

TECHNICAL SPECIFICATIONS

DIVISION 2: SPECIFICATIONS FOR THE CONSTRUCTION OF THE PROJECT

A) SCOPE OF WORK:

The Scope of Work under this contract includes mechanical and electrical services for the replacement of the air handling unit at the Municipal Water District of Orange County (Owner) facility. 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, functioning replacement of the existing system.

B) CONTRACTOR'S QUALIFICATIONS

- 1) Contractor is required to have capability to prepare the submittal documents.
- 2) Contractor shall have capability to furnish warranty service upon completion of the work.
- 3) All DDC controls work for the Building Automation System shall be performed by qualified technicians.
- 4) All electrical work required as part of this project shall be performed by Licensed Electrical Contractors. Electrical Contractor shall be qualified per NFPA-70E and California Title 8.
- 5) All materials and workmanship shall be guaranteed for a period of one year from date of final acceptance. Contractor shall provide a dedicated HVAC service team for this 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

- 1) The project includes new HVAC equipment, DDC controls, and related work.
- 2) All work shall conform to the requirements of all Applicable Laws. 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.
- 3) Responsibility: The construction of the entire scope of work under this RFP 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.

- 4) 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.
- 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 the 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) Ancillary Materials: The Contractor's Scope of Work shall include all supplementary parts and materials required to complete the work, even if not expressly 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 and to any related work, all of which shall conform to the Applicable Law.
- 8) Occupied areas: Construction may take place in areas of the building 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, are unsafe to employees, members, occupants, or visitors, or interfere with the normal conduct of business at the site.
 - a) Contractor shall provide and erect barriers, bollards, signage, and other devices to prevent employees, visitors, or occupants from entering the construction area.
 - b) Contractor shall maintain all exits free from barriers and/or obstacles to the path of travel.
 - c) 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.
 - d) 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.
 - e) 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.

- 9) 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 (1) one 8-hour day 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 site, 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 site to examine and memorialize any existing damage to the property, landscape, parking, or other improvements on the project site. The resulting record shall serve as a 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: The project intent is to prosecute the work to completion at the earliest practical date. Contractor shall assign a dedicated Project Manager as a single point-of-contact for the entire Project. 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 Project format. The Contractor's Project Manager shall conduct weekly meetings with the Owner 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 a complete Heating, Ventilating and Air Conditioning System in accordance with previously submitted proposal, as approved by Owner.
- C) All of the following items are included in the scope of work.
- 1) Furnish and install one 15,000 cfm draw-through chilled-water air handling unit, vertical stacked configuration, cooling only, as manufactured by McQuay Corporation, or equal.
 - 2) Connect chilled water piping and drainage piping to new unit. Provide valves as herein specified.
 - 3) Provide temporary cooling whenever construction occurs during building occupancy. It is intended that the work be performed on a Friday through Sunday construction window.
 - 4) Install an economy cycle controls system, including outside air and return air automatic dampers, connection for 100% outside air and exhaust, and for future connection to new Building Energy Management System.
 - 5) Furnish and install ductwork and transitions as required to install the new unit in the air-stream of the existing supply and return and outside air louver ductwork.
 - 6) Furnish and install smoke detectors as required.
 - 7) Remove and dispose of existing equipment to be replaced under the scope of this contract.
 - 8) Furnish all rigging, cranes, etc. required.
- 1) Connect and integrate Air Handling unit controls with Owner's existing Building Automation System (abbreviated as 'BMS' or 'EMS').
 - 2) Provide cutting, patching, painting, etc., for all areas affected by the scope of this contract, including new wall penetrations for economy cycle supply and exhaust louvers. It is intended that all work shall be confined to the Mechanical Room. No work which would require the removal, either temporarily or permanently, of the existing dropped ceiling panels is contemplated or intended for this project.

- 3) Furnish all necessary electrical connections.
 - 4) Furnish and install all curbs, sleepers, etc. required for the installation of the equipment under the scope of this contract.
 - 5) Provide all required subtrades for a complete project.
 - 16) Provide submittals, shop drawings, etc., for Owner's review.
 - 17) Obtain all Permits from regulatory agencies having jurisdiction.
 - 18) Provide testing & balancing:
 - a) Prior to commencing work, the Contractor shall perform an initial air flow test to verify the performance of the existing air handling unit, by recording the air volume (cfm) from each and every air supply outlet and return air inlet. Submit tabulated findings to the Owner.
 - b) Upon completion of the work, provide complete testing and balancing of the entire air supply and return system, as specified herein.
 - 19) Start-up, O&M Training, and assistance to the Owner's Representative as required.
 - 20) Unit pricing for additional work. The owner, at Owner's discretion may direct the Contractor to install a maximum of six new VAV-reheat zones. Provide total cost for six zones as part of this scope of work, and indicate the unit price for each zone, additive and/or deductive. Each zone will be complete with the following, and in accordance with the balance of this specification.
 - a) Variable volume terminal
 - b) Reheat coil
 - c) Thermostat, actuator, and controls
 - d) Connection to Central EMS station; CSI control, installed and programmed by Certified CSI dealer.
 - e) Associated piping and valves
 - f) Branch connection to existing ductwork; 15 feet of rigid, 12 inch by 12 inch insulated ductwork shall be included.
 - g) Complete installation, including hangars, supports, wiring, and accessories as required for a fully complete and operating VAV-reheat zone.
- D) 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, City requirements, ASHRAE, and any/all jurisdictions and/or regulatory agencies having authority. Mechanical Contractor shall be responsible for obtaining all required Building Department clearance and permits.

E) 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 members, employees or tenants or impedes egress or exiting shall be removed and relocated at contractor's expense.

F) Capacity:

- 1) Prior to ordering equipment, Contractor shall calculate the building heating and cooling loads, based upon Title 24 and ASHRAE standards, and shall provide evidence to the Owner that the specific equipment Contractor proposes to install is of suitable size and capacity for the intended use.
- 2) The load calculations shall reflect the actual building lighting, construction, and occupancy conditions. System shall maintain 74 deg. indoor in summer, 72 deg. indoor in winter, using ASHRAE weather data for the closest location to the site.
- 3) Prior to commencing work, the Contractor shall perform an initial air flow test to verify the performance of the existing air handling unit, by recording the air volume (cfm) from each and every air supply outlet and return air inlet. Submit tabulated findings to the Owner.

G) 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:

- 1) HVAC equipment, duct and piping layouts, indicating location of all valves, flanges, and measuring devices.
- 2) 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.
- 3) 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.
- 4) Specify the foundation and/or support requirements for mechanical equipment.
- 5) Drawings and calculations indicating the proposed method of providing electrical power to the proposed equipment.

H) Construction Submittals:

- 1) 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 following 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. Computer generated fan curves for the air handling unit shall be submitted with specific design operating point noted. A computer generated psychometric chart shall be submitted for each cooling coil with design points and final operating point clearly noted. Sound data for discharge, radiated and return positions shall be submitted by octave band for each unit. Calculations for required base rail 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 data of filter media, filter performance data, filter assembly, and filter frames.
 - 3) Provide manufacturer's installation instructions.

2) Provide submittals for the following equipment:

- a) Package Air Handling unit
- b) Ductwork
- c) VAV terminals
- d) Reheat coils
- e) Valves
- f) Accessories, including curbs and louvers
- g) Insulation
- h) Wiring Diagrams necessary for connection of equipment
- i) Modification to existing Temperature Control system
- j) Smoke Detectors
- k) Vibration Isolators

I) Coordinate work with other trades. Contractor shall manage the coordination with other sections of the specifications or with 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.

J) Performance:

- 1) Contractor shall guarantee the building air conditioning systems to maintain temperature of not more than 74°F in summer and not less than 72°F in winter.

K) Noise and Vibration Control:

- 1) HVAC system shall be designed per ASHRAE Design Guidelines for Office Buildings, assuming the provision of suspended acoustical ceiling and carpet.

- 2) All rotating equipment to have seismically-restrained vibration isolation.
 - 3) Dampers will be located so that their operation will not generate excessive noise in the occupied spaces.
- L) 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, starters (except on packaged AC units and chillers), 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
 - 5) All VFD's for HVAC system will be , set in place and connected.
 - 6) General construction including mechanical area walls, doors, ceilings, roofing, and wall construction and treatments.
 - 7) Structural steel for equipment supports as required.
 - 8) Cutting, patching, coring, painting, fire caulking/sealing, roofing, and framing of openings.
 - 9) Architectural sheet-metal or exterior louvers of any kind.
 - 10) Concrete for inertia base fill, concrete pads, or curbs.
 - 11) Painting: all walls which 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.
 - 12) Access doors in finished walls, ceilings, etc.
 - 13) Condensate drain piping, equipment drains, equipment floor drains, approved receptors, gas piping, make-up water, backflow preventers, pressure reducing valves/stations, and all final connections.
 - 14) Acoustical wall lining as may be required.

- 15) Demolition work.
- 16) Work performed outside normal working hours.
- 17) Structural calculations.
- 18) Air Balance report, independent testing of life-safety systems, duct pressure testing, etc.

PART 2. - PRODUCTS

- A) Air Handling Unit: Vertical Draw-through central station air handling unit, Daikin McQuay 'Vision' or equal.
- 1) General:
 - a) Configuration: Similar to existing.
 - b) Performance: 15,000 cfm, 3.5 inches TSP, 683,000 Btu/hr cooling capacity with 45 deg to 55 deg chilled water, 56/55 deg LDB/LWB.
 - c) Acoustics: Sound power levels based upon office occupancy standards. The manufacturer shall provide the necessary sound treatment to meet these levels if required.
 - d) Install in accordance with manufacturer's Installation & Maintenance instructions.
 - 2) Unit Construction
 - a) Fabricate unit with heavy gauge channel posts and panels secured with mechanical fasteners. Unit to include factory-furnished mixing plenum section, filter and coil section, and fan/discharge section. All panels, access doors, and ship sections shall be sealed with permanently applied bulb-type gasket. Shipped loose gasketing not permitted.
 - b) Panels and access doors shall be constructed as a 2-inch nominal thick; thermal break, double wall assembly, injected with foam insulation with an R-value of not less than R-13.
 - a. Inner liner and floor plate: G90 galvanized steel.
 - b. Outer panels: G90 galvanized steel.
 - c. Unit will be furnished with solid inner liners.

- c) Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, maximum 5 inches of positive or 6 inches of negative static pressure. Deflection shall be measured at the panel midpoint.
- d) The casing leakage rate shall not exceed .5 cfm per square foot of cabinet area at 5 inches of positive static pressure or 6 inches of negative static pressure.
- e) Module to module field assembly shall be accomplished with an overlapping, full perimeter internal splice joint that is sealed with bulb type gasketing on both mating modules to minimize on-site labor and meet indoor air quality standards.
- f) Access doors shall be flush mounted to cabinetry, with minimum of two six inch long stainless steel piano-type hinges, latch, and full size handle assembly. Access doors shall swing outward for unit sections under negative pressure. Access doors on positive pressure sections, shall have a secondary latch to relieve pressure and prevent injury upon access.
- g) A 6-inch formed G60 galvanized steel base rail shall be provided by the unit manufacturer for structural rigidity and condensate trapping. The base rail shall be constructed with 12-gauge nominal for unit sizes 003 - 035 and 10-gauge nominal for unit sizes 040 - 090. The required height of the base rail shall allow for adequate drainage by gravity. Should the unit base rail not be factory supplied at adequate height, the Contractor shall supply a concrete housekeeping pad to make up the difference.
- h) Drain pans shall be stainless steel with cross break and double sloping pitch to drain connection. Provide drain pans under cooling coil section. Drain connection centerline shall be a minimum of 3'' above the base rail to aid in proper condensate trapping. Drain connections that protrude from the base rail are not acceptable. Minimum 2'' thickness of insulation under drain pan.

3) Fan Assemblies

- a) Acceptable fan assembly shall be a double width, double inlet, class II, belt-drive type housed airfoil fan dynamically balanced as an assembly. Maximum fan RPM shall be below first critical fan speed. Fan assemblies shall be dynamically balanced by the manufacturer on all three planes and at all bearing supports.
- b) Copper lubrication lines shall be provided and extend from the bearings and attached with grease fittings to the fan base assembly near access door. If not supplied at the factory, contractor shall mount copper lube lines in the field.

- c) Fan motor shall be ODP premium efficiency motor, wired to Variable Speed Drive with fused disconnect.
- d) Fan and motor shall be mounted internally on a steel base. Factory mount motor on slide base that can be slid out the side of the unit if removal is required. Provide access to motor, drive, and bearings through hinged access door. Fan and motor assembly shall be mounted on 2" deflection spring vibration type isolators inside cabinetry. Seismic snubbers shall be provided.

4) Bearings, shafts and drives

- a) Bearings: Basic load rating computed in accordance with AFBMA - ANSI Standards. The bearings shall be designed for service with an L-50 life of 200,000 hours and shall be a heavy duty pillow block, self-aligning, grease-lubricated ball or spherical roller bearing type.
- b) Shafts shall be solid, hot rolled steel, ground and polished, keyed to shaft, and protectively coated with lubricating oil. Hollow shafts are not acceptable.
- c) V-Belt drives shall be cast iron or steel sheaves, dynamically balanced, bored to fit shafts and keyed. Fixed sheaves, matched belts, and drive rated based on motor horsepower. Minimum of 2 belts shall be provided on all fans with 10 HP motors and above. Standard drive service factor minimum shall be 1.1 S.F. for 1/4 HP – 7.5 HP, 1.3 S.F. for 10 HP and larger, calculated based on fan brake horsepower.

5) Electrical

- a) Fan motors shall be manufacturer provided and installed, Open Drip Proof, premium efficiency (meets or exceeds EPA requirements), 1750 RPM, single speed. Complete electrical characteristics for each fan motor shall be as shown in schedule.
- b) The air handler shall be ETL listed by Intertek Testing Services, Inc. Units shall conform to bi-national standard ANSI/UL Standard 1995/CSA Standard C22.2 No. 236.
- c) Wiring Termination: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclosed terminal lugs in terminal box sized to NFPA 70.
- d) Manufacturer shall provide ASHRAE 90.1 Energy Efficiency equation details for individual equipment to assist Building Engineer for calculating system compliance.
- e) Contractor shall provide GFI receptacle within 25 feet of unit to satisfy National Electrical Code requirements.

f) Air handler manufacturer shall provide, mount and wire variable speed drive with electrical characteristics such as indicated and shown on manufacturer's data sheets.

g) Air handler manufacturer shall provide and mount a 120V transformer.

6) Cooling Coil

a) Certification: Acceptable coils shall be certified in accordance with AHRI Standard 410 and bear the AHRI label. Manufacturer must be ISO 9002 certified.

b) Provide access to coils for service and cleaning. Enclose coil headers and return bends fully within unit casing. Unit shall be provided with coil connections that extend a minimum of 5" beyond unit casing for ease of installation. Drain and vent connections shall be provided exterior to unit casing. Coil connections must be factory sealed with grommets on interior and exterior panel liners to minimize air leakage and condensation inside panel assembly. If not factory packaged, Contractor must supply all coil connection grommets and sleeves. Coils shall be removable through side and/or top panels of unit without the need to remove and disassemble the entire section from the unit.

- 1) Headers shall consist of seamless copper tubing to assure compatibility with primary surface. Headers to have intruded tube holes to provide maximum brazing surface for tube to header joint, strength, and inherent flexibility. Header diameter should vary with fluid flow requirements.
- 2) Fins shall have a minimum thickness of 0.0075 inch copper plate construction. Fins shall have full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer. Tubes shall be mechanically expanded into the fins to provide a continuous primary to secondary compression bond over the entire finned length for maximum heat transfer rates. Bare copper tubes shall not be visible between fins. Coil shall include Electro-fin corrosion protection coating.
- 3) Coil tubes shall be 5/8 inch OD seamless copper, 0.020 inch nominal tube wall thickness, expanded into fins, brazed at joints. Soldered U-bends shall be provided to minimize the effects of erosion and premature failure having a minimum tube wall thickness of .025 inches.
- 4) Coils shall have a factory-applied corrosion resistant coating, such as 'Luvata,' or equal. On-site application not acceptable. Submit product information for approval.

- 5) Coil connections shall be carbon steel, NPT threaded connection. Connection size to be determined by manufacturer based upon the most efficient coil circuiting. Vent and drain fittings shall be furnished on the connections, exterior to the air handler. Vent connections provided at the highest point to assure proper venting. Drain connections shall be provided at the lowest point to insure complete drainage and prevent freeze-up.
- 6) Coil casing shall be a formed channel frame of stainless steel.

7) Filters

- a) Furnish flat panel filter section with 4-inch pleated MERV 8 filter with microbial resistant coating. Provide side loading and removal of filters.
- b) Filter media shall be UL 900 listed, Class I or Class II.
- c) Filter Magnehelic gauge(s) shall be furnished and mounted by others.
- d) Provide one extra set of filters for change-out after completion of construction.

8) Ultraviolet (UV) Germicidal Lamps

- a) The air handling unit manufacturer shall furnish and install, including interconnecting wiring and safety interlocks, a heavy-duty UVC germicidal irradiation system using short wave UVC germicidal lamps within the air handler.
- b) Intensity: The minimal UV energy striking a targeted surface shall be sufficient to destroy a monolayer of common mold and fungi within six hours.
- c) Lamps and fixtures are to be installed in sufficient quantity and in such a manner to ensure equal distribution of UV energy across the cooling face and drain pans.
- d) Lamps: Each lamp shall contain no more than 8 milligrams of mercury consistent with current environmental practices and shall be capable of producing its specified output in temperatures of 55 - 135° and airflow velocities up to 1000 fpm. Useful lamp life shall be 9,000 hours with no more than 20% output loss at the end of one year, continuous use. Lamps shall be constructed of UV proof metal bases and shall not produce ozone or other secondary contamination.
- e) Fixtures: Each fixture shall be constructed of stainless steel. Galvanized steel or aluminum is not acceptable. All integral parts of the fixture shall be self-contained. Fixtures constructed to UL drip proof design and equipped with safety approved fixture-to-fixture plugs to facilitate UL approved multiple fixture and row coupling to A/C power. The UV assembly shall include mechanical interlocks to prevent energizing unless the system is properly installed.

- f) Power Supplies: The power supply shall be electronic, high-efficiency type capable of producing the required coverage at no more than 80 watts of power consumption for each four square feet of cross sectional plenum area. Power supply shall be matched to the lamp and designed to maximize photon production, radiance and reliability. Electronic power supply shall be UL listed for application in airstreams between 55 and 135 deg F.
- g) Portal: The UV lamp plenum area shall be equipped with a portal for viewing the lamp assembly. Portal shall be constructed to allow viewing without the possibility of exceeding the Minimal Erythermal Dose.
- h) Testing and Safety Listing: UV fixtures shall have been tested and listed as UL/C-UL under Category Code ABQK (accessories, air duct mounted), UL Standards 153, 1598 and 1995 respectively, no exceptions. Manufacturer of UVC components shall be ISO 9001 certified.
- i) Installation by Air Unit Manufacturer: Air handling unit factory authorized and trained service technicians shall install the tubes in the air-handling units after the units have been installed. UV light manufacturer is to certify installation has been such that UV reflective and shadowed energy losses are the lowest possible. Cumulative sum length of UV fixtures end-to-end shall equal the coil width \pm 3 inches. System shall be installed a minimum of 8 inches and maximum of 20 inches from coil surface (based on manufacturer's calculations and recommendations.) One row of lamps shall serve not more than 48 inches of coil height. Installation shall be installed on tracks allowing the UV fixture to slide into place. Tracks shall be designed in such a manner the UV fixture can be easily removed and maintained or replaced. Multiple UV assemblies shall connect via interlock. Fixture rows shall be terminated to factory supplied hard-wired module. Light rows shall be mounted so UVC covers the entire coil face and drain pan surfaces as well as line-of-sight airstream. Installation shall include all mechanical interlock and wiring to assure UV light assembly is not energized when any access door is opened. Include detailed drawings showing the fixtures' locations in all operation and maintenance manuals.

B) Vibration Isolation and Noise Control:

- 1) All mechanical equipment will be isolated from the structure by means of resilient or spring vibration and noise isolators. Submit manufacturer's recommended equipment.
- 2) Use Mason Industries, or M.W. Sausse, or equal.
- 3) Isolation for major HVAC machinery will be 2" deflection. Provide inertia bases as required.

C) 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.

D) Dampers:

- 1) Provide balancing volume dampers in each main supply-air duct installed within the mechanical room, under this contract, to provide for complete air balancing. Fit each manual volume damper with bearings and an adjusting device having a locking mechanism.
- 2) Dampers shall be stamped blade or airfoil design as scheduled.
- 3) Fire Dampers: shall be a standard manufactured item, Units shall be tested and listed by UL, and constructed in accordance with, NFPA, CSFM, and local fire department and building department requirements. Dynamic type fusible link out of the airstream type. Horizontal dampers to include blade-lock and stainless steel closure ring. Each unit shall have Manufacturer's name and model number identified. Provide suitable access for inspection and service of each damper. As manufactured by Pottorff or Ruskin, or equal.
- 4) Combination fire and smoke dampers: Shall be louver blade type, leakage rated combination fire/smoke dampers. End switches where required for life-safety monitoring. Units shall be tested and listed by UL, and constructed in accordance with NFPA, CSFM, and local fire department and building department requirements. Dampers shall be a minimum Class 1, 250 deg .F. leakage/temperature rating, with maximum leakage of 4 cfm per square foot of damper area at 1" W.G. As manufactured by Pottorff or Ruskin, or equal.
- 5) Isolation Dampers: Airfoil blade with jam and blade seals.

E) Ducts, plenums, and sheet Metal Work:

- 1) 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.
- 2) All ductwork to be rigid galvanized steel.
- 3) All connections to main cold supply ducts shall be made with low loss fittings.
- 4) 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.

- 5) Transverse joints on all supply ducts shall be sealed with mastic for all medium pressure applications.
- 6) 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.
- 7) Lock joints shall be hammered to make them airtight. Inside of duct shall present a smooth surface to air-flow.
- 8) 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.
- 9) 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.
- 10) 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.
- 11) Pipes, conduits, structural members, or any other material may not pass through ductwork.
- 12) 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.
- 13) Verify approval of material with local authorities.
- 14) 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.
- 15) 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.

F) Controls:

- 1) Provide new dampers, and controls suitable to utilize 100% outside air 'economy cycle' as weather permits.
- 2) Provide a stand-alone Economy Cycle module, BACnet compatible, by ALC, Johnson Control, Siemens, or equal. Provide start-stop and monitoring control to the Owner's existing Energy Management System as per existing EMS.

- 3) Proximity to chemical vapors: Provide capability to monitor outside air and restore system to minimum outside air when odor conditions exist, as directed by the Owner. System shall re-set to economy cycle after an adjustable preset time, as directed by the Owner.

H) Variable Speed Drive:

- 1) Adjustable speed AC drives to be Asea Brown Boveri (ABB) Model ACH-400, or equal.
- 2) Include: NEMA 1 enclosures, 460/3/60 rated, UL approval, customer training, 2 year standard warranty, 3 contactor manual bypass, fused door interlock disconnect switch, and the following:
- 3) Power-on, bypass drive, safety indication lights.
- 4) Normal-off-test switch.
- 5) Motor overload relay (with aux. Contact for alarm if tripped).
- 6) External fault termination switch (smoke detector).
- 7) Communication module interface
- 8) Manual speed potentiometer.
- 9) Complete factory testing and certification.

I) Variable Volume terminal units ('VAV Terminals')

- 1) Certify that units have been tested and rated in accordance with ADC Test Code 1062R4, in an ADC certified laboratory.
- 2) In accordance with NFPA 90A, and UL 733 for internal insulation, coating and adhesive to meet flame and smoke requirements.
- 3) Pressure independent control, reset for airflow between zero and maximum cfm. Airflow limiters not permitted.
- 4) Low static pressure requirement; 0.5 inches of water gauge, maximum.
- 5) Casings: 22 gauge galvanized steel, internally lined with $\frac{3}{4}$ 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.
- 6) Label each unit with unit number, and air volume settings.

- 7) 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 overstroking. Damper seal of closed-cell foam gasket to limit leakage.
- 8) Controller: Controller reset span of 5 psi regardless of cfm selection. 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 existing EMS system.

J) Reheat Coils:

- 1) Factory installed on VAV terminal unit discharge.
- 2) Steel casing, copper tubes, aluminum fins at a maximum of 10 fins per inch.
- 3) Leak test at 300 psig.
- 4) At each hot water supply connection; shut-off valve, strainer, gauge cock and union for easy removal of coil. At each hot water return connection; union, vent, gauge cock, thermometer well, 2-way control valve, balancing valve and shut-off valve.

K) Piping:

- 1) All piping in accordance with ASTM and ANSI latest Standards.
- 2) Heating hot water piping: Match existing piping material.
- 3) Equipment vents, relief valve discharge: Galvanized Steel, schedule 40

L) Valves and fittings:

- 1) General: The system shall be provided with valves so located and arranged to give complete regulating control over all systems.
 - a) All valves to be of the same size as the upstream pipe.
 - b) Valves shall be installed on both sides of all equipment and fixtures, on risers, and on all branch mains.
 - c) All valves to be easily accessible for maintenance and adjustment control.
 - d) Valves of similar service to be by same manufacturer.

- 2) Applications: Unless otherwise noted, the following shall apply:
 - a) Shutoff service; Ball or butterfly valves.
 - b) Throttling service: Angle, ball, butterfly or globe valves
 - c) Main shut-off valves at equipment: provide ¾-inch ball drain valve. Pipe to nearest drain.
- 3) Types:
 - a) Gate valves: Nibco S-113, 125 bronze, solder joint ends, or equal. Nibco T-113, 125 lb. Bronze, screwed ends. Nibco F-619, 125 lb. Iron body bronze mounted, flanged.
 - b) Globe valves: Nibco S-211, 125 bronze, solder joint ends or equal. Nibco T-211, 125 lb. Bronze, screwed ends. Nibco F-918, 125 lb. Iron body bronze mounted, flanged.
 - c) Check valves: Nibco S-413, 125 bronze, solder joint ends or equal. Nibco T-413, 125 lb. Bronze, screwed ends. Nibco F-918, 125 lb. Iron body bronze mounted, flanged.
 - d) Ball valves: Nibco S-580, 125 bronze, solder joint ends or equal. Nibco T-580, 125 lb. Bronze, screwed ends. Nibco F-510, 150 lb. Carbon steel, flanged.
 - e) Butterfly valves: Nibco or Wheatley, or equal 200 lb. Wafer style with lever lock handle.
 - f) Two-way thermostatic valves: Self-contained, bronze solder joint ends. Honeywell V4043 screwed or flanged ends. Honeywell 5086, Bell & Gossett TM-21 or equal.
 - g) Two-way electric valves: 24 V actuator, bronze solder joint ends. Honeywell V 4043, screwed or flanged ends or equal. Honeywell V-5011 or equal.
 - h) Three way electric valve: 24 V actuator, screwed or flanged ends. Honeywell 5013 or equal.
 - i) Balancing valves: Bronze solder joint ends with test ports. Bell & Gossett or Wheatley circuit balancer or equal.
- 4) At Contractor's option, a 'Triple Duty Valve' or equivalent may be used at the discharge of pumps in place of check, balancing, and gate valves. Triple Duty Valve shall be of the same size as the piping.
- 5) Flow Control Valves: Automatic pressure compensating type. Valves shall be factory set and have a minimum operating pressure of 2 psi. All working parts shall be stainless steel. Provide certified performance data. Provide metal identification tags for each valve, plus one dual hose meter kit for testing, to be turned over to maintenance personnel, Griswold, Autoflow Flow Control or equal.

- 6) Pressure Operated bypass valve; High capacity angle type back pressure valve, adjustable range 10-70 psi. Screwed connections, bronze body and trim. Cash Acme K-5 or equal.
- 7) Dielectric isolators: Wherever incompatible materials come in contact.
- 8) 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 or equal.
- 9) Pressure Relief valves: ASME rated, properly sized for the system in which installed, and with discharge piping run to the nearest approved receptor.
- 10) Thermometers: Mercury or vapor tension actuated with not less than 4-1/2' diameter dial. Rigid stem and adjustable separable stainless steel socket, bottom connection for direct pipe or duct mounting. Armor protected stainless steel seamless tubing and sensing bulb, back connected, flush mounted on gauge board for remote sensing. Install at inlet and discharge of all heat exchanging equipment piping, including, but not limited to, boilers, air handler, and cooling coils. Not required at reheat coils. Phenol, aluminum or brass case. Range as required. Trefice or equal.

11) Pressure Gauges

- a) Bourdon spring type with non-corrosive movement, cast iron case, black flange, press brass rings. Case and rings black enamel finish, minimum 2-1/2" dial with white background. Black lines and figures. Ranges as required.
- b) Install at inlet and discharge of air handling unit and cooling coils.

13) Fittings:

- a) Fitting 2-1/2 inches and larger: Butt welded steel, ANSI B16.9, same thickness as connecting pipe. Elbows shall be long radius type.
- b) Fittings to 2 inches: Malleable iron ANSI B16.3, screwed type or butt welded steel with same wall thickness as connecting pipe.
- c) 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 or equal.
- d) 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.

- M) 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.
- N) 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.
- O) Insulation:
- 1) All thermal insulation shall comply with the State of California Energy Conservation Standards. All supply air ducting shall be wrapped or lined as specified herein.
 - 2) Thermal Duct Insulation: Insulate all cold supply air ducts and plenums unless otherwise specified, with J-M Microlite fiberglass duct insulation, or equal, foil-faces, 1 lb. density, 1-1/2 inch thick insulation wrapped entirely around duct with joints lapped at least 2 inches and secured with staple bonds. All joints to be taped and sealed. Insulation shall cover all surfaces including standing seams.
 - 3) Piping 2 inches and smaller: 1 inch thick insulation.
 - 4) Piping larger than 2 inches: 1-1/2 inch thick insulation.
 - 5) Fittings, valves, flanges, shall be insulated with thermally equivalent thickness of fiberglass insulation, with PVC fitting covers, suitable for easy removal and re-attachment.
 - 6) Areas of equipment which may be subject to sweating shall be insulated.
- P) Acoustical and thermally lined ducts:
- 1) Supply and return ducts in mechanical equipment room shall be internally lined.
 - 2) 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.
 - 3) Certain-Teed, Owens Corning, Johns Manville Duct liner or equal.

PART 3. - EXECUTION

- A) General: Examine the project area and conditions prior to commencing any work. Document and report any conditions which 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.
- C) The Contractor has sole responsibility to implement any and all safety precautions in the hoisting and installation of materials and equipment.
- D) Demolition
 - 1) Disconnect, remove, and dispose of existing equipment and components 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 code.
 - 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: 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.
 - 2) Sheet metal ductwork.
 - a) Cross-break or kink flat surfaces to prevent vibration.
 - b) All supply and return air ducts lined with flexible blanket type insulation with plastic coating to air stream.
 - 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 all main supply ducts installed as part of this contract.

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

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 Applicable Law.

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) At fire rated walls and partitions; install insulation continuously through penetrations of fire-rated walls and partitions. 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 within the mechanical room.
- 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 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.
- 2) Install insulation over all joints, fittings, valves, strainers, flanges and unions and other specialties with a continuous thermal and vapor barrier.
- 3) Insulation shall be continuous through any wall, floor, or roof penetrations.
- 4) All piping to be fully pressure tested and approved before insulation is applied.
- 5) 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.
- 6) 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.
- 7) 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.
- 8) Piping shall be covered with a 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.
- 9) Unions: Insulate in same manner as fittings, flanges and valve bodies.

- 10) 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.
- 11) The jacketing shall be continuous over all surfaces, including areas inside pipe sleeves, hangers, and other concealment.
- 12) Jacket laps, flaps, and bands shall be securely cemented in place with aluminum jacket sealant. Jacketing bands for butt joints shall be 6" wide.
- 13) All exposed longitudinal edges of aluminum jacketing shall be stiffened by bending a 1" hem on one edge.
- 14) Expansion joint shall provide for maximum and minimum dimensional fluctuations.
- 15) To prevent corrosion, the aluminum jacketing shall not come in direct contact with other type of metal.
- 16) At each pipe hanger protect insulation with 4 inch long, 18 gauge galvanized metal shield.
- 17) 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 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 use. Piping shall not come in contact with ceiling construction or partitions in a manner which would create noise or vibration in the wall or ceiling system.
- 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.

K) 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.

L) 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 handling units, etc.: laminated plastic showing identification number, HP, CFM capacity, service, static pressure, and electrical characteristics.
- 3) VAV-reheat terminals: laminated plastic showing zone number, set-point and minimum CFM.
- 4) Identify all piping with laminated plastic bands, black with white engraved lettering. Locate bands at supply and discharge connections to equipment.

M) 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.

N) 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 air and water 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.
- O) Start-Up: All equipment and systems start-up will be performed by the Contractor. Coordinate with Owner.

P) 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 proportional area of the space vs. the proportional cfm of the system.
 - b) Balancing of hot water reheat coils added as part of this project.
 - c) Testing of equipment.
 - d) Adjusting belt drives.
 - e) Test Reports:
 - f) Sound levels at selected locations.
 - g) Retests of air systems, water systems, and sound levels subsequent to corrective construction work.
- 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. Additional test forms for variable flow systems shall be developed by testing organization and submitted for review and acceptance.
 - 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:
 - 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 duct system data at the mechanical room:
 - (1) Duct air quantities, at maximum and minimum airflows: outside air, total air and exhaust.
 - (2) Duct size.
 - (3) Number of Pitot tube pressure measurements.
 - (4) Sum of velocity measurements. Do not add pressure measurements.
 - (5) Average velocity.
 - (6) Residual pressures at inlet of variable air volume boxes.
 - (7) Recorded test air volume.
 - (8) Design air volume.
 - (9) Actual pressures at static pressure control points (static pressure controllers).
- e) Include following recorded data for VAV boxes 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 box at maximum and minimum flow.
- f) Water system Test Reports Shall Include the following coils recorded data for reheat coils added as part of this project
 - (1) Type of equipment and identification, location or number designation.
 - (2) Entering and leaving air conditions.
 - (3) Entering and leaving water temperatures.
 - (4) Face velocity in FPM (at coils).
 - (5) Volumetric flow rate, air and/or water (CFM and/or GPM).
 - (6) Water pressure drop and/or air pressure drop.
 - (7) Temperature rise or drop.
- g) Water system Test Reports Shall Include the following coils recorded data:
 - (1) Type of equipment and identification, location or number designation.
 - (2) Entering and leaving air conditions.
 - (3) Entering and leaving water temperatures.
 - (4) Face velocity in FPM (coils).
 - (5) Volumetric flow rate, air and/or water (CFM and/or GPM).
 - (6) Water pressure drop and/or air pressure drop.
 - (7) Temperature rise or drop.

- h) Field Tests: Field tests are required for Air handling system and VAV-reheat terminals.
- Q) 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.
- R) Adjust system and components to perform as required, using procedures described in accepted agenda.
- S) Conduct operating tests of cooling coils, reheat coils, fans, and other equipment after stabilized operating conditions have been established.
- T) 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. V-belt drives, including fixed pitch requirements. 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 remote terminal units. Damper restriction of system's total flow not allowed.
 - 2) Record pressure drop readings across major system components and significant drops within duct systems.
 - 3) 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.
 - 4) 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.
 - 5) Adjust exhaust system to CFM requirements.
 - 6) Test function of automatic dampers and operation of air terminal units. Check controls for proper operation.
- U) Field Tests: Water Distribution Systems:
- 1) Perform final water balance after system has been flushed, cleaned and filled.
 - 2) Balance water system to provide required quantity to or through each component. Water balance includes performance readings on pump, coils, and flow measuring devices. Adjust pump flows to actual system heads by adjustment of balancing valves. Flow measuring devices take precedence over pump head readings. Record discrepancies for evaluation. Tabulate both design and test data.

- 3) Make adjustments to distribution systems by means of balancing devices (cocks, valves and fittings) and automatic flow control valves as provided; do not use service valves for purpose of balancing.
- 4) Report pressure drop ratings across major system components both for flow determination and deviations between actual and design values.

V) Field Tests: Sound Levels

- 1) Perform tests to demonstrate compliance with requirements for variable volume boxes and 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.

W) Final Tests and Acceptance:

- 1) Perform necessary tests to demonstrate capacities and general performance of air and water systems comply with Contract requirements.
- 2) At time of final inspection, recheck in presence of Owner random selections of data, water and 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.

X) 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.

Y) Pressure Tests

- 1) Piping: Test chilled water piping hydrostatically to 150 psi for two hours. With system valves capped and pressure apparatus disconnected, test shall show no change in pressure.

- 2) 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 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 set of as-built drawings, and two computer files, on AutoCAD, latest version, to the Owner.
- C) Operating and Maintenance Manuals: Submit (3) hard 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.
- D) Operating and Maintenance 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, and one electronic copy. 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:

Exhibit 1: Electrical Specifications

Exhibit 2: Substitution Request Form

EXHIBIT 1: ELECTRICAL SYSTEM 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 replacement air conditioning unit, and ancillary equipment, as indicated in the Heating Venting and Air Conditioning Specification,. Provide any supplementary labor or materials required for a complete and properly operating installation, 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 air-handling unit.
 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 30 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 period of one year 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, 240V and 600V 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.

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.

J. 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 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.
- C. Warranty: Include all warranty documents on all installed equipment, materials, and labor for five years from date of start-up for beneficial use.

End of Electrical Specifications

EXHIBIT 2

SUBSTITUTION REQUEST FORM:

(Bidders shall use this or similar form to identify any non-specified items. Add additional pages as required).

To: _____
Re: _____
Date: _____

Gentlemen:

We hereby submit for your consideration the following product instead of the specified item for the above project:

Specified item: _____
Substituted item: _____

Attached are complete technical data, including laboratory reports as applicable, as required by the Specifications. Also included is complete information regarding changes to drawings and specifications that the proposed substitution will require for proper installation.

(COMPLETE THE FOLLOWING :)

Does the substitution affect the dimensions allocated for the specified item? Yes: _____ No: _____

What effect does the substitution have on other trades? _____

What are the differences between the specified item and the proposed substitution?

Indicate any differences in manufacturer's warranties between the specified item and the proposed substitution.

Indicate the savings in cost between the specified item and the proposed item. Include total installed costs, including work of other trades. _____

The undersigned states that the function, appearance, and quality of the substitution are equivalent to or superior to the specified item.

The undersigned states that the project schedule is not affected by this substitution.

Submitted by:
(Contractor): _____

Name: _____ Date: _____

OWNER'S RESPONSE:

Accepted: ___ Not Accepted: ___ Accepted as Noted: _____

Owners Signature: _____ Date: _____

Remarks: _____

End of Exhibit 2