have full-time capability to prepare the submittal documents, including licensed Professional Engineers on staff.
- 3) Contractor shall have capability to furnish extended service upon completion of the work.
- 4) All DDC controls work for the Building Automation Controls System shall be performed by the Mechanical Contractor's technicians. Contractor shall have, as part of his staff, technicians certified to perform work on ALC controls, which is the existing control system to be expanded as part of this work.
- 5) Electrical work required as part of this project shall be performed by an electrical Contractor as a sub-contractor to the Mechanical Contractor. This contractor shall coordinate with Owner's Electrical Contractor to provide all necessary information for proper connection of the HVAC work to the electrical Emergency Power system.
- 6) All materials and workmanship shall be guaranteed for a minimum of one year, but no less than guarantee periods furnished by manufacturer's, from date of final acceptance. Contractor shall provide a dedicated HVAC service team for the warranty period. Correct or replace any work or material or equipment found to be faulty during that period, without expense of any kind to Owner, immediately upon written notification from the Owner or Owner's agent.

C. CONTRACTOR'S RESPONSIBILITIES

The project includes new HVAC equipment, DDC controls, and related scope, with a mechanical contractor having the responsibility of Prime Contractor, herein referred to as the 'Contractor'.

Contractor is required to have, as part of his staff, licensed Professional Engineers and Contractors, in accordance with Regulations of the State of California.

- 1) All work shall conform to the requirements of all laws, rules and codes of regulatory agencies. Requirements of this specification are the minimum acceptable and shall govern, except that Building Laws shall govern when their requirements are greater or more stringent, without any added cost to the Owner. When a conflict is encountered, the Contractor shall notify the Owner in writing and receive written approval prior to proceeding.
- 2) Responsibility: The construction of the entire scope of work of this project is the sole responsibility of the Contractor, including, but not limited to, all required regulatory agency approvals and for all associated costs thereof, subject in all cases to prior approval of the Owner.
- 3) It shall be Contractor's responsibility to include costs of all equipment, whether indicated herein or not, including but not limited to, temporary power, temporary air-conditioning, equipment and protection of existing systems and finishes, necessary to provide a fully functioning system.
- 4) It shall be the Contractor's responsibility to survey the site and independently confirm all means of delivering and installing all equipment, including cranes, etc., and determining the adequacy of load bearing capacity, and clearances from adjacent structures, walls, pathways, roadways, etc., to support that delivery and installation equipment.
- 5) Prior to submission of proposal, Contractor is required to survey the site and independently confirm all data in the field, code requirements, space conditions, etc. Contractor is not relieved of any responsibility or liability by nature of any of the information set forth herein.
- 6) Proposed Designs: The Contractor's work, which follows the details of these Specifications, will not relieve the Contractor of the total responsibility for the fabrication, erection, and performance of the work. Contractor's submittals and other related documentation and certifications must demonstrate conformance with the information in the Specifications.
- 7) Requests for additional compensation for omissions or errors in design or prosecution of the Scope of work ('SOW') on the part of the Contractor or any subcontractor will not be accepted.
- 8) Ancillary Materials: The Contractor's Scope of Work shall include all supplementary parts and materials required to complete the work, even if not definitely specified, and Contractor shall provide all inserts, fasteners, bracings, housekeeping pads, frameworks, and similar items and materials required for proper anchorage of the work to the building structure or surface pads, and to any related work, all of which shall conform to the Building Code and all other regulatory agency requirements.
- 9) Occupied areas: Construction may take place in areas of the building or its surroundings occupied by the Owner, and/or while visitors unfamiliar with the building may be present. Contractor shall ensure that work in this Scope of Work does not impede the normal or

emergency flow of traffic in the building, and shall not create any conditions whatsoever that, in the opinion of the Owner, is unsafe to employees, members, occupants, or visitors, or interfere with the normal conduct of business at the site.

- i. Contractor shall provide and erect barriers, bollards, signage, and other devices to prevent employees, visitors, or occupants from entering the construction area.
 - ii. Contractor shall maintain all exits free from barriers and/or obstacles to the path of travel.
 - iii. Contractor shall provide 48 hours written notice to Owner, and obtain Owner's approval, prior to commencing any scheduled shut-down of electrical, air conditioning, gas, water, or any other utility as part of the scope of work.
 - iv. Project Decorum: Management of and responsibility for the deportment of field labor forces is the sole responsibility of the Contractor. Unnecessary interaction by field labor forces with employees, visitors, or occupants not associated with the project is prohibited. In the event of inappropriate behavior, including but not limited to, profanity or offensive and/or unprofessional manner, the Contractor shall remove said worker from the site immediately, and replace said worker with a worker of equivalent skill, at no cost to the Owner. The Owner also retains the right to demand the removal/replacement of any individual displaying inappropriate deportment at their sole discretion.
 - v. Badges and Identification Material: Contractor shall provide laminated badges for all workers on-site, and shall be responsible for verifying, on a daily basis, that all workers are properly identified and carrying an additional acceptable form of identification. If Owner notes the presence of an unidentified worker on the site, the Contractor shall remove said worker from the site immediately, and replace said worker with a worker of equivalent skill, at no cost to the Owner.
 - vi. Coordination of the Work: The Contractor shall be responsible for the coordination of all work with subcontractors, contractors under contract to the Owner, the Owner's Representative, and manufacturers.
- 10) O&M Training of Owner's Personnel: The Contractor shall furnish the Owner's designated personnel with 8-hours of training and instruction. The training and instruction shall be scheduled at a time and location of mutual convenience.
- a) Training shall occur after all equipment has been tested, and the systems are verified by the Owner's Representative to be operating within their nominal operating parameters.
 - b) All training shall take place at the project sites, unless approved by the Owner.
- 11) Site Condition Survey: Prior to commencing any work, the Contractor's Project Manager and any other necessary team member, escorted by the Owner's Representative will tour the project sites to examine and memorialize any existing damage to the property, landscape, parking, or other improvements on the project sites, using a digital camera. The resulting record shall serve as the basis for determination of possible damage due to Contractor's operations and shall be

signed by both parties involved in the tour. Any damage to existing improvements not noted in the initial survey, but subsequently discovered, shall be brought to the Owner's attention immediately. Contractor shall photograph (digital) and describe in text any damage.

- 12) Project Administration: Contractor shall assign a dedicated Project Manager as a single point-of-contract for all of the facilities. It shall be the Project Manager's responsibility to develop and maintain the overall Project Schedule, which shall be updated weekly and distributed electronically. Schedule to be in MS Excel or Project format. The Contractor's Project Manager shall maintain weekly Owner's meetings and report on the progress of the work, and of the overall schedule of the work herein specified.

D) ITEMS TO BE FURNISHED BY OWNER:

- 1) Owner will make available any existing as-built drawings. Owner does not represent these drawings to be complete or current, nor should Contractor rely upon the accuracy or completeness of these drawings for the execution of his work, or for the location of any existing utilities.
- 2) Owner will designate parking for Contractor's personnel.
- 3) Contractor will be responsible for the secure storage and security of any tools, equipment, Owner furnished or otherwise, materials, etc., at all times.

HEATING, VENTILATING AND AIR CONDITIONING SYSTEM SPECIFICATIONS

PART 1. - GENERAL

- A) General Requirements: In accordance with Division 1 - General Conditions of the Contract for Construction.
- B) Scope: Agency approvals, certified construction drawings, labor, materials, appliances, tools, equipment, facilities, transportation, fees, and services necessary for, and incidental to, performing all operations in connection with demolition, furnishing, delivering, and installation labor necessary and incidental for replacing two Air Conditioning Systems, in accordance with previously submitted proposal, as approved by Owner.
- C) All of the following items are included in the scope of work at the Admin Building:
- 1) Remove the existing Server Room rooftop single package heating/cooling unit. Existing pad shall be re-used for new unit.
 - 2) Install a new 3-ton in-ceiling/rooftop split system precision cooling unit appropriate for a Server Room, such as Data Aire, or Owner Approved equal.
 - 3) Replace and modify ductwork as required for connection to existing terminals.
 - 4) Provide electrical connection from new Breaker Panel in Mechanical Room to new Split system at roof and at Server Room. Coordinate with Owner's electrical contractor as required to provide a fully functional system
 - 5) Structural supports, including vibration isolation and seismic restraints.
 - 6) Retrofit vibration isolation supports for two existing in-ceiling air conditioning units to remain, suitable for office occupancy NC levels.
 - 7) Provide a new VAV-terminal and duct connection from building HVAC system supply and return ducts to Server Room distribution system. Provide and automatic dampers and controls to open and operate the VAV terminal unit when room temperature exceeds 72 degrees F (adjustable via EMS).
 - 8) Provide all ALC controls, connected to existing ALC front-end, as indicated in these specifications.
- D) All of the following items are included in the scope of work:
- 1) Patch existing abandoned openings
 - 2) Provide ALC controls as indicated herein communicating with Owner's existing web-based ALC system, incorporating weather anticipating programs, remote access, monitoring, scheduling, and reporting programs.
 - 3) Connect electrical supply, and drainage piping to new units.
 - 4) Furnish and install ductwork and transitions as required to install the new units in the air-stream of the existing supply and return ductwork.

- 5) Furnish and install smoke detectors, including in-duct detectors as required.
- 6) Remove and dispose of, in a manner consistent with codes, existing equipment to be replaced under the scope of this contract. Remove and dispose of, in a manner consistent with codes, all liquids, such as refrigerant and chilled or hot water, from existing equipment being replaced.
- 7) Furnish all rigging, cranes, etc. required. Investigate existing access and load bearing capability for cranes and confirm with Owner as part of bid.
- 8) Provide cutting, patching, painting, etc., for all areas affected by the scope of this contract.
- 9) Furnish details, and coordinate all electrical contracting required, with Owner's Electrical Contractor.
- 10) Furnish new disconnect switches for new equipment.
- 11) Furnish and install all curbs, sleepers, etc. required for the installation of the equipment.
- 12) Provide all required sub-trades for a complete project.
- 13) Provide submittals, shop drawings, etc., for Owner's review.
- 14) Obtain all Permits from regulatory agencies having jurisdiction.
- 15) Provide testing & balancing:
 - a) Prior to commencing work, the contractor shall perform an initial air flow test to verify the performance of each of the existing terminals, to determine their operating conditions. Upon completion of the initial test, provide a report to the Owner indicating the acceptability of each terminal for continued use, or recommendation for repair or replacement.
 - b) Upon completion of the work, provide complete testing and balancing of the air supply and return system, as specified herein.
- 16) Start-up, O&M Training, and assistance to the Owner's Representative as required.
- 17) The design and installation of all equipment under the scope of this contract shall be in strict conformance with the Uniform Mechanical Code, Uniform Building Code/IBC, California Energy Code, each City's requirements, ASHRAE, and any/all jurisdictions and/or regulatory agencies having authority. Contractor shall be responsible for obtaining all required Building Department clearance and permits for each site.
- 18) Piping, ductwork, and equipment shall be located in a manner avoiding obstructions, interference between trades, preserving headroom, keeping openings, passageways and common areas clear at all times. Stored material, tools or equipment that in the sole discretion of the Owner presents a

hazard to employees or tenants, or impedes egress or exiting shall be removed and relocated at Contractor's expense.

19) Submittals: Submittals shall be furnished within fourteen (14) calendar days after contract award. The following information is required in the submittal package from the Contractor:

20) For HVAC equipment, submit duct and piping layouts, indicating location of all valves, flanges, and measuring devices.

21) Submittals

- a) Shop Drawings: Indicate assembly, unit dimensions, weight, required clearances, construction details, field connection details, electrical characteristics and connection requirements.
- b) Product Data: Provide literature that indicates capacities, ratings, fan and motor performance, gauges and finishes of materials, and electrical characteristics and connection requirements.
- c) Manufacturer's Installation Instructions.

22) Manufacturer equipment cut sheets and electrical power requirements on all equipment. Contractor shall verify the electrical voltage and phase of all equipment prior to ordering of equipment.

23) Specify the location of all equipment by dimensions from column lines and show sizes and weights of all equipment, ductwork and piping requiring structural support or framing.

24) Specify the foundation and/or support requirements for mechanical equipment.

25) Construction Submittals: Before ordering materials, and before work is started, Contractor shall submit three identical copies of a complete list, including catalogs and other descriptive matter of the materials and equipment intended for use on the project. Material list shall be submitted in a hard-bound 3-ring binder. Identify the specific make and model applicable to the project. Submittals shall include, but not be limited to, the following:

- a) Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements. Sound data for discharge, radiated and return positions shall be submitted by octave band for each unit. Calculations for required heights to satisfy condensate trapping requirements of cooling coil shall be included.
- b) Product Data:
 - 1) Provide literature that indicates dimensions, weights, capacities, ratings, fan performance, finishes of materials, electrical characteristics, and connection requirements.
 - 2) Provide manufacturer's installation instructions.

26) Provide submittals for the following equipment:

- a) AC units
- b) Ductwork

- c) VAV terminals
- d) Accessories, including curbs and louvers
- e) Insulation
- f) Wiring Diagrams necessary for connection of equipment
- g) Automatic Control system
- h) Smoke Detectors
- i) Vibration Isolators

27) Coordinate work with other trades. Contractor shall manage the coordination with other sections of the specifications and with Owner's other contractors, to order and install work in such a manner that each and every item is coordinated. No change orders for additional costs will be accepted by Owner due to lack of coordination between trades.

28) Performance:

Contractor shall guarantee the Admin Building Server Room air conditioning system to maintain 70 in summer and 70 in winter.

E) Related Work to be included: Contractor shall include the full scope of services of other trades as required or as indicated herein, for the completion of the project Scope of Work:

- 1) All electrical wiring whether line (110 VAC and greater), low (110 VAC and lower), or control voltage, conduit, wire, flex, disconnects, etc. A complete wiring diagram will be furnished by Contractor, as are all thermostats, sub-bases and temperature control devices.
- 2) Low voltage wiring for temperature controls, all LAN cable wiring, and/or DDC control wiring, for the BMS system.
- 3) All temperature control panels and devices.
- 4) Pressure switches indicating equipment run status will be furnished and installed by Mechanical Contractor.
- 5) General construction made necessary by Contractor's work
- 6) Structural steel for equipment supports as required.
- 7) Cutting, patching, coring, painting, fire caulking/sealing, roofing, and framing of openings. Roof patching shall be furnished by Owner's designated roofer, as a sub-contractor to this Contractor.
- 8) Architectural sheet-metal, equipment screens, or exterior louvers of any kind.
- 9) Concrete for inertia base fill, concrete pads, or curbs.
- 10) Painting: all walls that have been cut and/or patched shall be painted. All areas to be painted shall first be cleaned and primed. Finish painting shall be in accordance with manufacturer's

recommendations. Extent of painting shall be entire wall from corner to corner, unless otherwise approved by Owner.

- 11) Access doors in finished walls, ceilings, etc.
- 12) Condensate drain piping, equipment drains, and all final connections.
- 13) Demolition work.
- 14) Structural calculations shall be by Owner's Structural Engineer based upon data furnished by Contractor.
- 15) Air Balance report, independent testing of life-safety systems, duct pressure testing, etc.

PART 2. – PRODUCTS

- A) Computer Room Air Conditioning Unit: Split system unit, Data Aire Mini Plus or equal as approved by Owner.
 - a) Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by Data Aire Inc., or equivalent as approved by Owner
 - b) Description: The environmental control, Computer Room Air Conditioning unit shall be provided with a high sensible cooling system, self-contained, factory assembled, piped, wired, and factory tested prior to shipment. Units shall include an enclosure/cabinet assembly, fan section, filter section, cooling coil, controls, and interconnecting piping internal to unit.
 - c) The total cooling capacity shall be as detailed on the project drawings and schedule.
 - d) Quantities and configurations as shown on the project drawings.
 - e) Safety Certification: Units shall be ETL or UL listed.
 - f) Cabinet and Frame
 - 1) The frame shall be constructed of 18 gauge welded tubular steel and be coated with a heavy corrosion inhibiting finish for long life. The side panels shall be of galvanized steel. The cabinet shall be insulated with one-quarter inch (1/4") thick, closed cell insulation.
 - 2) An integral return air filter box with duct connection shall be factory installed.
 - 3) The unit shall come in horizontal air-flow direction for ducting.
 - 4) Removal of the unit from the ceiling space shall not be required for access.
 - g) Air Cooled Split System (Outdoor Condensing Unit): The refrigeration system shall be split type consisting of an indoor evaporator and a remote outdoor air-cooled condensing unit. The evaporator and condensing unit shall be factory assembled and tested.
 - h) The indoor evaporator shall have a cooling coil constructed with copper tubes and aluminum fins for maximum heat transfer. The single refrigeration circuit shall include the expansion valve with

external equalizer, filter drier and sight glass. The condensate drain pan shall be constructed of stainless steel and provide a positive drain to prevent standing water in the condensate pan. The evaporator shall be mounted in the ceiling space with ducted supply and return air as required on the project drawings. See 'Blower Assembly' section of this document for evaporator blower details.

- i) The remote outdoor condensing unit shall be low profile, slow speed and direct drive propeller fan type. The condensing unit shall be constructed of aluminum and contain a copper tube and aluminum fin condenser coil for maximum heat transfer. The air discharge shall be vertical to minimize the effects of wind blowing through the coil at low ambient temperatures. The condensing unit shall include a single or dual refrigeration circuit. The compressor(s) shall be hermetic scroll type, with complete overload protection on all three power lines, internal thermostat for winding protection, crankcase heater(s), sight-glass(es), high and low safety pressure switches and low pressure override timer(s) for positive starting at low temperatures. The high and low pressure safety switches are connected to the refrigerant system with a Schrader fitting that allows replacement without affecting the refrigerant charge, making recovery unnecessary. The condensing unit shall have fan speed control with transducer(s) to modulate the speed of the first condenser fan motor and provide positive start-up and operation at ambient temperatures to -20°F (-29°C). Additional condenser fan motors are to be controlled by ambient thermostats. All controls including the fan speed control shall be factory mounted, wired and tested in the condensing unit. The condensing unit shall be manufactured by the manufacturer of the indoor unit.

Piping and wiring between the indoor evaporator and the outdoor condensing unit shall be field provided by the installing contractor.

j) Blower Assembly

- 1) The evaporator blower assembly shall be a double width, double inlet, blower with belt drive and variable pitch sheave and self-aligning ball bearings rated for an average life of 100,000 hours.
- 2) The system shall be designed for draw-through air arrangement to insure even air distribution over the entire face of the coil.
- 3) Air delivery as detailed on the project plans and schedule.

- k) Filter: An integral return air filter box with duct connection shall be factory installed and contain 2-inch (2") thick MERV 8 filters (based on ASHRAE Std. 52.2).

l) Electrical

- 1) All electrical components, including capacitors, contactors, relays and control transformers shall be pre-wired and contained in a hinged electrical box that shall swing out for easy access and servicing.
- 2) The control circuit voltage shall be 24 volts.
- 3) The input electrical power shall be as shown on Schedule
- 4) A factory installed micro-switch will disable the unit prior to condensate pan overflow should the drain become plugged with debris.

m) Microprocessor Control System

- 1) Includes a stand-alone panel, micro-processor based with LED illuminated keys, backlit keys. All settings programmable from the face of the panel, and including a USB port for software download/upload.
- 2) Panel shall display: time and date, unit status (on or off), temperature setpoint, current temperature, humidity setpoint, current humidity, current return air temperature, discharge air temperature.
- 3) Control system shall be compatible with and communicate with the Owner's existing ALC system
- 4) Including the following programmable features, all including diagnostics and alarms
 - a) Sequential load activation
 - b) Compressor short cycle control
 - c) Automatic or manual reset
 - d) Humidity anticipation
 - e) Dehumidification Mode lockout
 - f) Start time delay
 - g) Automatic compressor rotation for multi-stage units
 - h) Temperature setpoint with high & low temperature alarm limits
 - i) Humidity Setpoints with high & low humidity alarm limits
 - j) Compressor short cycling alarm
 - k) Message for alarm contact person
- n) Hot Gas Bypass: Hot gas bypass control on the refrigerant circuit shall maintain a minimum suction pressure during low entering air conditions.

7) VIBRATION ISOLATION AND NOISE CONTROL:

- a) All mechanical equipment will be isolated from the structure by means of resilient or spring vibration and noise isolators. Submit manufacturer's recommended equipment.
- b) Use Mason Industries, or M.W. Sausse.
- c) Provide inertia bases as required.
- d) Seismic Restraints:
 - 1) All base mounted equipment shall be equipped with seismic snubbers. Snubbers shall be capable of withstanding a horizontal force equal to 1 G, and a vertical force equal to 0.5 G. All suspended equipment to be equipped with aircraft cable, with slack.

- 2) Isolation for smaller equipment and piping systems will be 1.5” deflection springs.
 - 3) All isolation will be engineered by a person licensed in the State of California. All isolation will be designed to meet the most current code edition of the UBC Seismic Code.
- 8) Ducts, plenums, and sheet Metal Work:
- a) All ductwork shall be constructed, erected and tested in accordance with local regulations and procedures detailed in the ASHRAE Handbook of Fundamentals, or the applicable standards adopted by the Sheet Metal and Air conditioning Contractors National Association. Provide prefabricated spiral lock-seam ducts and fittings and rectangular ducts of galvanized steel.
 - b) All ductwork to be rigid galvanized steel. Final 6-feet of branch ductwork to air terminals may be flexible duct.
 - c) All connections to main cold supply ducts shall be made with low loss fittings.
 - d) Flat duct surfaces shall be crimped diagonally regardless of size. Longitudinal joints in all duct sizes may be flat-lock joints. Transverse joints and intermediate bracing shall be constructed of galvanized sheet metal or galvanized structural angles in accordance with requirements of the SMACNA guide and public authorities having jurisdiction.
 - e) Transverse joints on all supply ducts shall be sealed with mastic for all medium pressure applications.
 - f) Longitudinal joints on low-pressure supply ducts with internal static pressure below 0.75” w.g. shall be sealed with mastic or tape. Above 0.75” w.g. use medium pressure mastic only.
 - g) Lock joints shall be hammered to make them airtight. Inside of duct shall present a smooth surface to air-flow.
 - h) Horizontal ductwork shall be supported with 1-inch, 18 gauge galvanized strap hangers in accordance with the requirements of SMACNA and public authorities having jurisdiction.
 - i) Plenums shall be made of 18 gauge galvanized sheet steel reinforced horizontally on a maximum of 48 inch centers by 1-1/2 x 1-1/4 x 1/8 inch galvanized angles and reinforced vertically by 1-1/2 inches standing seams.
 - j) Elbows and tees shall have a centerline radius of 1-1/2 times duct width. All square elbows shall be equipped with turning vanes of double thick metal, airfoil design. Holes for duct and damper rods shall be sealed airtight.
 - k) Pipes, conduits, hangars, structural members, or any other material may not pass through ductwork.

- l) Flexible connections: Neoprene double-coated fiberglass sleeve, to provide minimum 3 inch, or 150% of clear dimension, in addition to width required, clearance between metal parts of all fan and unit connections. Outdoor flexible connections; double coated with weather-proof, UV and ozone-resistant synthetic rubber.
 - m) Verify approval of material with local authorities.
 - n) Seal joints on the main supply air ducts with UL classified sealant. Sealant shall be specifically designed to seal high velocity and medium-pressure ductwork.
 - o) Supports, access doors not part of ducts, bar or angle reinforcing, damper rods, and items made of uncoated steel shall be painted with two coats of primer.
- 9) Variable Volume terminal units ('VAV Terminals')
- a) Certify that units have been tested and rated in accordance with ADC Test Code 1062R4, in an ADC certified laboratory.
 - b) In accordance with NFPA 90A, and UL 733 for internal insulation, coating and adhesive to meet flame and smoke requirements.
 - c) Pressure independent control, reset for airflow between zero and maximum cfm. Airflow limiters not permitted.
 - d) Low static pressure requirement; 0.5 inches of water gauge, maximum.
 - e) Casings: 22 gauge galvanized steel, internally lined with ¾ inch, 1-1/2 pcf fiberglass insulation. Casing sealed to prevent leakage. Alternate: external acoustical wrap, provided all controls and devices mounted on exterior of casing are exposed and able to function throughout their entire range without interference with wrap.
 - f) Label each unit with unit number, and air volume settings.
 - g) Damper: heavy gauge metal with shaft rotating in Delrin self-lubricated bearing. Damper and other internal devices of corrosion resistant material. Shaft marked on end to indicate damper position, with built-in stop to prevent over-stroking. Damper seal of closed-cell foam gasket to limit leakage.
 - h) Controller: Field calibration and adjustment by both external gage taps and maximum and minimum cfm dials on controller. All controls shall be CSI, installed, commissioned, and programmed by Certified Dealer. Control shall be via the EMS system.

10) Piping:

- a) All piping installed in accordance with ASTM and ANSI latest Standards.

- b) Overflow and Condensate drain piping: copper.
- c) Equipment vents, relief valve discharge: Galvanized Steel, schedule 40

11) Valves and fittings:

- a) Applications: Unless otherwise noted, the following shall apply:
 - 1) Shutoff service; Ball or butterfly valves.
- b) Types:
 - 1) Gate valves: Nibco S-113, 125 bronze, solder joint ends. Nibco T-113, 125 lb. Bronze, screwed ends. Nibco F-619, 125 lb. Iron body bronze mounted, flanged.
 - 2) Ball valves: Nibco S-580, 125 bronze, solder joint ends. Nibco T-580, 125 lb. Bronze, screwed ends. Nibco F-510, 150 lb. Carbon steel, flanged.
 - 3) Butterfly valves: Nibco or Wheatley, 200 lb. Wafer style with lever lock handle.
 - 4) Dielectric isolators: Wherever incompatible materials come in contact.
 - 5) Automatic air vents: Cast brass body, automatic float type with brass closed float, non corrosive seat and stem and means for preventing back leakage of air. Inlet size not less than 3/8". Install at high points of systems. Label for identification. Wheatley.
- 6) Fittings:
 - a) Fittings to 2 inches: Malleable iron ANSI B16.3, screwed type or butt welded steel with same wall thickness as connecting pipe.
 - b) Mechanical Couplings: May be substituted for flanges for water services not exceeding 200 degrees F, if coupling is exposed and accessible for service, but not permitted in risers. Manufacturers: Victaulic, Tyler.
 - c) Pipe sleeves: shall be installed on all pipes passing through walls. Sleeves shall be 18 gauge galvanized steel furnished flush with wall surface. Sleeves shall have a mastic and oakum seal to prevent the entrance of moisture. Insulation shall terminate flush with each end of sleeve. Provide polished chrome-plated finish plates where pipes penetrate finished surfaces.
- 7) Pipe supports and hangars: Horizontal piping supported by trapeze hangars or clevis type hangars of steel or malleable iron with sockets for rods. Pipe supports for horizontal pipe shall be attached to structure with suitable bolts or lag screws. Vertical

pipes shall be secured by means of steel or malleable iron clamps bolted around the pipes and secured to the adjacent building construction. No welding or drilling of the building structure permitted.

- 8) Metal Guards: Cover all moving parts of machinery, such as shaft couplings, belt-drives, exposed fan intakes, etc., with removable metal guards. Provide access in guard for tachometer readings. Comply with applicable safety regulations.

12) Insulation:

- a) All thermal insulation shall comply with the State of California Energy Conservation Standards. All supply and return air ducting shall be lined as specified herein.
- b) Piping 2 inches and smaller: per Title-24D, Table 120.3-a.
- c) Condensate overflow drain piping shall be insulated.
- d) Fittings, valves, flanges, shall be insulated with thermally equivalent thickness of fiberglass insulation, with PVC fitting covers, suitable for easy removal and re-attachment.
- e) Areas of equipment that may be subject to sweating shall be insulated.
- f) All new supply and return ducts shall be internally lined.
 - i. Material shall be flexible glass fiber, blanket type duct liner. Lining must be approved by local Codes and in accordance with NFPA standards. NRC rating shall be at least 0.80 at frequencies above 1000 Hz. Maximum moisture adsorption of 0.5% by volume when exposed to moisture laden air at 120 degrees F. and 96% RH. 0.24 'K' value maximum.
 - ii. Certain-Teed, Owens Corning, Johns Manville Duct liner

PART 3. - EXECUTION

- A) General: Examine the project area and conditions prior to commencing any work. Document and report any conditions that are different than at time of pre-bid tour. Report any conditions which would adversely impact the prosecution or completion of the installation
- B) Install all equipment such that satisfactory and adequate clearance to electrical and mechanical components is maintained for service and installation.
 - 1) Startup must be done by trained personal that are experienced with the type of equipment specified.

- 2) Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters and controls are in place, bearings lubricated, and manufacturers installation instructions have been followed.
- C) The Contractor has sole responsibility to implement any and all safety precautions in the delivery, hoisting, and installation of materials and equipment.
- 1) Where equipment, piping or ductwork is hung below 6'-0" from finished floor, provide 'CAUTION' tape along the entire low-hanging section.
- D) Demolition
- 1) Disconnect, remove, and dispose of existing equipment and components that are indicated to be removed.
 - 2) Remove any existing concrete curbs under the supervision of a licensed structural engineer.
 - 3) Collect, remove, and dispose of any oil and refrigerant in accordance with codes.
 - 4) Equipment to be removed: disconnect and cap services and remove equipment.
 - 5) Equipment to be removed and reinstalled: disconnect and cap services and remove and store equipment. When appropriate, reinstall, reconnect, and make equipment operational.
 - 6) Upon completion of demolition, patch all openings, etc., and restore to same conditions as surrounding areas.
- E) Installation of Ductwork
- 1) General: Ductwork shall be supported and braced by SMACNA "Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Piping Systems", and to the currently adopted CBC and California Code of Regulations.
 - 2) Sheet metal ductwork.
 - a) Cross-break or kink flat surfaces to prevent vibration.
 - b) All supply and return air ducts to be internally lined.
 - c) Internally seal with mastic at joints.
 - 3) Connections:
 - a) Install and make necessary connections for the complete supply, re-circulation, and exhaust systems, including ductwork, collars, intake housings, hangers, connections, fasteners and other items required.

b) All air supply and return air ducts shall have their longitudinal and transverse seams tightly sealed to provide an air-tight system.

4) Volume dampers:

a) Provide adjustable volume dampers in branch supply ducts installed as part of this contract.

b) Locate the dampers as close as possible to the main duct.

c) Provide remote operating device where damper is inaccessible.

5) Fire dampers and combination smoke/fire dampers:

a) Install as required by governing Code.

b) Contractor shall confirm with local Fire Marshal that all required fire dampers are installed and in compliance with the local Code requirements.

F) General Ductwork Insulation

1) All ductwork, equipment and appurtenances handling air at temperatures above or below room ambient shall be insulated as generally described herein.

2) Installation shall be neat and workmanlike in appearance and quality of workmanship. Insulation shall be neatly cut at supports, etc., and beveled at inspection doors, unions, etc., and shall be first class in workmanship. Installation shall be in direct compliance with manufacturer's written and approved instructions for these particular materials.

3) Extraordinary care shall be taken during installation to eliminate or reduce dust and dirt to a minimum. Waste and debris shall be removed as it accumulates, but no less than daily.

4) Insulation shall be continuous through any wall, floor, or roof penetrations, other than at fire-rated walls and partitions.

5) Terminate insulation at fire-damper sleeves, and externally insulate damper sleeve to match adjacent insulation and overlap duct insulation a minimum of two inches.

G) Acoustical and Thermally Lined Ductwork

1) Location: All supply air and return air ductwork.

2) Application: adhere to metal using fire-resistive adhesive over 100% of the surface (plus weld pins or friction clips on 12" centers when duct dimensions exceed 24"). Air-side surface shall be uniform. No tufting allowed. Seal all raw edges.

- 3) Where ducts are lined on the interior, no external insulation is required.

H) Piping Insulation

- 1) All refrigerant piping, supply and return, between sections of split-system unit at Fountain Valley, shall be insulated.
- 2) Condensate overflow drain line shall be insulated for its entire length.
- 3) All workmanship shall reflect the best current practices in the trade. Contours on exposed work shall be smooth and continuous. Cemented laps, flaps, bands, and tapes shall be smoothly and securely pasted down. Adhesives shall be applied on a full-coverage basis, unless otherwise specified.
- 4) Install insulation over all joints, fittings, valves, strainers, flanges and unions and other specialties with a continuous thermal and vapor barrier.
- 5) Insulation shall be continuous through any wall, floor, or roof penetrations.
- 6) All piping to be fully pressure tested and approved before insulation is applied.
- 7) All joints shall be tight with insulation lengths tightly butted against each other. Use preformed fitting insulation or mitered fittings of the same material and density as adjacent piping. Each piece shall be butted tightly against adjacent pipe insulation, and finished with an insulating adhesive.
- 8) Where lengths are cut, cuts shall be smooth, and square and without breakage of end surfaces. Where insulation terminates, ends shall be neatly tapered and effectively sealed, or finished as specified. Longitudinal seam of exposed insulation shall be directed away from normal view.
- 9) All materials shall be clean and free of all oil and grease before insulation adhesives or mastics are applied. Solvent cleaning required to bring metal surfaces to such condition shall be provided.
- 10) Piping shall be covered with fiberglass pipe insulation with factory-attached, pre-sized, white glass cloth. Jackets, jacket laps, flaps, and bands shall be securely cemented in place with vapor-barrier adhesive. Jacket overlap shall be not less than 1-1/2". Jacketing bands for butt joints shall be 3" wide.
- 11) Unions: Insulate in same manner as fittings, flanges and valve bodies.
- 12) Pipe supports shall be installed on the outside of the insulation. An insert section of foamed glass or urethane pipe insulation (1/8" long) shall be installed at all supports of piping larger than 1 1/2" diameter. Insert sections shall be provided as specified herein.
- 13) The jacketing shall be continuous over all surfaces, including areas inside pipe sleeves, hangers, and other concealment.

- 14) Jacket laps, flaps, and bands shall be securely cemented in place with aluminum jacket sealant. Jacketing bands for butt joints shall be 6” wide.
- 15) All exposed longitudinal edges of aluminum jacketing shall be stiffened by bending a 1” hem on one edge.
- 16) Expansion joint shall provide for maximum and minimum dimensional fluctuations.
- 17) To prevent corrosion, the aluminum jacketing shall not come in direct contact with other type of metal.
- 18) At each pipe hanger protect insulation with 4 inch long, 18 gauge galvanized metal shield.
- 19) At all openings in jacket, an outdoor vapor barrier coating shall be applied for 2” in all directions; the jacketing shall be applied while waterproofing is tacky.

I) Piping Installation

- 1) Installation shall be the best standard practice of the trade. Inspect all piping prior to installation. Coupled short sections of piping, bushings, close nipples, long screws, bullhead tees and crosses are prohibited.
- 2) All drainage piping systems shall be pitched and valved to provide complete drainage and control of all systems.
- 3) Install piping to allow for expansion, using offsets necessary to prevent undue strain on piping. The springing of piping into place is prohibited. Required offsets, fittings, unions, flanges, and the like shall be furnished to allow valving-off for maintenance, removal, and repair with minimal removal of piping. Provide flexibility of equipment connections and branch line takeoffs with 3-elbow swing joints.
- 4) All piping shall be installed in such a manner as to prevent any undue noise from the flow of water under normal . Piping shall not come in contact with construction or partitions in a manner that would create noise or vibration in the wall or ceiling system. Maximum 6 fps velocity in pipes.
- 5) Where incompatible materials come in contact, they shall be isolated with the material best suited for that purpose.
- 6) Pipe supports shall be spaced a maximum of 10’-0” on centers, and provided with lateral seismic restraints.
- 7) Piping and ductwork shall be supported and braced by SMACNA “Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Piping Systems”, and to the currently adopted CBC and California Code of Regulations.

J) Painting:

- 1) All pipe supports shall be painted with zinc-based paint where original plating has been removed due to welding, threading or scraping.
- 2) Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangars and supports.
- 3) Galvanized surfaces; clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint.

K) Equipment Identification

- 1) Identify all equipment and each valve with numbered and labeled brass discs. Install in readily visible locations, not interfering with insulation. Minimum lettering size; ½ inch.
- 2) Fans, air conditioning units, etc.: laminated plastic showing identification number, HP, CFM capacity, service, static pressure, and electrical characteristics.
- 3) VAV terminals: laminated plastic showing zone number, set-point and minimum CFM. Zone number to be coordinated with Owner's existing system.
- 4) Identify all piping with laminated plastic bands, black with white engraved lettering. Locate bands at supply and discharge connections to equipment.

L) All equipment cleaned, primed and finish painted. All grease and oil spots shall be removed. Any damaged factory applied finishes shall be repainted, including preparation, prime and finish coats in accordance with manufacturer's recommendations. Any exposed surfaces subject to rust shall be wire-brushed and re painted.

M) Cleanup:

- 1) Cover all equipment and machinery to protect from dirt and water during construction. Cap all openings in ducts and pipes during construction.
- 2) Premises shall be kept reasonably clean and free from debris, dust, cuttings, and waste material. All debris, rubbish, leftover materials, tools and surplus equipment shall be removed from the site prior to final acceptance.
- 3) Prior to testing and balancing of systems, clean interior of duct systems and air handling equipment, and flush and thoroughly clean inside of all piping systems back to nearest isolation valve of pipe branch.

N) Start-Up: the Contractor will perform all equipment and systems start-up. Coordinate schedule with Owner.

O) Testing and Balancing:

- 1) Testing Organization: Qualified testing firm certified by Associated Air Balance Council (AABC), or NEBB, or firm shall submit proof that it meets technical standards for AABC membership as published in AABC National Standards for Field Measurement and Instrumentation, Total System Balance, Vol. 2, No. 12173.
- 2) Testing: In accordance with specified procedures and as described in AABC National Standards for Field Measurement and Instrumentation, Total System Balance, Vol. 2, No. 12173.
- 3) Includes:
 - a) Balancing of air systems, supply air, return air, exhaust air, outside air and ventilation air. Air supply to each space shall be on the basis of the drawings.
 - b) Testing of equipment.
 - c) Adjusting belt drives.
 - d) Test Reports
- 4) General Test Report Requirements:
 - a) Each Report: Certified by registered Professional Engineer qualified in testing, balancing, and adjusting of environmental systems.
 - b) Detailed Agenda: Include following narrative procedures, system diagrams and forms for test results:
 - c) Specific standard procedures required and proposed for each system. Additional procedures for variable flow systems shall be developed by testing organization and included for review and acceptance.
 - d) Specified test forms for recording each testing procedure and for recording sound measurements..
 - e) System diagrams for each air and water system. Diagrams may be single line.
- 5) Reports: Submit to Owner (3) copies of reports.
- 6) Include in report; types, serial numbers and date of calibration of instruments.

- 7) After completion of tests, submit complete test reports for acceptance. Identify in reports each item not conforming to Contract requirements, or obvious mal-operation and design deficiencies of equipment or controls; include explanatory comments in report.
- 8) Contractor: Submit final reports prior to requesting final inspection for Project.
- 9) Air System Test Reports for Split-system AC unit:
 - a) Include following installation data::
 - (1) Manufacturer and model.
 - (2) Size.
 - (3) Arrangement, discharge and class.
 - (4) Motor HP, voltage, frequency, phase and full load current.
 - (5) Location and local identification data.
 - (6) Design data for equipment listed in schedules, Drawings and Specifications.
 - b) Include following recorded fan test data, both at minimum and maximum flow; fan and air handling units.
 - (1) Air volume; actual supply air, outside air, return air and exhaust air.
 - (2) Suction discharge static pressure for each fan.
 - (3) Component pressure drops, coils, filters, sound attenuators, louvers, dampers, etc.
 - (4) Fan speed, RPM
 - (5) Economizer cycle air volume at minimum outside air and 100 percent outside air.
 - (6) Motor operating current and voltage, on each leg if three phase.
 - (7) Motor operating BHP.
 - (8) Pressure profile curves through air handling unit.
 - c) Variable air volume system: Record flow (CFM), pressure and motor load for system at full un-throttled capacity, at design (100 percent) flow and at 10 percent increments down to minimum attainable to verify fan tracking and control. Modulate systems by varying the room thermostat settings or changing internal load.
 - d) Include following recorded data for VAV terminals installed as part of this scope of work:
 - (1) Terminal identification, supply or exhaust, location, or space served and number designation.
 - (2) Type, size, manufacturer and catalog identification.
 - (3) Applicable factor for application, velocity, area, etc. and designated areas.
 - (4) Test each VAV terminal at maximum and minimum flow.
 - e) Field Tests: Field tests are required for Chillers, Boiler, Air handling system, fan-coil system, computer room AC unit, and VAV-reheat terminals.
- P) Perform final balancing after system has been completed and is in full working order. Put HVAC system into full operation and continue operation of system during each working day of balancing.

Q) Adjust system and components to perform as required, using procedures described in accepted agenda.

R) Conduct operating tests of coils, fans, and other equipment after stabilized operating conditions have been established.

S) Field Tests: Air Distribution Systems:

- 1) Balance systems to design ratings. Adjust fan speeds to provide design flows, including system diversifiers, at actual system pressures. Coordinate VAV balancing, including supply and return fan volume controls. Set supply fan static pressure control as low as practicable and still maintain required pressure at the terminal units. Damper restriction of system's total flow not allowed.
- 2) Adjust outside air and return air quantities for systems to within plus or minus 10 percent. Total supply air quantity for the system shall be not less than indicated.
- 3) Make flow and pressure measurements at each terminal device and each supply, return or exhaust diffuser. Adjust each air outlet unit within plus 10 percent or minus 5 percent of design requirements, but total air for each system shall be not less than shown. Readjust supply air to individual rooms if required to obtain design temperature in each room.
- 4) Test function of automatic dampers and operation of air terminal units. Check controls for proper operation.

T) Field Tests: Sound Levels

- 1) Perform tests to demonstrate compliance with requirements for air inlet and outlet terminals at three selected points to be designated in agenda.
- 2) Sound reference levels, formulas and coefficients shall be according to ASHRAE Handbook, 1999 HVAC Applications volume, Sound and Vibration Control.

U) Final Tests and Acceptance:

- 1) Perform necessary tests to demonstrate capacities and general performance of air systems to comply with Contract requirements.
- 2) At time of final inspection, recheck in presence of Owner random selections of data, air quantities, air motion and sound levels recorded in certified report.
- 3) Select points and areas for recheck to acceptance of Owner.
- 4) Use measurements and test procedures as accepted for work originally to form basis of certified report.

- 5) Retest: If random tests elicit measured flow deviation at 10 percent or more of rechecked test points, automatically reject report. In event report is rejected, readjust systems, retest, record new data, submit new certified report; make new inspection tests at no additional cost to Owner.
- V) Marking of Settings: Following final acceptance of certified reports permanently mark settings of valves, splitters, and other adjustment devices so that adjustment can be restored if disturbed at any time. Do not mark devices until after final acceptance.
- W) Pressure Tests
- 1) Ductwork: Perform testing in accordance with SMACNA Manual. Pressurize system to 150% of operating pressure and repair significant and audible leaks. Leakage shall be limited to 1% of design cfm from fan to first branch take-off to VAV boxes.

PART 4 – PROJECT COMPLETION

- A) Fully instruct the Owner’s operating personnel and demonstrate performance, operation and maintenance of equipment. Amount of time allocated for said instruction and demonstration of equipment and systems shall be part of this obligation.
- B) Furnish (2) complete reproducible sets of as-built drawings, and two on AutoCAD, latest version, to the Owner.
- C) Operating and Maintenance Manuals: Submit (3) copies of all operating instructions and maintenance manuals. Manuals shall be hard-cover three-ring binders, containing:
- 1) Identification, on outside cover, of the project name.
 - 2) Table of Contents.
 - 3) Complete instructions regarding the operation and maintenance of all equipment.
 - 4) Nomenclature of replaceable parts, their part numbers, and location of nearest vendor.
 - 5) Copy of all Warranties and guarantees showing dates of coverage.
 - 6) Separate Manual for the SEOC and another for the Admin Building
- D) Systems Operation Manuals
- 1) Provide a Systems Operations Manual that includes single-line diagrams and schematics for all major systems, controls drawings, sequences of controls, and a table of all set-points, instructions for emergency operations, seasonal adjustments, start-up and shut-down procedures, instructions for energy savings strategies, and recommended trend-logs.
 - 2) Provide three copies for Owners’ use, bound in 3-ring binders. Provide a Table of Contents and indexed tabs, in the following order:
 - a) Sequence of Operation
 - b) Control Drawings
 - c) Points List

- d) Controller data
- e) Thermostats and times
- f) Sensors and switches
- g) Valves and valve actuators
- h) Dampers and damper actuators

3) Provide three copies of all Manufacturers' catalogs for all installed equipment, including schematics, troubleshooting, and maintenance sections.

E) All items of this section must be furnished to Owner as a condition of final payment.

End of Mechanical Specifications

Following pages, which are part of the Scope of Work of this Contract include:

Exhibit 2: Electrical Specification

Exhibit 3: Controls Specifications

EXHIBIT 2: ELECTRICAL SPECIFICATION

PART 1: GENERAL

- A. **Scope of Work:** Perform, furnish and install all calculations, design, labor, material, equipment, and services necessary for electrical system connections to new Split-system Unit at Fountain Valley Admin Building, and new Heat Puypm Unit at SEOC Mission Viejo, and ancillary equipment, as indicated in the Heating Venting and Air Conditioning Specification, as a sub-contractor to the Mechanical Contractor (hereinafter referred to as the ‘Contractor’). Provide any supplementary labor or materials required for complete and properly operating installations, per the National Electric Code, whether or not indicated or specified. Provide all electrical equipment information required by other trades. Principal items of work include, but are not limited to the following:
1. Motor starters and disconnect switches. Provide new disconnect switches and accessories as required for the new split system and Heat pump.
 2. Circuit breakers, switches, fuses, wires, conduits, hangers, supports and accessories necessary for a complete electrical distribution system.
 3. Connections to all electrically operated equipment covered under this and other Sections of the Specifications such as fans, motor control devices, Building Energy Management System, controls, and detectors.
 4. Modifications and/or removal of existing electrical distribution system equipment as required to support new equipment installations.
- B. **Verification of conditions:** Verify existing conditions of the electrical distribution system equipment before planning and installing new electrical equipment. Document and report to the Contractor any conditions which impact or could potentially impact the proper completion of the work provided under this Scope.
- C. **Design Submittals:**
1. Submit within five (5) calendar days after contract award the following:
 - a. Disconnect Switches and Motor Starters.
 - b. All special or custom-built equipment
 - c. Overcurrent Protection Devices
 - d. Control Equipment
 - e. Junction boxes, conduit, and wire

2. On submittals, list manufacturers' names, model numbers, dimensions, type, rating, size and type of breakers, starters, gauge, finish, etc. which are pertinent to the construction or fabrication of the components. All equipment shall interface with existing equipment.
- D. Guarantee: All materials and workmanship shall be guaranteed for a minimum period of one year, but no less than manufacturer's guarantee, from date of final acceptance. Correct, repair and/or replace any work or material or equipment found to be faulty during that period, without expense of any kind to the Owner, immediately upon written notification.
- E. Ordinances, Codes, Permits, Inspections and Plan Check
1. Complete all work in accordance with the following rules, codes and regulations, all of which are hereby made a part and parcel of these Specifications:
 - a. California State Fire Marshal
 - b. Utility Company regulations
 - c. State of California Electrical Regulations
 - d. Applicable City or County Electrical Codes
 - e. Occupational Safety and Health Act
- F. Furnish without any extra charge, any additional material or labor, or both, when required for compliance with these rules, codes and regulations and where the work is not specifically memorialized in these Specifications.
- G. Secure and pay for all permits, plan checks, certificates or any inspection of any regulatory agency having jurisdiction over all or any part of the scope of work included. Before the final certificate of payment will be issued, deliver to Owner, via the Contractor, all certificates, permits and record drawings.
- H. Locations: Confirm locations through verification of existing conditions of all equipment to be installed.

PART 2: PRODUCTS

- A. General: All materials and equipment shall be new and in proper working condition when installed. Materials and equipment shall be of the same manufacturer throughout for each class or group. All materials and equipment shall be listed by UL and bear their label, where standards have been established for such materials. In addition, materials and equipment shall comply with the latest requirements of the following:
1. American Society of Testing Materials (ASTM)
 2. Insulated Power Cable Engineers Association (IPCEA)
 3. National Electrical Manufacturer's Association (NEMA)
 4. American National Standards Institute (ANSI)
 5. National Fire Protection Association (NFPA)

B. Equipment Feeder Overcurrent Protection: Circuit Breakers: Molded case, thermal magnetic, automatic trip, bolted type. Voltage and trip ratings as required for the application. Interrupting capacity of minimum 65,000A RMS for 480/277V and 14,000A RMS for 120/208V panelboards, unless available fault currents at the panelboard locations are greater than these values.

1. Circuit numbers of black-on-white laminated plastic tabs or other permanent type not readily changed from the front. Index cards behind heavy clear plastic in card holders on inside of doors.

C. Safety Switches

1. Heavy duty type, single throw disconnect switches. Provide only fused type for motor or equipment disconnects. Provide switches with the number of poles and the voltage, current and horsepower ratings as required.
2. Provide externally operable, quick-make, quick-break type with cover interlock and pad-lockable in either the open or closed position. Unless indicated otherwise provide switches indoors in NEMA rated enclosure suitable for the location. Provide each switch with a nameplate indicating equipment controlled.

D. Terminal Cabinets

1. Provide flush mounted types of sizes as required. Construct of legal gauge sheet steel with minimum 12 gauge doors and trim. Hinged, lockable doors shall have fully concealed hinges and fasteners (flat front construction).
2. Where different systems are served in one cabinet, provide full-height vertical metal barriers to form the section widths as indicated. Terminate all conduits in the proper section of such cabinets.
3. On the outside of cabinet doors, provide a nameplate (as specified elsewhere in this Section) giving the cabinet designation in 1/4" high letters, and on a second line, the type of system in 1/8" high letters. On multi-section cabinets, provide a main nameplate on the backboard in each section for the types of systems.
4. Where a system operates at 120 volts or higher, provide on each backboard in the system a red-on-white laminated plastic warning sign engraved in 1/4" high letters to read: "CAUTION – (indicate voltage) VOLT SYSTEM".

E. Nameplates

Provide a nameplate for control device or major item of electrical equipment. Provide black-on-white laminated plastic nameplates engraved in minimum 1/4" high letters to correspond with the designation on drawings. Provide other or additional information on nameplates where indicated.

Attach nameplates to equipment with rivets, bolts, steel metal screws. Cemented attachments will not be acceptable.

F. Conduit and Fittings

1. Furnish and install complete systems of conduit for all wiring systems indicated.
2. All conduit exposed and subject to mechanical damage shall be rigid galvanized steel or intermediate metal conduit.
3. EMT shall be used in walls and ceilings in sizes up to 2", 2-1/2" and larger shall be rigid aluminum or steel.
4. Use flexible conduit from J-Box to the device.
5. Use liquid-tight flex for motors and machinery connections.
6. All exposed conduit fittings shall be of the cast metal type, galvanized sherardized.
7. E.M.T. fittings shall be Steel compression, Insulated throat type connectors only.
8. Make all joints in conduit watertight.
9. Use watertight connections on all conduit connections to electrical cabinets located in areas where water and/or condensation may be present.

G. Wire and Cable

1. Furnish and install wire and cable necessary for the proper connection and operation of the equipment. All wires and cables shall be U.L. listed and labeled.
2. Deliver wire to the job in unbroken packages, bearing the U.L. and manufacturer's label. Wire or cable shall be marked every 24" along its entire length showing manufacturer's name, the maximum allowable voltage, insulation type and conductor gauge and type.
3. All conductors for lighting or power circuits, unless specifically indicated otherwise, shall be a minimum size of #12 AWG, copper, rated type THW, THWN or THHN insulation. #8 AWG and larger shall be stranded.

H. Motor Controllers

1. Coordinate the features of each motor controller with the ratings and characteristics of the supply circuit, the motor, the required control sequence, the duty cycle of the motor, drive, and load, and the pilot device, and control circuit affecting controller functions. Provide controllers that are

horsepower rated to suit the motor controlled.

2. Overload Relays: Ambient-compensated type with inverse-time-current characteristic. Provide with heaters or sensors in each phase matched to nameplate full-load current of the specific motor to which connected with appropriate adjustment for duty cycle.
3. Enclosures: For individually mounted motor controllers and control devices, comply with NEMA Standard 250, "Enclosures for Electrical Equipment (1000 Volts Maximum)." Provide enclosures suitable for the environmental conditions at the controller location. Provide NEMA Type 12 enclosures except as otherwise indicated.
4. Provide motor starters for all drive motors, except single phase motors scheduled to be provided with manual starters.
5. Manual starters shall have a melting alloy ambient compensated bi-metal type thermal overload relay. Manual starters shall be equipped with a pilot light.
6. Thermal units shall be selected on the basis of measured actual full load amps of the particular motor. Sizing shall be done with the motor and driven device in its final and normal operating condition. Provide temporary heaters with each starter until the motor is in the proper operating condition and replace with heaters sized to the actual full load amps.
7. Each starter operating at other than 120 volts single phase shall have a control transformer providing 120 volts control power. The transformer shall have fused primary and secondary circuits with two (2) primary fuses and one (1) secondary fuse.
8. Starters and contactors shall be equipped with the following:
 - a. Two (2) N.O. and two (2) N.C. sets of auxiliary contacts.
 - b. Red pilot light to indicate motor operations.
 - c. Green pilot light to indicate motor stopped.
 - d. Amber pilot light to indicate H-O-A switch in "auto" position.
 - e. All pilot lights shall be "push-to-test" type.
 - f. Magnetic contactors shall be the same as specified magnetic starters except without overload protection suitable for motor loads.
9. Two speed starters shall be equipped with "Auto-off-Low-High" Selector Switch.

I. Duct Smoke Detectors

1. Ionization type Smoke Detectors
 - a. Sensor: Responsive to both visible and invisible products of combustion. Sensors shall be self-compensating for changes in environmental conditions.

- b. Detector sensitivity; between .5 and 1.7 percent/foot smoke obscuration when tested according to UL 268A
- 2. UL 268A listed, operating at 24-V dc, nominal.
- 3. Plug-in arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. The fixed base shall be designed for mounting directly to the air duct. Provide terminals in the fixed base for connection to the building wiring.
- 4. Weatherproof Duct Housing Enclosure: UL listed for use with the supplied detector. The enclosure shall comply with NEMA 250 requirements for Type 4X.
- 5. Self-restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
- 6. Integral Visual-Indicating Light: LED type. Indicating detector has operated, and power-on status.
- 7. Each sensor shall have multiple levels of detection sensitivity.
- 8. Sampling tubes; Design and dimension in accordance with manufacturers' recommendations for the specific duct size, air velocity, and installation conditions where applied.
- 9. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

PART 3: EXECUTION

A. General

- 1. Completely coordinate all work relating to the enclosures and spaces provided for major items of electrical equipment.
- 2. Before any work is started, verify with the equipment manufacturer that equipment dimensions and arrangements will be compatible with the installation indicated and will provide for all required ventilation, clearances, access and work spaces.
- 3. During construction, coordinate with the Contractor to ensure that all clearances are maintained and that supporting facilities, such as ventilation and access means, are provided.
- 4. Should any major changes to the work indicated be necessary in order to comply with requirements, notify the Contractor at once and cease all work affected until approval for the required modifications has been obtained from the Owner.

B. Protection of the Work: Protect work at all times from damage, defacement or deterioration from any cause whatever. Provide proper storage facilities and conduct operations to this effect. Perform electrical work in such a manner as to protect the work of other trades. Repair or replace damaged electrical work and be responsible for correction of any damage done in the performance of electrical work to the work of other trades.

C. Equipment Connections: Where connections are indicated to electrical equipment furnished under other than this Section, do the following:

1. Verify the exact locations and electrical requirements from the equipment shop drawings or from the vendor.
2. Provide the required final connection as recommended and required.

D. Equipment Installation

Install all equipment and exposed conduit in such a manner to avoid obstructions, preserve head-room, keep openings, common areas and passageways clear for work of other trades. Any changes in the location of equipment or conduit which may be necessary in order to accomplish this shall be done at no cost increase to the Owner.

E. Structural Conditions: Boring holes or notching for conduit or equipment in any structural elements will not be permitted whatsoever without the prior written consent of the Structural Engineer.

F. Cutting Fitting and Patching: Do all cutting required for installation of this work, only after having secured the prior written approval of the Owner as to the location, manner and extent of the cutting required. Perform all patching and/or repairing under direction of, and to the satisfaction of, the Owner. All costs of patching and repairing shall not be borne by the Owner under any circumstances.

G. Identification of Circuits: Tag all conductors of every system in all locations in which they are accessible. Identification shall be as required by OSHA.

H. Grounding: Furnish and install all ground connections and permanently and effectively ground all electrical equipment per NEC Article 250.

- I. Preliminary Operation: Should the Owner request the operation of any portion of the system or equipment, for other than test purposes, prior to the final completion and acceptance of the work, arrange for such operation under the supervision of the Owner. Any cost for such preliminary operation shall be submitted to the Owner for approval before proceeding.

- J. Cleaning: Maintain all surfaces to be painted in a clean and smooth condition. Remove all foreign material and restore all damaged finishes.

- K. General Workmanship
 - 1. Use only competent and skilled personnel and perform all work including aesthetic as well as electrical and mechanical aspect to standards consistent with the best practices of the trade.
 - 2. Repair or replace without additional compensation any work which, in the opinion of the Owner, does not conform to these specifications.
 - 3. When the work is substantially complete and at a time selected by the Owner, demonstrate all equipment and systems to operate in accordance with requirements of the Contract Documents and verify that the equipment and systems are free of electrical defects.

PART 4: PROJECT COMPLETION

- A. Furnish (3) complete sets of as-built drawings, on AutoCAD, latest version, to the Owner

- B. Fully instruct the Owner's operating personnel and demonstrate performance, operation and maintenance of equipment. Amount of time allocated for said instruction and demonstration of equipment and systems shall be part of this obligation.

End of Electrical Specifications

EXHIBIT 3: DIRECT DIGITAL CONTROLS SPECIFICATIONS

PART 1: General

- 1) The control system shall consist of a high-speed, peer-to-peer network of DDC controllers, a control system server, and a web-based operator interface.
- 2) System shall use the BACnet protocol for communication to the operator workstation or web server and for communication between control modules. I/O points, schedules, setpoints, and trends.
- 3) The system shall be manufactured Automated Logic Control ('ALC') WebCTRL, in full compatibility and conformance with Owner's existing system.
- 4) Installer and Manufacturer Qualifications
 - a) Installer shall have an established working relationship with Control System Manufacturer.
 - b) Installer shall have successfully completed Control System Manufacturer's control system training. Upon request, Installer shall present record of completed training including course outlines.
- 5) Performance Standards. System shall conform to the following minimum standards over network connections. Systems shall be tested using manufacturer's recommended hardware and software for operator workstation (server and browser for web-based systems).
 - a) Graphic Display: A graphic with 20 dynamic points shall display with current data within 10 sec.
 - b) Graphic Refresh: A graphic with 20 dynamic points shall update with current data within 8 sec. and shall automatically refresh every 15 sec.
 - c) Configuration and Tuning Screens. Screens used for configuring, calibrating, or tuning points, PID loops, and similar control logic shall automatically refresh within 6 sec.
- 6) Product Data and Shop Drawings: Meet requirements of HVAC Specifications for Shop Drawings and Product Data. In addition, the contractor shall provide shop drawings or other submittals on hardware, software, and equipment to be installed or provided under this section. No work may begin on any segment of this project until submittals have been approved for conformity with design intent. Include:
 - a) DDC System Hardware
 - i) A complete bill of materials to be used indicating quantity, manufacturer, model number, and relevant technical data of equipment to be used.
 - ii) Wiring diagrams and layouts for each control panel. Show termination numbers.
 - iii) Schematic diagrams for all field sensors and controllers. Provide floor plans of all sensor locations and control hardware. Riser diagrams showing control network layout, communication protocol, and wire types.
 - b) Controlled Systems
 - i) Riser diagrams showing control network layout, communication protocol, and wire types.
 - c) Quantities of items submitted shall be reviewed but are the responsibility of the Contractor.
 - d) Project Record Documents. Upon completion of installation, submit three copies of record (as-built) documents. The documents shall be submitted for approval prior to final completion and shall include:

- i) Project Record Drawings. As-built versions of submittal shop drawings provided as AutoCAD compatible files and as 11" x 17" prints.
 - ii) Operation and Maintenance (O&M) Manual.
 - iii) As-built versions of submittal product data.
 - iv) Names, addresses, and telephone numbers of installing contractors and service representatives for equipment and control systems.
- e) Operator's manual with procedures for operating control systems: logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing setpoints and variables.
 - f) Training: Provide 8 hours of training of Owner's assigned personnel. Training shall take place at the Project site, and shall commence after all systems have been installed and running in normal operation. Working with Owner's personnel during the testing and balancing of the systems shall not be considered as training.
 - g) Training Materials: Training shall be furnished via instructor-led sessions using Owner's existing Controller. Contractor will modify course outlines and materials if necessary to meet Owner's needs, and Owner will review and approve course outlines and materials at least one week before class.
 - h) Warrant work as follows:
 - i) Warrant labor and materials for specified control system free from defects for a period of 12 months after final acceptance. Control system failures during warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner. Respond during normal business hours within 24 hours of Owner's warranty service request.
 - ii) Work shall have a single warranty date, even if Owner receives beneficial use due to early system start-up. If specified work is split into multiple contracts or a multi-phase contract, each contract or phase shall have a separate warranty start date and period.
 - iii) If the Contractor and Owner agree that equipment and systems operate satisfactorily at the end of final start-up, testing, and commissioning phase, the date of acceptance shall begin warranty period.

PART 2: Products

- 1) Materials: Use new products the manufacturer is currently manufacturing and selling for use in new installations. Do not use this installation as a product test site. Spare parts shall be available for at least five years after completion of this contract.
- 2) Communication:
 - a) Control products, communication media, connectors, repeaters, hubs, and routers shall comprise a BACnet internetwork. Controller and operator interface communication shall conform to ANSI/ASHRAE Standard 135, BACnet.
 - b) Install new wiring and network devices as required to provide a complete and workable control network.
 - c) Use existing Ethernet backbone for network segments marked "existing" .
 - d) Each controller shall have a communication port for temporary connection to a laptop computer or other operator interface. Connection shall support memory downloads and other commissioning and troubleshooting operations.
 - e) Workstation is Existing at the Fountain Valley location, for both Fountain Valley and Mission Viejo controls.

- 3) Operator Interface: All new equipment shall be connected to the Owner's existing WebCTRL Server.
- 4) Controller Software:
 - a) Furnish the following applications for building and energy management. All software application shall reside and operate in the system controllers. Applications shall be editable through operator workstation, or web browser interface.
 - b) Scheduling. Provide the capability to execute control functions according to a user created or edited schedule.
 - c) System Coordination. Operator shall be able to group related equipment based on function and location and to use these groups for scheduling and other applications.
 - d) Binary Alarms. Each binary object shall have the capability to be configured to alarm based on the operator-specified state. Provide the capability to automatically and manually disable alarming.
 - e) Analog Alarms. Each analog object shall have both high and low alarm limits. The operator shall be able to enable or disable these alarms.
- 5) Controllers:
 - a) General. Provide an adequate number of Building Controllers (BC), Advanced Application Controllers (AAC), Application Specific Controllers (ASC), Smart Actuators (SA), and Smart Sensors (SS) as required to achieve performance specified. Every device in the system which executes control logic and directly controls HVAC equipment must conform to a standard BACnet Device profile as specified in ANSI/ASHRAE 135, BACnet Annex L. Unless otherwise specified, hardwired actuators and sensors may be used in lieu of BACnet Smart Actuators and Smart Sensors.
 - b) BACnet:
 - i.) Building Controllers (BCs). Each BC shall conform to BACnet Building Controller (B-BC) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L, and shall be listed as a certified B-BC in the BACnet Testing Laboratories (BTL) Product Listing.
 - ii.) Application Specific Controllers (ASCs). Each ASC shall conform to BACnet Application Specific Controller (B-ASC) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L and shall be listed as a certified B-ASC in the BACnet Testing Laboratories (BTL) Product Listing.
- 6) Input and Output Interface
 - a) General. Hard-wire input and output points to BCs, AACs, ASCs, or SAs.
 - b) Protection. All input points and output points shall be protected such that shorting of the point to itself, to another point, or to ground shall cause no damage to the controller. All input and output points shall be protected from voltage up to 24 V of any duration, such that contact with this voltage will cause no controller damage.

END OF SECTION
END OF SPECIFICATIONS