SECTION 01400

PROJECT SUSTAINABILITY REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

Section includes requirements for project compliance with the City of Livermore's Green Ordinance requirements for new construction. A copy of the checklist for the Project is attached. The Contractor shall be responsible to make sure the checklist requirements are fully complied with for the following activities:

A. Site work including landscaping (Phase IA)
B. Procurement and construction (Phase IB)
C. Commissioning in accordance with the Commissioning specification section attached (Phase IB)
D. Construction waste management in accordance with the Construction waste management specification section attached (Phase IB)
E. Submittal of all documentation required by the City of Livermore Green Ordinance for items 1 through 4 above.
F. Contractor shall review this section and include with the bid a list of exceptions to the requirements herein, if any.
G. Contractor shall review this section and include with the bid a list of conflicts, if any, between the requirements herein and any other contract document, for Owner's resolution.

1.02 Related Sections:

A. Comply with Section "Construction Waste Management".
B. Comply with Section "Commissioning".

1.03 DEFINITIONS

A. **Chain-of-Custody Certificates:** Certificates signed by manufacturers certifying that wood used to make products was obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship." Certificates shall include evidence that manufacturer is certified for chain of custody by an FSC-FSC-accredited certification body.
B. **LEED:** Leadership in Energy & Environmental Design.
C. **Rapidly Renewable Materials:** Materials made from plants that are typically harvested within a 10-year or shorter cycle. Rapidly renewable materials include products made from bamboo, cotton, flax, jute, straw, sunflower seed hulls, vegetable oils, or wool.
D. **Regional Materials:** Materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site. If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value.

E. **Regionally Manufactured Materials:** Materials that are manufactured within a radius of 500 miles from Project site. Manufacturing refers to the final assembly of components into the building product that is installed at Project site.

F. **Regionally Extracted and Manufactured Materials:** Regionally manufactured materials made from raw materials that are extracted, harvested, or recovered within a radius of 500 miles from Project site.

G. **Recycled Content:** The recycled content value of a material assembly shall be determined by weight. The recycled fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value.

H. "**Post-consumer**" material is defined as waste material generated by households or by commercial, industrial, and institutional facilities in their role as end users of the product, which can no longer be used for its intended purpose.

I. "**Pre-consumer**" material is defined as material diverted from the waste stream during the manufacturing process. Excluded is reutilization of materials such as rework, regrind, or scrap generated in a process and capable of being reclaimed within the same process that generated it.

1.04 SUBMITTALS

A. General: submittals required to document Project Sustainability Requirements Checklist compliance may be in addition to submittals required by other specification sections. If submitted item is identical to that submitted to comply with other requirements, provide duplicate copies to verify compliance with indicated Project Sustainability Requirements Checklist requirements.

B. Project Materials Cost Data: Provide statement indicating total cost for materials used for Project. Costs exclude labor, overhead, and profit. Include breakout of costs for the following categories of items:

a) Plumbing.
b) Mechanical.
c) Electrical.
d) Specialty items and equipment.
e) Wood-based construction materials.

1.05 Project Sustainability Action Plan: Provide a preliminary submittal within 14 days of date established for the Notice to Proceed indicating how the following requirements will be met:

A. Waste management plan complying with Construction Waste Management for Project Sustainability Requirements Checklist compliance.

B. Construction indoor-air-quality management plan.

C. List of proposed salvaged and refurbished materials. Identify each material that will be salvaged or refurbished, including its source, cost, and replacement cost if the item was to be purchased new.

D. List of proposed materials with recycled content. Indicate cost, post-consumer recycled content, and pre-consumer recycled content for each product having recycled content.
E. List of proposed regional materials. Identify each regional material, including its source, cost, and the fraction by weight that is considered regional.
F. List of proposed certified wood products. Indicate each product containing certified wood, including its source and cost of certified wood products.

1.06. Progress Reports: Concurrent with each Application for Payment, submit reports comparing actual construction and purchasing activities with Project Sustainability Action Plan for the following:
A. Waste reduction progress reports complying with "Construction Waste Management Compliance Checklist."
B. Receipts for salvaged and refurbished materials used for Project, indicating sources and costs for salvaged and refurbished materials.
D. Product data and certification letter indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content. Include statement indicating costs for each product having recycled content.
E. Product data for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
F. Product data indicating location of material manufacturer for regionally manufactured materials. Include statement indicating cost for each regionally manufactured material and for each regionally manufactured material. Include statement indicating location of and distance from Project to point of extraction, harvest, or recovery for each raw material used in regionally extracted and manufactured materials.
G. Product data and chain-of-custody certificates for products containing certified wood. Include statement indicating cost for each certified wood product.
H. Product data for temporary filtration media.
I. Product data for filtration media used during occupancy.

1.07. Construction Documentation: Six photographs at three different times during the construction period, along with a brief description of the SMACNA approach employed, documenting implementation of the indoor-air-quality management measures, such as protection of ducts and on-site stored or installed absorptive materials.

Signed statement describing the building air flush-out procedures including the dates when flush-out was begun and completed and statement that filtration media was replaced after flush-out.
Product data for filtration media used during flush-out and during occupancy.
Product data for adhesives and sealants used inside the weatherproofing system indicating VOC content of each product used. Indicate VOC content in g/L calculated according to 40 CFR 59, Subpart D.

Product data for paints and coatings used inside the weatherproofing system indicating VOC content of each product used. Indicate VOC content in g/L calculated according to 40 CFR 59, Subpart D.
Product data for products containing composite wood or agrifiber products or wood glues indicating that they do not contain urea-formaldehyde resin.

PART 2 PRODUCTS

2.01 GENERAL

A. Where products specified in any specification section do not support compliance with Project Sustainability Requirements Checklist, equivalent alternative products with equal or better performance shall be proposed with the bids.

2.02 SALVAGED AND REFURBISHED MATERIALS

A. Provide salvaged or refurbished materials for a minimum of 1 percent of building materials (by cost).
B. Provide salvaged or refurbished materials for a minimum of 5 percent of building materials (by cost).

2.03 RECYCLED CONTENT OF MATERIALS

A. Provide building materials with recycled content such that post-consumer recycled content plus one-half of pre-consumer recycled content constitutes a minimum of 10 percent of cost of materials used for Project.
B. Cost of post-consumer recycled content of an item shall be determined by dividing weight of post-consumer recycled content in the item by total weight of the item and multiplying by cost of the item.
C. Cost of pre-consumer recycled content of an item shall be determined by dividing weight of pre-consumer recycled content in the item by total weight of the item and multiplying by cost of the item.

2.04 REGIONAL MATERIALS

A. Provide a minimum of 10 percent of building materials (by cost) that are regional materials.

2.05 CERTIFIED WOOD

A. Provide a minimum of 50 percent (by cost) of wood-based materials that are produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
B. Wood-based materials include, but are not limited to, the following materials when made from wood, engineered wood products, or wood-based panel products:
   1. Rough carpentry.

2. Miscellaneous carpentry.
3. Heavy timber construction.
4. Metal-plate-connected wood trusses.
5. Structural glued-laminated timber.
6. Finish carpentry.
7. Architectural woodwork.
8. Wood cabinets.
9. Furniture.

2.06 LOW-EMITTING MATERIALS

A. For field applications that are inside the weatherproofing system, use adhesives and sealants that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D:

- Wood Glues: 30 g/L.
- Metal to Metal Adhesives: 30 g/L.
- Adhesives for Porous Materials (Except Wood): 50 g/L.
- Subfloor Adhesives: 50 g/L.
- Plastic Foam Adhesives: 50 g/L.
- Carpet Adhesives: 50 g/L.
- Carpet Pad Adhesives: 50 g/L.
- VCT and Asphalt Tile Adhesives: 50 g/L.
- Cove Base Adhesives: 50 g/L.
- Gypsum Board and Panel Adhesives: 50 g/L.
- Rubber Floor Adhesives: 60 g/L.
- Ceramic Tile Adhesives: 65 g/L.
- Multipurpose Construction Adhesives: 70 g/L.
- Fiberglass Adhesives: 80 g/L.
- Contact Adhesive: 80 g/L.
- Structural Glazing Adhesives: 100 g/L.
- Wood Flooring Adhesive: 100 g/L.
- Structural Wood Member Adhesive: 140 g/L.

2.07 Special Purpose Contact Adhesive (contact adhesive that is used to bond melamine covered board, metal, unsupported vinyl, Teflon, ultra-high molecular weight polyethylene, rubber or wood veneer 1/16 inch or less in thickness to any surface): 250 g/L.

- Top and Trim Adhesive: 250 g/L.
- Plastic Cement Welding Compounds: 250 g/L.
- ABS Welding Compounds: 325 g/L.
- CPVC Welding Compounds: 490 g/L.
- PVC Welding Compounds: 510 g/L.
- Adhesive Primer for Plastic: 550 g/L.
- Sheet Applied Rubber Lining Adhesive: 850 g/L.
- Aerosol Adhesive, General Purpose Mist Spray: 65 percent by weight.
- Aerosol Adhesive, General Purpose Web Spray: 55 percent by weight.

2.08 Special Purpose Aerosol Adhesive (All Types): 70 percent by weight.
- Other Adhesives: 250 g/L.
- Architectural Sealants: 250 g/L.
- Nonmembrane Roof Sealants: 300 g/L.
- Single-Ply Roof Membrane Sealants: 450 g/L.

2.09 Other Sealants: 420 g/L.
Sealant Primers for Nonporous Substrates: 250 g/L.
Sealant Primers for Porous Substrates: 775 g/L.
Modified Bituminous Sealant Primers: 500 g/L.

2.10 Other Sealant Primers: 750 g/L.

2.11 For field applications that are inside the weatherproofing system, use paints and coatings that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D.
- Flat Paints, Coatings, and Primers: VOC not more than 50 g/L.
- Nonflat Paints, Coatings, and Primers: VOC not more than 150 g/L.
- Anticorrosive and Antirust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
- Clear Wood Finishes, Varnishes: VOC not more than 350 g/L.
- Clear Wood Finishes, Lacquers: VOC not more than 550 g/L.

2.12 Floor Coatings: VOC not more than 100 g/L.
- Shellacs, Clear: VOC not more than 730 g/L.
- Shellacs, Pigmented: VOC not more than 550 g/L.

2.13 Stains: VOC not more than 250 g/L.
Do not use composite wood or agrifiber products or adhesives that contain urea-formaldehyde resin.

PART 3 EXECUTION

3.01 GENERAL: Where the methods of execution specified in any specification section do not support compliance with Project Sustainability Requirements Checklist, alternative methods with equal or better performance shall be proposed with the bids.

3.02 CONSTRUCTION INDOOR-AIR-QUALITY MANAGEMENT:

A. Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction."
B. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period as specified in Division 1 Section "Temporary Facilities and Controls," install filter media having a MERV 8 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.
C. Replace all air filters immediately prior to occupancy.

D. After construction ends, prior to occupancy and with all interior finishes installed, perform a building flush-out by supplying a total volume of 14000 cu. ft. of outdoor air per sq. ft. of floor area while maintaining an internal temperature of at least 60 deg F and a relative humidity no higher than 60 percent.

E. roject's mechanical engineer of record should verify that HVAC system design and equipment indicated are capable of delivering flush-out indicated, and provide HVAC system and equipment operating information necessary to achieve credit. If Project HVAC systems and equipment cannot suit requirement, consider requiring temporary systems and equipment.

F. If occupancy is desired prior to flush-out completion, the space may be occupied following delivery of a minimum of 3500 cu. ft. of outdoor air per sq. ft. of floor area to the space. Once a space is occupied, it shall be ventilated at a minimum rate of 0.30 cfm per sq. ft. of outside air or the design minimum outside air rate required otherwise, whichever is greater. During each day of the flush-out period, ventilation shall begin a minimum of three hours prior to occupancy and continue during occupancy. These conditions shall be maintained until a total of 14000 cu. ft./sq. ft. of outside air has been delivered to the space.

F. Mech. Engineer will provide operating procedure for each HVAC system and piece of equipment and the operating duration required for flush-out.

G. Air-Quality Testing:

1. Conduct baseline indoor-air-quality testing, after construction ends and prior to occupancy, using testing protocols consistent with the EPA's "Compendium of Methods for the Determination of Air Pollutants in Indoor Air," (EPA standard referenced in first subparagraph below is available from NTIS by calling (800) 553-6847 with PB90200288 ordering number).
2. Demonstrate that the contaminant maximum concentrations listed below are not exceeded:
   Formaldehyde: 50 ppb.
   Particulates (PM10): 50 micrograms/cu. m.
   Total Volatile Organic Compounds (TVOC): 500 micrograms/cu. m.
   4-Phenylcyclohexene (4-PH): 6.5 micrograms/cu. m.
   Carbon Monoxide: 9 ppm and no greater than 2 ppm above outdoor levels.
3. For each sampling point where the maximum concentration limits are exceeded, conduct additional flush-out with outside air and retest the specific parameter(s) exceeded to indicate the requirements are achieved. Repeat procedure until all requirements have been met. When retesting noncomplying building areas, take samples from same locations as in the first test.
4. Air-sample testing shall be conducted as follows:

a) All measurements shall be conducted prior to occupancy but during normal occupied hours, and with building ventilation system starting at the normal daily start time and operated at the minimum outside air flow rate for the occupied mode throughout the duration of the air testing.

b) Building shall have all interior finishes installed including, but not limited to, millwork, doors, paint, carpet, and acoustic tiles. Nonfixed furnishings such as workstations and partitions are encouraged, but not required, to be in place for the testing.

c) Number of sampling locations will vary depending on the size of building and number of ventilation systems. For each portion of building served by a separate ventilation system, the number of sampling points shall not be less than one per 25,000 sq. ft. or for each contiguous floor area, whichever is larger, and shall include areas with the least ventilation and greatest presumed source strength.

d) Air samples shall be collected between 3 and 6 feet from the floor to represent the breathing zone of occupants, and over a minimum four-hour period.

END OF SECTION

SECTION 01515

CONSTRUCTION WASTE MANAGEMENT

PART 1 GENERAL

1.01 SUMMARY

A. Construction waste management, complying with City of Livermore Green Ordinance Requirements for New Construction.
B. The Construction Waste Management shall include but not limited to the following:
   a. Salvaging nonhazardous construction waste.
   b. Recycling nonhazardous construction waste.
   c. Disposing of nonhazardous construction waste.
   d. Other construction waste item as required by the City of Livermore or USGBC or other prevailing industry practice

1.02 Related Sections:

A. Comply with Section "Project Sustainability Requirements".
B. Comply with Section “Commissioning”.

1.03 DEFINITIONS

A. **Construction Waste:** Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
B. **Disposal:** Removal off-site of construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
C. **Recycle:** Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
D. **Salvage:** Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
E. **Salvage and Reuse:** Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.04 PERFORMANCE REQUIREMENTS

A. General: Develop a waste management plan that results in end-of-Project rates for salvage/recycling of at least 75 percent by weight of total waste generated by the Work, including the following materials.

B. Construction Waste:
- Site-clearing waste.
- Masonry and CMU.
- Lumber.

- Wood sheet materials.
- Wood trim.
- Metals.
- Roofing.
- Insulation.
- Carpet and pad.
- Gypsum board.
- Piping.
- Electrical conduit.

C. Packaging: Regardless of salvage/recycle goal indicated above, salvage or recycle 100 percent of the following uncontaminated packaging materials:
- Paper.
- Cardboard.
- Boxes.
- Plastic sheet and film.
- Polystyrene packaging.
- Wood crates.
- Plastic pails.
- Other materials as required.

1.05 SUBMITTALS

A. Waste Management Plan: Submit 3 copies of plan within 30 days of date established for the Notice to Proceed.

B. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit three copies of report. Include the following information:
- Material category.
- Generation point of waste.
- Total quantity of waste in tons.
- Quantity of waste salvaged, both estimated and actual in tons.
- Quantity of waste recycled, both estimated and actual in tons.
- Total quantity of waste recovered (salvaged plus recycled) in tons.
- Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

C. Waste Reduction Calculations: Before request for Substantial Completion, submit three copies of calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.

D. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.

E. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

F. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities

licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

G. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

H. Waste management statement, signed by Contractor, tabulating total waste material, quantities diverted and means by which it is diverted, and statement that requirements of the City of Livermore for the credit have been met.

I. Qualification Data: For Waste Management Coordinator.

1.06 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Waste Management Conference: Conduct conference at Project site and review methods and procedures related to waste management including, but not limited to, the following:

C. Review and discuss waste management plan including responsibilities of Waste Management Coordinator.

D. Review requirements for documenting quantities of each type of waste and its disposition.

E. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.

F. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.

G. Review waste management requirements for each trade.

1.07 WASTE MANAGEMENT PLAN

A. General: Develop plan consisting of waste identification, waste reduction work plan, and cost/revenue analysis. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of site-clearing and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.

C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

D. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.

E. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.

F. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
G. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
H. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
I. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location on Project site where materials separation will be located.
J. Cost/Revenue Analysis: Indicate total cost of waste disposal as if there was no waste management plan and net additional cost or net savings resulting from implementing waste management plan. Include the following:
K. Total quantity of waste.
L. Estimated cost of disposal (cost per unit). Include hauling and tipping fees and cost of collection containers for each type of waste.
M. Total cost of disposal (with no waste management).
N. Revenue from salvaged materials.
O. Revenue from recycled materials.
P. Savings in hauling and tipping fees by donating materials.
Q. Savings in hauling and tipping fees that are avoided.
R. Handling and transportation costs. Include cost of collection containers for each type of waste.
S. Net additional cost or net savings from waste management plan.
T. Forms: Prepare waste management plan on forms acceptable to City of Livermore.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.01. PLAN IMPLEMENTATION
A General: Implement waste management plan as approved by Owner. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
B. Comply with Specification Section "Temporary Facilities and Controls" for operation, termination, and removal requirements.
C. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan. Coordinator shall be present at Project site full time for duration of Project.
D. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project

site.

E. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
F. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
G. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
H. Comply with Specification Section "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.02 RECYCLING CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.
B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.
C. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical.
D. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
E. Inspect containers and bins for contamination and remove contaminated materials if found.
F. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
G. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
H. Store components off the ground and protect from the weather.
I. Remove recyclable waste off Owner's property and transport to recycling receiver or processor.

3.03 RECYCLING CONSTRUCTION WASTE

A. Packaging:
    1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
    2. Polystyrene Packaging: Separate and bag materials.
    3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.

4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:
1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
3. Gypsum Board: Stack large clean pieces on wood pallets and store in a dry location.
4. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

3.04 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill acceptable to authorities having jurisdiction.
B. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
C. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
D. Burning: Do not burn waste materials.
E. Disposal: Transport waste materials off Owner's property and legally dispose of them.

END OF SECTION

SECTION 01810

FUNDAMENTAL COMMISSIONING OF BUILDING ENERGY SYSTEMS

PART 1 - GENERAL

1.01 CONDITIONS AND REQUIREMENTS

A. The General Conditions, Supplementary Conditions, and Division 1 - General Requirements of the Contract Documents are hereby made a part of this Section of the specifications as fully as if repeated herein.

1.02 DESCRIPTION OF WORK

A. Fundamental commissioning of the following building energy systems complying with City of Livermore requirements for LEED for New Construction v2.2, Credit EA1.

1. Heating, ventilating and air conditioning (HVAC) systems and associated controls

2. Lighting and daylighting controls.

3. Domestic hot water systems.

4. Site lighting and controls.

B. Related Section:

1. Comply with Section 01400 - “Project Sustainability Requirements”.

2. Requirements of Division-15 & Division-16 drawings and specifications.

3. Architectural, Civil & Landscape drawings and specifications.

4. Title-24 compliance requirements.

5. City of Livermore requirements for LEED for New Construction v2.2, Credit EA1 and checklist of targeted LEED points.

1.03 DEFINITIONS

A. **Acceptable Performance:** That level of performance, by equipment and systems meets the standards s defined by the equipment/system’s manufacturer, and the construction contract documents. “Acceptable Performance” is confirmed through Pre-functional and Functional testing.

B. **BoD:** Basis of Design. A document that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.
C. **Commissioning:** The process to demonstrate to the Owner that systems and equipment including mechanical, electrical, controls, and other special systems, function individually, and as a system, properly to meet performance requirements established in the Contract Documents.
D. **Commissioning Process:** The process of demonstrating to the Owner that systems are installed, functionally tested and capable of being operated and maintained to perform in conformity with the construction documents and manufacturer's standards. The commissioning process encompasses and coordinates the traditionally separate functions of equipment start-up, control system calibration, testing and balancing acceptance, performance testing, system documentation and training.
E. **Commissioning Plan:** A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
C. **CxA:** Commissioning Authority; the designated person on the Contractor's team who plans, schedules, and coordinates the commissioning team to implement the commissioning process.
D. **OPR:** Owner's Project Requirements. A document that details the functional requirements of a project and the expectations of how it will be used and operated. These include Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.
E. **Systems, Subsystems, Equipment, and Components:** Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.04 COMMISSIONING TEAM

A. Members Appointed by Contractor: Individuals, each having the authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated action, including the Commissioning Authority (CxA). The commissioning team shall consist of, but not be limited to, representatives of Contractor, including Project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.
B. Members Appointed by Owner:
C. Engineering design professionals.

1.05 OWNER'S RESPONSIBILITIES

A. Provide the OPR documentation to the CxA and Contractor for information and use.
B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities.

C. Provide the BoD documentation, prepared by the Engineer and approved by Owner, to the CxA and Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.

1.06 CONTRACTOR'S RESPONSIBILITIES

A. Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:
B. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
C. Cooperate with the CxA for resolution of issues recorded in the Issues Log.
D. Attend commissioning team meetings held on a weekly basis.
E. Integrate and coordinate commissioning process activities with construction schedule.
F. Review and accept construction checklists provided by the CxA.
G. Complete electronic construction checklists as Work is completed and provide to the Commissioning Authority on a weekly basis.
H. Review and accept commissioning process test procedures provided by the Commissioning Authority.
I. Complete commissioning process test procedures.

1.07 CxA'S RESPONSIBILITIES

A. Organize and lead the commissioning team.
B. Provide commissioning plan.
C. Convene commissioning team meetings.
D. Provide Project-specific construction checklists and commissioning process test procedures.
E. Verify the execution of commissioning process activities using random sampling. The sampling rate may vary from 1 to 100 percent. Verification will include, but is not limited to, equipment submittals, construction checklists, training, operating and maintenance data, tests, and test reports to verify compliance with the OPR. When a random sample does not meet the requirement, the CxA will report the failure in the Issues Log.
F. Prepare and maintain the Issues Log.
G. Prepare and maintain completed construction checklist log.
H. Witness systems, assemblies, equipment, and component startup.
I. Compile test data, inspection reports, and certificates; include them in the systems manual and commissioning process report.

PART 2 - PRODUCTS

2.1 HVAC SYSTEMS TO BE COMMISSIONED

A. HVAC systems installed under this contract are to be inspected, tested, signed off as complete and operational, and operated for commissioning agency verification as described in Part 3 of this Section. This includes, but is not necessarily limited to the work listed for each system. The foregoing includes all the following:

a) AC-C-1 through AC-C-6: Including relief fans, automatic control dampers, temperature control, outside air economizer operation, outside air verification, carbon dioxide sensor activated demand control ventilation. Verifying the operation in heating and cooling modes, minimum & maximum heating and cooling operation, etc. Requires factory start-up and commissioning and documentation.
b) Exhaust fans EF-C-1 thru EF-C-3 operation.
c) Fire-Smoke Dampers (FSDs): Verify that the FSD is installed, controlled and operating properly per the manufacturer listing and per applicable Code.
d) Verify that the units are seismically anchored and all the utilities are installed (power, controls, gas, condensate drain, ductwork) supported and braced to the structure properly.
e) Domestic Hot Water system including the Water Heater (WH-1),tempering control valve operation and heat tracing or water recirculating systems.

2.2 PRE-FUNCTIONAL PERFORMANCE TEST

A. Hot water – work includes installation inspections and checks; pressure tests and documentation; expansion tanks; confirmation of flow balancing completion; seismic restraints installation certification. Refer to Functional Performance Test checklist #X in 2.3.

B. Duct and Air-Handling systems – work includes (AC units & Exhaust Fans) installation inspections and checks; confirmation of flow balancing completion; leak testing as applicable; seismic restraints installation certification. checkout and startup by manufacturer's representative; documented performance measurements including capacity, evaporator and condenser air flows, static pressures & temperatures, motor amperage, operation of all controls, and sound levels. Refer to Systems Verification checklist #X in 2.2. 10.

C. Water Heaters: Work includes installation inspections and checks (including seismic restraints installation certification); checkout and startup by manufacturer's representative; documented performance measurements including combustion efficiency, capacity test, burner and

controls operation, verification of thermostatic mixing (tempering valve), water temperature maintenance system, thermal insulation, etc.. Refer to System Verification checklist #X in 2.2.

D. Supply, Return, Relief and Exhaust Fans – Work includes checks on installation (including seismic restraints, dampers and other accessories), rotation, sound levels, motor current draw, and airflows and pressures. Refer to System Verification checklists #X through #Y in 2.2.

The contractor shall be responsible for carrying out all work required for commissioning these systems that is defined as a contractor responsibility in Part 3 of this Section.

2.3 SYSTEM VERIFICATION CHECKLISTS

This specification contains the system verification checklists as listed below:

1. Rooftop packaged air-handling unit, gas heat/DX cool units
2. Return fan
3. Exhaust fan
4. Domestic hot water system
5. Exterior & interior lighting

Refer to Attachment -A for the checklist

2.4 FUNCTIONAL PERFORMANCE TEST CHECKLISTS

This specification contains functional performance test checklists. Refer to paragraph 2.1 for the equipment and systems that require performance test.

2.5 MEMBERS OF THE COMMISSIONING TEAM

The commissioning team will consist of representatives of the following:

1. Owner’s Representative or Construction Manager (O)
2. Architect & Engineers of Record (AE)
3. Commissioning agency (CA)
4. General Contractor (GC)
5. Mechanical (Div. 15) contractor, Includes Plumbing, Fire Protection (M).
6. Electrical (Div. 16) contractor (E)
7. Controls contractor (ATC)
8. Testing, Adjusting, and Balancing Agency (TAB)

During the commissioning process, participation of team members will generally be required as noted in the following table (with abbreviations as noted in brackets in the preceding list of team members). The mechanical contractor, indicated by “M”, includes all mechanical subcontractors or suppliers whose participation is required for commissioning a particular system or piece of equipment.

EQUIPMENT/SYSTEM DESCRIPTION

Hot Water Heater - CA, GC, O, M
Rooftop AC units – CA, GC, O, A/E, M, E, TAB, ATC
Exhaust fan - CA, GC, O, M, E, TAB, ATC
Lighting - CA, GC, O, A/E, E

PART 3 – EXECUTION

3.1 COMMISSIONING RESPONSIBILITIES – NON-CONTRACTOR TEAM MEMBERS

A. Introduction: As noted in 2.2, a multi-disciplinary team carries out commissioning. The commissioning responsibilities of some non-contractor team members during the construction and acceptance phases of the project are provided here for information, and to provide some context for the overall process.

B. Commissioning Agency Responsibilities: The commissioning agency will:

- Plan, organize and implement the commissioning process as specified herein,
- Prepare the commissioning plan, and ensure its distribution for review and comment,
- Revise the commissioning plan as required during construction,
- Chair commissioning meetings, and prepare and distribute minutes to all commissioning team members, whether or not they attended the meeting,
- In conjunction with the General Contractor, coordinate commissioning activities among all contractors, sub-trades and suppliers,
- Monitor system verification checks, and ensure the results are documented as the checks are done,
- Monitor controls point-to-point checks done by the controls contractor, and ensure the results documented as the checks are done,
- Observe all start-ups and initial system operations tests and checks,
- Direct the contractors to operate equipment and systems as required to ensure that all required functional performance tests are carried out for verification purposes,
- Witness all functional performance tests and document the results,
- Prepare and submit a Commissioning Report which documents all checks and tests done throughout the Commissioning process, and the results obtained from each, and

- Ensure all required O&M manuals, instructions and demonstrations are provided to the Owner's designated operating staff.

C. Mechanical Engineer Responsibilities:

- The Mechanical Engineer will review the Commissioning Plan, and will participate, as appropriate, in on-site commissioning meetings.

- During the acceptance phase of the commissioning process, the Mechanical Engineer may be on site to review commissioning documentation, to witness functional performance tests, and to analyze the installation and its performance.

D. Owner's Responsibilities:

- The Owner will ensure the availability of operating staff for all scheduled instruction and demonstration sessions. This staff will possess sufficient skills and knowledge to operate and maintain the installation following attendance at these sessions.

- The Owner will also ensure the appropriate involvement of the

E. Electrical Engineer, Architect, and any other consultants as required, in the commissioning process.

3.2 COMMISSIONING RESPONSIBILITIES – GENERAL CONTRACTOR

The General Contractor has responsibility to ensure the overall completion of the Work. In this regard, he shall:

1. Participate as required in the HVAC commissioning process,
2. Ensure the Mechanical Contractor performs all assigned HVAC commissioning responsibilities as specified in 3.3,
3. Ensure the testing, adjusting and balancing agency performs HVAC commissioning responsibilities as listed in 3.4,
4. Ensure the Electrical Contractor performs all assigned HVAC commissioning responsibilities as specified in 3.6,
5. Ensure the cooperation and participation in the HVAC commissioning process of all other sub-contractors as applicable.

The General Contractor shall assign a representative to the commissioning team, and submit the person's name to the commissioning agency, within one (1) month of the award of the contract.

The representative shall have the authority to make decisions on behalf of the general contractor as they relate to the organization and scheduling of HVAC commissioning. The representative shall facilitate communications among all

contractors and suppliers and other commissioning team members, and shall foster the necessary cooperative action. One specific responsibility shall be to attend commissioning meetings, and ensure action items arising from them are attended to as required to allow the commissioning process to proceed on schedule.

In the event that any scheduled equipment or system start-ups or functional performance tests are terminated because the CA or the mechanical engineer discover deficient or incomplete work, or due to the non-attendance of required contractor or supplier personnel, the contractor or sub-contractor responsible for the termination shall also be responsible for paying reasonable costs of time and travel expenses of any or all of the following representatives who were physically present for the purpose of witnessing the start-up or the FPT: the CA, the mechanical engineer, the electrical engineer, and the owner. The owner may provide a statement to the General Contractor identifying the specific activity that was terminated, the scheduled date, and a list of those in attendance, along with their reasonable time and travel expense costs.

3.3 COMMISSIONING RESPONSIBILITIES – DIVISION 15 (MECHANICAL) CONTRACTOR

The mechanical contractor, and all the sub-contractors and suppliers within Division 15, shall cooperate with the commissioning agency (CA), and other commissioning team members, to facilitate the successful completion of the commissioning process.

The contractor shall assign a representative to the commissioning team, and submit the person's name to the commissioning agency, within one (1) month of the award of the contract. The representative shall have the authority to make decisions on behalf of the mechanical contractor as they relate to the organization and scheduling of HVAC commissioning. The representative shall ensure communications between Division 15 contractors and suppliers and all other commissioning team members, and shall foster the necessary cooperative action. One specific responsibility shall be to attend commissioning meetings, and ensure action items arising from them are attended to as required to allow the commissioning process to proceed on schedule.

The Mechanical Contractor, and all mechanical sub-contractors and suppliers, shall cooperate with the Commissioning Agency in carrying out the HVAC commissioning process. In this context, the Mechanical Contractor shall:

1. Each contractor and sub-contractor in this division shall include in their quotes the cost of participating in the commissioning process as specified herein.
2. Ensure the automatic temperature controls (ATC) contractor performs HVAC commissioning responsibilities as listed in 3.5.
3. Provide instruction and demonstrations for the Owner's designated operating staff, in conjunction with the commissioning agency and

mechanical engineer, and with the participation of qualified technicians from major equipment suppliers and the controls contractor.

4. Include requirements for submittal data, O&M data, and training information in each purchase order or sub-contract written.
5. Ensure cooperation and participation of specialty sub-contractors such as sheet metal, piping, refrigeration, and water treatment as applicable.
6. Ensure participation of major equipment manufacturing in appropriate start-up, testing and training activities.
7. Attend HVAC commissioning meetings scheduled by the CA.
8. Notify the CA a minimum of two weeks in advance of scheduled equipment and system start-ups, so that the CA may witness system verifications, and equipment and system start-ups.
9. Provide sufficient personnel to assist the CA as required during system verification and functional performance testing.
10. Prior to start-up, inspect, check and confirm the correct and complete installation of all equipment and systems for which system verification checklists are included in the commissioning plan. Document the results of all inspections and checks on the checklists and sign them. If deficient or incomplete work is discovered, ensure corrective action is taken and re-check until the results are satisfactory and the system is ready for safe startup.
11. Notify the CA a minimum of two weeks in advance, of the time for start of the TAB work. Attend the initial TAB meeting for review of the TAB procedures.
12. Provide equipment and systems start-up resources as specified and required. If during an attempted equipment or system start-up, deficient or incomplete work is discovered that would preclude safe operation, the start-up shall be aborted until corrective action has been taken. Ensure such action is taken and verified before re-scheduling a new start-up. Those responsible for deficient or incomplete work will be responsible for costs in accordance with 3.2 in this Section.
13. Carry out performance checks to ensure that all equipment and systems fully functional and ready for the CA to witness formal functional performance tests (FPTs).
14. Operate equipment and systems for FPTs in accordance with the commissioning plan and as directed by the commissioning agency. If improper functionality, incomplete work, or other deficiencies affecting system performance are discovered, the FPTs will be stopped by the CA. Those responsible for deficient or incomplete work will be responsible for costs in accordance with 3.2 in this Section. Ensure that all corrections necessary for full and complete system operation as specified are completed; then with the ATC contractor and other applicable sub-contractors, carry out functional performance checks to confirm correct operation before applying to the CA to reschedule the FPTs for the system in question.
15. Prepare preliminary schedule for mechanical system orientation and inspections. O & M manual submission, training sessions, pipe and duct system testing, flushing and cleaning, equipment start-up TAB, and task

completion for use by the CA. Update schedule as appropriate throughout the construction period.

16. Attend initial O&M staff training session.
17. Conduct mechanical system orientation and inspection at the equipment placement completion stage.
18. Update drawings to as-built condition and review with the CA.
19. Gather O & M data on all equipment, and assemble in binders as required by the commissioning specification. Submit to CA prior to the completion of construction.
20. Participate in, and schedule vendors and contractors to participate in the O&M staff training sessions as set up by the CA.
21. Provide written notification to the general contractor [or construction manager] and CA that the following work has been completed in accordance with the contract documents and the equipment, systems and sub-systems are operating as required.
    - HVAC equipment including all fans, air handling units, dehumidification units, ductwork, dampers, terminals and all Division 15 equipment.
    - Refrigeration equipment, pumping systems and heat rejection equipment.
    - Fire stopping in the fire rated construction, including fire and smoke damper installation, caulking, gasketing and sealing of smoke barriers.
    - Seismic restraints installed to specification; a certification from the seismic restraint engineer meets this requirement.
    - Dedicated smoke control systems including stairway pressurization and atrium systems.
    - Non-dedicated systems using the air-handling units for smoke control.
    - Fire detection and smoke detection devices furnished under other divisions of this specification as they affect the operation of the smoke control systems.
    - That the building control system is functioning to control mechanical equipment and smoke control systems as specified.
22. Provide a complete set of as-built drawings and O & M manuals to the CA.

3.4 COMMISSIONING RESPONSIBILITIES – TAB AGENCY

With respect to HVAC commissioning, the TAB agency shall:

1. Include costs for HVAC commissioning requirements in the quoted price.
2. Attend commissioning meetings scheduled by the CA prior to, and during, on-site TAB work being done.
3. Submit proposed TAB procedures to the CA and mechanical engineer for review and acceptance.

4. Attend the TAB planning meeting scheduled by the CA. Be prepared to discuss the procedures that shall be followed in testing, adjusting and balancing the HVAC system.
5. At the completion of the TAB work, submit the final TAB report to the general contractor [or construction manager], with copies to the Owner, CA and mechanical engineer.
6. Participate in verification of the TAB report by the CA for verification or diagnostic purposes. This will consist of repeating a sample (normally 10% to 20%) of the measurements contained in the TAB report as directed by the CA.
7. Participate in O & M personnel training sessions as scheduled by the CA.

3.5 COMMISSIONING RESPONSIBILITIES – CONTROLS CONTRACTOR

With respect to HVAC commissioning, the controls contractor shall:

1. Include cost for commissioning requirements in the quoted price.
2. Review design for controllability with respect to equipment selected for the project;
   - Review and confirm in writing that a proper hardware specification exists to permit functional performance testing as required by specification and sequence of operation.
   - Review and confirm in writing that proper safeties and interlocks are included in design.
   - Ensure the proper sizing of control valves and actuators, based on design pressure drops. Ensure that control valve authority will result in capacity control as specified. Include valve sizing and authority information in submittal to mechanical engineer.
   - Ensure the proper sizing of control dampers. Ensure damper authority to control air flows as specified. Review and confirm in writing proper damper positioning for mixing to prevent stratification. Ensure correct actuator vs. damper movement for smooth operation. Include damper sizing, control authority and actuator selection data in submittal to mechanical engineer.
   - Ensure the proper selection of sensor ranges, and include data with submittal to mechanical engineer.
   - Clarify all questions concerning sequences of operation with the mechanical engineer.
3. Attend commissioning meetings scheduled by the CA.
4. Provide the following submittals to the CA for review;
   - Hardware and software submittals.
   - Control panel construction shop drawings.
   - Diagrams showing all control points, sensor locations, point names, actuators, controllers and where necessary, points of access, all superimposed on diagrams of the physical equipment.
   - Narrative description of all control sequences for each piece of equipment controlled.
   - Logic diagrams showing the logic flow of all control sequences.

- A list of all control points, including analog inputs, analog outputs, digital inputs and digital outputs. Include the values of all parameters for each system point. Provide a separate list for each stand-alone control unit.
- A complete control language program listing including all software routines employed in operating the control system. Also provide a program write-up, organized in the same manner as the control software. This narrative shall describe the logic flow of the software and the functions of each routine and sub-routine. It should also explain individual math or logic operations that are not clear from reading the software listing.
- Hardware operation and maintenance manuals.
- Application software and project applications code manuals.

5. Inspect, check, and confirm the proper installation and performance of controls/BAS hardware and software provided by others.
6. Integrate installation and programming scheduling with construction and commissioning schedules.
7. Inspect, check and confirm the correct installation and operation of input and output field points and devices through documented and signed off point-to-point checkouts.
8. Provide thorough training to operating personnel on hardware operations and programming, and the application program for the system, in accordance with the O&M staff training program in the commissioning plan.
9. In conjunction with the mechanical contractor, demonstrate system performance to the CA including all modes of system operation (e.g. occupied, unoccupied, emergency) during the functional performance tests (FPTs). If improper functionality, incomplete work, or other deficiencies affecting system performance are discovered, the FPTs will be stopped by the CA. Those responsible for deficient or incomplete work will be responsible for costs in accordance with 3.2 in this Section.
10. Provide control system technician to assist during system verification and functional performance testing.
11. Provide support and coordination with TAB contractor on all interfaces between controls and TAB scopes of work. Provide, at no additional cost to the TAB and commissioning agencies, all devices, such as portable operator's terminals and all software for the TAB agency to use in completing TAB procedures.

3.6 COMMISSIONING RESPONSIBILITIES – ELECTRICAL (DIVISION 16) CONTRACTOR

With respect to HVAC commissioning, the electrical contractor shall:

1. Include cost for HVAC commissioning requirements in the quoted price.
2. Review design with respect to providing power to the HVAC equipment;
   - Verify that proper hardware specifications exist for functional performance and sequence of operation required by specification.

- Verify that proper safeties and interlocks are included in the design of electrical connections for HVAC equipment.

3. Attend commissioning meetings scheduled by the CA.
4. Schedule work so that required electrical installations are completed, and systems verification checks and functional performance tests can be carried out on schedule.
5. Inspect, check and confirm in writing the proper installation and performance of all electrical services provided.
6. Provide electrical system technicians to assist during system verification and functional performance testing as required by the CA.

END OF SECTION

SECTION 15010

GENERAL REQUIREMENTS - MECHANICAL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The Conditions of the Contract and applicable requirements of Division 1, "General Requirements," and this Section govern the work of this Division.

1.02 DESCRIPTION

A. This Division requires the furnishing and installing of all items including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and equipment specified. Elements of the work include, but are not limited to, materials, labor, supervision, coordination, supplies, equipment, transportation, storage, hoisting, utilities and all required permits and licenses.

B. Specifications: Refer to this Division for the primary technical specifications of mechanical, plumbing and fire protection work (Requirements given within this Section apply to the Work of all Sections of this Division). The actual performance of the Work stays within the Section in which it occurs; but subject to the requirement of this Section to the extent applicable.

C. Work Included: This Work includes the furnishing of all labor, materials, equipment, fixtures, apparatus, and appurtenances and commissioning required for complete installation of operating heating, ventilating, air-conditioning, plumbing and drainage and fire protection systems as specified, in place and ready for service.

1.03 WORK SPECIFIED ELSEWHERE

A. Concrete pads and bases: Division 3 CONCRETE.

B. Electrical (except as specified herein): Division 16 ELECTRICAL.

C. Painting of exposed mechanical components: Section 09900 PAINTING.

D. Access panels in public area ceilings: Division 9 FINISHES

E. Additional and other access panels: Furnished under this Section. Installation of access panels is in Division 9 FINISHES.

F. Structural steel (except as specified herein) Division 5 METALS.

G. Firestopping and firesafing at mechanical penetrations: Section 07840 FIRESTOPPING

H. Subsurface drainage up to and including pits: Division 2 SITE WORK.

1.04 QUALITY ASSURANCE

A. Manufacturers, materials, and methods described in the various sections of the Specifications, and indicated on the Drawings are intended to establish a standard of quality, utility requirements and space requirements. Products manufactured by other companies are acceptable, provided they meet the performance requirements, fit in the available space, not heavier than the specified, equal or higher in operating efficiency, quieter, etc. Also, the fact that a specific manufacturer is listed as an acceptable manufacturer should not be interpreted to mean that the manufacturers standard product will meet the requirements of the project design, Specifications and time constraints. The Owner/Architect shall be the sole judge of quality and equivalence of equipment, materials and methods and his decision shall be final.

B. The project requires compliance with City of Livermore Green Ordinances and LEED credits, as such, the energy efficiency and compliance with all the requirements of mandatory prerequisite and optional credit items is of great importance to the project. Contractor shall become familiar of the LEED requirements and comply in meeting all the requirements of the respective trade work. Refer to LEED checklist, drawings and specifications for other requirements.

C. All work shall comply with the applicable State, County and City Codes, Rules, Regulations and Ordinances.

1.05 SITE VISIT AND FAMILIARIZATION

A. General: Become familiar with the Drawings and Specifications, examine the premises, and understand the conditions under which the Contract shall be performed, prior to submitting a bid.

B. Site: Be informed of the site conditions, verify locations of new and existing equipment and utilities, and determine exact requirements for connections.

C. Coordination: Submission of a bid for this project infers that the Contractor has visited the site and has become familiar with the Drawings and site conditions and has included in his proposal all work necessary to properly install the systems on the project.

D. Pre-Bid Conference: Refer to Division 1.

1.06 DRAWINGS AND SPECIFICATIONS

A. General: The Drawings are schematic in nature and indicate approximate locations of the heating, ventilating and air conditioning systems, plumbing equipment, fixtures and piping systems, fire sprinkler equipment, risers, mains and heads, except where specific locations are noted and dimensioned on the Drawings. All items are shown approximately to scale. The intent is to show how these items shall be integrated into the construction. Locate all items by on the job measurement and in accordance with the Contract Documents. Cooperate with other trades to ensure project completion as indicated. Provide materials and systems indicated in either Drawings or Specifications.

The drawings alone may not be used for quantity take-offs of any items. If an item is

specified or scheduled to apply for certain location or use, it must be used everywhere at such locations or uses, whether shown on the drawings or not. For example if specifications require contractor to provide concealed damper regulator for dampers in inaccessible ceilings, they shall be provided for all dampers located above inaccessible ceilings, whether shown on the drawings (partially or fully) or not.

B. Location: Prior to locating diffusers, grilles, other exposed air devices, plumbing fixtures, fire sprinklers and plumbing items, obtain the Architect's approval as to exact location. Locations shall not be determined by scaling Drawings. Contractor shall be responsible for costs of redoing work of other trades necessitated by failure to comply with this requirement.

C. Specifications: The specifications are intended to supplement the drawings and it is not in the scope of the specifications to mention any part of the work which the Drawings fully explain. Conversely, any part of the work which the specifications fully explain, may not be mentioned on the Drawings.

D. Disagreement: Disagreement between the Drawings or Specifications or within the Drawings or Specifications shall be bid using the better quality or greater quantity of material or installation, and a request for clarification shall be made to the Architect. Do not proceed with the work without the Architect's decision on the request.

1.07 DISCREPANCIES

A. Clarification: Clarification shall be obtained before submitting a proposal for the Work under this Division referring to discrepancies or omissions from the Contract Documents or questions as to the intent thereof.

B. Detailed Instructions: Should it appear that the work hereby intended to be done or any of the materials relative thereto, is not sufficiently detailed or explained in the Drawings or Specifications, then the Contractor shall apply to the Architect for such further Drawings or explanations as may be necessary, allowing a reasonable time for the Architect to respond. The Contractor shall conform to this additional information as a part of the Contract without additional cost to the Owner or Architect.

C. Interpretations: Should any doubt or questions arise respecting the true meaning of Drawings or Specifications, reference shall be made to the Architect, whose written decision shall be final and conclusive.

D. Contractor Agreement: Consideration will not be granted for misunderstanding of the amount of work to be performed. Submission of a bid conveys full Contractor agreement of the items and conditions specified, shown, scheduled, or required by the nature of the project.

1.08 UTILITIES

A. General: Utility information shown on the Drawings have been shown based upon data obtained from the site survey and the agencies having jurisdiction and are accurate to the best of the knowledge of the Architect.

B. Coordination: The Contractor shall be responsible for field verification of the actual locations of site and/or building utilities and shall make modifications necessary for connection to or construction around those utilities at no additional cost to the Owner or

Architect.

1.09 CODES AND STANDARDS

A. Provide Work in strict accordance with Federal, State and City, codes, rules and regulations, as well as those of other regulatory agencies having jurisdiction. Do not construe Specifications or Drawings as permitting anything contrary to above requirements.

B. When Specifications or Drawings have more stringent requirements than the above mentioned laws, etc., Specifications and Drawings have precedence.

C. In case Specifications or Drawings do not comply with above mentioned laws, etc., the latter have precedence.

D. Provide Work in accordance with appropriate codes and standards.

1.10 LICENSES, PERMITS AND FEES

A. Procure and pay for licenses and permits and pay fees, deposits, and other charges required in order to provide Work of this Division.

1.11 REVIEW OF CONSTRUCTION

A. Work may be reviewed at any time by representatives of Architect.

B. Advise Architect that Work is ready for review at following times:

1. Prior to backfilling buried Work.

2. Prior to concealment of Work in walls and above ceilings.

3. When requirements of Contract have been completed.

C. Neither backfill nor conceal Work without Architect's consent.

D. Maintain on job a set of Specifications and Drawings for use by Architect's representative.

1.12 SCHEDULE OF WORK

A. Arrange Work to conform to schedule of construction established or required to comply with Contract Documents. In scheduling, anticipate means of installing0 equipment through available openings in structure.

1.13 SUBMITTALS

A. General: Submittals required for this project shall include, but not be limited to:

1. Coordination Drawings

2. Shop drawings and Product Brochures.

3. Samples and Mock-ups.

4. Certifications and Test Reports.

5. Operating and Maintenance Manuals.

6. Warranties (Guarantees).

7. Seismic Restraint Calculations.

B. Coordination Drawings:

1. The Contractor shall prepare and submit to the Architect for approval coordination drawings (Plans and Sections) of all areas of the Project and as outlined hereinafter.

2. Coordination drawings shall be prepared in sufficient time to allow for review and response by the Architect and correction by the Contractor so as not to delay the work.

3. Relocations required due to Work installed or modified prior to approval of coordination drawings shall be made without additional expense to the Owner.

4. The coordination drawings shall use a common architectural layout as a background. The drawings shall be prepared at the same scales to permit overlaying on light tables.

   a. Ductwork, Mechanical Piping, Mechanical Equipment, Plumbing and Automatic Temperature Control.

   b. Automatic Fire Sprinklers.

5. The original coordination drawings shall be prepared on 3 mil mylar at 1/4 in. scale on sheets of same size as the Contract Drawings.

6. The sizes and bottom elevations shall be shown for all rectangular ductwork; the sizes and centerline elevations shall be shown for all round ductwork and piping. Also indicate acoustical lining in ductwork. All major components, such as dampers, valves, and cleanouts shall be dimensioned from column centerlines. All access panel locations shall be indicated.

7. Deviations from the Contract shall be encircled, approval requested and the reasons for the deviation stated.

8. The coordination drawings of all trades shall be included in each submission. One complete floor of a building shall be included in each submission.

9. Double lines shall be shown for all ductwork and pipes 6 inches and above. Single lines shall be shown for lines below the sizes noted above.

10. Coordination drawings shall be printed and distributed in the same manner as required for Mechanical shop drawings.

11. All coordination drawings submitted for approval shall bear the signed approval stamp of each of the trades and/or subcontractors affected and of the Contractor, stating they have been reviewed and approved for coordination. All coordination drawings shall be keyed and cross referenced to the Contract Drawings.

12. Sepia copies shall be used for coordination between the trades and shall be submitted for approval.

13. The mylar originals of the coordination drawings shall be kept up to date with revisions which reflect the record conditions. The mylar originals of the coordination drawings shall be submitted to the Architect at the completion of all work for approval, corrected by the Contractor if so required, and returned to the architect prior to final payment to the Contractor.

14. The Contract Drawings shall not be considered as fabrication or installation drawings. They do not indicate every item required to complete the Work.

15. The Contractor shall show all offsets, fittings and similar items necessary in order to accomplish the requirements of coordination without additional expense to the Owner.

16. If Shop Drawings show variations from Contract requirements because of standard shop practice, or any other reasons, make specific mention of variations in transmittal letter to Architect, as well as encircle variation of Shop Drawings to identify and call them to the Architect's attention.

17. All dimensions shall be verified in the field.

18. Structural Beam Penetration Coordination: Beam penetrations shown on Mechanical and Structural Plans shall be verified by Contractor through shop drawing and details. Any new beam penetration that is required during shop drawing coordination shall be approved by the Architect and Structural Engineer.

C. Shop Drawings and Product Data:

1. Refer to individual Mechanical Section for submittals required.

2. If the equipment submitted under Division 15 requires changes in material or labor from that required in the Contract Documents, such changes shall be submitted as shop drawings.

3. Any changes in piping, wiring, controls, or installation procedures required by the equipment manufacturer shall be made at no additional cost to the Owner.

4. Submit a complete list of material and equipment proposed for the job, including manufacturer's names, even if they are as specified or shown on Drawings.

5. Reference listings to Specification's article to which each is applicable.

6. Include complete catalog information such as construction, ratings, and performance

curves as applicable.

7. For any material specified to meet UL, FM or other trade standards, furnish manufacturer's or vendor's certification that material furnished for work does, in fact, equal or exceed Specifications.

8. Add and sign the following paragraph on all equipment and materials submitted for review. Failure to add the following statement will result in delay of review of submittal:

   a. "It is hereby certified that the (equipment) (material) shown and marked in this submittal is that proposed to be incorporated into the Project; is in compliance with the Contract Drawings and Specifications; can be installed in the allocated spaces."

D. Deviations from Contract Documents:

1. Submittals which are intended to be reviewed as a substitution, variations, or departure from Contract Documents, must be submitted to the Architect no later than ten (10) calendar days before date set for opening bids.

2. Unless Contractor has notified Architect of variations, deviations, or omissions and received his written acceptance, Contractor will be required at his sole expense to repair, replace, furnish whatever materials are required and perform work necessary to rectify such deviations and variations as directed by Architect at time such variations, deviations or omissions are discovered, even though this does not occur until after Shop Drawings have been reviewed and Work in question has been completed. Replacement and repair shall be mandatory in such instances and shall be performed at no cost to Owner.

3. Contractor shall be responsible for equipment ordered and/or installed prior to receipt of Shop Drawings returned from the Architect bearing the stamp of "Review". Corrections or modifications to equipment as noted on Shop Drawings shall be performed or equipment removed from the job site at request of Architect without additional compensation.

4. Submittals will be checked for general compliance with Drawings and Specifications only. The Contractor must be responsible for deviations from the Drawings or Specifications and for errors or omissions of any sort in submittals.

E. Required Shop Drawings:

1. HVAC: Submit Drawings, minimum scale 1/4 inches = 1'-0 inches unless otherwise noted.

   a. Floor Plans (Piping and ductwork)

   b. Roof Plans

2. Plumbing: Submit Drawings, minimum scale 1/8 inches = 1'-0 inches unless otherwise noted.

a. Foundation Plans

b. Floor Plans

c. Roof Plans

d. Toilet room Plans (minimum 1/4 inches = 1'-0 inches scale)

F. Samples: Submit two samples, where indicated on Drawings or Specifications or upon request, of mechanical/plumbing/fire protection devices and materials for review by the Owner/Architect. Samples will be returned upon written request of the Contractor.

1.14 OPERATING AND MAINTENANCE MANUALS

A. Submit two copies of Operating and Maintenance Manuals to the Architect for approval prior to the beginning of operator training. Provide four approved Operating and Maintenance Manuals for use in operator training. Manuals shall be bound in rigid cover, 3-ring binders with spine and cover labels and shall provide operating and maintenance information for every piece of equipment furnished under this Specification. All sections shall be typed and indexed into sections and labeled for easy reference. Bulletins containing information about equipment which is not installed on the project shall be properly marked up or stripped and reassembled. All pertinent information required by the Owner for proper operation and maintenance of equipment supplied by Division 15 shall be clearly and legibly set forth in memoranda which shall, likewise, be bound with bulletins. As a minimum, the following information shall be provided as applicable:

1. Complete description of each system, item of equipment, and apparatus provided under this Division, including ratings, capacities, performances, data and curves, characteristics identifying name and number, locations, wiring diagrams, and sources for all parts.

2. Fully detailed parts lists, including all numbered parts and recommended spare parts, of each item of equipment and apparatus provided under this Division.

3. Manufacturer's printed instructions describing operation, service, maintenance, and repair of each item of equipment and apparatus.

4. Typewritten record of tests made of materials, equipment, and systems included under this Division. Such records shall state the dates the tests were conducted, name(s) of person(s) making and witnessing the tests, and citing any unusual conditions relevant to the tests.

5. Identifying names, name tags designations and locations for all equipment.

6. Valve tag lists with valve number, type, color coding, location and function.

7. Equipment and motor nameplate data.

8. Copies of all approved Shop Drawing submittals and testing and balancing reports.

9. Fabrication drawings.

10. Equipment and device bulletins and cutsheets clearly highlighted to show equipment installed on the project and including performance curves and data as applicable.

11. Maintenance instructions clearly highlighted to show all required periodic maintenance and lubrication.

12. Wiring diagrams.

13. Operating instructions clearly highlighted to show proper operating procedures for all equipment.

14. Exploded parts views and parts lists for all equipment and devices.

15. Color coding charts for all painted equipment and conduit.

16. Location and listing of all spare parts and special keys and tools furnished to the Owner.

B. Tools: Provide and deliver to the Owner's authorized representative any special tools required for maintenance of systems, equipment, and apparatus installed under this Division prior to requesting final acceptance of the installation.

1.15 PROJECT RECORD DOCUMENTS

A. Site Prints: Maintain a set of clearly marked black line prints of the Contract Drawings at the job site which shall be used for recording the work details, final size, location, interrelation, and similar items of all work under this Division. This set of Drawings shall be corrected daily as the Work progresses and shall clearly indicate all changes to suit field conditions, changes made by "Field Order" or "Change Order", accurate dimensions of all buried or concealed work, precise locations of all concealed work, locations of all concealed valves, controls and devices and any deviations from the work shown on the Construction Documents which are required for coordination. All dimensions shall be to at least two permanent structure points.

B. Upon completion of the work, the Contractor shall transfer all marks from the site prints to a set of sepia mylar reproducible record "As-Built" Drawings using red pencil. The reproducible record "As Built" Drawings shall have the Engineer's name and seal removed or blacked out and shall be clearly marked and signed on each sheet.

1.16 MATERIALS AND WORKMANSHIP

A. General: Materials and equipment shall be new, of best grade and quality, and standard products of reputable manufacturers regularly engaged in the production of such materials and equipment.

B. Workmanship: Work shall be executed and materials installed in accordance with the best practice of the trades in a thorough, substantial, workmanlike manner by competent

workmen, presenting a neat appearance when completed.

C. Manufacturer's Recommendations: With exceptions as specified or indicated on the Drawings or in the Specifications, apply, install, connect, erect, use, clean, and condition manufactured articles, materials, and equipment per manufacturer's current printed recommendations. Copies of such printed recommendations shall be kept at the job site and made available as required.

1.17 SPACE REQUIREMENTS

A. General: Determine in advance of purchase that the equipment and materials proposed for installation will fit into the confines indicated, leaving adequate clearances for traffic, adjustments, repair, or replacement.

B. Clearance: Allow adequate space for clearance in accordance with requirements of the Code and local inspection department.

C. Scheduled Equipment: The design shown on the Drawings is based on the equipment scheduled.

D. Responsibility: Since space requirements and equipment arrangement vary for each manufacturer, the responsibility for initial access and proper fit rests with the Contractor.

E. Review: Final arrangements of equipment to be installed shall be subject to the Architect's review.

1.18 SAFETY REGULATIONS

A. All mechanical work shall be performed in compliance with all applicable and governing safety regulations. All safety lights, guards, signs, and other safety materials and provisions required for the performance of the mechanical work shall be provided by and operated by the Contractor.

1.19 DELIVERY, STORAGE AND HANDLING OF MATERIALS

A. General: Protect all materials and equipment to be installed under this Division from physical and weather damage.

B. Scope: Work under this Division shall include, but not be limited to:

1. Shipping from point of manufacture to job site.

2. Unloading, moving, and storage on site with proper protection required.

3. Hoisting and scaffolding of materials and equipment included in this Division.

4. Ensuring safety of employees, materials, and equipment using such hoisting equipment and scaffolding.

C. Coordination: All large pieces of apparatus which are to be installed in the building and which are too large to permit access through doorways, stairways, or shafts shall be brought to the job by the Contractor and shall be placed in the spaces before enclosing

partitions and structure are completed. All apparatus shall be cribbed up from the floor by Contractor and shall be covered with tarpaulins or other protective covering where required for protection.

1.20 NOISE AND VIBRATION

A. General: Warrant the heating, ventilating, air conditioning systems, and their component parts to operate without objectionable noise or vibration. Noise from systems or equipment which results in noise within occupied spaces above the recommended NC or RC curves (refer to ASHRAE Standard) shall be considered objectionable. Vibration shall not be apparent to the senses in occupied areas of the building. Objectionable noise, vibration, or transmission thereof to the building shall be corrected.

1.21 CONTRACTOR WARRANTIES AND GUARANTEES

A. General: Contractor shall guarantee all material and equipment installed by him against defective material and faulty workmanship for a period of 12 months after final acceptance of the work by the Owner and he shall repair or replace any materials or equipment revealing such defects within that time, promptly on due notice given him by the Owner and at Contractor's sole cost and expense. Due to the 24 hour operation of the building, the Owner may be forced to immediately do the repair work himself during the warranty period. The Contractor shall reimburse the Owner for such costs.

B. Equipment: All equipment bearing a manufacturer's guarantee, such as motors, AC units, water heaters, compressors, heat exchangers, water heaters, fans, controls, and similar items, may have an extended guarantee to the Owner by the manufacturer. Any such equipment that proves defective in materials or workmanship within the guarantee period is to be replaced by the Contractor in accordance with the manufacturer's guarantee.

C. Start-up: The Contractor shall provide instructions and equipment starting help on new equipment for one complete year after date of final acceptance of the work by the Owner, at Contractor's sole cost and expense.

1.22 OWNER INSTRUCTION

A. General: This Contractor and appropriate factory-trained representatives shall instruct the Owner's representative in the proper operation and maintenance of all systems and equipment and shall explain all warranties.

B. Outline: Prior to instruction of Owner Personnel, prepare a typed outline, listing the subjects that will be included in this instruction, and submit the outline for review by the Architect.

C. Certification: At the conclusion of the instruction period obtain the signature of each person being instructed on each copy of the approved outline to signify that he has a proper understanding of the operation and maintenance of the systems and resubmit the signed outlines.

D. Other Requirements: Refer to other Division 15 Sections for additional operator training requirements.

1.23 DEFINITIONS

A. "Concealed": Embedded in masonry or other construction, installed in furred spaces, within double partitions or hung ceilings, in trenches, or in enclosures.

B. "Connect": Complete hook-up of items with required services.

C. "Control or Actuating Devices": Automatic sensing and switching devices such as thermostats, pressure, float, electro-pneumatic switches and electrodes controlling operation of equipment.

D. "Drop": A vertical pipe or duct that does not penetrate a floor.

E. "Exposed": Not installed underground or "concealed" as defined above.

F. "Finished Space": A room or space that is not unfinished as described below. Any space ordinarily visible to the visiting public and staff (excluding maintenance personnel), including exterior spaces.

G. "Furnish" or "Supply": To purchase, procure, acquire and deliver complete with related accessories.

H. "Header": A pipe or duct of constant size that serves a battery of closely spaced inlet or outlet connections.

I. "Indicated", "Shown" or "Noted": As indicated, shown or noted on Specifications or Drawings.

J. "Individual Mechanical Section": Any of the Sections of the Specifications under Division 15.

K. "Install": To erect, mount and connect complete with related accessories.

L. "Motor Controllers": Manual or magnetic starters (with or without switches), individual pushbuttons or hand-off-automatic (HOA) switches controlling the operation of motors.

M. "Other Division": The portions of the Specifications that does not include the Mechanical Division.

N. "Piping": Pipe, tube, fittings, flanges, valves, controls, strainers, hangers, supports, unions, traps, drains, insulation, and related items.

O. "Provide": To supply, install and connect up complete and ready for safe and regular operation of particular Work referred to.

P. "Public Space": A finished space (including toilets, lounges, restaurants) that is open to the general public using the Airport. Excludes Airport and Airline support staff areas, maintenance equipment/personnel areas.

Q. "Reviewed", "Satisfactory" or "Directed": As reviewed, satisfactory, or directed by or to Architect.

R. "Riser": A vertical pipe or duct having a vertical length greater than one story height.

S. "This Division": The Mechanical Division (Division 15) of the Specifications; a portion of the Specifications that includes all the Sections of the Specifications.

T. "Unfinished Space": A room or space that is ordinarily accessible only to building maintenance personnel. A room that in the Architect's finish schedule has exposed and unpainted construction for walls, floor and ceiling. Room specifically mentioned as "Unfinished".

U. "Upfeed Connection": A vertical pipe or duct that penetrates a floor, but has a vertical length of less than one story height.

V. "Wiring": Raceway, fittings, wire, boxes and related items.

W. "Work": Labor, materials, equipment, apparatus, controls, accessories, and other items required for proper and complete installation.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Materials and equipment shall be new, shall be current models of manufacturers, and shall bear complete identification by manufacturer.

B. All items of similar nature shall be by the same manufacturer. Trim for major items shall be by the same manufacturer as the item.

C. Materials and equipment shall be guaranteed by manufacturer to equal or exceed specified performance requirements.

D. Materials and equipment shall be those of major and reputable manufacturers with ability to render competent and thorough technical services through local organizations, and to expeditiously provide spare parts.

E. Identify materials, equipment by manufacturer's name, nameplate data. Remove unidentified materials, equipment from site.

F. Equipment specified by manufacturer's number shall include all accessories, controls, etc., listed in catalog as standard with equipment. Provide optional or additional accessories as specified.

G. Where no specific make of material or equipment is mentioned, any first class product of reputable manufacturer may be used, provided it conforms to requirements of system and meets with acceptance of Architect.

H. Equipment, material damaged during transportation, installation, and operation is considered as totally damaged. Replace with new. Variance from this permitted only with written acceptance.

I. Provide an authorized representative to constantly supervise Work of this Division, check all materials prior to installation for conformance with Specifications and Drawings.

PART 3 - EXECUTION

3.01 COORDINATION OF MECHANICAL WORK

A. General: Refer to Division 1 for general coordination requirements applicable to the

entire work. It is recognized that the Contract Documents are diagrammatic in showing certain physical relationships which must be established within the mechanical work, and its interface with other work including utilities and electrical work and that such establishment is the exclusive responsibility of the Contractor. The Drawings show diagrammatically the sizes and locations of the various ductwork and piping systems and equipment items and the sizes of the major interconnecting ducts and pipes, without showing exact details as to elevations, offsets, control lines, and installation details.

1. Arrange mechanical work in a neat, well organized manner with services running parallel with primary lines of the building construction.

2. The Contractor shall carefully lay out his work at the site to conform to the architectural and structural conditions, to avoid obstructions and to provide proper grading of lines. Exact locations of outlets, apparatus and connections thereto shall be determined by reference to detail Drawings, equipment Drawings, roughing-in Drawings, etc. by measurements at the building and in cooperation with other Contractors and in all cases shall be subject to the approval of the Architect. Relocations necessitated by the conditions at the site or directed by the Architect shall be made without any additional cost to the Owner or Architect.

3. All ducts and pipes except those in the various equipment rooms, in unfinished spaces or where specifically designated herein or on the Drawings shall be run concealed in furrings, plenums and chases. Wherever conditions exist which would cause any of these items to be exposed in finished spaces, the Contractor shall immediately call the situation to the attention of the Architect and shall stop work in those areas until the Owner's Representative directs the resumption of the work. Submit for approval a Shop Drawing for any change in piping, equipment placement, ductwork, etc.

4. Equipment has been chosen to fit within the available space with all required Code and maintenance clearances and shall be installed as shown. Every effort has been made to also accommodate equipment of other approved manufacturers, however since equipment and access space requirements vary, the final responsibility for installation access and proper fit of substituted equipment rests with the Contractor.

5. Piping interferences shall be handled by giving precedence to pipe lines which require a stated grade or location for proper operation. Where space requirements conflict, the following order of precedence shall, in general, be observed:

    a. Building lines.

    b. Structural members.

    c. Soil and drain piping.

    d. Sprinkler piping. (Mains and branches larger than 1-1/2 inches).

    e. Vent piping.

f. Supply ductwork.

g. Exhaust ductwork.

h. Heating hot water piping.

i. Domestic water piping.

j. Electrical conduit.

6. Locate operating and control equipment properly to provide easy access. Arrange entire mechanical work with adequate access for operation and maintenance.

7. Advise other trades of openings required in their work for the subsequent move in of large units of mechanical work.

8. Coordinate all items which will affect the installation of the work of this Division. This coordination shall include, but not be limited to, voltage, ampacity, capacity, electrical and piping connections, space requirements, sequence of construction, building requirements and special conditions.

9. When submitting Shop Drawings, Contractor is indicating that all necessary coordination has been completed and that the systems, products and equipment submitted can be installed in the building and will operate as specified and intended, in full coordination with all other Contractors and Subcontractors.

B. Coordination Drawings: Prepare Coordination Drawings and Shop Drawings showing the actual physical dimensions (at accurate scale) required for the installation of mechanical system and equipment fitted within the allotted spaces. Prepare and submit coordination Drawings prior to purchase-fabrication-installation of any of the elements involved in the coordination.

3.02 INSTALLATION OF MATERIAL, EQUIPMENT AND APPARATUS

A. Installation of material, equipment and apparatus shall be in an orderly and neat manner, with like elements and appurtenances in similar location, position and elevation. The installation shall be adjusted for lighting fixtures, doors, windows, and other architectural elements to avoid interferences.

B. Operation, maintenance and access shall be arranged for in all installations in accordance with good practice.

C. Furnish access panels to service valves, cleanouts, shut-offs, dampers, sensors, controllers, equipment, and automatic devices at inaccessible locations and here indicated; sizes as required to permit easy servicing and removal of the item.

D. Manufacturer's Directions:

1. Follow in all cases where manufacturers of articles used provide directions covering points not specified or shown.

E. Equipment which is required to be field assembled shall be assembled under the direct supervision of the manufacturer's agent. Prior to the final acceptance submit letters from the manufacturers that this has been done.

F. Equipment:

1. Accurately set and level with supports neatly placed and properly fastened. Properly fasten equipment in place with bolts to prevent movement in earthquake. No allowance of any kind will be made for negligence on part of Contractor to foresee means of bringing in, installing equipment into position inside building.

G. Piping and/or Ductwork Systems:

1. Complete, integrated arrangement with like elements to make Work neat appearing, finished.

2. Run concealed, except as shown otherwise; where exposed, parallel with walls or structural elements; vertical runs plumb; horizontal runs levels, parallel with structure or uniformly pitched as appropriate.

3. Install with adequate passageways free from obstructions, as high as practicable to maintain adequate head room, as shown or as required. Notify Architect before installation whenever head room of less than 7 feet 6 inches will result. Coordinate with Work of other Divisions to achieve proper head room as specified in this Division.

4. Clearance: Do not obstruct spaces required by Code in front of electrical equipment, access doors, etc.

5. Flash and counterflash all pipes and ducts through roof.

6. Penetrations:

a. Insulated piping or ductwork through sleeves shall have uninterrupted insulation inside sleeves or openings. Pack space between piping or ductwork and sleeve or opening with non-combustible material.

b. Make penetrations through floors watertight with mastic even though concealed within wall or furred space. Provide suitable frame below slab to prevent packing from falling out. Caulk space between pipe or duct and concrete to full concrete thickness with rope, fiberglass, and mastic.

c. Make penetrations through any dampproofed-waterproofed surfaces dampproof-waterproof by appropriate means to maintain integrity of system penetrated. Includes penetrations caused by hangers suspended off such surfaces.

7. Cleaning and Closing: Inspect all piping, ductwork and equipment before placing; clean interior before closing. Close all piping and ductwork at end of each day's Work.

8. All motors and bearings shall be covered with watertight and dustproof covers during

construction period. All motors and belts shall be accessible for service.

9. Lubrication: Provide all lubrication for the operation of all equipment until acceptance.

10. Fixtures and Equipment Provided By Others (Not under this division): Where the Drawings indicate fixtures and equipment which are to be provided and installed by others, and which require connections to the Mechanical systems, provide and install all rough-in of piping or ducts. All necessary traps, stops, and supplies, and make final connections to the fixtures and equipment. Rough-in locations shall be determined from the equipment itself or from the equipment manufacturer's shop Drawings.

11. Valves shall be provided on all piping wherever shown or specified using adapters where required. All removable or replaceable equipment shall be valved. Valves shall have a securely fastened stamped brass metal plate, each bearing a different number identified in the maintenance manual.

12. All cooling, heating and reheat coils shall have hinged access doors in duct for inspection of coils on upstream and downstream side of coils and shall not be less than 12 by 12 inches. Access doors can be omitted at Air Terminal units' reheat coils.

3.03 PREVENTION OF RUST

A. Surfaces of ferrous metal exposed to weather or corrosive atmosphere shall be given a rust-inhibiting coating. The treatment shall withstand 200 hours in salt-spray fog test in accordance with Method 6061 of Federal Standard No. 141. Immediately after completion of the test the specimen shall show no signs of rust creepage beyond 1/8 inch on either side of the scratch mark. Where steel is specified to be hot-dip galvanized, mill galvanized sheet steel may be used provided all raw edges are painted with a zinc-pigmented paint. Piping installed in raceways, shafts, furred ceilings and similar protected spaces shall not be coated unless specifically indicated on the Specifications or Drawings.

3.04 PROTECTION FROM MOVING PARTS

A. All belts, pulleys, chains, gears, couplings, projecting setscrews, keys and other rotating parts shall be fully enclosed with removable supports and properly guarded in compliance with the State of California Safety Codes. Provisions for removal of guards shall be made including provisions for RPM check. Guards shall be provided around all moving machinery parts such as pump couplings. Warning signs, as required by state regulations shall be posted near automatically started equipment.

3.05 SPARE PARTS DATA

A. As soon as practicable after approval of materials and equipment and not later than four (4) months prior to the date of beneficial occupancy, furnish spare parts data for each different item of equipment listed. The data shall include a complete list of parts and supplies, with current unit prices and sources of supply.

3.06 VERIFICATION OF DIMENSIONS

A. Verify any and all dimensions in the field, including inverts, and advise the Architect in writing of any discrepancy.

3.07 CUTTING OF STRUCTURES

A. Cut no beams, girders, columns or other structural members, or run any pipes in any way through slabs, unless specifically shown on the Drawings, or unless written approval is obtained from the Architect. Cutting of walls, floors, or other parts of the building or repairing any Work due to neglect of properly direct the location of the necessary openings and framing beforehand, shall be done at no additional cost to the Owner.

3.08 CUTTING AND PATCHING

A. All cutting of concrete shall be done with rotary diamond drilling equipment and/or concrete saws. The use of impact tools for cutting is prohibited except by the express written permission of the Architect. Patch cut surfaces to match adjoining uncut construction as directed by the Architect.

3.09 PROTECTION

A. Protect all Work, equipment and materials against loss or damage. Close all pipe openings with caps or plugs during installation and until connections are made thereto.

B. Protect all stored pipe; prevent dirt or debris from entering pipe prior to installation.

C. House or cover equipment to protect same against weather, adverse construction conditions, dirt or damage caused by water, chemicals or mechanical accident.

D. See respective Sections for specific protection requirements of the materials therein.

3.10 CLEANING

A. Properly prepare Work under this Division to be finish painted under Section 09900: PAINTING.

B. Equipment, piping, ductwork, filters, scale pockets, and strainers shall be thoroughly cleaned prior to final acceptance of this Work. Discoloration or damage to systems or building finish or furnishings resulting from failure to properly clean respective systems shall be repaired or replaced at no additional expense to the Owner.

C. Ductwork:

1. Prior to operating air conditioning systems for tests and prior to installation of grilles and painting of building, clean ducts to remove rubbish, debris, dust and dirt; blow out ducts by operating fans with all dampers wide open.

D. Clean Strainers: Remove, clean and reinstall each strainer screen as specified below after systems have been flushed.

1. Clean each strainer after all adjustments have been made and system has operated a minimum of 24 hours but before final test and balancing operation is started.

2. Clean each strainer again, after final test and balancing operation and before acceptance of the Project.

3. Certain screens may remain out of the strainer body after removal during the final cleaning only as directed by the Architect.

E. Protect all finished surfaces of fixtures, floor drains and cleanouts with heavy paper pasted thereon, or by other means, throughout the period of construction.

F. Exterior surfaces of uninsulated pipe, insulation, ductwork and equipment shall be left clean.

G. Plumbing Fixtures:

1. Scour with approved domestic scouring powder.

H. Purge all air from water systems.

I. Protect all furnishings and finishes, and repair or replace to original condition, those damaged as a result of servicing or other work.

J. Replace insulation removed or damaged after each operation.

K. Remove all tags and shipping labels.

3.11 INSTRUCTIONS AND TRAINING

A. The Owner's testing agent, or Owner's assigned representatives, shall schedule and conduct comprehensive training sessions for the Owner's engineers to help them understand the systems and operate and maintain each major piece of equipment.

B. The Contractor shall attend all training sessions and shall add to each session any special information relating to the details of installation of the equipment as it might impact the operation and maintenance.

C. The Contractor shall make the factory approved, manufacturer's representatives available, whenever scheduled by the Owner's agent, to provide the detailed instructions for operation, preventive maintenance, troubleshooting and repair of each major piece of equipment and their automation/control system. The manufacturer's representatives shall instruct the Owner's engineers in classroom setting as well as shall provide hands on explaining and demonstration of their respective equipment. These training sessions shall be of minimum duration listed below and shall cover but not be limited to the following:

EQUIPMENT	Minimum Training Session
Air Conditioning Units	4 hours
Water Heaters, Boilers	4 hours
Controls	4 hours

D. The piping, insulation and sheet metal installers shall conduct a minimum of 2 sessions of 8 hours each with the Owner's engineers to explain peculiarities of the systems, their

installations and maintenance requirements. The systems covered shall be HVAC, Plumbing and Fire Sprinklers.

E. The air and water balancing Subcontractor's representative shall conduct a training session with the Owner's engineers to review the procedure and methods used and results obtained in the balancing process.

3.12 START-UP SERVICE

A. Equipment Check-Out:

1. Prior to start-up, check proper equipment rotation, wiring, auxiliary connections, lubrication, venting, controls, and properly set relief and safety valves.

B. System Start-Up:

1. Start and operate systems. Provide services of factory-trained technicians for start-up of major equipment and systems, including fans, AHU's, AC units, pumps, heat exchangers, water heaters, etc.

3.13 SPECIAL TOOLS

A. Furnish to Owner one (1) set of any special tools required to operate, adjust, dismantle, or repair any equipment of this Section. "Special tools" mean those not normally found in possession of mechanics or maintenance personnel. Also location of supplier where extra sets can be purchased.

3.14 RECORD DRAWINGS

A. Record of Job Progress:

1. Keep an accurate record of as-built locations and of Work. Keep record up-to-date on blueline prints as job progresses and available for inspection at all times. Progress payment will not be approved if Drawings are not current.

B. In addition to any other requirements, include on as-built Drawings the following:

1. Main shut-off valves plainly marked and identified.

2. Position of buried or concealed mains accurately dimensioned, both horizontally and vertically.

3. Changes in location of piping, duct, or equipment.

4. Ceiling access panel locations.

3.15 SAFETY

A. In accordance with generally-accepted construction practices, the Contractor will be solely and completely responsible for conditions of the job site, including safety of all persons and property during performance of the Work. the requirement will apply continuously and not be limited to normal working hours.

B. The duty of the Architect to conduct construction review of the Contractor's performance is not intended to include review of the adequacy of the Contractor's safety measures, in or near the construction site.

3.16 FINAL REVIEW

A. General: Upon completion of the Work, perform a final inspection and test of the entire system.

1. The system shall be operating properly with all water and air volumes balanced and all temperature controls adjusted.
2. After the final inspection and test, any changes or corrections noted as necessary for the Work to comply with these Specifications or the Drawings shall be accomplished without delay in order to secure final acceptance of the Work.

3. The date for the final test shall be sufficiently in advance of the Contract completion date to permit execution, before expiration of the Contract, of any adjustments or alterations which the final acceptance tests indicate as necessary for the proper functioning of all equipment. Any such modifications shall be completed within the time allotted for completion of the Contract. Retests shall be conducted as directed and shall be of such time duration as necessary to ensure proper functioning of adjusted and altered items. Retests shall not relieve the Contractor of completion date responsibility.

4. Certificates, including certificates of occupancy from local authorities and documents required herein, shall be completely in order and presented to the Architect at least one week prior to the review.

B. Qualified Person: Individuals knowledgeable of the systems and persons approved by the Architect, shall be present at this final inspection to demonstrate the system and prove the performance of the equipment.

C. Comply with all the LEED requirements including providing documentation necessary to show the compliance with the selected LEED checklist items, complying with the construction waste recycling requirements, satisfying indoor environmental quality requirements during construction and prior to occupancy, certifying the installation of the equipment and systems through testing and commissioning, etc.

END OF SECTION

SECTION 15200

HEATING, VENTILATING AND AIR CONDITIONING

PART 1 - GENERAL

1.01 DESCRIPTION

A. The intent of these specifications and supplemental drawings is to define the HVAC criteria and scope of work for the HVAC trade contractor to provide HVAC system and associated control system for a complete and fully functioning HVAC system for the facility.

The Contractor shall include in this price all items indicated and/or specified and of work reasonably inferred by these specifications and required for compliance with applicable codes to provide such fully functioning facility with all systems complete. If the Contractor is in doubt as to the intent of any portion of these specifications and drawings or suspects necessary information is omitted, then the Contractor shall notify the Owner in writing in sufficient time for the Owner's clarifications or corrections by addendum.

B. The Contractor shall review drawings and specifications of all disciplines (i.e., Architectural, Structural, Mechanical, Electrical, Civil & Landscape etc.), and include all related mechanical work unless specifically excluded.

C. The contractor shall coordinate the work of this trade with the work of all other trades during design phase as well as during construction. Contractor shall include in the scope providing all necessary utilities, services, temporary connections, controls, plumbing & electrical provisions as necessary for a complete system. The Contractor shall include all leakage testing, balancing of air & water systems, functional and performance testing and documentation necessary for T-24 and LEED compliance.

D. Related Sections: The completion of the work described in this Section may require work in or coordination with other Sections of these specifications. The Contractor shall be responsible for identifying and including all related work in other Divisions and Division-15 specification Sections and/or drawings necessary for a complete installation of the work described in this Section.

1.02 SCOPE OF WORK

A. The scope shall include the design of the HVAC work, materials, equipment, fabrication, installation and tests in conformity with applicable codes, professionally recognized standards and authorities having jurisdiction as follows:

1. Seismic anchorage calculations for all the equipment including but not limited to rooftop AC units and exhaust fans, ductwork and piping.

2. Submittal of HVAC system submittals for equipments and shop drawings for all City/County/State approvals as required for permits and inspections

including Title 24 and LEED requirements.

3. Submittal of HVAC drawings to other entities including but not limited to the local utilities companies for service applications, LEED-NC v2.2 compliance requirements, savings-by-design, etc. as identified by the architect.

4. Provide Testing and Fundamental Commissioning for all equipments and systems identified in Section 01810 – Commissioning, including the preparation and submitting of necessary Reports.

5. The HVAC scope of work shall include but not be limited to the following:

    a. Provide all equipment, shipping, storage, handling, labor, factory start-up and commissioning for all the HVAC systems serving the building.
    b. Provide control system for the HVAC system including all the low-voltage (24-volt) power and control wiring, network communication wiring, conduits and cables, etc.
    c. Provide all exterior architectural louvers required and/or inferred in the various documents, all sheetmetal flashing and counterflashing. Coordinate with architect for size, quantity and locations. Provide acoustically lined plenums at the air intake and exhaust louvers through the side wall louvers.
    d. Provide all air inlets and outlets and air distribution for the project. Coordinate the location of the air inlets and outlets with architectural reflected ceiling plans and lighting plans.
    e. Provide programmable electronic room thermostats for each unit and mount them for ADA compliance. Provide carbon dioxide (CO2) room sensors for conference rooms and high density spaces mandated by T-24 and LEED to adjust the outside air and exhaust air dampers to maintain CO2 levels to within the acceptable range.
    f. Provide supports and seismic restraints for all equipments, ductwork, piping and conduits. Submit engineered seismic calculations for all equipments weighing in excess of 40 pounds.
    g. Provide make-up air and exhaust system for the toilet rooms, janitor rooms, electrical rooms, etc.
    h. Provide rooftop packaged gas-electric air-conditioning units (AC Units) to serve the respective areas. Each of the AC units shall be provided with low pressure drop MERV 14 filters, controls, air distribution including all the FSDs and balancing dampers, duct insulation and automatic shut down as required by CMC.
    i. Provide hot water flues and combustion air intake for the domestic water heaters, per the water heater manufacturer requirements. Terminate the heater vents per Code.
    j. Division-15 contractor shall furnish and install all required fire dampers (FD), smoke dampers (SD) and combination fire-smoke dampers (FSD) and associated smoke detectors. The FSDs and the smoke detectors shall be powered, controlled and status monitored by Division-16.

B. Related Work

1. Plumbing.

2. Electrical.

3. Fire Protection System.

4. Commissioning.

5. Project Sustainability Requirements

1.03 QUALITY ASSURANCE

A. Contractor's Qualifications: Regularly engaged in construction on projects of similar sizes using types of equipment, material and methods as specified herein - for minimum of 5 years. A letter from the contractor certifying these qualifications must be provided to the Owner before signing the construction contract.

1. By accepting to work, the Contractor agrees that he has understood the intent of the design/build and is reasonably sure that it can be accomplished by proceeding in accordance with these drawings and specifications.

2. All equipment and accessories to be the product of a manufacturer regularly engaged in its manufacture.

3. Supply all equipment and accessories new and free from defects.

4. All items of the same given type and size shall be the products of the same manufacturer.

5. Satisfy seismic requirements of the State of California.

6. Comply with all applicable State, County and City Codes and Regulations including T-24 and City of Livermore Green Ordinance & LEED requirements.

1.04 SUBMITTALS

A. Prepare and submit the following Shop Drawing information to the owner/Architect in an organized manner for all equipment and materials used in the project:

1. Manufacturer’s name, brand name and catalog reference of all equipment and materials supplied. Submit complete material and equipment list prior to submittal of Shop Drawings. Submit sound data, energy efficiency data, certified performance data, weight, size, etc. for each piece of equipment.

2. Detailed description of items supplied, including specifications, performance characteristics, materials, diagrams and schedules.

3. Seismic calculations stamped by a registered civil/structural engineer

D. Refer to Division-0 and Division-1 sections for other requirements for the submittal requirements for warranty and guaranty period, equipment start-up and commissioning, T-24 & LEED certification requirements, owner training, spare parts, etc.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Equipment shall be shipped in its original packages to prevent damaging or entrance of foreign matter. All handling and shipping shall be performed in accordance with manufacturer's recommendations. Provide protective covers during construction.

B. Replace at no expense to Owner, equipment or material damaged during storage or handling, as directed by the Architect.

C. All items shall be tagged with a weatherproof tag identifying equipment by name and purchase order number. Packing and shipping lists shall be included.

1.06 CRITERIA

A. Outside Design Conditions

1. Summer: 95ºF Dry Bulb and 68ºF Wet Bulb.

2. Winter: 22ºF Dry Bulb.

B. Inside Design Conditions: (ºF).

	Summer	Winter
	74	72

C. Related Documents

1. Refer to accompanying A-series drawings for building envelop data, space layout, ceiling height, number of people and activity in each space.
2. USGBC/LEED-NC v2.2 Checklist.
3. T-24 analysis, report and installation certification.
4. M, E & P series D-B Criteria drawings and specifications.

1.07 RECORD DRAWINGS

A. Maintain complete set of HVAC and Control Record Drawings (field drawings) indicated all work installed differently from original Contract Drawings

B. At end of project, transfer all changes via CAD (AutoCAD) and submit one set of plots electronic disk and field drawings to Owner.

PART 2 - PRODUCTS

2.01 PACKAGED ROOFTOP AC UNITS:

A. Manufacturer: Trane, Carrier, York or approved equal.

B. The Packaged rooftop AC units shall be gas-electric packaged unit complete with prefabricated roof curb, relief/exhaust fans, automatic control dampers for outside air and exhaust air, integrated economizer controls, variable capacity, Non-CFC and Non-HCFC refrigerant based and integral high-efficiency gas furnace. Single point power connection, insulated double wall, insulated access doors. UL listed and meet CAC Title 24 energy regulations.

C. Units shall be equipped with matching T-24 compliant electronic programmable room thermostats and carbon dioxide room sensors and associated sequence of controls to maintain the room temperature and CO2 levels at an optimum level.

D. The units shall be listed by UL and/or Electrical Laboratories (ETL) and bear the UL/ETL labels.

E. All wiring shall be in accordance with the National Electrical Code (N.E.C.) and all wiring in EMT conduits. All outdoor wiring shall be in liquid-tight galvanized conduits and Nema-3R rate enclosures.

F. The units shall be manufactured in a facility registered to ISO 9001 and ISO14001 which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).

G. A full charge of R-410A for the units shall be provided.

H. The units shall be started-up and commissioned by the factory trained representatives.

I. The units shall be capable and ready for networking the controls and monitoring and programming from a central building controller by the maintenance engineer.

J. Fans: Statically and dynamically balanced.

2.04 Exhaust Fans: Greenheck or equal, spun aluminum construction, mushroom type, premium efficiency motor, backdraft damper, bird screen, mounted on prefabricated insulated roof curb, vibration isolators and seismic anchorage. Fans shall be direct drive with factory installed speed controllers for air balancing. Fans shall be UL listed and Capacity as scheduled.

2.05 Fire-smoke dampers: UL 555S & California State Fire Marshall Listed, Ruskin FSD-60 or approved equal combination fire-smoke dampers with electric actuators, end switches, fusible link and other features as required per the application requirement. For FSDs with wall registers, provide front access type FSDs with integral supply and exhaust registers in

the rated walls.

2.06 DUCTWORK:

A. General:

1. Construct with gauges, joints, bracing, reinforcing, and other construction details per CMC, ASHRAE, or SMACNA unless specified otherwise, and comply with the requirements of NFPA. Comply with most stringent.

2. Construct ductwork of low carbon galvanized sheet metal of lock forming quality (LFQ), and minimum 1.25 oz. per square foot galvanized, except where otherwise indicated. Sheet metal gauge and LFQ visibly marked thereon by manufacturer.

3. Diagonally or transversely crossbreak panels on metal rectangular ducts over 18" in either direction.

4. Duct dimensions indicated are net, inside, clear dimensions. For internally lined ducts, add lining thickness to determine metal duct dimensions.

5. Classifications: Classify and construct ducts per latest SMACNA classifications as follows:

a. All Supply and Return Air Ducts and other Supply Air Ducts: +/-2" static pressure rating; 2,000 FPM maximum, seal Class B.

b. All Supply ducts located outdoors shall be designed for +/- 2” static pressure rating; seal class A and internally insulated with 2” thick duct liner. The top of the ductwork cross-broken to prevent water ponding.

6. Provide all necessary transitions and additional fittings as required to clear obstructions, maintain clearances, and coordinate with other trades at no extra cost to the Owner.

7. Joint Sealing: Seal all transverse and longitudinal joints of all ductwork to comply with CCR Title 24. Seal duct joints using Hardcast PS-S tape or DT tape and HD-20 adhesive as recommended by manufacturer. At Contractor's option, United Hi-Vel sealer may be used for duct joint sealing.

8. Provide intake and exhaust hoods to prevent entry of rainwater through the AC unit opening.

9. The rooftop equipment curbs, equipment support pads, shaft closure caps and all support rails and piers shall be provided with stainless steel caps to prevent entry of rainwater through the respective support systems.

B. Round Duct Fittings: Fittings shall be manufactured by United Sheet Metal, or approved substitute, or may be manufactured by the Contractor is of equal quality and pressure loss.

1. Elbows shall be five piece with centerline radius equal to 1-1/2 times the diameter for medium pressure ducts. For low pressure ducts, centerline radius shall be minimum 1 times the diameter.

2. Fittings shall be smooth on the inside and shall be designed for minimum pressure drop and minimum noise generation.

3. Pleated and adjustable elbows, non-standard "jerry-rigged" fittings not allowed.

C. Rectangular Duct Fittings: Fittings shall be manufactured according to SMACNA standards.

1. The throat radius of all bends shall be 1-1/2 times the width of the duct wherever possible and, in no case, shall the throat radius be less than one width of the branch duct. Provide square elbows with double thickness turning vanes where space does not permit the above radius or where square elbows are shown.

2. The slope of transitions shall be approximately one to five and no abrupt changes or offsets of any kind in the duct system shall be permitted without prior approval.

D. Flexible Ducts:

1. Thermaflex, Genflex, or approved substitute, flexible sound absorbing ducts with scrim cloth inner liner and outer plastic liner, R-4 insulation, helical support wire. UL Class I air duct to comply with UL-181.

2. Low Pressure Duct: Thermaflex M-KE, or approved substitute. Use for final connections to all ceiling supply air outlets.

F. Exhaust ductwork: Same as for the supply and return air ducts.

2.07 DUCTWORK SPECIALTIES:

A. Flexible Duct Connections: Ventfabrics, or approved substitute. Ventglass if exposed to weather. Install to maintain not less than 2" metal to metal separation

B. Turning Vanes: Double thickness, airfoil-type.

C. Bird Screens: 14 gauge, 2" galvanized wire mesh, set in galvanized steel frame

D. Duct Access Doors: With hinges and latches, Ventlock, or approved substitute. Insulated as specified for ducts in which installed. Size as required for proper access.

E. Concealed Damper regulators: Ventlok model 677 or equal, with mitergears and rod attachments as required.

2.08 AIR OUTLETS:

A. Acceptable manufacturers are Titus, Krueger,Tuttle & Bailey, ETI, or approved substitute.

B. Outlets may be steel or aluminum. Provide aluminum in toilet rooms and janitor rooms and other wet areas.

C. Provide factory-baked white enamel unless otherwise indicated. Flat black interiors on perforated face outlets.

D. Provide gaskets at supply outlet flanges. Provide frames to match the ceiling type.

E. On grilles, diffusers, or registers utilizing a plenum box, provide box fabricated of 22 gauge, zinc coated steel with internal surfaces internally lined with minimum 1" thick duct liner as specified under INSULATION.

F. Provide all exterior louvers and grilles and exhaust outlets as required and when not provided under other divisions. Coordinate with architect for type, size, and style.

2.09 DAMPERS:

A. Balancing Dampers:

1. Construct balancing damper per SMACNA. Use single blade or multi-blade dampers per ASHRAE/SMACNA recommendations.

2. Provide hand locking quadrant with standoff bracket.

B. Automatic Control Dampers:

1. In Rectangular Duct: Ruskin, Model CD-35 opposed blade control damper with neoprene jamb and blade edge seals

2. Round Ducts: Ruskin, Model CDRS-25, control damper with neoprene seal

C. Fire Dampers: U.L. listed and California Fire Marshal approved.

1. Supply Air: Air Balance Inc., 119BLX, 100% free area.

2. Return Air: Air Balance Inc., 119BLX, 100% free area.

3. Ceiling: Air Balance Inc., assembly A-2 with FD-30 fire damper.

4. At wall outlet: Air Balance Inc., 119AF

D. Backdraft Dampers: Ruskin, Airodynamic counterbalance-type, Model CBD-4, or approved substitute.

E. Combination Fire/Smoke Dampers

1. California Fire Marshal approved, UL listed per UL 555 (1-1/2 hour fire damper) and UL 555S leakage Class I and 350 degrees F elevated

temperature rating.

2. Heavy 13 gauge equivalent frame construction.

3. Low pressure drop airfoil or single blade.

4. Firestat to close damper at 212 degrees F.

5. Damper electric actuator, power open - fail close type, heavy duty, low noise and non-stall type.

6. Ruskin FSD60 or approved substitute.

7. All FSD'S shall be installed with remote position indicator light plate affixed to the ceiling tile.

2.10 FANS:

A. Provide fans constructed and factory-tested in accordance with AMCA and ARI. Fan wheels statically and dynamically balanced.

B. Manufacturers: Greenheck, Cook, Twin City or approved substitute.

C. Bearing Life: AFMBA L-10 life of 40,000 hours minimum, 200,000 hour average.

2.11 EQUIPMENT SUPPORTS:

A. All rotating equipment and equipment capable of transmitting vibration into the space shall be mounted on vibration isolators and bases. The isolators and bases shall be properly sized by the isolator manufacturer, taking into account the piece of equipment, its center of gravity, anchor points, weight of bases, and the structure upon which it is setting, so that vibration transmitted to the structure is held to a level acceptable to the Owner.

B. Isolators shall be provided for equipment mounted aboveground and as required by acoustical consultant.

C. The isolators shall be fastened to the structure and to the equipment with properly sized and structurally engineered anchors and bolts. Structural calculations shall be provided by the isolator manufacturer or supplier.

D. The bases and isolators shall be as manufactured by Mason, Kinetics, or Amber-Booth. Other manufacturers not allowed.

E. Isolator springs shall be as follows:

1. Single coil cadmium-plated helical steel springs with minimum diameter 0.8 of operating height.

2. Reserve deflection (from operating to solid height) 50% of specified deflection.

3. Ratio of horizontal to vertical spring constants shall be within range of 0.90 to 1.10.

4. Provide corrosion resistant protection for all springs and their housings, for out-of-doors installations, and also for materials exposed to out-of-doors during construction. Hot-dipped galvanized or coated with neoprene or polyvinylchloride.

F. For rooftop pipes and conduit supports, provide premanufactured non-combustible sleeper supports, which are attached to the roof structure and flashed, as manufactured by B-Line or equal..

2.12 SEISMIC RESTRAINTS:

A. General: Provide seismic restraints per applicable code and standards. Design and provide restraints to prevent permanent displacement in any direction caused by lateral motion, overturning or uplift. Restraints shall not short circuit vibration isolated equipment under normal operation.

B. Requirements:

1. Criteria: Design restraints per SMACNA/PPIC "Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Piping Systems", for equipment, ducts, and piping.

2. Seismic Force Criteria: 1 G

3. Contractor shall submit Seismic Restraint calculations that are signed by a structural engineer registered in the State of California. Calculation must confirm the adequacy of the restraints and their anchoring to the building structural elements.

2.13 INSULATION: Insulation for ductwork, piping and equipment shall be in conformance with the California Title-24 2008 Edition for Non-residential buildings requirements and per this Section.

A. Ductwork Insulation:

1. Wrap all unlined sheet metal supply and return ducts with minimum 1-1/2" thick duct wrap with reinforced foil facing, Fiberglas RFK 75 insulation as manufactured by Owens Corning Fiberglas Corporation, Manville, or Certain-Teed. Adhere to duct surfaces with Foster #81-99, or approved substitute, adhesive, applied in strips about 6" wide on approximately 12" centers. Lap all circumferential joints and longitudinal joints a minimum of 2". On circumferential joints, the 2" flange of the facing shall be secured using 9/16" flare door staples applied 6" on center and taped with a minimum of 3" wide foil reinforced craft tape. All pin penetrations or punctures in facing shall also be taped.

2. Provide acoustical lining in rectangular supply and return air ducts exposed to outdoors. Per SMACNA Duct Liner Application Standard and as follows:

lining shall be 2" thick, except where noted otherwise. 3# minimum density J-M Microcoustic, Fiberglas, or Certain-Teed with black coating and shall comply with UL-181. Cement the lining in place with 100% coverage of adhesive and coat all butt joint edges and joints with sealants. Cover all joints and exposed edges of duct liner with 6 oz. canvas cemented in place with Arabol. No bare fiberglas edges shall be left exposed to air stream. Adhesive and sealants shall be UL listed or classified Type I per Adhesive and Sealant Council Standard ASC-A-7001.

3. Provide Plenum lining in return exhaust and outside air plenums where indicated on the drawings. Lining shall be 2" thick 3.0 PCF density black coated rigid fiberglass board. Apply as indicated above for duct lining.

4. All externally insulated piping and fittings located on roof and exposed to weather shall be protected with aluminum jacketing (Childers or equal) to prevent the entry of moisture. The aluminum jacketing shall cover 100% of the insulation including the elbows and fittings.

B. Piping Insulation:

1. Insulate piping and equipment per Title-24 2005 Edition for Non-residential buildings, Section 123 “Requirements for Pipe Insulation”, except for cold water, vents, overflow drain and relief piping as allowed by Exceptions” to Section 123. Insulation, jackets, facings, adhesives coatings and accessories fire hazard rated by Underwriters’ Laboratories, Inc. The flame spread rating not-to-exceed 25, fuel contributed and smoke developed rating not-to-exceed 50. Insulation shall be labeled per Title-24 CEC-2005 Edition.

2. Piping insulation shall mean insulation of all components of the piping system including, but not limited to piping, fittings, flanges, equipment, tanks, valves, pump volutes and all exposed surfaces subject to temperatures above 100 deg F or below 60 deg F.

3. Insulation material: Molded fiberglass pipe covering, Owens Corning Fiberglas SSLII or equal. Minimum density 3.5 PCF, maximum thermal conductivity of 0.25 BTUH/sq. ft. °F./in. at 75°F.

4. Jacket: Factory applied, paintable, white kraft outer surface bonded to aluminum foil and reinforced with fiber glass yarn with self-sealing lap. Maximum vapor permeance of 0.02 perms and minimum beach puncture of 50 units. Seal end joints with sealing strip or tape to provide vapor tight installation.

5. Fittings and Valves: Premolded PVC fitting covers over precut insulation of same thickness as adjacent piping. In addition, on cold and chilled water pipes, apply vapor-barrier adhesive mastic on PVC cover seams and on circumferential edges wrap with vapor-barrier pressure-sensitive tape. The tape shall overlap 2" over the adjacent pipe insulation.

6. Expansion Joints: At all the expansion joints in insulated piping, provide factory made insulation covers specifically made for the purpose. The

covers shall be preshaped, shall cover entire joints including flanges and shall allow the anticipated movement of the joints without breaking the insulation or jacket. The covers shall also be removable to facilitate inspection of joints by maintenance personnel. Insulation for chilled water and cold piping shall allow for continuous vapor barrier across the joints.

8. System Codes and Insulation Types: Provide fiberglass insulation, unless indicated otherwise.

   a. CODE I - Domestic hot water, tempered water

   b. CODE II - Rainwater Leaders, Storm and overflow drains (where indicated)

   c. CODE III - Condensate drains, domestic cold water (where indicated)

   d. CODE IV - Lavatory drain traps and tail pieces, refrigerant pipes.

9. Piping Insulation Schedule:

	Pipe Sizes	
System Code	2" and Smaller	2-1/2" and Larger
I	1-1/2"	1-1/2"
II	1"	1"
III	1"	1"
IV	1/2"	--

   a. Where piping systems are scheduled, insulate all supply and return piping.

C. Equipment Insulation

   A. Rigid Board without Vapor Barrier Equipment Insulation:

      a. Insulation: Fiberglass board, Owens Corning Fiberglas Type 705 or equal. Minimum density 6 PCF, maximum thermal conductivity 0.25 BTUH/sq. ft. °F./in. at 75°F.

      b. Application: Impale insulation on weld pins on flat surfaces, or band in place on irregular surfaces with 16 gauge annealed steel wire on maximum 9" centers. Apply 1/4" coat of insulating and finishing cement filling all voids. Secure lightweight glass cloth with Foster 30-36 adhesive over cement.

   B. Calcium Silicate Equipment Insulation:

      a. Insulation: Preformed calcium silicate block insulation. Minimum density 12.5 PCF, maximum thermal conductivity 0.40 BTUH/sq. ft. °F./in. at 200°F.

b. Application: Securely band blocks, tightly butted, and joints evenly staggered with 16 gauge galvanized annealed steel wire on maximum 12" centers. Provide weld pins, clips, and angles for anchors. Stretch 2" hexagonal mesh wire on anchors. Apply 1/4" coat insulating and finishing cement. Apply heavy weight glass cloth with Foster 30-36 adhesive. Apply finish coat of adhesive.

C. Plastic Foam Equipment Insulation:

a. Insulation: Plastic foam with minimum density 5.0 PCF, maximum thermal conductivity 0.28 BTUH/sq. ft. °F./in. at 75°., and maximum flame spread rating of 25.

b. Application: Adhere insulation to clean, oil free surfaces with adhesive. Seal joints with adhesive.

c. Finishes: Apply flexible waterproof finish from manufacturer over all insulation outdoors.

D. Equipment Insulation Schedule:

Service	Temperature Range	Insulation Type	Insulation Thickness
Boilers, Water Heaters, Hot Water Storage Tanks, and other hot surfaces.	All	Rigid Board without Vapor Barrier	1-1/2"

D. condensate Drain Piping: Insulate indoor condensate drainage piping with 1” foam insulation Armstrong or approved equal. Protect outdoor insulation with aluminum jacketing.

2.14 TEMPERATURE CONTROL:

A. Contractor shall provide temperature control system to control and monitor, start-stop, adjust heating and cooling set points, for each of the packaged rooftop AC units and the associated exhaust fans.

B. The AC unit controllers shall be capable of being networked to a central controller for remotely scheduling the start-stop, monitoring alarms, changing the room set points, etc. without adding any additional control devises at the units. Acceptable manufacturers are Trane, Carrier, York or equal.

C. Provide complete control wiring between the room thermostat, CO2 sensors and outdoor AC units, for proper operation of the unit.

D. All work shall be coordinated with other trades and the building owner to minimize impact on the areas served by the system.

E. All power and control wiring shall be in EMT conduit per Division-16 specification requirements. All electrical power and control wiring connections on roof shall be in liquid tight conduits.

PART 3 - EXECUTION

3.01 GENERAL

A. Check Architectural drawings and drawings of other trades relating to work to verify spaces in which work will be installed. Maintain headroom and space condition to all points. Install ductwork tight to the underside of the structure and coordinate with other tradework to avoid conflicts. Where necessary reroute or reshape the ductwork of equal cross section to avoid conflicts. Any equipment, materials, piping, ductwork and air devices installed in conflict with the dropped ceiling and lights shall be relocated at the direction of the Architect at no additional cost to the Owner.

B. Set and layout work on premises. Base all measurements from approved bench marks and correct setting or work to agree with established lines and levels. Should discrepancy exist between actual measurements and those indicated, notify Architect in writing and do not proceed with work affected until written instructions are received from Architect.

C. Install equipment and ductwork rigid and secure, plumb and level, and in true alignment with related and adjoining work. No welding of HVAC materials for attachment or support is permitted.

D. Drawings and Arrangement: Install equipment and materials with all working parts readily accessible for inspection, repair and removal. The right is reserved to make reasonable changes in locations of equipment shown on drawings prior to roughing-in without involving additional expense to the Owner.

E. Prior to all work of this Section, carefully inspect the existing and installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

F. The installation of all ductwork, louvers, dampers, etc., shall be according to the SMACNA standards.

G. Ducts shall be hung with galvanized 1" x 18 gauge duct straps with spacing as recommended by SMACNA or as required by local codes, whichever is most stringent.

H. Provide sway bracing on all ductwork in accordance with the local codes and seismic requirements.

3.02 PIPING INSTALLATION

D. Thoroughly clean all pipe and maintain in such condition throughout construction. Temporarily cap off plug ends of unprotected pipe.

E. Install unions at connections to equipment, on service side of valves and elsewhere as required or shown to facilitate maintenance.

F. Install dielectric insulating connections between all dissimilar metals unless otherwise indicated.

G. Run all piping generally level, free of unnecessary traps and bends, and arrange to conform to the building requirements and to suit necessities of clearance for other work.

H. Arrange piping and hangers to allow for expansion, contraction, and structural settlement. Do not install piping in contact with the building structure.

I. Make changes in size or direction with manufactured fittings. The use of bushings, reducing flanges, or bending of a pipe is not allowed.

J. Install piping full size through shut-off valves, balancing valves, etc. Change pipe size within three pipe size diameters of the final connection to fixtures and equipment.

K. Unless specifically indicated otherwise, install piping concealed above ceilings, beneath the floors, or in walls. Route piping to linear beams, columns, obstructions and the work of other trades.

3.03 START-UP SERVICES:

A. Prior to start-up, ensure that the systems are ready, including the following: Proper equipment rotation, proper wiring, auxiliary connections, lubrication, venting controls, all filters in place and properly set relief and safety valves.

B. Start and operate all systems. Provide the services of factory trained technicians for start-up of major equipment and all systems including but not limited to temperature controls, AC units, and fans.

C. Adjust all controls, fans, flow and pressure regulators, and any other adjustable equipment for optimum performance and to suit job conditions.

D. Personnel performing start-up services shall be fully qualified, experienced, and normally engaged in this type of work. If the Contractor does not have such personnel available from his own company, he shall hire, at his own expense, Subcontractors who are qualified.

E. The Contractor shall designate one field person who is overall responsible for start-up procedures which include testing and balancing. He shall directly supervise the start-up operations and be available for required coordination before, during, and after start-up. Coordinate with the commissioning agent and GC for commissioning

the equipment and systems.

F. A final and complete start-up, pre-functional test and functional test reports shall be submitted prior to final acceptance and payment. This report shall be signed by each person doing the start-up task and by the responsible field person. Report shall include, but not be limited to: date of test, instrument used, date of last calibration, temperatures, humidities, set points, rpm, voltage, amperage, pressures, stability, vibration, etc.

3.04 CLEANING

D. Brush and clean work prior to concealing, painting and acceptance. Clean and repair soiled or damaged painted exposed work and match adjoining work before final acceptance. Remove debris from inside and outside of material, equipment and structure.

3.05 TESTING, ADJUSTING AND BALANCING:

D. Personnel performing testing, adjusting and balancing shall be fully qualified, experienced, and normally engaged in this type of work. The Contractor shall have membership in the AABC, or certified by the NEBB and shall have no less than 5 years experience of projects in similar scope and complexity.

E. Provide all labor, equipment, and materials required to perform tests and balancing. Instruments for testing and balancing shall have been calibrated within a period of six months and verified for accuracy prior to start of work.

F. Protect valves and equipment from damage during tests. Include connection to previously tested sections, if the systems are tested in sections.

G. Prior to the final observation of construction or commencement of the balancing procedure, whichever occurs first, operate all systems for at least 72 consecutive hours in automatic mode, or longer if required, to prove satisfactory automatic operation. If system shutdown is experienced for any reason, repeat the test until 72 consecutive hours are achieved. Operate equipment as recommended by the equipment manufacturer's and in such a manner as to avoid damage to the work of other trades.

H. The air systems shall be adjusted and tested as specified below by the Contractor before full balancing.

1. Complete all Punch List items.

2. Install all dampers and other balancing devices as called for in the construction documents, and verify that same are properly installed, indexed, and in good working order.

3. Place all systems in automatic operation.

4. Check all motor starters and verify that the heater sizing is correct taking length of electrical feeders into consideration. Record amp and voltage

readings on all motors, (all legs) as well as nameplate data.

5. Check-out and align all equipment drives.

6. Set all fan sheaves to provide approximately the indicated capacities.

7. Set all manual balancing dampers, valves, and balancing valves at 100% open position. Verify all fire dampers to be open.

8. Clean interior of all plenums, casings and ducts and install all filters before starting systems.

9. Make sure all control systems are calibrated and functioning properly.

I. Balancing Submittals

1. Data Sheets on Testing Equipment:

a. Submit data sheets on each item of testing equipment required

b. Include names of device, manufacturer's name, model number, latest date of calibration, and correction factors.

2. Report Form:

a. Format per AABC.

b. Bound 8-1/2" x 11".

c. Include name of balancing company.

3. Report Content: Include balancing company certification that methods used and results achieved are as specified and reported.

4. Report Content:

a. Air Balance:

1) Fans:

Number, service, model, and size

Delivery in CFM with system both in 100% O.A. and exhaust and with minimum O.A

Minimum outside air CFM.

Static pressure: suction, discharge, and total.

Voltage: rated and actual.

Motor amperage: rated and actual.

Motor sheave diameter: adjustable or solid

Fan sheave diameter.

Motor RPM.

Fan RPM.

2) Fans Graphic Plot: For each fan, on its actual fan curve, plot intersections of the following lines:

CFM from transverse.

Static pressure (or total pressure for fans so rated).

Brake horsepower from amperes.

RPM

Position of fans variable adjustment.

3) Filter banks, outside air, return air, and exhaust air CFM's.

4) All supply, exhaust, and return air diffusers and grilles; arrange in following columns:

Outlet location by room number, or other suitable means

Include key plans, if necessary, to identify locations.

Supply/make-up outlet size and type.

Supply outlet design CFM.

Supply outlet actual CFM.

Return or exhaust outlet size and type.

Return or exhaust outlet design CFM.

Return or exhaust outlet actual CFM.

J. Air Balancing:

1. Balance with outside, return, and exhaust air dampers fixed in 100% outside air and 100% exhaust positions. Obtain value of minimum outside air from drawings.

2. Verify proper automatic operation of automatic outside, return, and exhaust air dampers throughout entire range of operation.

3. Balance with filter pressure drop at midpoint between clean and dirty filters. Artificially create required pressure drop, if necessary, by blanking off coils.

4. Balance with doors and windows in their normal, closed position.

5. Balance air to be the following tolerances:

   a. Each outlet: +/-10%.

   b. Each room with multiple outlets: 0% to + 10%.

   c. Each system: 0% to + 10% of system CFM.

6. Balance main exhaust systems to maintain interior building pressure at 0.05" water greater than outdoor pressure. This may require different exhaust or return air quantities than scheduled.

7. Adjust throw patterns of supply air outlets to result in uniform, draft-free room air distribution.

8. System design static pressures are approximations. Make changes in sheaves and belts as required for specific air balance. Final adjustment of sheaves to result in sheave with additional possible adjustment in both directions.

9. Inspect all rooms for room temperatures, drafts, and noise. Make adjustments to correct any problems.

10. Operate each room thermostat to verify correct system response to raising and lowering thermostat set points.

H. Water Balancing:

1. Adjust water systems to provide required or design quantities.

2. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gages to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.

3. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

4. Effect system balance with automatic control valves fully open to heat transfer elements.

5. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

6. Where available pump capacity is less than total flow requirements or

individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

3.06 OPERATION MANUALS AND MAINTENANCE INSTRUCTIONS:

D. Furnish three (3) complete sets of operating and maintenance instructions for all equipment (of all types) and automatic control systems bound in a hardboard binder and indexed. Start compiling the data upon approval of list of materials. Submit no later than thirty (30) calendar days prior to substantial completion. Final payment will not be made until booklets are approved by Engineer.

E. These sets shall incorporate the following:

1. Complete operating instructions for each item of equipment.

2. Test data and air balancing reports as specified.

3. Typewritten maintenance instructions for each item of equipment listing in detail the lubricants to be used, frequency of lubrication, inspections required, adjustments, etc.

4. Manufacturer's bulletins with parts numbers, instructions, etc., for each item of equipment, properly separated and assembled.

5. Special diagrams and literature that may be required.

6. Diagrams, descriptions and sequence of controls for each system.

7. Include telephone numbers and addresses of service companies.

8. Approved product data submittals.

F. A permanent, non-fade, reproduction (such as a photo copy) of the As-built control and wiring diagrams shall be framed and mounted where directed by the architect/owner.

END OF SECTION 15200

SECTION 15300

FIRE PROTECTION SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. The intent of these specifications is to define the fire protection scope of work for a complete and fully functioning facility and to enable the Design-Build Contractor to prepare a bid price to construct the work under a Design/Build process.

These specifications are not intended for construction purposes.

The Contractor shall include in this price all items indicated and/or specified and of work reasonably inferred by these specifications and required for compliance with applicable codes to provide such fully functioning facility with all systems complete. If the Contractor is in doubt as to the intent of any portion of these specifications or suspects necessary information is omitted, then the Contractor shall notify the Architect in writing in sufficient time for the Architect's clarifications or corrections by addendum.

B. The Contractor shall review specifications of all disciplines (i.e., Architectural, Structural, Mechanical, Electrical, etc.), and include all related fire protection work unless specifically excluded.

C. The project will be completed and occupied in multiple phases. The Design-Build contractor shall coordinate the phasing requirements with the owner and the architect and provide all necessary utilities, services, temporary connections, sectionalized valves, plumbing & electrical provisions as necessary for the phased construction and to maintain services to the occupied portion of the building.

D. The project will include solar thermal and Photovoltaic systems on the roof. The Design-Build fire protection contractor shall provide customized sprinkler protection for these areas to provide 100% coverage of all areas and as per the local jurisdiction requirements.

E. Provide U.L. listed and the local water company approved double check detector check valves as necessary to provide adequate Code required flow and pressure based on the available city water pressure.

F. Provide complete fully engineered fire protection system including the wet and dry stand pipes, fire department connections, approved type backflow preventers, post indicator valves, fire hose valves where required both for occupant use and fire fighters use. Provide water motor bells or other electrically operated audible alarms as required by the local jurisdictions.

G. Coordinate with the Division-16 in monitoring of the flow and tamper switches. Coordinate the power requirements for the fire pump and jockey pumps and control panels.

H. Provide permanent identification labels for all fire protection equipment, stand pipe risers, control valves assemblies, main and branch pipes per NFPA and local authority requirements.

I. Coordinate with Division-15 plumbing trade work for providing floor sinks, indirect drainage receptors for fire protection test drains per Code. Test drain piping shall be schedule-40 galvanized steel piping.

J. All exposed piping shall be galvanized schedule-40 steel. All exposed heads shall be corrosion proof type, all heads located in equipment rooms and low head rooms shall be protected with approved type protection guards.

K. Coordinate with architect for fire control valve assembly and fire riser location within the building. Coordinate with structural consultant for sleeving the foundation and slab for bringing in the fire water service line to the room. Comply with City of Livermore Fire Department requirements for quantity and location of fire department connection locations and sprinkler alarm locations.

1.02 SCOPE OF WORK

A. The scope shall include the design of the fire protection work, materials, equipment, fabrication, installation and tests in conformity with NFPA 13, & 14, using the latest edition that the city of Livermore follows, and applicable codes, professionally recognized standards and authorities having jurisdiction as follows:

1. Calculations supporting the design.

2. Submittal of fire protection shop/construction drawings for all City jurisdiction approvals as required for permits and inspections.

3. Shop/Construction drawings and specifications.

B. Related Work

1. Plumbing.

2. Solar Hot Water System

3. Mechanical General requirements

4. Heating, Ventilating and Air-Conditioning.

5. Division-16 - Electrical connections for alarms and tamper switches.

6. Site Fire Protection mains up to 5 feet of the building. Coordinate fire department connection line, backflow preventer location and pumper connection with civil engineer.

1.03 QUALITY ASSURANCE

A. Construction Documents shall be designed/engineered by a registered Professional Engineer licensed by the State of California.

B. Contractor's Qualifications: Duly licensed in the state of California and regularly engaged in design/build installations of Fire Protection systems for similar projects in the local area.

C. All equipment and accessories to be the product of a manufacturer regularly engaged in its manufacture.

D. Supply all equipment and accessories new and free from defects.

E. All items of the same given type and size shall be the products of the same manufacturer.

F. Satisfy seismic requirements of the State of California and NFPA 13, latest edition that the City of Livermore follows.

1.04 SUBMITTALS:

A. Detailed engineering calculations, shop drawings and specifications, stamped and signed by a registered Professional Engineer indicating the specific fire protection design for the project, shall be submitted to the Architect for review prior to the ordering of materials and equipment and the installation of the work. The Engineer shall become the Engineer of Record for the project.

Type and arrange specifications in 3 part CSI format, adequately describing the materials, system operations where applicable, and execution of the work.

B. After acceptance of shop drawings and specifications and at a time designated, submit the following shop drawing information to the Architect in an organized manner for all equipment and materials used in the project:

1. Shop Drawings: Shall be scaled layout drawings for fire protection equipment, pipe and fittings including, but not necessarily limited to, pipe and tube sizes, sprinkler head types and locations, elevations, and slopes of horizontal runs, wall and floor penetrations, and connections. Indicate interface and spatial relationship between piping and proximate equipment, lighting fixtures, etc.

2. Manufacturer’s name, brand name and catalog reference of all equipment and materials supplied. Submit complete material and equipment list prior to submittal of Shop Drawings.

3. Detailed description of items supplied, including specifications, performance characteristics, materials, diagrams and schedules.

4. Seismic calculations stamped by a registered civil/structural engineer.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Equipment shall be shipped in its original packages to prevent damaging or entrance of foreign matter. All handling and shipping shall be performed in accordance with manufacturer’s recommendations. Provide protective covers

during construction.

B. Replace at no expense to Owner, equipment or material damaged during storage or handling, as directed by the Architect.

C. All items shall be tagged with a weatherproof tag identifying equipment by name and purchase order number. Packing and shipping lists shall be included.

1.06 DESIGN CRITERIA:

A. General: Based upon latest NFPA 13, & 14, latest edition that the city follows, and its applicable appendices and City of Livermore Fire Department. The system should be hydraulically designed.

B. Areas Covered: Entire building including Rooftop penthouse mechanical rooms and solar panels.

C. Areas Excluded: None.

D. Residential Areas: Light Hazard.

E. Mechanical Equipment Rooms, boiler rooms, pumps rooms, trash rooms & Storage Areas: Ordinary Hazard, Group 1.

F. Other Areas: Per latest NFPA 13.

G. Head Spacing: Per NFPA 13.

H. Flow Rate Densities: Per NFPA 13 area/density.

I. Piping Distribution: Combination system for sprinklers and standpipes.

J. Sprinkler Risers: Sprinkler floor control valve station at each riser shall be provided with a fire department test drain valve. Provide drain connection to building sewer.

K. Fire Department Connection: As required by the local fire department.

L. Standpipe System as required by the City of Livermore and NFPA 14.

M. All system and floor control valves including backflow preventer OS&Y valves shall be supervised.

N. All waterflow indicator and monitor switches shall be connected to the annunciator panels and to a central station signal system.

O. For criteria which is not specified and which may have to be established during design, call attention of such items to Owner and Architect. Establish and document such criteria, with approval of Owner and Architect, consistent with good engineering practice.

P. Provide separate sprinkler subzones for other auxiliary spaces, covered walkways, etc. as required by the owner/architect and/or local jurisdiction requirements.

1.07 RECORD DRAWINGS

A. Maintain complete set of Fire Protection Record Drawings (field drawings) indicated all work installed.

B. At end of project, transfer all changes via CAD (Autocad 2007) and submit one set of plots electronic disk and field drawings to Owner. Mark drawings "RECORD DRAWINGS", dated and signed by the Contractor.

PART 2 - PRODUCTS

2.01 GENERAL:

A. All materials and equipment shall be new and free of all defects, best quality of their respective grades in accordance with these specifications, and packed in their original sealed containers. Materials not specifically mentioned by trade name shall be best quality of their respective grades. Imperfections in manufacture or damage in shipment will be cause for rejection of the work unless corrections are made to the complete satisfaction of the Architect.

2.02 PIPING:

A. Underground: Cast iron piping conforming to ANSI A21.6, 150 PSIG; bituminous external coated, ANSI A21.11, push-on or mechanical joints. ANSI A21.4 cement-mortar interior lining. Provide as required corrosion protection for the pipe and fittings.

B. Aboveground: Black steel, schedule 40, conforming to ASTM A120. Fittings, threaded cast iron conforming to ANSI B16.4, 125 PSIG class. Threads, ANSI B2.1.

C. Pipe supports: Install pipe supports, braces and anchors per NFPA 13, or as required by applicable local codes.

2.03 VALVES:

A. General Service:

1. Manufacturers: Crane, Jenkins, Stockham, Walworth or approved equal U.L. listed. Model numbers given are for Stockham.

2.	Gate Valves	2" and smaller	Fig. B-133
		2-1/2" and larger	Fig. G-634
3.	Check Valves	2" and smaller	Fig. B-319
		2-1/2" and larger	Fig. G-940
4.	Angle Globe		Fig. B-222

B. Alarm Check Valve:

1. Manufacturers: Automatic, Grinnell, Viking or approved substitute. Selection based on Viking.

2. Type: Model F-1 with Model B-3 retard chamber and special alarm trim for remote electric signal.

3. Gong: Model B-3 water motor operated.

2.04 PIPING SPECIALTIES:

A. Manufacturers: Automatic, Grinnell, Marsh, Simplex, Viking, or approved substitute.

B. Gauges: Marsh No.8, 3-1/2" Dial, dial range twice the system working pressure, 1/4" bottom connection, shut off valve. Provide gauges as required by NFPA 13 and at inspector's test valve in the mechanical penthouse.

C. Flow switches: Vane type, with adjustable time delays, UL listed. Each with two contacts for local and remote alarms.

D. Valve supervisory switches: Provide on main and other shutoff valves that can interrupt flow to sprinklers.

E. Electric Alarm: Locate as required by fire authorities.

F. Adjustable nipples:axial field adjustable , UL listed.

G. Other specialty items as required by NFPA 13 or local conditions and codes.

2.05 SPRINKLER HEADS:

A. Manufacturers: Automatic, Grinnell, Reliable, Viking or approved substitute.

B. Areas without suspended ceilings: Automatic 1/2" pendant or upright issue E 165 degree F. rating, rough brass, quick response type.

C. Residential Areas: quick response, residential type, coordinate with the owner and architect regarding the finish

D. Lobbies and Public Areas: Concealed, 165 degrees F. quick response with finish as approved by the Architect.

E. Other areas with suspended ceilings: Automatic 1/2" pendant issue E flush type, 165° F. rating quick response, polished chrome plated with white enamel escutcheon.

F. Submit one sample of each type of heads to Architect for approval.

G. Spare Sprinklers: Provide spare sprinklers, wrenches, and cabinet per NFPA 13.

H. Provide approved type sprinkler protection guards at the parking garage and

other open ceiling areas to prevent damage to the heads.

2.06 PUMPER CONNECTIONS:

A. Manufacturers: Elkart, Powhattan, Standard, Potter-Roemer or approved substitute. Selection based on Potter-Roemer.

B. Wall Type, Polished chrome plated. Coordinate with the Architect for the exact location.

2.07 PIPE HANGERS AND SUPPORTS:

A. Supports and Hangers:

1. Use Super Strut, Unistrut, B-Line, Elcen or Grinnell hangers and structural attachments to properly support the piping system according to good standard practice and according to the manufacturer's recommendations. Minimum safety factor of 5.0.

2. No piping shall have direct contact with the hanging and support system or the structure.

3. Size hangers properly to fit around bare pipe.

4. Use cadmium plated or galvanized hangers, attachments, rods, nuts, bolts and other accessories.

5. Do not use wire, plumber's tape, or other make-shift devices for hangers.

6. Do not burn or weld any structural member without the written approval of the Owner or Architect.

7. No valve or piece of equipment shall be used to support the weight of any pipe for pipes 1-1/2" and larger.

8. Provide a support or hanger close to each change of direction the pipe, either horizontal or vertical.

9. When piping is installed using a trapeze hanger, bolt the pipe to the trapeze using a pipe clamp, strap or "U" bolt. Do not weld the pipe to the trapeze.

2.08 SEISMIC RESTRAINTS:

A. General: Provide seismic restraints per NFPA 13, and applicable codes and standards. Design and provide restraints to prevent permanent displacement in any direction caused by lateral motion, overturning or uplift.

PART 3 - EXECUTION

3.01 GENERAL:

A. Entire Project to be sprinkler protected per NFPA 13 and per City of Livermore Fire Authority requirements.

B. Layout the fire protection system in careful coordination with the approved shop drawings, determining proper elevations for all components of the system and using only the minimum number of bends to produce a satisfactorily functioning system.

C. Install pipes fully concealed and to clear all beams and obstructions; do not cut structural members without the approval of the Architect.

D. Check Architectural drawings and drawings of other trades relating to work to verify spaces in which work will be installed. Maintain headroom and space condition to all points. Any equipment , materials, and piping installed in conflict with the dropped ceiling and lights shall be relocated at the direction of the Architect at no additional cost to the Owner.

E. Set and layout work on premises. Base all measurements from approved bench marks and correct setting or work to agree with established lines and levels. Should discrepancy exist between actual measurements and those indicated, notify Architect in writing and do not proceed with work affected until written instructions are received from Architect.

F. Install equipment and piping rigid, secure, plumb, and in true alignment with related and adjoining work. No welding of fire protection materials for attachment or support is permitted.

G. Arrangement: Install equipment and materials with all working parts readily accessible for inspection, repair and removal. The right is reserved to make reasonable changes in locations of equipment prior to roughing-in without involving additional expense to the Owner.

H. Prior to all work of this Section, carefully inspect the existing and installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

I. Provide sidewall heads if required for special areas as directed by the architect at no extra cost to the owner.

3.02 PIPING:

A. Underground piping shall be installed, cleaned and tested per NFPA 24. Terminate Underground service at riser location with flange and spigot piece securely anchored to building wall.

B. Installation: Install aboveground pipe, fittings and hangers in accordance with NFPA Pamphlet No.13, 14 and 20 and local code requirements, including seismic sway and uplift bracing.

C. Reducers: Make reductions in pipe sizes with one piece reducing fitting. Bushings will not be acceptable, except when standard fittings of proper size are not manufactured. Single bushings of the face type will be permitted up to 5% of total number of reducing fittings in system. Where bushings are used, install with outer

face flush with face of fitting opening being reduced.

D. Use no coupling except where length of pipe between fittings exceeds 20 feet.

E. Use flanged fittings on main riser and drain assembly.

F. Provide next to sprinkler main risers a framed printed sheet protected by transparent plastic, safety glass, or plexiglas cover with brief instructions regarding all necessary aspects of sprinkler controls, emergency procedure, etc.

G. Drains: Install main drain at riser and auxiliary drains at all low points in the system on each floor. Install inspector's test drains on sprinkler system at main riser assembly and at most remote high point in the system from the main riser (penthouse mechanical room or as directed by Architect). Use angle type drain valves. Five or fewer trapped heads may be drained through a plugged fitting. Pipe drain valves to discharge, as approved by the Architect and local fire department officials, outside building unless noted otherwise.

H. Sprinkler head clearance between the deflectors and the walls or ceilings, roof decking or roof joists shall be in accordance with the requirements of the NFPA Pamphlet No. 13.

I. Install a hinged chrome plated escutcheon at all visible wall, floor and ceiling pipe penetrations.

J. Thoroughly clean all pipe and maintain in such condition throughout construction. Temporarily cap off plug ends of unprotected pipe.

K. Install unions at connections to equipment, on service side of valves and elsewhere as required or shown to facilitate maintenance.

L. Install dielectric insulating connections between all dissimilar metals unless otherwise indicated.

M. Run all piping generally level, free of unnecessary traps and bends, and arrange to conform to the building requirements and to suit necessities of clearance for other work.

N. Arrange piping and hangers to allow for expansion, contraction, and structural settlement. Do not install piping in contact with the building structure.

O. Make changes in size or direction with manufactured fittings. The use of bushings, reducing flanges, or bending of a pipe is not allowed.

P. Install piping concealed above ceilings, and beneath the floors. Route piping to linear beams, columns, obstructions and the work of other trades.

Q. Provide corrosion protection for all underground piping. Provide Link Seals at all pipe penetrations to prevent water entry into the building.

3.03 CLOSING IN UNINSPECTED WORK:

A. General: Do not cover up or enclose work until it has been properly and completely inspected and approved.

B. Noncompliance: Should any of the work be covered up or enclosed prior to all required inspections and approvals, uncover the work as required and after it has been completely inspected and approved, make all repairs and replacements with such materials as are necessary to the approval of the Architect.

3.04 FLUSHING, TESTS AND ADJUSTMENTS:

A. After fire sprinkler piping installation has been completed, flush entire system to remove foreign substances under pressure as required under NFPA 13. Continue flushing until water is clear and check to ensure that debris have not clogged sprinklers.

B. Test the installations in accordance with the following requirements and all applicable codes.

1. Notify the Architect at least 7 days in advance of any test.

2. All piping shall be tested at completion of roughing-in, or at other time as directed by the Architect.

3. Furnish all necessary materials, test pumps, gauges, instruments and labor required for testing.

4. Perform all testing in the presence of the following persons: Municipal Inspector, Fire Marshal and the Architect's representative. Test all above and below grade piping at not less than 200 PSIG pressure, unless local Fire Marshal requires stricter tests. Flush and test until accepted all underground piping before connecting above grade piping at riser connection.

C. Perform operational and alarm tests under simulated or actual service conditions, including one test of complete fire protection system installation with all appliances connected.

D. Should any material or work fail in any of these tests, it shall be immediately removed and replaced by new material, and portion of the work replaced shall again be tested by Contractor at his own expense.

E. Instruct Owner's operating personnel during operating adjustment period.

3.05 CERTIFICATES:

A. Submit to Architect all certificates in triplicate indicating approval of work, approval or performance of tests as required and of final inspection issued by Fire Marshal before final acceptance of sprinkler system.

3.06 CLEANING

A. Brush and clean work prior to concealing, painting and acceptance. Clean and

repair soiled or damaged painted exposed work and match adjoining work before final acceptance. Remove debris from inside and outside of material, equipment and structure.

B. Sprinkler Heads: If sprinkler heads are in place prior to painting, cover each head with a small paper bag of a UL approved type, which shall be removed only after painting is complete. After painting is completed, remove bags and clean and polish each head.

C. Clean-up: Upon completion of all work of this section, remove debris created by this work.

END OF SECTION

SECTION 15400

PLUMBING

PART 1 - GENERAL

1.01 DESCRIPTION

A. The intent of these specifications and supplemental drawings is to define the plumbing scope of work for a complete and fully functioning facility and to enable the Contractor to prepare a bid price to construct the work per the applicable Codes.

The Contractor shall include in this price all items indicated and/or specified and of work reasonably inferred by these specifications and required for compliance with applicable codes to provide such fully functioning facility with all systems complete. If the Contractor is in doubt as to the intent of any portion of these specifications and drawings or suspects necessary information is omitted, then the Contractor shall notify the Architect in writing in sufficient time for the Architect's clarifications or corrections by addendum.

B. The Contractor shall review drawings and specifications of all disciplines (i.e., Architectural, Structural, Mechanical, Electrical, etc.), and include all related plumbing work unless specifically excluded.

C. The project will be completed and occupied in multiple phases. The Contractor shall coordinate the phasing requirements with the owner and the architect and provide all necessary utilities, services, temporary connections, sectionalized valves & dampers, heating and ventilation provision, plumbing & electrical provisions as necessary for the phased construction and to maintain services to the occupied portion of the building.

1.02 SCOPE OF WORK

A. General: The scope shall include the plumbing work, materials, equipment, fabrication, installation and tests in conformity with applicable codes, professionally recognized standards and authorities having jurisdiction as follows:

1. The scope of work indicated on plans and this section shall include but not limited to providing the Domestic Hot & Cold Water systems, storm drain system, sanitary sewer system, natural gas distribution, condensate drainage system for HVAC equipment, interfacing with the solar water heating system, providing make-up water system for all the HVAC, solar and irrigation system and other systems as indicated on plans.

2. All work shall be in accordance with the plumbing code, local jurisdiction requirements, and in accordance with recognized industry standards, ASPE, ASHRAE, etc., California Plumbing Code, T-24 and USGBC/LEED-NC v2.2 requirements.

3. Submittal of coordination drawings and permit drawings for City/State agency approvals as required for permits and inspections including Title 24.

4. USGBC/LEED-NC v2.2 Compliance: Comply with the water efficiency requirements, energy efficiency, indoor air quality and resource/water efficiency, etc for the project. Meet the prerequisites and the selected optional water efficiency targets for the project through providing water efficient plumbing fixtures. See attached LEED point Checklists for the requirements.

5. Preparation of submittal of detailed shop drawings and cutsheets and performance data.

6. Maintain accurate mark-up of as-built conditions and at the end of the project submit final As-built plans in AutoCAD and hard copies per Div-0 & Div-1 requirements.

7. Submit shop drawings to interface with the various phases of the project as required by the architect/owner. Coordinate with other disciplines, for the service size, point-of-connection, inverts, etc. Coordinate the plumbing fixture locations with the architect.

8. Prepare and submit enlarged scale plans (minimum ¼" to 12') at the toilet rooms and water heater rooms, solar water heating equipment room, and at other locations necessary to clearly route all the plumbing piping in relations to the building elements, structure, and other trade work.

B. The scope of work included in the Section shall cover but not limited to the following:

1. Provide all plumbing piping, central gas domestic water heating with circulated hot water and hot water storage tank, and plumbing fixtures and other accessories required to provide complete and working plumbing systems that includes the sanitary sewer system, storm drain system, domestic hot & cold water system, natural gas distribution, make-up water to the mechanical system, connections to the landscape system, etc. Provide hose bibs, water hammer arrestors, trap primers, thermal insulation, hot water temperature control valves, floor drains, roof drains, overflow drains, labeling, etc. as indicated on the drawings.

2. The plumbing contractor shall coordinate all plumbing penetrations in the building foundation, exterior walls, roof members, etc. with the structural engineer prior to submitting the shop drawing. Similarly, all concrete inserts and sleeves necessary for pipe penetration, supporting and bracing the plumbing systems shall be coordinated and placed the slabs are poured.

3. All underground metal plumbing pipes shall be protected from corrosion with proper coating or plastic sleeves.

4. Provide a main shut-off valves for domestic hot and cold water so that during shut down of one building does not affect the other buildings. Locate the isolation valves in an accessible location. This is in addition to the isolation valves provided at the fixture connections.

5. Provide ultra high-efficiency condensing water heater with all accessories including but not limited to condensate neutralizing system, intake and exhaust vents, relief valve discharge piping, insulated water storage tank return water circulation pumps and interconnection with the solar thermal system.

6. Provide floor drains in the public toilet rooms, water heater room, complete with the drains, trap primer connections and sanitary waste and vent connections. Provide roof main and overflow drains, area drains, complete with fixtures, drainage and coordinate locations with the project architect.

7. Provide hose bibs in the toilet rooms and at building exterior as directed by the architect. Outdoor faucets shall be wall flush mounted in brass enclosure with keyed cover.

8. Provide ultra-high-efficiency plumbing fixtures including but not limited to the water closets, waterless urinals, service sinks & faucets, all faucets, hose Bibbs, floor drains, floor sinks, trap primers, roof drains, deck drains, area drains, etc. The plumbing fixtures, faucets and shower model, make, style, finish & type shall be as indicated in the fixture schedule.

9. Provide and install ADA compliant Hi-Lo electric water coolers per architectural drawings. Coordinate with Division-16 for electrical connections.

10. Install owner furnished equipments and provide utility connections to all the owner furnished equipment and appliances such as the drinking water dispensers, water connections to coffee maker and refrigerator, including all the accessories, hoses, isolation valves, pressure regulators, backflow devices, flex connections, etc. required for proper operation of the appliances.

11. Provide gas distribution from PG&E gas meter to water heater, rooftop packaged gas-electric AC units and other equipment indicated on the plans. Provide UL listed earthquake shut off valves at the entry to the building.

12. Provide color coded pipe labeling, valve identification tags, equipment identification tags, etc. for the complete project. Identification system shall be Seton, Brady or approved equal.

13. Provide U.L. listed through penetration assemblies at all fire and smoke rated wall and shaft wall pipe penetrations.

14. Where pipes enter the building from outdoors or underground provide Link Seal type water seals at the wall or floor penetrations to prevent ground water from leaking into the building.

15. Coordinate with the respective tradework and provide drainage connections, floor drains, indirect waste, trap primers and vent connections for sprinkler test drainage system, condensate discharge for AC units and for receiving the condensate from the high-efficiency (condensing type) water heating equipment. Provide acid neutralizing kit for high-efficiency water heaters

before terminating into the building sewage system.

16. Coordinate with plumbing work provided under this division with work of civil trade and landscape work and provide proper interface between the building utilities and the site utilities. Based on the underground utilities available on the streets at the project site, configure the building services with least number of points of connections to the street utilities.

17. Prepare and submit service connection applications for the domestic water, natural gas, fire water, storm drainage and sewer connections with the respective utility agencies and obtain the required services for the building.

18. Provide approved type backflow preventer assembly for the main building water service, and landscape irrigation service. Provide reduced pressure type devices per the local jurisdiction requirements.

19. Provide schedule 40 galvanized steel drain for the sprinkler test drain riser at each stairwell per the sprinkler system consultant requirements and indirectly terminate to sanitary sewer per local jurisdiction requirements.

20. Provide symmons Tempcontrol water tempering valve and hot water temperature maintenance system consisting of properly sized insulated return water pipe loop, aquastatic and outside air temperature control. Alternately, provide heat tracing for 110 deg F water supply to the public lavatory faucets.

1.03 RELATED WORK

1. Heating, Ventilating and Air-Conditioning.

2. Fire Protection.

3. Electrical.

4. Civil: site water, fire, storm and sanitary drainage main and water up to 5 feet of building. Coordinate point of connection with Civil Engineer.

5. Landscape Architecture Work.

1.04 QUALITY ASSURANCE

A. Installer's Qualifications: Firm with at least 10 years of successful installation experience on projects with plumbing systems work similar to that required for project.

B. All equipment and accessories to be the product of a manufacturer regularly engaged in its manufacture.

C. Supply all equipment and accessories new and free from defects.

D. All items of the same given type and size shall be the products of the same manufacturer.

E. Satisfy the requirements of the latest version of T-24 energy standards in effect and seismic requirements of the State of California.

F. Codes and Standards:

1. Plumbing Code Compliance: Comply with California Plumbing Code and applicable portions of Local Plumbing Code pertaining to selection and installation of plumbing materials and products.

2. ANSI Compliance: Comply with applicable ANSI standards pertaining to materials, products, and installation of soil waste and storm drainage systems.

3. ASSE Compliance: Comply with applicable ASSE standards pertaining to materials, products, and installation of soil and waste systems.

4. PDI Compliance: Comply with applicable PDI standards pertaining to products and installation of soil and waste systems.

5. CMC Compliance: Fabricate and install natural gas systems in accordance with "California Plumbing Code" and PG&E requirements.

6. CCR Compliance: Comply with applicable State energy regulations and handicap requirements.

7. AGA Compliance: All gas appliances and equipment shall comply with requirements of American Gas Association.

8. USGBC/LEED-NC v2.2 Green Point Checklist and T-24 requirements, City of Livermore Green Ordinance requirements.

9. Requirements of Americans with Disability Act (ADA) and City agencies.

1.05 SUBMITTALS:

A. Prepare and submit equipment cutsheets, manufacturer data, shop drawings, equipment schedules, to the owner/Architect in an organized manner for all equipment and materials used in the project:

a. Manufacturer’s name, brand name and catalog reference of all equipment and materials supplied. Submit complete material and equipment list prior to submittal of Shop Drawings.
b. Detailed description of items supplied, including specifications, performance characteristics, materials, diagrams and schedules.
c. Shop drawings, As-builts, O&M manuals, warranty & guarantee.

B. Refer to Division-0 and Division-1 sections for other requirements for the submittal requirements for warranty and guaranty period, equipment start-up and commissioning, T-24 certification requirements, owner training, spare parts, etc.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Equipment shall be shipped in its original packages to prevent damaging or entrance of foreign matter. All handling and shipping shall be performed in accordance with manufacturer's recommendations. Provide protective covers during construction.

B. Replace at no expense to Owner, equipment or material damaged during storage or handling, as directed by the Architect.

C. All items shall be tagged with a weatherproof tag identifying equipment by name and purchase order number. Packing and shipping lists shall be included.

1.07 DESIGN CRITERIA:

A. Soil, Waste and Vent System: Size per 2007 CPC and applicable local regulations.

B. Water Piping: Size piping per CPC Latest Edition. Limit velocities to 6 feet per second and friction loss to no more than 8 ft. per 100 ft for water piping. Limit velocities to 5 ft. per second for hot water piping as required by code.
1. Minimum pressure at remote fixture : 30 PSIG.

2. Maximum pressure : 75 PSIG.

3. Water temperature to Public Lavatories: 110ºF (per T-24).

C. Gas Piping: Per 2007 California Plumbing Code.

D. Roof and Overflow Drains: Per 2007 California Plumbing Code for the rainfall rate of 2" per hour.

1.07 RECORD DRAWINGS

A. Maintain complete set of Plumbing Record Drawings (field drawings) indicated all work installed differently from original Contract Drawings

B. At end of project, transfer all changes via CAD (Autocad 2007) and submit one set of plots, electronic disk and field drawings to Owner. Mark drawings RECORD DRAWINGS, dated and signed by the Contractor.

PART 2 - PRODUCTS

2.01 PIPING:

1. Refer to piping schedule on the drawings.

2. High efficiency water heater condensate piping: Provide acid neutralizing system to neutralize the acidic condensate discharge from the high-efficiency condensing type boilers and water heaters prior to terminating to the building sanitary sewer system. Provide approved type (SS or CPVC) piping and fittings for the condensate drainage system.

2.02 VALVES:

A. Provide Jenkins, Stockham, Demco, Grinnell, or Milwaukee. All ball or butterfly valves for general use shall have EPT seats. Valve handles, except in ground, shall be infinite throttling with memory stop.

B. Gate Valves:

1. 1/2" through 2” - Threaded: Stockham Figure B-105.

2. 1/2" through 2" - Sweat: B-109, screw bonnet.

3. 2-1/2" and above - Flanged: Stockham Figure G-623 bronze fitted.

C. Hand Valves:

1. 1/2" through 2" - Ball Valve - Threaded: Stockham Figure S-214-BR-R-T.

2. 1/2" through 2" - Ball Valve - Sweat: Stockham Figure S-214-BR-R-S.

3. 2-1/2" and above - Butterfly Valve: Demco Series NE, lug type. Provide infinite throttling and memory stop handle. Valves to permit removal of piping on either side with valve in place.

D. Balance Valves:

1. 1/2" through 2" - Ball Valve: Same as hand valve.

2. 2" and above - Plug Valve: Homestead Figure 1522 (semi-steel body).

E. Check Valves:

1. 2" and Smaller - Threaded - Stockham Figure B-319.

2. 2" and Smaller - Sweat - Stockham Figure B-309.

3. 2-1/2" and Larger - Flanged - Stockham Figure G-931.

F. Globe Valves:

1. 2" and Smaller - Threaded - Stockham Figure B-13T.

2. 2" and Smaller - Sweat - Stockham Figure B-14T screwed bonnet.

3. 2-1/2" and Larger - Flanged - Stockham Figure G-512.

G. Gas Cocks: Rockwell, Homestead, Matco, or approved substitute, shall be an approved valve for gas service use.

1. 1-1/4" and Smaller: Matco Catalog #58S AGA.

2. 1-1/2" or 2": Rockwell Figure 114, threaded.

3. 2-1/2" to 4": Rockwell Figure 115, flanged.

H. Pump Discharge Check Valves: Mueller, Clow, or approved substitute.

1. 2" and Smaller: Mueller Figure #203BP.

2. 2 1/2" and Larger: Mueller Figure #101AP.

I. Pressure reducing valves (water): Watts, A.W. Cash, Clayton or approved substitute.

1. General purpose (1/2" to 2 1/2"): Cash figure EB-24U with back pass and optional union inlets.

J. Safety and Relief Valves: Kunkle, Crosby, Watts or approved substitute.

1. Constructed, rated, and stamped per ASME. Relief valves for unheated liquids. Safety relief valves for heated liquids.

2. Set pressure: Must not be above the pressure rating of protected equipment.

3. Size and Capacities: Size valves so that maximum energy of protected equipment is released with pressure not exceeding 10% above valve set pressure.

K. Backflow and Anti-siphon Valves: Clayton, Watts, Febco, Hersey or approved substitute.

1. Reduce Pressure Backflow Preventer: Clayton Model RP.

2. Double Check Valve Backflow Preventer: Clayton Model D.

3. Water heater vacuum breaker: Watts Model 36A.

2.03 DOMESTIC WATER HEATER (GAS):

A. Boilers

1. General: Provide 94% efficient or higher domestic water heaters.

a. Manufacturer: Phoenix, A.O. Smith, Lochinvar, Raypak, Teledyne-Laars, high-efficiency type.

b. Approval: AGA approved and listed in California Energy Commission Directory of Certified Water Heater.

2. Construction: All copper heat exchanger, ASME stamped bronze headers for 160 psi. AGA certified and NBS stamped.

3. Accessories and trim:

   a. Temperature and pressure gauges

   b. Draft Diverter

   c. Electric ignition and California code controls

   d. Power supply 115V

   e. Single stage on/off switch

   f. Time-delay pump control

   g. Burner gas cock

   h. Aquastats on/off temperature controls

   i. Safety gas shut-off valve

   j. Flow switch

   k. Gas pressure regulator

   l. Tankstat and control panel wired for remote sensor

   m. Water heater staging Controller with interface with the BMS.

4. Controls: Fully automatic and factory-set modulating gas and operating controls, water heater staging and capacity control. Provide auxiliary contact in boiler panel to interlock remote tank sensors for operating controls of the boilers. Provide adjustable time delay (0-5 min. adjustable time) relay to quick start and delayed shut-down of boiler circulation pump.

5. Start-Up: Provide factory trained personnel for check-out, start-up, adjustment and instruction services.

6. Provide stainless steel double wall water heater flue termination head for above roof per the water heater manufacturer requirements and its' listing.

2.04 EXPANSION TANK:

A. General: Wessel, Amtrol or approved substitute. NSF and California Codes approved.

B. Precharge: 40 PSI.

C. Rating: Maximum working pressure 150 PSI and 200ºF.

D. Start Up: Set proper operating pressure as scheduled by filling or removing air.

2.05 CIRCULATION PUMP AND CONTROLS:

A. Circulating Pumps: Bell and Gossett, Taco, Thrush, or approved substitute, all bronze type. Complete with aquastat and timer. All bronze type, in-line, suitable for 140 F applications.

B. Hot Water Circulator Controls: Line voltage immersion thermostat, Honeywell, or approved substitute; set to open at 135ºF. and close at 115ºF. on domestic hot water return system.

2.06 DRAINAGE AND PIPING SPECIALTIES:

A. Manufacturers: Smith, Josam, Wade, Jonespec, or Zurn. 100% U.S.A manufactured components only.

B. Cleanouts: Provide types and sizes per code and as directed by the Architect

C. Drains and Floor Sinks: Provide types and sizes per code and as directed by the Architect.

D. Trap Primer: Install where required by code. Precision Plumbing Products differential pressure operated.

E. Traps: Provide for drains, floor sinks, floor-mounted service sinks, showers, and similar type fixtures. Provide clean-out plug in all sink P-traps.

F. Water Hammer Arrestor: Provide where flushometer valves are used. Size per manufacturer's recommendations and PDI Standard.

G. Air Chambers: Provide on all cold and hot water connections without a water hammer arrestor, 18" high and diameter same size as supply. Nibco Model 620L.

2.07 FIXTURE SUPPORTS:

A. General: Provide plumbing fixture carriers, supports, and devices to carry loads independently of walls or partitions. Securely bolt supports to floor with powder-driven or drilled inserts or studs.

B. Manufacturer: Josam, Smith, Wade or Zurn. Selection based on J.R. Smith.

C. Water Closets: Fig. 210 Series for all hung type.

D. Wall Hung Lavatories: Fig. 700 Series.

E. Urinals: Fig. 637.

2.08 SPECIALTY EQUIPMENT CONNECTIONS:

A. General: For equipment provided under other sections, or by Owner, requiring piped utility services, rough-in and connect per applicable equipment shop drawings. Investigate actual equipment supplied to determine need for backflow devices. Conceal piping, valves, and piping accessories except where it is mandatory to be exposed. Exposed work polished chrome plated. Provide insulated hot piping with polished stainless steel jacket.

B. Trim Supplied with Equipment: Install items such as faucets, valves, sink drains, safety devices, gauges, thermometers, pressure reducing valves, traps, and control devices.

C. Connections: Provide all required piping, valves, piping accessories, trim, and safety devices, type as listed under appropriate system.

1. Indirect Waste Connections: Copper; drainage, Type M, or DWV.

2. Plumbing P-traps: Equipment Connected to Waste System - provide type listed under "Plumbing Fixtures".

3. Water Connections: Fixture stops and supplies - provide type listed under "Plumbing Fixtures".

D. Refrigerator Cold water valve box: Provide recessed valve box containing cold water stop valve at each refrigerator locations in the kitchen. The box shall be as manufactured by Guy Gray Mfg. Co. or approved equal.

F. Hose Bibb: Zurn, Smith or approved equal, key operated, with integral backflow device.

2.09 PLUMBING FIXTURES:

A. General: Provide factory-fabricated fixtures of type, style and material indicated or as specified. For each type fixture, provide manufacturer's standard trim, carrier, seats, and valves as indicted by their published product information; either as designed and constructed, or as recommended by the manufacturer, and as required for a complete installation. Where more than one type is indicated, selection is Installer's option but all fixtures of same type must be furnished by single manufacturer. Where type is not otherwise indicated, provide fixtures complying with governing regulations.

B. Manufacturers: Provide fixtures per Paragraph 2.09.K. When not specifically listed provide the following manufacturers.

1. Fixtures: American Standard, Kohler, Eljer, or Crane. Selection based on American Standard unless otherwise noted.

2. Fixture Trim: American Standard, Kohler, Chicago Faucet, or Speakman.

3. Flush Valves: Sloan, Zurn or approved substitute.

4. Water Closet Seats: Olsonite, Church, Sperzel, or Beneke.

C. Vitreous China Fixtures: CS20.

D. Fixture Supplies and Stops:

1. Lavatories: Speedway CRSST-1912-A, or approved substitute.

2. Sinks: Speedway CRSST-1912-K, or approved substitute.

3. Flush Valves: Lockshield key operated stops.

4. Tank water closets: Speedway CRSST-1912-DL.

5. Wall mounted faucets: Screwdriver stops or faucets may have integral stops in lieu of separate stops.

E. Fixture Flow Controls: To comply with Title 24 & Build-it-Green requirements at each fixture as follows. Model numbers are for Dole:

1. Lavatories: Type FMB, 0.5 GPM except faucets with integral 0.5 GPM flow control.

2. Service Sinks: Type SR, 2.2 GPM.

F. Lavatory and Sink Traps: 17 gauge adjustable "P" traps, cleanout plug, tubing to wall. Polished chrome plated.

G. Fixture Color: White.

H. Trim Finish: Polished chrome plated.

I. Handicapped Requirements:

1. All designated fixtures for handicapped shall be installed per California Code of Regulations, Title 24, Part 2, handicapped requirements.

2. Wrap P-Trap, cold and hot water tubing and stops with SKAL+GARD to protect against scalding and scraping.

J. Other Materials:

1. All other materials not specifically described but required for a complete and proper installation shall be new, first quality of their respective kinds, and subject to the approval of the Architect.

K. Plumbing Fixtures Schedule:

1 Drinking Fountain (DF-1): Wall-mounted Dual units for ADA compliance, 18 ga. Type 304 Stainless steel construction, SS back panel, push-button valves, State of California AB-1953 compliant, Polished chrome-plated bubbler heads with integral shield and laminar flow pattern, vandal

resistance design, Haws Model 1011MS or approved equal.

2. Refer to plumbing fixture schedule on drawings for other plumbing fixtures.

2.10 PIPE HANGERS AND SUPPORTS:

A. Supports and Hangers:

1. Use Super Strut, Unistrut, B-Line, Elcen or Grinnell hangers and structural attachments to properly support the piping system according to good standard practice and according to the manufacturer's recommendations. Minimum safety factor of 5.0.

2. No piping shall have direct contact with the hanging and support system or the structure. On pipes that are insulated, run the insulation continuous through the hanger and provide sheet metal shields of proper length and gages under the insulation to prevent crushing. On uninsulated copper piping, use Stoneman "trisolator" or similar Unistrut or Super-Strut device at each hanger or support point.

3. Size hangers properly to fit around bare pipe, isolator, hanger shield, or insulation as required.

4. Use cadmium plated or galvanized hangers, attachments, rods, nuts, bolts and other accessories.

5. Do not use wire, plumber's tape, or other make-shift devices for hangers.

6. Do not burn or weld any structural member without the written approval of the Owner or Architect.

7. No valve or piece of equipment shall be used to support the weight of any pipe for pipes 1-1/2" and larger.

8. Provide a support or hanger close to each change of direction the pipe, either horizontal or vertical.

9. When piping is installed using a trapeze hanger, bolt the pipe to the trapeze using a pipe clamp, strap or "U" bolt. Do not weld the pipe to the trapeze.

10. Provide support to all underground piping, support to be attached to the floor slab. Provide corrosion protection to all underground piping.

11. Provide vibration elimination supports at all the party walls and corridor walls to eliminate noise and vibration transfer to the adjacent space. Provide the sound and vibration eliminators as recommended by the project acoustical consultant.

EQUIPMENT SUPPORTS:

A. All rotating equipment and equipment capable of transmitting vibration into the

space shall be mounted on vibration isolators and bases.

B. Isolators shall be provided for equipment mounted aboveground and as required for controlling the noise & vibration transmission to the structure.

C. The isolators shall be as manufactured by Mason, Kinetics, or Amber-Booth. Other manufacturers not allowed.

2.12 SEISMIC RESTRAINTS:

A. General: Provide seismic restraints per applicable code and standards. Design and provide restraints to prevent permanent displacement in any direction caused by lateral motion, overturning or uplift. Restraints shall not short circuit vibration isolated equipment under normal operation.

B. Requirements:

1. Criteria: Design restraints per SMACNA/PPIC "Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Piping Systems", for equipment, and piping.

2. Seismic Force Criteria: 1.0 G

3. Contractor to submit Seismic Restraint calculations that are signed by a structural engineer registered in the State of California. Calculation must confirm the adequacy of the restraints and their anchoring to the building structural elements.

2.13 INSULATION:

A. Pipe Insulation: Type and Thickness:

1. General: In accordance with Title 24 energy regulations.

2. Manufacturers: Owens-Corning, Manville, Certain-Teed, or approved substitute.

3 Domestic Hot Water, (Supply and Return): Premolded fiberglass with ASJ. R-4 minimum.

4. Provide insulation for pipes that are located outdoors to protect against freezing.

5. Horizontal rain water leaders located in an active ceiling plenum shall be insulated to prevent sweating.

6. Where necessary, provide acoustical insulation on the piping as recommended by the acoustical consultant.

2.14 WATERPROOFING AND CORROSION PROOFING:

A. All pipe penetrations to the building exterior walls, floors and footings shall be provided with link seal type sealer to prevent ground water and rain water from entering the building.

B. The exterior wall & roof penetrations shall be similarly flashed and sealed to prevent the rainwater from entering the building.

PART 3 - EXECUTION

3.01 GENERAL

A. Check Architectural drawings and drawings of other trades relating to work to verify spaces in which work will be installed. Maintain headroom and space condition to all points. Any equipment, materials, and piping installed in conflict with the dropped ceiling and lights shall be relocated at the direction of the Architect at no additional cost to the Owner.

B. Set and layout work on premises. Base all measurements from approved bench marks and correct setting or work to agree with established lines and levels. Should discrepancy exist between actual measurements and those indicated, notify Architect in writing and do not proceed with work affected until written instructions are received from Architect.

C. Install equipment and piping rigid and secure, plumb and in true alignment with related and adjoining work. No welding of plumbing materials for attachment or support is permitted.

D. Drawings and Arrangement: Install equipment and materials with all working parts readily accessible for inspection, repair and removal. The right is reserved to make reasonable changes in locations of equipment shown on construction drawings prior to roughing-in without involving additional expense to the Owner.

E. Prior to all work of this Section, carefully inspect the existing and installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

F. Provide adequately sized floor sink in the boiler room and booster pump room with backflow preventer to drain the relief discharge from the system. Similarly, provide adequately sized floor sinks and floor drains in the boiler room.

G. Provide adequately sized roof main drains, overflow drains, deck drains area drains as required and as indicated on the architectural and plumbing drawings.

H. Coordinate termination of storm drain to the site storm drainage system with the project site work and landscape contractors for the point of connection, size, inverts, etc. For storm drains daylighting on the side of the building provide cast brass ornamental escutcheons (J.R. Smith or equal) at the overflow drains that are terminated through the walls in the public areas.

3.02 PIPING INSTALLATION

A. Thoroughly clean all pipe and maintain in such condition throughout construction. Temporarily cap off plug ends of unprotected pipe.

B. Install unions at connections to equipment, on service side of valves and elsewhere as required or shown to facilitate maintenance.

C. Install dielectric insulating connections between all dissimilar metals unless otherwise indicated.

D. Run all piping generally level, free of unnecessary traps and bends, and arrange to conform to the building requirements and to suit necessities of clearance for other work.

E. Arrange piping and hangers to allow for expansion, contraction, and structural settlement. Do not install piping in contact with the building structure.

F. Make changes in size or direction with manufactured fittings. The use of bushings, reducing flanges, or bending of a pipe is not allowed.

G. Install piping full size through shut-off valves, balancing valves, etc. Change pipe size within three pipe size diameters of the final connection to fixtures and equipment.

H. Install piping concealed above ceilings, beneath the floors, or in walls. Route piping to linear beams, columns, obstructions and the work of other trades.

3.03 FIXTURE INSTALLATION AND CONNECTIONS:

A. General:

1. Set fixtures to equal height, plumb, or at right angles to wall. Connect to waste and water supplies in neat, uniform, and finished manner. Provide necessary trim and appurtenances for complete installation. See architectural drawings for fixture heights, spacing, arrangement, etc.

B. Inspection and Preparation:

1. Examine roughing-in work of domestic water and piping systems to verify actual locations of piping connections prior to installing fixtures. Also examine floors and substrates, and conditions under which fixture work is to be accomplished. Correct any incorrect locations of piping, and other unsatisfactory conditions for installation of plumbing fixtures. Do not proceed with work until unsatisfactory conditions have been corrected.

2. Fasten plumbing fixtures securely to indicated supports or building structure; and ensure that fixtures are level and plumb. Secure plumbing supplies behind or within wall construction so as to be rigid, and not subject to pull or push movement. Support piping independent of wall construction.

C. Cleaning and Protection:

1. Clean plumbing fixtures of dirt and debris upon completion of installation.

2. Protect installed fixtures from damage during the remainder of construction period.

D. Field Quality Control:

1. Upon completion of installation of plumbing fixtures and after units are water pressurized, test fixtures to demonstrate capability and compliance with requirements. When possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.

2. Inspect each installed unit for damage to finish. If feasible, restore and match finish to original at site; otherwise, remove fixture and replace with new unit. Feasibility and match to be judged by Architect. Remove cracked or dented units and replace with new units.

3.04 STERILIZATION OF PIPES:

A. After preliminary purging, cleaning, and flushing of the system, chlorinate the entire potable domestic water system in accordance with the current recommendations of the American Water Works Association and in accordance with all pertinent state and local health codes and regulations.

B. Chlorinate only when prescheduled and provide proper warning signs at outlets.

C. Upon completion of the sterilization, thoroughly flush the entire potable water system and immediately fill the system.

D. When sterilization and flushing are complete, arrange with pertinent agencies for all required tests on mains and systems.

3.05 START-UP SERVICES:

A. Prior to start-up, ensure that the systems are ready, including the following: Proper equipment rotation, proper wiring, auxiliary connections, lubrication, venting, controls, and properly set relief and safety valves.

B. Start and operate all systems. Provide the services of factory trained technicians for start-up of equipment and all systems including but not limited to controls, and pumps.

C. Adjust all balancing valves, controls, fans, flow and pressure regulators, and any other adjustable equipment for optimum performance and to suit job conditions.

D. Personnel performing start-up services shall be fully qualified, experienced, and normally engaged in this type of work. If the Contractor does not have such personnel available from his own company, he shall hire, at his own expense, Subcontractors who are qualified.

E. The Contractor shall designate one field person who is overall responsible for start-up procedures which include testing and balancing. He shall directly supervise the start-up operations and be available for required coordination before, during, and after start-up.

F. A final and complete start-up report shall be submitted prior to final acceptance and payment. This report shall be signed by each person doing the start-up task and by the responsible field person. Report shall include, but not be limited to: date of test, instrument used, date of last calibration, temperatures, set points, rpm, voltage, amperage, pressures, stability, vibration, etc.

G. Submit a signed copy of all test reports to the Architect.

3.06 CLEANING

A. Brush and clean work prior to concealing, painting and acceptance. Clean and repair soiled or damaged painted exposed work and match adjoining work before final acceptance. Remove debris from inside and outside of material, equipment and structure.

B. Prior to acceptance of the buildings, thoroughly clean all exposed portions of the plumbing installation, removing all labels and all traces of foreign substance, using only a cleaning solution approved by the manufacturer of the plumbing item and being careful to avoid all damage to finished surfaces.

END OF SECTION

SECTION 15900

ACCEPTANCE TESTING AND DOCUMENTATION

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. This section describes the Acceptance Testing and documentation of the mechanical system(s) and outlines the duties and responsibilities of the contracting team for Acceptance Testing.

B. The Acceptance requirements shall be applied to all products, equipment and systems provided under this Division, where indicated on plans, and where required by California Title 24 requirements and LEED requirements.

C. The Mechanical Contractor shall engage the services of a firm specializing in commissioning of mechanical systems or shall submit contractor qualifications for review by architect where testing and documentation is to be performed by contractor. Where duct pressure testing validation is required, submit name and qualification for HERS Certified testing agency.

D. Provide fundamental commissioning for all the mechanical, electrical and plumbing systems. Provide all the labour and materials necessary for executing the fundamental commissioning including coordination will all the trade contractors, commissioning plans, commissioning forms, testing calibrating and submitting the test & commissioning forms to the architect. Include adequate manhours for coordination meetings, testing and documentation necessary for the project compliance with appropriate owner chosen LEED and T-24 energy efficiency credit compliance methods.

E. Refer to other requirements in the Dision-1, Division-15, Division16 sections, including the following:

A.	Section 01400	Project Sustainability Requirements
B.	Section 01810	Commissioning
C.	Section 01515	Construction Waste Management

1.02 THE COMMISSIONING TEAM

A. The Commissioning Team shall be formed and consists of:

1. Mechanical contractor's representative.

2. Controls contractor’s representative, if required.

3. HERS Certified Testing Agency where required.

4. Commissioning Agent.

5. Owner's staff representative.

6. Air balancing company.

7. General and other trade contractors.

PART 2 - PRODUCTS

2.01 DUTIES OF THE TEAM

A. The duties of the Team are as outlined in the Title 24 & LEED Requirements and summarized below:

1. The mechanical contractor shall plan, organize and implement the Acceptance Testing process and shall within one month of the award of the contract, submit the names and addresses of the Testing team member(s).

2. The Acceptance testing team shall submit a complete description of the testing procedures and systems to be tested to the architect for review.

3. The Acceptance testing team shall co-ordinate all tests of systems and equipment and assemble all documentation related to tests. All documentation relative to tests and proposed procedures shall be submitted to design engineer for review prior to submitting documentation to Authority having jurisdiction. Team shall be responsible for performing data analysis, calculation of performance indices and crosschecking of results with the requirements of Title 24 and the Contract documents. The installing contractor or agent responsible for testing and documentation shall record their State of California Contractor's license number or their State of California Professional Registration License number on each Certificate of Acceptance for submittal.

4. Contractor shall be fully responsible for submitting Certificate of Acceptance including paper and electronic copies of all measurements and monitoring results and all supporting documentation to the Authority having jurisdiction. Where Authority having jurisdiction questions results or requires additional testing, contractor shall complete additional testing and provide required documentation at no additional cost to the Owner.

2.02 TIME SCHEDULE

A. The time period of the commissioning of the systems shall be determined by the general contractor and Acceptance testing team. It is important to note that Authority having jurisdiction will not release a final Certificate of Occupancy until a Certificate of Acceptance is submitted that demonstrates that the specified systems and equipment have been shown to be performing in accordance with the Title 24 standards.

2.03 ACCEPTANCE TESTING – PHASE I - DOCUMENTATION

A. Team shall assemble documentation showing all thermostat and sensor locations, control device locations, control sequences and notes.

B. Per Title 24 requirements, team shall provide record drawings to building owner within 90 days of receiving a final occupancy permit (refer to other specification sections for requirements on record drawings.)

C. Per Title 24 requirements, team shall provide operating and maintenance manuals to the building owner (refer to other specification sections for requirements on operation and maintenance manuals.)

2.04 ACCEPTANCE TESTING – PHASE II – INSPECTION AND TESTING

A. Team shall review the installation, perform acceptance testing and document results for the following systems:

1. Constant Volume Systems
2. Package Systems
3. Air Distribution Systems
4. Economizers
5. Demand Control Ventilation Systems
6. Ventilation Systems
7. Variable Frequency Drive Fan Systems
8. Hydronic Control Systems
9. Supply Water Reset Controls
10. System Programming
11. Time Clocks

B. Review of installation shall confirm mechanical equipment and devices are properly located, identified, calibrated, and set points and schedules programmed per contract document requirements.

2.05 ACCEPTANCE TESTING - PHASE III - CERTIFICATION

A. Team shall document operating and maintenance information, complete installation certificate, and indicate test results on the Certificate of Acceptance, and submit the Certificate to the Authority having jurisdiction prior to receiving final occupancy

permit. Team shall submit forms MECH-1-A through MECH-9-A as required by Title 24 requirements.

PART 3 - EXECUTION

3.01 ACCEPTANCE TESTS AND DOCUMENTATION

Refer to California Title 24, Non-residential manual for specific testing procedures and documentation requirements.

END OF SECTION

SECTION 16000
ELECTRICAL - GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 CONDITIONS AND REQUIREMENTS

A. The General Conditions, Supplementary Conditions, and Division 1 - General Requirements of the Contract Documents are hereby made a part of this Section of the specifications as fully as if repeated herein.

1.02 DESCRIPTION OF WORK

A. Provide all labor, equipment and materials that are required to provide power to parking lot and walkway lighting and future two-single story buildings 7800 SF each, as indicated on the drawings and as described in these specifications, including that reasonably inferred for proper execution of work and system operation.

B. Provide cutting and patching as required for execution of work performed under this Section unless specifically provided for, under other Sections.

C. Coordinate with work performed Division 15, in order to accommodate the requirements of this Section, and to assure adequate space and proper location for all necessary work of this project whether or not work is under this Section.

D. Provide all seismic restraints required by code, or by this specification, whichever is more stringent for all equipment and materials furnished under this Section. This Contractor is responsible for the design of the restraints and for proof of adequacy of the restraints.

E. Provide all labor and material required to set and adjust the installation so that it performs in accordance with the design intent included in the Drawings and these Specifications.

1.03 CODES AND REGULATORY REQUIREMENTS

Follow applicable version of the following codes and regulations:

CBC	2007 California Building Code
CEC	2007 California Electric Code
CFC	2007 California Fire Code
CA Title 24	2007 Energy Efficiency Standards for Non-Residential Buildings.
NEC	National Electrical Code - Latest Edition
ANSI Std. 241	Recommended Practice for Electric Power Systems in Commercial Building (IEEE Gold Book).
ANSI Std. 493	Recommended Practice for Design of Reliable Industrial and Commercial Power Systems (IEEE Gold Book).
ANSI Std. P-1110	Recommended Practice for Powering and Grounding Sensitive

Electronic Equipment (IEEE Emerald Book).
American with Disabilities Act (ADA).
PGE Greenbook 2008/2009 Version

1.04 QUALITY ASSURANCE

A. All equipment shall conform to the National Electrical Manufacturer's Association Standards, and shall bear Underwriter Laboratories label where applicable.

B. Manufacturer's Qualifications: Firms regularly engaged in manufacture of the specified products, of types, materials, and sizes required, and whose products have been in satisfactory use in similar service for not less than 5 years.

C. Contractor's Qualifications: Regularly engaged in construction on projects of similar sizes using types of equipment, material and methods as specified herein - for minimum of 5 years. A letter from the Contractor certifying these qualifications must be provided to the Owner before signing the construction contract.

D. By accepting to perform the work under this contract, the Contractor agrees that he has understood the intent of the design and is reasonably sure that it can be accomplished by proceeding in accordance with these Drawings and Specifications.

1.05 DRAWINGS AND SPECIFICATIONS

A. Consider all drawings and all Divisions of this Specification as a whole and provide work of this Division shown anywhere therein.

B. Absolute accuracy of the Drawings and Specifications is not guaranteed. While reasonable effort has been made to coordinate the location of equipment and materials with the structure and other trades, it is the responsibility of this Contractor to coordinate exact requirements and locations as governed by actual job conditions, manufacturer's recommendations etc. Check all information and report any discrepancies to the Owner before fabrication or purchasing any equipment and in time to avoid unnecessary work or project delays.

C. Drawings:

1. For purposes of clarity, legibility, drawings are essentially diagrammatic to extent that many offsets, bends, special fittings, exact locations of items are not indicated, unless specifically dimensioned.
2. Exact routing of wiring and locations of outlets, panels, etc. shall be governed by structural conditions, obstructions. Contractor shall make use of data in Contract Documents. In addition, the Owner reserves the right, at no increase in price, to make any reasonable change in location of electrical items and those exposed at ceiling and/or on walls, to group them into orderly relationships and/or to increase their utility. Division 16 shall verify Owner's requirements in this regard prior to roughing-in.
3. All branch circuit conduits to contain minimum two wires plus a ground or as

noted adjacent to branch circuit symbols on Drawings.

4. All wires are no. 12 except as noted on Drawings, or noted hereinafter, or as noted under "Wire", as specified hereinafter
5. Dimensions, location of doors, partitions, similar physical features shall be taken from the Civil Drawings, verified at site by this Division.
6. Mounting heights of brackets, outlets, etc., shall be as required by equipment to be installed or specified on Electrical drawings and/or as noted elsewhere. Submit any cases, which are not clear to Architect for clarification in advance of construction.
7. The general arrangement and location of wiring and equipment is shown on Electrical drawings, and shall be installed in accordance therewith, except for minor changes required by conflicts with the work of other trades.

D. Coordination:

1. Become familiar with conditions at the jobsite, and with the mechanical, plumbing, landscape and architectural drawings and specifications, and plan the installation of the electrical work to conform with that shown and specified, so as to provide the best possible assembly of the combined work of all trades.
2. Work out all "tight" conditions involving work under this Division and work in other Divisions in advance of installation. If necessary, and before Work proceeds in these areas, prepare supplementary Drawings under this Division for review, showing all work in "tight" areas. Provide supplementary Drawings, additional work necessary to overcome "tight" conditions, at no increase to construction costs.
3. Provide templates, information and instructions to other Divisions, to properly locate holes and openings to be cut or provided for Electrical Work.

E. Equipment Rough-In:

1. Rough-in locations shown on Electrical Drawings for equipment furnished are approximate only. Rough-in locations shall be reviewed in the field.
2. Obtain exact rough-in locations from following sources:
   a. From shop drawings for switchgear manufacturer and PG&E shop drawings.
   b. Vendor's shop drawings.
3. Verify connection requirements of equipment with Construction Documents before starting rough-in.

F. Measurements:

1. Before ordering any material or closing in any work, verify all measurements on the job. Any differences found between dimensions on the drawings and actual measurements shall be brought to Owner's attention for consideration before proceeding.
2. Verify that all equipment will fit through building openings for movement to final place of installation.

1.06 SUBMITTAL DATA

A. General:

1. Contractor is required, within thirty (30) days of awarding the Contract, to submit product data and shop drawings for all work in accordance with the General Conditions Section 01330 and as outlined in this paragraph, the more restrictive or extensive requirement shall govern.
2. Contractor shall review all submittals prepared by his suppliers and mark all copies as acceptable to him. This acceptance shall construe that all required service connections are shown and in the proper location to meet the installation requirements and that the equipment can fit in the space allowed.
3. Do not order equipment until submittals have been reviewed and approved by the Owner or Owner’s representatives.
4. Each item submitted shall be labeled or identified the same as on the drawings.
5. Mark submittal "Exactly as Specified" or accompanied by a letter from the supplier explaining in detail what difference, if any, exists between the submitted item and the specified item. Failure to point out the differences will be considered cause for disapproval. The Engineer will not assume any responsibility for differences concealed or otherwise not brought to their attention, and the Contractor will be required to correct any deficiencies or differences discovered at a later date, and assume responsibility for any delays, damage, and/or expenses incurred by others due to such action.
6. Brands or trade names are mentioned to set standards of quality only; use no substitute materials, however, unless approved in writing by the Owner. Approval of substitute materials does not relieve the Contractor of responsibility for providing a workable and functioning system as designed.
7. Submittals will be checked for general conformance with the design concept but acceptance by the Owner in no manner is meant to verify that dimensions, quantities, or location of services are as necessary to meet the job requirements. This remains the responsibility of the Contractor.

B. Product Data:

1. Submit manufacturer's specifications, data sheets, certified drawings, and installation instructions for equipment, materials, and fixtures specified. Include physical and performance data such as weights, sizes, capacities, required clearances, acoustical characteristics, finishes, color selection, and accessories.
2. Submit all items from each section of the work at one time, if possible, but do not

delay submittals for lack of one or two items.

3. Prepare binders for product data, brochures, catalog cuts, etc., in the following sequence:
   a. Index sheet (with each item cross-identified with reference to contract documents and the divider tab number).
   b. Divider Tab #1 (with item identification).
   c. The brochure, product data sheet, or catalog cut for the item.
   d. Repeat items b and c above for each item of the submittal.

C. Shop Drawings:

1. Prepare and submit plans, sections, details and diagrams to required scales for specified areas. Drawings shall be coordinated, dimensioned and indicate equipment, pipe, duct, fire protection, structural elements and electrical in relation to and structural features. Include minor piping, drains, air vents, etc. Indicate exact locations and elevations of all lighting, conduit, access doors, etc. Highlight any deviations in work from what is indicated on the contract drawings.
2. Required Drawings - Electrical: Submit drawings, minimum scale 3/8"=1'-0" unless otherwise noted for the following:
   a. Main Switchboard MS2 showing switches, breakers, wiring, fuse sizes, interconnection diagram, cabinet arrangement and sizes to PG&E.

D. Review and Resubmissions:

1. Submittals may be returned marked "No Exceptions Taken" or "Exceptions Taken" in which case, resubmittals are not required, and will not be accepted.
2. Correct and resubmit in the original quantities required all submittals marked "Exceptions as Noted".
3. Submittals marked "Not Acceptable" are so marked because the submittal is either as incorrect, incomplete, or illegible as to prevent review; or contains inferior product not complying with the Specifications. Resubmit rejected submittals only after appropriate corrective measures are taken or equal product substituted.
4. Submittals marked "Not Reviewed" shall indicate extra submittals that were not required to be submitted in the first place. This action does not imply acceptance or rejection and Contractor remains obligated to ensure that the product meets drawings and Specifications.
5. Identify all resubmittals as being resubmittals and identify with the original Owner’s transmittal number.

1.07 SUBSTITUTIONS

A. General:

1. Submit product options and substitutions as specified herein.
2. Where possible, more than one manufacturer or vendors are listed for acceptable materials and/or equipment to be used in the work. The material and/or equipment of one of the manufacturers or vendors may be cited and specified by model name, number, or description as the established standard. Bids shall be based on using one of the specified brands. The term "products" used below refers to materials and equipment.
3. Adjacent materials and systems have been designed and detailed to accommodate the established standard manufacturer's products. If one of the other approved manufacturers is selected by the Contractor, the Contractor shall design and detail all changes in all adjacent materials necessary to accommodate the selected products, and when approved, shall make such changes to his and other trades' work at no extra cost to the Owner. If additional work is required of Owner or Owner consultants as a result of the substitution, Contractor shall be responsible for the cost of such work.

B. Substitutions:

1. The successful bidders may, within 30 calendar days after award of contract, propose a substitution of a material or apparatus other than those specified. Proposal shall be in writing and shall include change in price, description, and specification data. The Owner shall be the sole judge as to the merits of the proposed substitute and reserves the right to accept or reject it based on price, quality, past performance or delivery, etc. and Owner's decision can not be challenged. Substitution proposals made after 30 days after award of contract will not be accepted.
2. Present each substitution individually. If a proposed substitute is not found to be acceptable, then the established standard must be supplied.
3. Failure by the Contractor to order materials or equipment in a timely manner will not constitute justification for substitution.
4. If changes to adjacent materials are required to accommodate a substituted product, all the requirements of A.2. and A.3. above apply.

1.08 SPACE REQUIREMENTS

A. Consider all space requirements for all work indicated in the contract documents and subsequent drawings before installing any portions of the work. Space conflicts which occur during or after installation of work, caused by failure to consider all such requirements, shall be resolved by the Contractor to the satisfaction of the Owner at the Contractor's expense.

B. Install equipment and materials with all working parts readily accessible for inspection, repair, and renewal. The right is reserved to make reasonable changes in locations of equipment on the drawings prior to rough-in without involving additional expense to the

Owner.

C. Confer with the Owner to establish exact locations, mounting heights, and arrangements of all electrical outlets prior to roughing in.

1.09 WORKMANSHIP AND MATERIALS

A. Workmanship shall be first class throughout and performed only by competent and experienced workmen in a manner satisfactory to the Owner. Constant supervision of the work, either by the Contractor or his competent representative, shall be maintained.

B. Work shall be performed so as not to delay the progress of construction and shall be properly coordinated with other trades.

C. Use only new materials in perfect condition. Inspect all materials upon arrival at job site and immediately remove defective items from site.

1.10 CUTTING AND REPAIRING

A. Include all cutting and repairing necessary and required for this installation that is not covered by other trades. Structural members shall not be cut except with the written approval of the Owner. Repairing shall be performed by workmen skilled in the trades involved in a manner satisfactory to the Owner.

1.11 NOISE AND VIBRATION

A. The limiting of transmission of noise and vibration is extremely important. This Contractor is to pay particular attention that conduit and equipment are installed so as not to rattle or touch or rub against other materials, equipment, and the building structure. Provide isomode pads, insulation, or other suitable materials to avoid direct contact. Consider, in particular, proper shields at hangers and conduit penetrations of walls and floors.

1.12 TESTING AND ADJUSTING

A. Upon completion of the work, test and regulate all systems to the intent of their design and to the Owner's satisfaction. Furnish the Owner a binder of the equipment data and instruct its representatives as to the proper operation of all systems.

B. Schedule and coordinate all testing and adjusting with the Owner.

1.13 FINAL OBSERVATION

A. The Owner shall make final observation of the job and note unacceptable items in a punch list. Final acceptance shall not be made until all items on this list have been corrected and until all functional performance tests are successfully completed by the Owner.

1.14 GUARANTEE/WARRANTY

A. All materials, parts, equipment, modifications made, and workmanship shall be guaranteed for a period of one year from date of acceptance of the work.

B. Submit all guarantees/warranties as required.

1.15 RECORD DRAWINGS

A. Record of job progress: keep an accurate, dimensioned record of the as-built locations of all work. Keep an up-to-date on blueline prints as the job progresses and make them available for inspection at all times.

B. A set of final as-built reproducible drawings and in ACAD 2004 or later format electronic files saved in CD-rom or DVD-rom shall be submitted to the Owner prior to final acceptance of the Project. The drawings shall be done in drafting standards acceptable to the Owner. These shall include, but not limited to the following:

1. Position of all buried or concealed conduits accurately dimensioned, both horizontally and vertically.
2. All electrical plans.
3. Riser diagrams

1.16 OPERATION MANUALS AND MAINTENANCE INSTRUCTIONS

A. Furnish three (3) complete sets of operating and maintenance instructions for all equipment (of all types) and control systems bound in a hardboard binder and indexed. Submit no later than thirty (30) calendar days prior to Substantial Completion.

B. In addition to specific requirements specified in the various sections of work, incorporate the following:

1. Complete operating instructions for each item of equipment.
2. Test data and other reports that may be specified.
3. Manufacturer's bulletins with parts' numbers, instructions, etc., for each item of equipment, properly stripped and assembled.
4. Special diagrams and literature that may be required.
5. Include telephone numbers and addresses of service companies.

1.17 INSTRUCTIONS AND TRAINING

A. The Contractor shall schedule and conduct comprehensive training sessions for the Owners to help them understand the systems and operate and maintain each major piece of equipment.

B. The Contractor shall attend all training sessions and shall add to each session any special information relating to the details of installation of the equipment as it might impact the operation and maintenance.

C. The Contractor shall make the factory approved, manufacturer's representatives available, whenever scheduled by the Owner, to provide the detailed instructions on each major piece of equipment and automation/control system. The manufacturer's representatives shall instruct the Owner as well as shall provide hands on explaining and demonstration of their respective equipment. These training sessions shall be as shown in all other respective sections and shall cover but not limited to the following:

EQUIPMENT	Minimum Training Session
1. New Main Service Switchboard #2	1 hour
2. Time Switch Controller	1 hour

PART 2 - MATERIALS

2.01 UNIFORMITY

A. All items of similar nature shall be by the same manufacturer. Trim for major items shall be furnished by the same manufacturer as the item.

2.02 SEISMIC RESTRAINTS

A. General: Provide seismic restraints per applicable code and standards. Design and provide restraints to prevent permanent displacement in any direction caused by lateral motion, overturning or uplift. Restraints should not short circuit vibration isolated equipment under normal operation.

B. Requirements:
1. Criteria: Design restraints for conduit and equipment per SMACNA 1991 Edition, "Seismic Restraint Manual Guidelines for Mechanical Systems" or any similar pre-approved hanger manufacturer's details. Submit required structural calculations for rigidly and flexibly attached equipment.
2. Seismic Force Criteria:
   a. Rigidly Attached 0.5 G.
   b. Flexibly Attached 1.0 G.
3. Restraint to include the following:
   a. Floor mounted equipment

4. Contractor to submit Seismic Restraint calculations that are signed by a structural engineer registered in the State of California. Calculation must confirm the adequacy of the restraints and their anchoring to the building structural elements.

PART 3 - EXECUTION

3.01 CLOSING IN UNINSPECTED WORK

A. Do not cover up or enclose work until it has been properly and completely inspected and approved.

B. Should any of the work be covered up or enclosed prior to all required inspections and approvals, uncover the work as required and, after it has been completely inspected and approved, make all repairs and replacements with such materials as are necessary to the approval of the Owner.

3.02 EQUIPMENT INSTALLATION

A. Position equipment to result in good appearance, easy access to all components for maintenance. Install the accessories so that they do not interfere with equipment access.

B. Install equipment level, secure, and out of moisture. Provide shims, anchors, support straps, angles, grouted bases, etc. as required to accomplish this.

C. Use only galvanized screws, nuts, bolts, rods and washers or where required stainless steel. After fabrication, hot dip galvanized unfinished ferrous items for outdoor use or other areas subject to moisture.

D. Start Up: Secure the services of the manufacturer's representative to start up all equipment where specified and which is special and for which Contractor's personnel does not have adequate experience with. All start up shall be prescheduled and coordinated with the Owner and must be witnessed by him.

E. Manufacturer's Directions: Follow the manufacturer's directions where these directions cover points not included on Drawings or in Specifications.

3.03 IDENTIFICATION

A. Properly identify main switchboard, panelboard, time switch control devices and other equipment provided under this Division by means of engraved laminated plastic descriptive nameplates 3/8 inch high white lettering on black for panel/equipment designation including panel/equipment voltage in ¼” high lettering. Mount nameplate using pop-rivets or screws, clamp holders in any form are not acceptable.

B. Properly identify all field devices (i.e. receptacles, switches, junction boxes, lighting, motors, and any other load). These shall be clearly labeled with panel and circuit designation. Provide screwed phenolic labels with 1/4 “block black lettering on white background. Hand letter and /or permanent markers are NOT ALLOWED.

C. Identification of Pull Boxes and Junction Boxes:

1. For Power Feeders:
   a. Stencil cover with identifying circuit number.
   b. Lettering 1" high.

c. Color of lettering, black.
d. Place lettering on cover in neat manner; run parallel to long sides of box.

2. For Branch Circuits, Grounding and Control Systems:
   a. Location: Entire cover.
   b. Color Coding: Per ANSI Z53.1.

D. Identification of Conduits and Raceways:

1. Power Feeders:
   a. Stencil voltage and phase within 10' of all pull boxes, change of direction and terminations.
   b. Letter 1" high.
   c. Color of Lettering:

   120/208V - Normal: Black with 1" wide Blue band for normal systems.

E. Provide laminated plastic nameplates, minimum engraved lettering shall be ¼" high white on red matte finish.

3.04 WATERPROOF CONSTRUCTION:

A. Maintain the waterproof integrity of penetrations through materials intended to be waterproof. Provide flashings at exterior wall and roof penetrations. Caulk watertight penetrations of foundation walls and floors. Provide membrane clamps at penetrations of waterproof membranes.

3.05 ADJUSTMENTS TO SYSTEMS:

A. Adjust all equipment and system components as scheduled on drawings, or as required, to result in the intended system operation.

B. Thereafter, as a result of system operation or as directed by the Owner, make readjustments as necessary to refine performance.

3.06 PRELIMINARY OPERATION:

A. Operate any portion of the installation for the Owner's convenience if so required by the Owner. Such operation does not constitute acceptance of work as complete. Cost of utilities, such as gas and electrical power, will be borne by the Owner if operation is required by the Owner.

3.07 START-UP SERVICES:

A. Coordinate and schedule all start-up work with Owner.

B. Prior to start-up, ensure that the systems are ready, including the following: Proper wiring and auxiliary connections.

C. Start and operate all systems. Provide the services of factory trained technicians for start-up of major equipment and all systems including but not limited to electrical distribution equipment, standby electrical equipment and lighting controls.

D. Adjust all adjustable equipment for optimum performance and to suit job conditions.

E. Personnel performing start-up services shall be fully qualified, experienced, and normally engaged in this type of work. If the Contractor does not have such personnel available from his own company, he shall hire, at his own expense, Subcontractors who are qualified.

F. The Contractor shall designate one field person who is overall responsible for start-up procedures. He shall directly supervise the start-up operations and be available for required coordination before, during, and after start-up. The same person shall assist the Owner in testing and verification of design intent.

G. A final and complete start-up report shall be submitted prior to final acceptance and payment. This report shall be signed by each person doing the start-up task and by the responsible field person.

H. Contractor shall be responsible for utility system shutdowns and start-ups. Coordinate with PG&E.

END OF SECTION

SECTION 16011
ELECTRICAL ACCEPTANCE TEST

PART 1 - GENERAL

1.01 SUMMARY:

A. This Division 16 shall engage the services of a recognized independent testing firm for the purpose of performing inspections and tests as herein specified.

B. The testing firm shall provide all material, equipment, labor, and technical supervision to perform such tests and inspections.

C. It is the purpose of these tests to assure that all tested electrical equipment, both Contractor and Owner-supplied, is operational and within industry and manufacturer's tolerances and is installed in accordance with design specifications.

D. The tests and inspections shall determine suitability for energization.

E. The test shall include only the equipment and devices installed. An itemized description of equipment to be inspected and tested is as follows:

1. Cables
2. Switches - Low Voltage
3. Circuit Breakers - Low Voltage
4. Grounding Systems
5. Motor Control

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. The following work is included in other Sections. Where coordination is necessary, it shall be provided by this Contractor.

1. Section 16000 - Electrical - General Requirements
2. Section 16111 - Conduit
3. Section 16120 - Wire and Cable
4. Section 16130 - Boxes
5. Section 16140 - Wiring Devices
6. Section 16170 – Grounding
7. Section 16190 - Supporting Devices
8. Section 16400 – Service and Distribution
9. Section 16424 - Motor Connections and Controls
10. Section 16495 - Requirements For Other Equipment
11. Section 16510 - Interior Building Lighting
12. Section 16720 – Fire Detection and Alarm Systems

1.03 REFERENCE STANDARDS

A. All inspections and tests shall be in accordance with the following codes and standards except as provided otherwise herein:

1. National Electrical Manufacturer's Association - NEMA
2. American Society for Testing and Materials - ASTM
3. Institute of Electrical and Electronic Engineers -IEEE
4. International Electrical Testing Association - NETA Acceptance Testing Specifications - ATS-1991
5. American National Standards Institute - ANSI C2: National Electrical Safety Code
6. Federal, State and local codes and ordinances
7. Insulated Cable Engineers Association - ICEA
8. Association of Edison Illuminating Companies - AEIC
9. Occupational Safety and Health Administration - OSHA
10. National Fire Protection Association - NFPA
    a. ANSI/NFPA 70: National Electrical Code
    b. ANSI/NFPA 70B: Electrical Equipment Maintenance
    c. NFPA 70E: Electrical Safety Requirements for Employee Workplaces
    d. ANSI/NFPA 78: Lightning Protection Code
    e. ANSI/NFPA 101: Life Safety Code

B. All inspections and tests shall utilize the following references:
1. Project design specifications
2. Project design drawings
3. Project short-circuit and coordination study
4. Manufacturer's instruction manuals applicable to each particular apparatus.
5. Project list of equipment to be inspected and tested

1.04 QUALIFICATIONS OF TESTING FIRM

A. The testing firm shall be a testing organization which can function as an unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers of equipment or systems evaluated by the testing firm.

B. The testing firm shall be regularly engaged in the testing of electrical equipment devices, installations, and systems.

C. The testing firm shall meet OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907, or be a Full Member company of the InterNational Electrical Testing Association.

D. The lead, on-site, technical person shall be currently certified by the InterNational Electrical Testing Association (NETA) or National Institute for Certification in Engineering Technologies (NICET) in electrical power distribution system testing.

E. The testing firm shall utilize engineers and technicians who are regularly employed by the firm for testing services.

F. The testing firm shall submit proof of the above qualifications with bid documents, when requested.

G. The terms used herewith, such as test agency, test contractor, testing laboratory, or contractor test company, shall be construed to mean the testing firm.

H. Qualified Testing Agencies:

1. Electro-test, Inc. (800) GO-TO-ETI (www.electro-test.com)
2. Power Systems Testing Company (510)783-5096 (www.powersystemstesting.com)

1.05 DIVISION OF RESPONSIBILITY

A. The Contractor shall perform routine insulation-resistance, continuity, and rotation tests for all distribution and utilization equipment prior to and in addition to tests performed by the testing firm specified herein.

B. This Division 16 shall supply a suitable and stable source of electrical power to each test site. The testing firm shall specify the specific power requirements.

C. This Division 16 shall notify the testing firm when equipment becomes available for acceptance tests. Work shall be coordinated to expedite project scheduling.

D. The Contractor shall supply a short-circuit analysis and coordination study, a protective device setting sheet, a complete set of electrical plans, specifications, and any pertinent change orders to the testing firm prior to commencement of testing.

E. The testing firm shall notify the Architect prior to commencement of any testing.

F. Any system, material, or workmanship which is found defective on the basis of acceptance tests shall be reported to the Architect.

G. The testing firm shall maintain a written record of all tests and, upon completion of project, shall assemble and certify a final test report.

H. Safety and Precautions

1. Safety practices shall include, but are not limited to, the following requirements:
   a. Occupational Safety and Health Act
   b. Accident Prevention Manual for Industrial Operations, National Safety Council
   c. Applicable state and local safety operating procedures

d. Owner's safety practices
e. National Fire Protection Association - NFPA 70E
f. American National Standards for Personnel Protection

2. All tests shall be performed with apparatus de-energized. Exceptions must be thoroughly reviewed to identify safety hazards and devise adequate safeguards.
3. The testing firm shall have a designated safety representative on the project to supervise the testing operations with respect to safety.

1.06 GENERAL

A. Suitability of Test Equipment

1. All test equipment shall be in good mechanical and electrical condition.
2. Selection of metering equipment should be based on knowledge of the waveform of the variable being measured. Digital multi-meters may be average or RMS sensing and may include or exclude the dc component. When the variable contains harmonics or dc offset and, in general, any deviation from a pure sine wave, average sensing, average measuring RMS scaled meters may be misleading. Use of RMS measuring meters is recommended.
3. Field test metering used to check power system meter calibration must have an accuracy higher than that of the instrument being checked.
4. Accuracy of metering in test equipment shall be appropriate for the test being performed.
5. Wave-shape and frequency of test equipment output waveforms shall be appropriate for the test and tested equipment.

B. Test Instrument Standards

1. All equipment used for testing and calibration procedures shall exhibit the following characteristics:
   a. Maintained in good visual and mechanical condition
   b. Maintained in safe operating condition
2. Test equipment should have operating accuracy equal to, or better than, the following limits:
   a. Portable multimeters should be true RMS measuring.
   b. Multimeters should have the following accuracy limits, or better:
      1) AC voltage ranges: .75% +/-3 last single digits @ 60 Hz
      2) AC current ranges: .90% +/-3 last single digits @ 60 Hz, including adapters, transducers
      3) DC voltage ranges: .25% +/-1 last single digit
      4) DC current ranges: .75% +/-1 last single digit
      5) Resistance ranges: .50% +/-1 last single digit
      6) Frequency range: .10% +/-1 last single digit @ 60 Hz
   c. Clamp-on ammeters: ac current +/-3% of range +/-1 last single digit @ 60 Hz
   d. Dissipation/power factor field equipment
      1) +/-0.1% power factor for power factor values up to 2.0%

2) 5% of the reading for power factor values above 2.0%

e. Low-range dc resistance equipment: 1.0% of reading, +/-2 last single digits
f. Transformer turns-ratio test equipment: 0.5% or better @ 60 Hz
g. Ground electrode test equipment: +/-2% of range
h. Insulation test sets: 0-1000V dc +/-20% of reading at mid-scale
i. Electrical load survey equipment
   1) +/-5% total error, including sensors
   2) 1% resolution
   3) Current transformers +/-2% of range @ 60 Hz
   4) Voltage transformers +/-0.5% of range @ 60 Hz
j. Liquid dielectric strength test equipment: +/-2% of scale
k. Infrared scanning equipment: sensitivity of 2oC
l. Phase shifting equipment: +/-1.0o over entire range
m. High-current test equipment: +/-2% of range
n. DC high potential test equipment: +/-2% of full scale
o. AC high potential test equipment (60 Hz): +/-2% of full scale

C. Test Instrument Calibration

1. The testing firm shall have a calibration program which assures that all applicable test instruments are maintained within rated accuracy.
2. The accuracy shall be directly traceable to the National Institute of Standards and Technology.
3. Instruments shall be calibrated in accordance with the following frequency schedule:
   a. Field instruments: 6 months maximum
   b. Laboratory instruments: 12 months
   c. Leased specialty equipment: 12 months
      (Where accuracy is guaranteed by lessor)
4. Dated calibration labels shall be visible on all test equipment.
5. Records, which show date and results of instruments calibrated or tested, must be kept up-to-date.
6. Up-to-date instrument calibration instructions and procedures shall be maintained for each test instrument.
7. Calibrating standard shall be of higher accuracy than that of the instrument tested.

D. Test Report

1. The type written test report shall include the following:
   a. Summary of project
   b. Listing of equipment tested
   c. Test results
   d. Recommendations
2. Furnish copies of the complete type written report to the Architect as directed in the contract documents.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 INSPECTION AND TEST PROCEDURES

A. Switches - Low-Voltage

1. Visual and Mechanical Inspection
   a. Compare equipment nameplate information with single-line diagram.
   b. Inspect for physical and mechanical condition.
   c. Check for proper anchorage and required area clearances.
   d. Perform mechanical operation tests.
   e. Verify fuse sizes and types are in accordance with drawings.
   f. Check blade alignment.
   g. Check each fuse holder for adequate mechanical support of each fuse.
   h. Inspect all bus or cable connections for tightness by using calibrated torque wrench. Refer to manufacturer's instructions or Table 4.0.A for proper torque levels.
   i. Test all electrical and mechanical interlock systems for proper operation and sequencing.
   j. Clean entire switch using approved methods and materials.
   k. Check proper phase barrier materials and installation.
   l. Lubricate as required.
   m. Exercise all active components.
   n. Inspect all indicating devices for proper operation.
2. Electrical Tests
   a. Perform insulation-resistance tests on each pole, phase-to-phase and phase-to-ground for one (1) minute. Test voltage and minimum resistances should be in accordance with Table 4.0.B.
   b. Perform contact-resistance test across each switch blade and fuse holder.
3. Test Values
   a. Bolt-torque levels shall be in accordance with Table 4.0.A unless otherwise specified by manufacturer.
   b. Minimum insulation resistance shall be in accordance with Table 4.0.B or manufacturer's recommended minimum.
   c. Determine contact resistance in microhms. Investigate any values which deviate from adjacent poles or similar switches by more than fifty percent (50%).

E. Circuit Breakers - Low-Voltage

1. Visual and Mechanical Inspection: Molded Case
   a. Circuit breaker shall be checked for proper mounting, conductor size and

feeder designation.

b. Operate circuit breaker to insure smooth operation.

c. Inspect case for cracks or other defects.

d. Check tightness of connection with torque wrench in accordance with manufacturer's recommendations.

2. Electrical Tests:

a. Contact resistance shall be measured.

b. Time-current characteristic tests shall be performed by passing 300 percent rated current through each pole. Trip time shall be determined.

c. Instantaneous pickup current shall be determined by run-up or pulse method. Clearing times should be within four cycles or less.

d. Insulation resistance shall be determined pole to pole, across pole and pole to ground. Test voltage shall be 1,000 volts D.C.

e. Test Values:

1) Contact resistance shall be compared to adjacent poles and similar breaker. Deviations of more than 50 percent shall be investigated.

2) Insulation resistance shall not be less than 50 megohms.

3) All trip times shall fall within Table F.1. Circuit breakers exceeding maximum 300 percent time (column 5) shall be replaced.

4) Instantaneous pickup current levels should be within 29 percent of manufacturer's published values.

TABLE F.1

Values for Overcurrent Trip Test

(at 300 Percent of Rated Continuous Current of Breaker)

Tripping Time,Seconds

Minimum Maximum

Voltage, Volts Range of Rated Continuous Current, Amperes Thermal Breakers Magnetic Breakers Maximum Tripping Times For Cable Protection

(1)(2)(3)(4)(5)(6)

240 50 - 100 5 - 70 200

60015 - 455 5 80100

240110 - 22510 5200300

600110 - 22510 - 200300

600 250 - 45025 - 250300

600500 - 60025 10 250300

600 700 - 1,200 2510 450600

600 1,400-2,5002510 600 750

*These values are based on heat tests conducted by circuit breaker manufacturers on conductors in conduit. NEMA reference.

F. Grounding Systems

1. Visual and Mechanical Inspection
   Inspect ground system for compliance with drawings and specifications.
2. Electrical Tests (Small Systems)
   Perform ground-impedance measurements utilizing the fall-of-potential method per ANSI/IEEE Standard 81 "IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System." Instrumentation utilized shall be as defined in Section 12 of the above guide and shall be specifically designed for ground impedance testing. Provide sufficient spacing so that plotted curves flatten in the 62% area of the distance between the item under test and the current electrode.
3. Electrical Tests (Large Systems)
   When sufficient spacing of electrodes per 3.01.J.2 is impractical, perform ground-impedance measurements utilizing either the intersecting curves method or the slope method. (Ref. Nos. 40 and 41 in IEEE Std. 81.)
4. Equipment Grounds
   Utilize two-point method of IEEE Std. 81. Measure between equipment ground being tested and known low-impedance grounding electrode or system.
5. Test Values
   The main ground electrode system impedance-to-ground should be no greater than 0.1 ohms. Equipment grounds, depending on size and length of grounding conductor, should be only fractionally higher than system ground.

G. Motor Control

1. Visual and Mechanical Inspection
   a. Inspect for physical damage, proper anchorage, and grounding.
   b. Inspect equipment for compliance with drawings and specifications.
   c. Motor-running protection
      1) Compare overload heater rating with motor full-load current rating to verify proper sizing. (Adjust as necessary if power factor correction capacitors are connected on load side of heaters.)
      2) If motor-running protection is provided by fuses, verify proper rating considering motor characteristics and power-factor correction capacitors if applicable.
      3) Check tightness of bolted connections using calibrated torque wrench.
2. Electrical Tests
   a. Insulation tests:
      1) Measure insulation resistance of each bus section phase-to-phase and phase-to-ground for one (1) minute. Test voltage shall be in accordance with Table 4.0.B.
      2) Measure insulation resistance of each starter section phase-to-phase and phase-to-ground with the starter contacts closed and the protective device open. Test voltage shall be in accordance with Table 4.0.B.
      3) Measure insulation resistance of each control circuit with respect to ground. Refer to Table 3.01.A and Section 3.01.L.2.

b. Test motor overload units by injecting current through overload unit and monitoring trip time at three hundred percent (300%) of motor full-load current.
NOTE: Test times will, in general, be longer than manufacturer's curve if single-pole testing is performed. Optionally test with all poles in series for time test and each pole separately for comparison.
c. Test molded-case breakers per Section 3.01.F.1.
d. Perform operational tests by initiating control devices to affect proper operation.

3. Test Values
a. Bolt-torque levels shall be in accordance with Table 4.0.A unless otherwise specified by manufacturer.
b. Insulation-resistance test results shall conform with Table 4.0.B.
c. Control wiring-insulation test voltage shall be 1000V dc. Manufacturer shall be consulted for test voltage where solid-state control devices are utilized.
d. Perform overload tests at three hundred percent (300%) of motor full-load current. Trip times shall be in accordance with manufacturer's tolerances. Investigate values in excess of one hundred twenty (120) seconds.

3.02 SYSTEM FUNCTION TESTS

A. General

1. Perform system function tests upon completion of equipment tests as defined in Section 3.01. It is the purpose of system function tests to prove the proper interaction of all sensing, processing, and action devices.
2. Implementation
a. Develop test parameters for the purpose of evaluating performance of all integral components and their functioning as a complete unit within design requirements.
b. Test all interlock devices.
c. Record the operation of alarms and indicating devices.

Table 4.0
Tables A U.S. Standard

Bolt Torque Values for Bus Connections
Heat-Treated Steel - Cadmium or Zinc-Plated

GRADE	SAE	SAE 1&2	SAE 5	SAE 6	SAE 8	
	minimum tensile strength (P.S.I.)	64K	105K	133K	150K	
	bolt diameter (inches)		torque (foot pounds)			
	1/4	4.0	5.6	8.0	8.4	
	5/16	7.2	11.2	15.2	17.6	
	3/8	12.0	20.0	27.2	29.6	
	7/16	19.2	32.0	44.0	48.0	
	1/2	29.6	48.0	68.0		73.6
	9/16	42.4	70.4	96.0	105.6	
	5/8	59.2	96.0	133.6	144.0	
	3/4	96.0	160.0	224.0	236.8	
	7/8	152.0	241.6	352.0	378.4	
	1	225.6	372.8	528.0	571.2	

Bolt Torque Values for Bus Connections
Silicon Bronze Fasteners*

	Torque (Foot Pounds)	
Diameter	Non-Lubricated	Lubricated
5/16	15	10
3/8	20	14
1/2	40	25
5/8	55	40
3/4	70	60

*Bronze alloy bolts shall have a minimum tensile strength of 70,000 pounds per square inch.
Aluminum Alloy Fasteners**

	Torque (Foot Pounds)
Diameter	Lubricated
5/16	8.0

3/8	11.2
1/2	20.0
5/8	32.0
3/4	48.0

**Aluminum alloy bolts shall have a minimum tensile strength of 55,000 pounds per square inch.

Bolt Torque Values for Bus Connections
Stainless Steel Fasteners***

	Torque (Foot Pounds)
Diameter	Uncoated
5/16	14
3/8	25
1/2	45
5/8	60
3/4	90

***bolts, cap screws, nuts, flat washers, locknuts: 18-8 alloy
Belleville washers: 302 alloy

Table B
Insulation-Resistance Test Voltages
for Electrical Apparatus

Maximum Voltage Rating of Equipment	Recommended Minimum Insulation Minimum Test Voltage, dc	Resistance in Megohms
250 Volts	500 Volts	25
600 Volts	1,000 Volts	100

Table C

Insulation-Resistance
Temperature Conversion Factors
For Conversion of Test Temperature to 20°C

Temperature		Multiplier Apparatus Containing
°C	°F	Solid Insulations
0	32	0.40
5	41	0.45
10	50	0.50
15	59	0.75
20	68	1.00
25	77	1.30
30	86	1.60
35	95	2.05
40	104	2.50
45	113	3.25
50	122	4.00
55	131	5.20
60	140	6.40
65	149	8.70
70	158	10.00
75	167	13.00
80	176	16.00

END OF SECTION

SECTION 16111
CONDUIT

PART 1 - GENERAL

1.01 DESCRIPTION:

A. General: Provide conduit including conduit, flexible conduit couplings and connectors, expansion fittings and surface metal and non-metallic raceway systems, complete, as specified per Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. The following work is included in other Sections. Where coordination is necessary, it shall be provided by this Contractor.

1. Section 16000 - Electrical - General Requirements
2. Section 16011 – Electrical Acceptance Test
3. Section 16120 - Wire and Cable
4. Section 16130 - Boxes
5. Section 16140 - Wiring Devices
6. Section 16170 – Grounding
7. Section 16190 - Supporting Devices
8. Section 16400 – Service and Distribution
9. Section 16424 - Motor Connections and Controls
10. Section 16495 - Requirements For Other Equipment
11. Section 16510 - Interior Building Lighting
12. Section 16720 – Fire Detection and Alarm Systems

1.03 REFERENCES

A. Underwriters' Laboratories, Inc., (UL) Standard and Product Listing.

B. National Electrical Manufacturers' Association (NEMA) Standards.

1.04 SUBMITTALS

A. Product data for material and equipment specified under this Section.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Conduit:

1. Minimum size 1”.
2. Rigid Schedule 40 PVC with code size ground wires may be used for

underground distribution feeders.

3. Encase PVC and rigid steel raceways with minimum of 3 inches of concrete slurry to exterior of building line.
4. 1/2 lap wrap raceways inside building underslab with "3M" Scotchwrap No. 50 tape or equal Manville Co. No. VID-10 tape; or minimum of 3 inches of concrete encasement.
5. Rigid schedule 40 PVC with code size minimum #12 ground wires may be used for branch circuits in soil or in concrete on grade (one inch maximum), terminate with schedule 80 stub-ups and elbows. Conduit placed on top of aggregate base and embedded into slab, shall not encroach more than 1-1/2" at any location.
6. Rigid threaded, hot dipped galvanized steel for service raceways and conduits in/under concrete floors or walls. All metallic conduits, couplings, and elbows in soil or in contact with soil to be 1/2 lap wrapped with Scotch #50 tape or factory coated with a bonded polyvinylchloride, minimum 20 mil thick, coating.
7. Electrical metallic tubing for interior branch circuit conduit work, above floor slab. Not for any work on building exterior.
8. Intermediate metal conduit (IMC) - threaded hot dipped galvanized for all conduits on building exterior.
9. Flexible metal conduit - minimum 1/2 inch size, steel armor type with code sized minimum #14 bare copper ground wire for interior work, for connection to recessed fixtures.
10. Liquid tight flexible metal conduit - minimum 1/2 inch size, with sunlight resistant PVC jacket over an inner flexible metal core. UL listed for grounding without separate ground wire for connections to motors and equipment, outdoors and in wet locations, with liquid tight connectors.

B. Couplings and Connectors:

1. Threaded for rigid galvanized steel and intermediate metal conduit.
2. Liquid tight compression gland or set screw for EMT.
3. Screw-in type connectors for flexible metal conduit with insulated throat.
4. Compression gland for liquid tight flexible metal conduit suitable for grounding.
5. Connectors to outlets, pull boxes, junction boxes and equipment liquid tight compression gland with insulated throat.

C. Expansion Fittings:

1. For expansion joints 0-inches to 2-inches: O-Z/GEDNEY type "AX" for rigid steel or IMC, type TX for EMT in open areas. Where used in cored openings through structure or in concrete combine AX with DX.
2. For expansion joints larger than 2-inches: OZ/GEDNEY AX8 in open areas. Where used in cored openings through structure or in concrete combine AX8 with DX.
3. In all areas provide bonding jumper listed for use with the expansion fittings.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Provide and place in the concrete forms all conduit, inserts and sleeves in time to prevent any delay in the concrete work.

B. Minimum burial for all conduits exterior to building shall be 36 inches, unless otherwise noted.

C. Size raceways in accordance with Chapter 9 Table 3A of NEC.

D. Install conduit concealed in all areas, excluding equipment rooms, connections to motors, and connections to surface cabinets.

E. For exposed runs, attach surface-mounted conduit with clamps. Route all exposed conduits parallel or perpendicular to building structure.

F. Make connections to motors with sufficient length of flexible conduit to avoid transmission of vibration and permit equipment location adjustment.

G. Coordinate installation of conduit in masonry work.

H. Install conduit free from dents and bruises. Plug ends to prevent entry of dirt or moisture.

I. Clean and swab conduits before installation of conductor.

J. Alter conduit routing to avoid structural obstructions, minimizing crossovers. Conduit placed on top of aggregate base and embedded into slab, shall not encroach more than 1-1/2" at any location.

K. Seal conduits with duct seal in junction/pull boxes where conduits leave heated area and enter unheated area.

L. Provide flashing and pitchpockets making watertight joints where conduits pass through roof or waterproofing membranes.

M. Allow minimum of 6 inches clearance at flues, steam pipes, and heat sources.

N. Fasten conduits securely to boxes with locknuts and bushings to provide good electrical continuity.

O. Provide chrome escutcheon plates at all exposed wall, ceiling and floor conduit penetrations.

P. Provide nylon pull lines in all empty conduits, minimum 100 lbs. tensile strength.

Q. Install surface metal raceway as noted, plumb with all edges aligned and flush. All sections field cut to be burnished to remove all sharp edges.

R. Penetrations:

1. Waterproof through Exterior Walls and floors Below Grade:
   a) Rigid steel as specified.
2. Through Interior Concrete Walls and Floors:
   a) General: Use rigid steel sleeves as specified.
   b) Wall Sleeves: Extend 2" on both sides of wall.
   c) Floor Sleeves: Set flush with bottom of floor, extend 2" above floor.
   d) Sleeves for Future Use: Shall have threaded end with cap above floor and on one side of wall.
3. In Shelter Building:
   a) Through floors, regardless of number of penetrations, provide rigid steel sleeves as specified for interior concrete walls and floors.
   b) Through walls provide slot openings to accommodate number of conduits.
4. Through Interior Fire Rated Dry Walls:
   a) For One or Two Conduits: Use sheet metal sleeves as specified. Extend sleeves minimum 1/4" on both sides of wall.
   b) For More Than Two Conduits: Provide opening in wall, maximum 3/4" larger than needed for conduits.
5. Through Interior Non Fire Rated Dry Walls:
   a) Provide opening in wall, maximum 3/4" larger than needed, for conduit or group of conduits.
   b) Fill openings around and between conduits with plaster.
6. Through Roof:
   a) Wall and Floor Openings: Verify exact locations and sizes prior to installation.

S. Sealing of Sleeves and Openings: Seal as follows:

1. Waterproof Walls and Floors: Provide O-Z/Gedney Type FSK and Type WSK or approved equal.
2. Fire Rated Floors and Walls: Provide approved fire stop system found in the UL Fire Resistance Directory, as manufacturer by Hevi-Duty/Nelson or 3M.

T. Maintain minimum separation 6" to all low voltage conduits, data, communication and signal.

U. All exposed raceways and boxes in occupied areas or on exterior walls shall be epoxy painted to match adjacent finishes (after installation). Install all exposed conduits parallel to building lines and in a neat and professional manner consistent with the adjacent areas.

END OF SECTION

SECTION 16120
WIRE & CABLE

PART 1 - GENERAL

1.01 DESCRIPTION:

A. General: Provide wire and cable, including wire, cable, connectors, lugs, splice insulation and terminal blocks, complete, as specified per Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. The following work is included in other Sections. Where coordination is necessary, it shall be provided by this Contractor.

1. Section 16000 - Electrical - General Requirements
2. Section 16011 – Electrical Acceptance Test
3. Section 16111 - Conduit
4. Section 16130 - Boxes
5. Section 16140 - Wiring Devices
6. Section 16170 – Grounding
7. Section 16190 - Supporting Devices
8. Section 16400 – Service and Distribution
9. Section 16424 - Motor Connections and Controls
10. Section 16495 - Requirements For Other Equipment
11. Section 16510 - Interior Building Lighting
12. Section 16720 – Fire Detection and Alarm Systems

1.03 REFERENCE STANDARDS

A. Underwriters' Laboratories, Inc. (UL) Standards and Product Listing.

B. Insulated Cable Engineers Association (ICEA):

1. "Thermoplastic Insulated Wires and Cable."

C. National Electrical Manufacturers Association (NEMA):

1. WC-5-1973 (R-1979)

D. Institute of Electrical and Electronic Engineers (IEEE).

1.04 SUBMITTALS

A. Product Data for all material and equipment specified under this Section.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Building Wire:

1. American Insulated Wire Co.
2. Essex Group Inc.
3. Houston Wire & Cable Co.
4. South Wire Co.

B. Lugs, Connectors and Terminations:

1. Burndy
2. Thomas and Betts
3. Minnesota Mining and Manufacturing
4. Gedney Co.
5. Terminal Blocks
   a. Buchanan
   b. Connectron
   c. Entrelec

2.02 MATERIALS

A. Building Wiring: 98 percent conductivity copper, 600 volt insulation, type THHN for branch circuits in dry locations, type THWN for wet locations and exterior work, type THHN for feeders. All cables No. 10 and smaller to be solid and all control wiring No. 14 and smaller to be stranded.

B. Branch Circuit Wiring: Conductors smaller than No. 12 AWG gauge not permitted. 20A, 120V branch circuits in excess of 100 feet, No. 10 throughout.

C. Lugs and Connectors for 600 Volt Class Conductors:

1. For cable connections to all equipment, except for connections to molded case circuit breakers. T&B 54100 series one hole for lugs and 54500 series for cable splice connectors.
2. Provide lugs and connectors larger than #2 with T&B "HS" heat shrinkable tubing insulation after assembly.
3. For cable connections #8 to #6 to all equipment, except for connections to molded case circuit breakers Burndy series 'QA-B' for lugs and Burndy series 'QR' with covers for cable splice connectors.
4. Series 'PT' with cover for taps in #6 and larger conductors and T&B series 54600 series for #8 and smaller conductors.
5. Lugs for #14 and smaller conductors Burndy type YAV/YAV-F to suit terminal, applied with proper tool.
6. For splices in #12 and #10 Scotchlock types 'Y' and 'R'.
7. Splices for control wiring to be T&B 'STA-KON' nylon self-insulated butt splices

applied with proper tool.

8. Splice Insulation: Electrical tape with vinyl plastic backing or rubber tape with protective friction tape.
9. Terminal blocks for control connections:
   a. All control connections shall be made to base mounted, 600 volt rated terminal blocks suitable lugs used, Connectron "KU" series with 'NUC' covers or approved equal by Entrelec.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Make conductor length for parallel feeders identical.

B. Lace groups of feeder conductors in pullboxes and wireways.

C. Provide copper grounding conductors and straps.

D. 600V Class Conductors:

1. Use wire-pulling lubricant for pulling No. 4 AWG and larger wire.
2. Install wire in conduit runs after concrete, plastering, and taping work is complete and after moisture and debris is swabbed from conduits.
3. Splice only in accessible junction or outlet boxes. Splices are not permitted in feeders.
4. Color code conductors to designate neutral conductor and phases as follows:

Voltage	Phasing	A	B	C	N	G
120/208	3 Phase 4W	Black	Red	Blue	White	Green

5. Connections to devices from "thru-feed" branch circuit conductors to be made with pigtails, with no interruption of the branch circuit conductors (or neutrals).
6. Neutral conductor identified by white outer braid, with different tracers of "EZ" numbering tags used where more than one neutral conductor is contained in a single conduit.
7. Neatly arrange and "marlin" wires in Switchboard, Distribution and other Panels, and Terminal Boxes with T&B "Ty-rap" or approved alternate plastic type strapping.
8. Install feeder cables in one continuous section. Exercise care in pulling, to avoid damage or disarrangement of conductors, using approved grips. No cable shall be bent to a smaller radius than the spool on which it was delivered from the manufacturer. Color code feeder cables at terminals. Provide identifying linen tags in each pull box.
9. Individual control wires shall be the same color throughout from origin to final termination, change of color at splices is prohibited, splices to be minimized.
10. The equipment grounding conductors shall be THW insulated copper, colored green, unless noted as bare.
11. Label each branch circuit wire of each electrical system in each pull box, junction

box, outlet box, terminal cabinet, and panelboard in which it appears with 'EZ' numbering tags. Provide feeders with linen tags, indicating point of origin and equipment served.

12. Provide and install vertical raceway cable supports in all risers not to exceed spacing per Table 300-19(a) N.E.C.

E. Lugs and connectors to be circumferentially crimped to conductors with proper tool and dies, with number of crimps as recommended by manufacturer.

F. All terminal blocks and terminals shall be identified and permanently labeled conforming to Contract and Vendor prepared drawings.

G. Where terminal blocks are installed in pullboxes to facilitate splices and taps, a typewritten listing of the terminals shall be affixed to the pullbox cover interior.

END OF SECTION

SECTION 16130
BOXES

PART 1 - GENERAL

1.01 DESCRIPTION:

A. General: Provide boxes, including pullboxes, junction boxes, outlet boxes, terminal boxes, exterior in-grade splice and pull boxes, and through floor fittings, complete, as specified per Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. The following work is included in other Sections. Where coordination is necessary, it shall be provided by this Contractor.
1. Section 16000 - Electrical - General Requirements
2. Section 16011 – Electrical Acceptance Test
3. Section 16111 - Conduit
4. Section 16120 - Wire and Cable
5. Section 16140 - Wiring Devices
6. Section 16170 – Grounding
7. Section 16190 - Supporting Devices
8. Section 16400 – Service and Distribution
9. Section 16424 - Motor Connections and Controls
10. Section 16495 - Requirements For Other Equipment
11. Section 16510 - Interior Building Lighting
12. Section 16720 – Fire Detection and Alarm Systems

1.03 REFERENCE STANDARDS

A. Underwriters' Laboratories, Inc. (UL) Standards and Product Listing.

B. National Electrical Manufacturers' Association (NEMA).

1. OS1-73 (R 1978) "Sheet steel outlet boxes, device boxes, covers and box supports, and cast aluminum covers."

1.04 SUBMITTALS

A. Product data for all material and equipment specified under this section.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Materials:

1. Pullboxes, Junction and Terminal: Metal construction, conforming to National Electrical Code, with screw-on or removable hinged cover.
2. Flush Mounted Pullboxes: Provide overlapping covers with flush-head cover retaining screws, prime coated.
3. Outlet Boxes: 4" square hot dip galvanized, 1.25 oz./sq. ft. or cadmium plated, conforming to UL requirements, ganged as required.
   a. Interior Boxes: Pressed sheet hard drawn steel. Provide attached lugs for mounting where required, or provide with hangers.
   b. Boxes mounted in concrete block, brick or exterior cast walls, Tile Wall type deep boxes.
   c. Exterior Surface Mounted Boxes: Cast, deep FS condulet type with hubs, gasketed cover with spring lid for receptacle covers. Exterior mounted boxes shall be epoxy painted to match adjacent finishes (after installation).

4. Mount Terminal boxes in accessible areas, maximum 72 inches to top. Provide with "Connection" type NT4/MFTA72/MCC or equal terminal strips, number of terminals as noted.
   a. Include on inside cover of terminal cabinets, coordination schedule cross-referencing terminal strip numbering with wiring diagrams.
5. Exterior in-grade splice and pull boxes pre-cast concrete in accordance with utility company specifications. Christy, Jensen Pre-Cast or Forni Corporation.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Locate pullboxes and junction boxes above removable ceilings in area of access panels or in electrical rooms, utility rooms, or storage areas and as noted on drawings.

B. Provide access panels size and type, as directed by Architect where behind finished surfaces.

C. Provide pull boxes, interior and exterior in all conduit runs in excess of 150 feet. Maximum distance between pull boxes not to exceed 250 feet.

D. Adjust position of outlets in finished masonry walls to suit masonry course lines.

E. For boxes mounted in exterior walls provide insulation behind outlet boxes to prevent condensation in boxes.

END OF SECTION

SECTION 16140
WIRING DEVICES

PART 1 - GENERAL

1.01 DESCRIPTION:

A. General: Provide wiring devices, including wall switches, receptacles, coverplates, complete, as specified per Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. The following work is included in other Sections. Where coordination is necessary, it shall be provided by this Contractor.

1. Section 16000 - Electrical - General Requirements
2. Section 16011 – Electrical Acceptance Test
3. Section 16111 - Conduit
4. Section 16120 - Wire and Cable
5. Section 16130 - Boxes
6. Section 16170 – Grounding
7. Section 16190 - Supporting Devices
8. Section 16400 – Service and Distribution
9. Section 16424 - Motor Connections and Controls
10. Section 16495 - Requirements For Other Equipment
11. Section 16510 - Interior Building Lighting
12. Section 16720 – Fire Detection and Alarm Systems

1.03 REFERENCE STANDARDS

A. Underwriters' Laboratories, Inc. (UL) Standards and Products Listing.

B. National Electrical Manufacturers Association (NEMA).

1. WD-1 "General-purpose wiring devices."
2. WD-6

1.04 SUBMITTALS

A. Product data for all material and equipment specified under this Section and 16000.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturer and Type - Leviton, Decora Plus 15A, 120/277 Volt Switches:

1. Single Pole - White Rocker and Frame - No. 5601 - W

2. Pilot Lights - No. 5640 - 2W

B. Manufacturer and Type - Leviton, Decora Plus 20A, 125 Volt, Receptacles:

1. NEMA 5-20R White duplex - No. 16352-W.
2. NEMA 5-20R White GFCI - No. 6899-W.

C. Cover Plates:

1. Smooth nylon, flush mounting, oversize, color to match device. Manufacturer same as device.
2. Cast Metal (for exterior and wet locations): Die cast profile, ribbed for strength, flash removed, primed with grey enamel, furnished complete with four mounting screws.
3. Gaskets: Resilient rubber or closed cell foam urethane.
4. Steel: Hot dip galvanized surface-mounted in mechanical areas.
5. Surface Box Plates: Bevelled, steel, pressure formed for smooth edge to fit box. Mechanical and electrical equipment rooms only.
6. Weatherproof Plates: Plastic coated cast metal gasketed; provide spring loaded gasketed doors. Exterior and wet locations only.

D. Other Acceptable Manufacturers:

1. Hubbell
2. Pass & Seymour

2.02 MATERIALS

A. Switches, Quiet action, rocker handle, with totally enclosed case, rated 20 ampere, specifications grade. Provide matching 2-pole, 3-way and 4-way switches.

B. Specification grade receptacles full gang size polarized, parallel blade, duplex or single, grounding type, rating as noted.

C. Nameplates: Provide engraved nameplates for devices other than standard duplex receptacles and switches indicating voltage, phase and amperes and circuit number.
D. Color: Provide white devices in areas with light wall finish. Receptacles connected to standby power circuits shall be red with red coverplates.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Mount switches 42 inches above floor unless otherwise noted.

B. Coordinate switch mounting locations with architectural details.

C. Mount receptacles vertically, square and plumb, above finished floor, with grounding

pole at top, unless noted otherwise on drawings.

D. Mount receptacles above counter above splash horizontally.

E. Corresponding branch panel and circuit shall be engraved on all trim plates.

F. Provide No.12, green, TW conductor from every outlet box to ground screw of every flush receptacle.

G. Install cover plates on all wiring devices and junction boxes.

END OF SECTION

SECTION 16170
GROUNDING

PART 1 - GENERAL

1.01 DESCRIPTION:

A. General: Provide power system grounding including ground rods, complete, as specified per Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. The following work is included in other Sections. Where coordination is necessary, it shall be provided by this Contractor.

1. Section 16000 - Electrical - General Requirements
2. Section 16011 – Electrical Acceptance Test
3. Section 16111 - Conduit
4. Section 16120 - Wire and Cable
5. Section 16130 - Boxes
6. Section 16140 - Wiring Devices
7. Section 16190 - Supporting Devices
8. Section 16400 – Service and Distribution
9. Section 16424 - Motor Connections and Controls
10. Section 16495 - Requirements For Other Equipment
11. Section 16510 - Interior Building Lighting
12. Section 16720 – Fire Detection and Alarm Systems

1.03 REFERENCE STANDARDS

A. Institute of Electrical and Electronic Engineers. (IEEE)

PART 2 - PRODUCTS

A. Rods:
1. As shown on plans.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Connect ground bus in Main Switchboard MS2 system ground wire system which shall be permanently bonded to concrete encased electrode ground system and to ground grid with rods. See plans for detail.

B. When more than one rod is driven, space them apart at least the full length of the rod or two lengths then able.

D. All ground wire connections shall be exothermic, "thermite" or "cadweld", welded.

E. Terminate grounding conduits at equipment with ground bushing; with ground wire connected through bushing.

F. Provide No. 12 (green) TW conductor from outlet box to ground screw of every receptacle.

G. Ground all isolated sections of metallic raceways.

H. Ground wires shall be bare copper cables in conduits with conduits bonded to ground cables.

K. Bond all metallic piping systems as per NEC Article 250-80.

L. Grounding system for Building B shall be as shown on plans.

END OF SECTION

SECTION 16190
SUPPORTING DEVICES

PART 1 - GENERAL

1.01 DESCRIPTION:

A. General: Provide all supporting devices as required for this work including conduit supports, meter/main anchoring, equipment anchoring, noise and vibration control, complete, as specified by Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. The following work is included in other Sections. Where coordination is necessary, it shall be provided by this Contractor.

1. Section 16000 - Electrical - General Requirements
2. Section 16011 – Electrical Acceptance Test
3. Section 16111 - Conduit
4. Section 16120 - Wire and Cable
5. Section 16130 - Boxes
6. Section 16140 - Wiring Devices
7. Section 16170 – Grounding
8. Section 16400 – Service and Distribution
9. Section 16424 - Motor Connections and Controls
10. Section 16495 - Requirements For Other Equipment
11. Section 16510 - Interior Building Lighting
12. Section 16720 – Fire Detection and Alarm Systems

1.03 VIBRATION ISOLATION GENERAL REQUIREMENTS

A. Submit shop drawings in accordance with Section 16000 and as noted herein. The submittal shall contain the following information:

1. Catalog cuts and data sheets on specific vibration isolators to be utilized, showing compliance with the specification.
2. An itemized list showing the items of equipment, to be isolated, the isolator type and model number selected, isolator loading and deflection.

B. Coordination: The Contractor shall coordinate his work with other trades to avoid rigid contact between isolated transformers and panel with the building. He shall inform other trades following his work to avoid any contact which would reduce the vibration isolation.

C. Conflicts and Discrepancies:
   1. The Contractor shall bring to the Owner's attention prior to installation any conflicts with other trades which will result in unavoidable contact to the equipment, piping, etc., described herein, due to inadequate space, etc. Corrective work necessitated by conflicts after installation shall be at the responsible Contractor's expense.
   2. The Contractor shall bring to the construction manager's attention any discrepancies between the specifications and field conditions, changes required due to specific equipment selection, etc., prior to installation. Corrective work necessitated by discrepancies after installation shall be at the Contractor's expense.

D. Seismic Restraint Requirements:

   1. Seismic restraint shall be furnished and installed in accordance with all relevant State and Local code requirements.

F. Responsibility of Manufacturer:

   1. Vibration isolation manufacturer shall have the following responsibilities:
      a. Determine vibration isolation sizes and locations.
      b. Provide equipment isolation system as scheduled or specified.
      c. Guarantee specified isolation system deflection.
      d. Provide installation instructions and drawings.
      e. Provide calculations by a licensed civil engineer certifying that the seismic restraints will act in accordance with the relevant state and local codes and will maintain equipment in captive position.
      f. Provide approved resilient restraining devices as required.
      g. Provide signature of a licensed engineer for all calculations on the seismic snubbers.

PART 2 - PRODUCTS

2.01 ANCHOR METHODS

A. Solid Masonry: Lead expansion anchors or preset inserts.

B. Concrete Surfaces: Self-drilling anchors or powder-driven studs.

2.03 VIBRATION ISOLATORS

A. General Properties:

   1. All vibration isolators shall have either known undeflected heights or other markings so that, after adjustment, when carrying their load, the deflection under load can be verified, thus determining that the load is within the proper range of the device and that the correct degree of vibration isolation is being provided according to the design.

2. All isolators shall operate in the linear portion of their load versus deflection curve. Load versus deflection curves shall be furnished by the manufacturer and must be linear over a deflection range 50% above the design deflection.
3. The ration of lateral to vertical stiffness shall not be less than 1.0 or greater than 2.0.
4. The vertical natural frequency for each support point, based upon the load per isolator and isolator stiffness, shall not differ by more than + or - 10%.
5. Wave motion through the isolator shall be reduced to the following extent: Isolation above the resonant frequency shall follow the theoretical prediction based upon an undamped single degree of freedom system, with a minimum isolation of 50 decibels above 150 cycles per second.
6. All neoprene mountings shall have a shore hardness of 50 to 60 after minimum aging of 20 days or corresponding oven aging.
7. All vibration isolation equipment exposed to moisture or an outdoor environment shall be coated as follows:
   a. All steel parts to be hot-dipped galvanized.
   b. All bolts to be cadmium plated.
   c. All springs to be cadmium plated and neoprene coated.

B. Isolator Types and Descriptions:

1. Type WMN - All direction mount with a captive neoprene element and steel insert. Capable of use in compression, tension and shear. Equal to Mason Industries Type RBA and RCA or approved equal.
2. Type HMN - Neoprene mount having seismic restraint. Maximum static deflection of 0.3 inch. Equal to Mason Industries "Seismic Neoprene Mount" or approved equal.
3. Type SSLFH - Captive spring mount. Equal to Mason Industries "SSLFH" or approved equal.
4. Type SER - Captive spring mount. Equal to Mason Industries.

PART 3 EXECUTION

3.01 INSTALLATION OF SUPPORTS

A. Design all electrical equipment, raceways and anchorages to resist earthquake loads required by the California Building Code - Seismic Zone 4.

3.02 INSTALLATION OF VIBRATION ISOLATION DEVICES

A. General:

1. Transmission of perceptible, vibration, structure borne noise to occupied areas by equipment installed under this contract will not be permitted.
2. Install vibration isolators per manufacturer's directions.

3.03 VIBRATION ISOLATION REQUIREMENTS

A. 240V Distribution Panels:

1. Wall mounted connected to adjacent transformers within buildings by flexible conduit.
2. Type WMN, 0.1 inch static deflection.
3. Locate at four corners.

END OF SECTION

SECTION 16400
SERVICE AND DISTRIBUTION

PART 1 - GENERAL

1.01 DESCRIPTION:

A. General: Provide all service equipment including main service switchboard/distribution and feeder, complete, as specified per Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. The following work is included in other Sections. Where coordination is necessary, it shall be provided by this Contractor.

1. Section 16000 - Electrical - General Requirements
2. Section 16011 – Electrical Acceptance Test
3. Section 16111 - Conduit
4. Section 16120 - Wire and Cable
5. Section 16130 - Boxes
6. Section 16140 - Wiring Devices
7. Section 16170 – Grounding
8. Section 16190 - Supporting Devices
9. Section 16424 - Motor Connections and Controls
10. Section 16495 - Requirements For Other Equipment
11. Section 16510 - Interior Building Lighting
12. Section 16720 – Fire Detection and Alarm Systems

1.03 REFERENCE STANDARDS

A. Underwriters' Laboratories, Inc. (UL) Standards and Products Listing

B. National Electrical Manufacturers' Association (NEMA):

1.04 SUBMITTALS

A. Submit Shop Drawings and Product Data for all equipment specified in this section in accordance with 16000.

1. Shop drawing showing switches, breakers, wiring, fuse sizes, interconnection diagram, cabinet arrangement and sizes.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Acceptable Manufacturers: Match Existing Switchboard or Cutler-Hammer, General Electric Company, Square "D" Co., or Siemens.

B. All equipment specified herein to be product of one manufacturer.

2.02 MAIN SWITCHBOARD (Existing)

2.03 PANELBOARDS AND DISTRIBUTION BOARDS

A. General:

1. Furnish and install at locations as shown on the drawings approved panelboards flush or surface mounted of a type indicated and specified herein.

B. Interiors:

1. All interiors shall be completely factory assembled. They shall be so designed that switching and protective devices can be replaced without disturbing adjacent units and without removing the main bus connectors, so that circuits may be changed without machining drilling or tapping.

2. Branch circuits shall be arranged using double row construction except when narrow column panels are indicated. A nameplate shall be provided listing panel type and ratings.
3. Unless otherwise noted, double size insulated neutral bars shall be included. Bus bar taps for panels with single pole branches shall be arranged for sequence phasing of the branch circuit devices. Neutral bussing shall have a suitable lug for each outgoing circuit requiring a neutral connection. A full size ground bus will be included in all panels.

C. Boxes:

1. Boxes shall be at least 20 inches wide made from galvanized steel. Provide minimum gutter space in accordance with National Electric Code. Where feeder cables supplying the mains of a panel are carried through its box to supply other electrical equipment, riser panels the box shall be sized to include the additional required wiring space. At least four interior mounting studs with adjustable nuts shall be provided.

C. Trim:

1. Switching device handles shall be accessible. Doors and panelboard trims shall not uncover any live parts. Doors shall have flush type cylinder lock and catch except doors over 48 inches in height shall have auxiliary fasteners top and

bottom of door in addition to the flush type cylinder lock and catch. Panelboard switching devices with individual dead front doors shall be acceptable in lieu of standard door in trim design. Panelboard trim clamps shall be of the indicating type. Bottom of all trims to have lugs for resting on cabinet flange.

2. Door hinges shall be concealed. All locks shall be keyed alike; furnish two keys for each panel; directory frame and card having a transparent cover shall be furnished with each door.

3. All exterior and interior steel surfaces of the trim shall be properly cleaned, primed with a rust inhibiting phosphatized coating and finish with a gray ANSI 61 paint. Trims for flush panels shall overlap the box for at least 3/4 inch all around. Surface trims shall have the same width and height as the box. Trims shall be mountable by a screwdriver without the need for special tools. After installation, trim clamps shall not be accessible when the panel door is closed and locked.

4. Panelboard fronts shall be door-in-door construction.

E. Conductors (Main Bus and Branch Connectors):

1. All main bus bars shall be copper sized in accordance with UL standards to limit the temperature rise on any current carrying part to a maximum of 50^{o}C above an ambient of 40^{o}C maximum.

F. Circuit Breaker Distribution Panels:

1. These panels shall be provided with bolt-on molded case circuit breakers tested and UL labeled per UL 489.

2. Breakers 100 ampere through 400 ampere frame sizes shall be thermal-magnetic trip with inverse time current characteristics, unless otherwise noted.

3. Breakers 600 ampere frame and above shall have solid-state trip and rating plugs with trip ratings as indicated on drawings. Rating plugs shall be interlocked so they cannot be inter- changeable between frames and interlocked such that the breaker cannot be latched with rating plug removed. Breakers shall have built-in test points for testing all breakers 600 ampere and above. Trip unit shall have adjustable short time delay and adjustable instantaneous pickup. Breakers shall be Westinghouse Seltronic or approved equal.

4. Molded case breakers shall have a minimum 18,000 symmetrical RMS interrupting capacity at 240 volts. Unless otherwise noted on single line diagram.

G. Lighting and Receptacle Panels:

1. Panels for use at 240 volts AC maximum shall incorporate bolt-on circuit breakers as shown rated at 10K A.I.C. symmetrical at 240 volts.

PART 3 EXECUTION

3.01 INSTALLATION

A. Provide mounting brackets, busbar drillings, and filler pieces for unused spaces.

B. Each branch circuit of lighting and power branch circuit panels to have a permanently fixed number with one word directory, mounted under celluloid on inside of cabinet door, showing circuit numbers and typewritten description of outlets controlled by breakers.

C. Color code mains and each breaker load side terminal, same as conductor insulation.

D. All lugs per Section 16120, Wire and Cables.

E. Align breakers on same phase horizontally. Provide common simultaneous trip for 2 and 3-pole breakers with one handle. Provide each panel with five handle locks.

F. Connections of busses and circuit breakers made with machine screws.

G. Provide locking devices for circuit breakers controlling electric discharge lighting circuits in accordance with local regulations.

H. Provide handle ties for breakers controlling multi-wire branch circuits in accordance with local Electrical Safety Orders. Install handle ties so that the individual breakers can 'trip free' without affecting other poles on common handle tie.

I. Structures, doors and trims primed and painted with one coat of factory standard color.

J. Properly identify all panelboards, switchboards, and other equipment provided under this section by means of black with white engraved laminated plastic descriptive nameplates 1/4 inch high lettering for panel designation and 1/8 inch high lettering for panel voltage. Mount nameplates using poprivets or screws, clamp holders in any form are not acceptable.

K. Distribution panelboards: Prepare and affix bakelite engraved phenolic nameplates to each breaker indicating loads controlled.

END OF SECTION

SECTION 16424
MOTOR CONNECTIONS AND CONTROLS

PART 1 - GENERAL

1.01 DESCRIPTION:

A. General: Provide motor connections and controls, complete, as shown and specified per Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. The following work is included in other Sections. Where coordination is necessary, it shall be provided by this Contractor.

1. Section 16000 - Electrical - General Requirements
2. Section 16011 - Electrical Acceptance Testing
3. Section 16111 - Conduit
4. Section 16120 - Wire and Cable
5. Section 16130 - Boxes
6. Section 16140 - Wiring Devices
7. Section 16170 – Grounding
8. Section 16190 - Supporting Devices
9. Section 16400 – Service and Distribution
10. Section 16495 - Requirements For Other Equipment
11. Section 16510 - Interior Building Lighting
12. Section 16720 – Fire Detection and Alarm Systems

B. Control Devices: Including low voltage and 120V control wiring and conduit; provided under Division 15, unless otherwise specified or shown.

C. Motors: Furnished under other applicable Sections, unless otherwise shown; installed and connected under this Section.

D. Starters and Disconnect Switches: Those furnished under other applicable Sections; installed and connected under this Section.

E. Refer to Mechanical control diagrams for coordination.

1.03 QUALITY ASSURANCE

A. Manufacturers: Same as selected for switchboards and panelboards.

1.04 SUBMITTALS

A. Shop Drawings: Include layout of starter units, and integral control wiring diagrams. Submit shop drawings in accordance with Section 01330 and 16000.

B. Product Data: Manufacturer's specifications and data.

C. Seismic Restraints: Design calculations as specified.

1.05 PRODUCT HANDLING

A. Delivery: Receive and store motors, and starters and disconnect switches furnished under other applicable Sections.

PART 2 - PRODUCTS

2.01 DISCONNECT SWITCHES

A. Heavy duty, horsepower rated.

B. Quick make, quick break.

C. Visible blade.

D. Provision for padlocking.

E. Dual cover interlock with switch handle.

F. Enclosures NEMA type, consistent with environment.

2.02 STARTERS

A. Manual Starters:

1. Molded plastic switch.
2. Overload trip resetable assembly; one in each phase.
3. Enclosures NEMA type; consistent with environment.

B. Combination Magnetic Motor Starters:

1. Combination fusible disconnect switch, magnetic motor starter.
2. 120 volt control circuit with fuse protection and control transformer.
3. Green neon indicating light.
4. Two normally open and one normally closed spare auxiliary contact in addition to those used.
5. Dual cover interlock with switch handle.
6. Thermal overload relays; one in each phase.
7. Enclosure NEMA type consistent with environment.
8. Identification nameplates; pop-rivet or screw fastened.
9. HAND-OFF AUTO switch, unless otherwise shown.
10. Provisions for padlocking.

2.03 EQUIPMENT FURNISHED BY OTHER DIVISIONS

A. Where equipment is to be provided by other divisions and requires electrical supply and/or connections, the contractor shall coordinate and determine the electrical equipment and material necessary for this division to provide and to install the complete system. The division furnishing the equipment shall erect, level, align and prepare the equipment for Division 16 work, along with providing the installation instructions, and the diagram for the electrical work. Division 16 shall provide the electrical rough-ins, electrical accessories not furnished by the other Division and the final connections for a complete and operating installation. Division 16 shall provide start up and testing assistance as agreed between the Divisions.

2.04 ELECTRICAL EQUIPMENT INSTALLATION

A. Electrical equipment associated with equipment provided under other divisions shall be furnished, installed, and wired in accordance with the following installation schedule. Deviations and clarifications of this schedule are permitted only with the written consent of the City.

B. Required power wiring and conduit shall be provided under Division 16 for all equipment and device.

C. Installation Schedule

		Furnish Equip. Device	Install Equip. Device	Provide Control Wire and Conduit
1.	Temperature control devices and panels	Division 15	Division 15	Division 15
2.	Electrical thermostats furnished as part of the equipment	Division 15	Division 15	Division 15
3.	Line voltage control thermostats furnished as part of the equipment	Division 15	Division 15	Division 15
4.	Control valves, automatic dampers, damper operators, solenoid valves, insertion temperature and pressure sensors	Division 15	Division 15	Division 15
5.	Airflow control devices	Division 15	Division 15	Division 15

6.	Air supply equipment	Division 15	Division 15	Division 15
7.	Switch and pilot light stations	Division 16	Division 16	Division 16
8.	Control power transformers	Division 15	Division 15	Division 15
10.	Duct Smoke Detectors	Division 16	Division 15	Division 16/15
11.	Smoke detectors, and alarms including relay for fan shutdown	Division 16	Division 16	Division 16/15
12.	Motors	Division 15	Division 15	Division 15
13.	Motors starters not furnished with mechanical equipment	Division 16	Division 16	Division 15
14.	Motor starters furnished loose with mechanical equipment	Division 15	Division 16	Division 15
15.	Disconnect switches, and thermal overload switches	Division 16	Division 16	Division 15
16.	Sprinkler system water flow and tamper switches	Division 15	Division 15	Division 16
17.	Mechanical piping heat tracing (including relays, contactors, thermostats, etc.)	Division 15	Division 16	Division 15
21.	Interlock wiring for mechanical equipment if indicated on electrical drawings	Division 16	Division 16	Division 16

PART 3 EXECUTION

3.01 GENERAL

A. Clearances: Provide code-required clearances and access for electrical devices, or as otherwise required by the Contract Documents.

B. Motor Connections: Make final connections to motors with liquid-tight flexible conduit and fittings as specified. Provide ground wire in flexible conduits and sized per code. Length and bend as specified under flexible liquid tight conduit installation methods.

C. Control Connections: Coordinate with work done under other trades to allow for proper connection and operation of each piece of equipment.

D. Starters: Check overload relay heaters with motor nameplate full load current. Change heaters per manufacturer's recommendation if not correctly rated at no additional cost.

E. Clean equipment before putting into operation.

3.02 TESTING

A. Motors and Starters: After connections are made, motors, and driven equipment are properly lubricated and preparations for operation, including that of other trades are completed, test motors for proper rotation and satisfactory operation.

B. Check overload elements in motor starters for suitability to motor ratings and operation characteristics.

C. Replace overload elements not properly sized.

D. Investigate and correct cause of motors operating above full load rating instead of increasing overload relay trip setting.

3.03 IDENTIFICATION

A. Provide nameplates as specified for individually mounted starters, relays, controllers, and control devices.

END OF SECTION

SECTION 16495
REQUIREMENTS FOR OTHER EQUIPMENT

PART 1 - GENERAL

1.01 DESCRIPTION:

A. General: Provide electrical connections meeting the requirements for other equipment, complete, as specified per Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. The following work is included in other Sections. Where coordination is necessary, it shall be provided by this Contractor.

1. Section 16000 - Electrical - General Requirements
2. Section 16011 - Electrical Acceptance Testing
3. Section 16111 - Conduit
4. Section 16120 - Wire and Cable
5. Section 16130 - Boxes
6. Section 16140 - Wiring Devices
7. Section 16170 – Grounding
8. Section 16190 - Supporting Devices
9. Section 16400 – Service and Distribution
10. Section 16424 - Motor Connections and Controls
11. Section 16510 - Interior Building Lighting
12. Section 16720 – Fire Detection and Alarm Systems

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 MISCELLANEOUS SYSTEMS

A. Provide power as required for the following Systems:

1. Fire Alarm System
2. Voice and Data Communication Systems (by others)
4. Security and Access Systems (by others)

3.04 Plywood Backboards: Where shown on plans: Provided under Section ROUGH CARPENTRY.

3.05 Grounding: Provide ground wire in 1”conduit as required for telephone/data equipments.

3.06 Fish Wire: Provide all empty conduits in excess of 15' length with nylon cord fish wire, tensile strength of 100 lbs. minimum.

END OF SECTION

SECTION 16510
INTERIOR BUILDING LIGHTING

PART 1 - GENERAL

1.01 DESCRIPTION:

A. General: Provide interior building lighting including luminaries, lamps, ballast, supports and accessories including plaster frames, trim rings and backboxes for plaster or drywall ceilings or concrete, complete, as specified per Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. The following work is included in other Sections. Where coordination is necessary, it shall be provided by this Contractor.

1. Section 16000 - Electrical - General Requirements
2. Section 16011 – Electrical Acceptance Test
3. Section 16111 - Conduit
4. Section 16120 - Wire and Cable
5. Section 16130 - Boxes
6. Section 16140 - Wiring Devices
7. Section 16170 – Grounding
8. Section 16190 - Supporting Devices
9. Section 16400 – Service and Distribution
10. Section 16424 - Motor Connections and Controls
11. Section 16495 - Requirements For Other Equipment
12. Section 16720 – Fire Detection and Alarm Systems

1.03 REFERENCE STANDARDS

A. Illuminating Engineering Society of North America (IES).

1.04 SUBMITTALS

A. Submit Shop Drawings and Product Data for all equipment and material specified in this Section in accordance with Sections 01330 and 16000.

B. Submit shop drawings for luminaries indicating pertinent physical characteristics.

C. Prior to shop drawing submittals, verify type of ceiling construction with type fixtures for proper fit of fixtures to be installed. Submit cross-referenced schedule with fixture brochure, denoting the number of each room, its ceiling construction and type fixture mounting for fixture(s) to be installed in room.

D. Where a specific finish or color is not specified and options exist, submit color and/or finish samples to Architect for selection. Fixtures not having color and/or finish acceptable to Architect shall be replaced at no additional cost.

1.05 COORDINATION

A. Coordinate installation of plaster frames, trim rings, and backboxes with other trades involved in ceiling.

B. Coordinate with Divisions 15 to avoid conflicts between luminaries, supports, fittings, and mechanical equipment.

PART 2 - PRODUCTS

2.01 LUMINARIES

A. Types and manufacturers as noted on luminaire schedule.

B. Substitutions, in accordance with Section 16000, to the base bid specification to be reviewed the following samples and technical information must be supplied:

1. A working sample of the alternative luminary complete with lamp, ballast and optical system that will be supplied for the bid installation. For convenience, the Architect may require a sample that operates at 120 volts.
2. A complete photometric report of the submitted sample with the specified lamp type and wattage including tabulated candlepower, coefficient of utilization, and iso-foot candle diagram. Prorated data will not be acceptable. The photometric report must be done in accordance with published IES testing procedures and certified by a registered electrical engineer. Data may also be supplied in the form of a data file on 3 1/2" floppy disk or CD in IES format for use in a recognized computer lighting program.
3. A current original catalog data sheet with luminary catalog number. Modified data sheets will not be acceptable.
4. A point by point computer printout verifying the illumination criteria for the entire site plan based on using the alternative luminaries. The spacing increment of points on the verification printout shall not exceed ten feet in either direction. The printout shall be based on maintained foot candle levels based on the criteria set by the engineer for this specific project with a summary table showing the maximum, minimum, and average horizontal foot candle levels on the entire area.

2.02 LAMPS

A. Acceptable Manufacturers:

1. Manufacturer and Type: General Electric Company.
2. Other Acceptable Manufacturers:
   a. Phillips.
   b. Sylvania/Osram.

B. Fluorescent Lamps:

1. Super T8, color temperature of 3500K and 85CRI, 3100 initial lumens 24,000 hour rated lamp life.
2. Compact fluorescent lamps 3000K color temperature and 85 CRI.
3. T5 lamps shall have minimum rated lamp life of 20,000 hours for 18 and 40 watt lamps and 12,000 hours for 27 and 50 watt lamps.
4. T4 lamps shall have minimum rated lamp life of 10,000 hours.

C. Install lamps in accordance with manufacturer's instructions.

D. All lamps to be properly operating at time of final acceptance.

2.03 BALLAST

A. Fluorescent Ballasts: Ballast shall be Advance High Frequency electronic or Universal electronic ballast, of US manufacture and carry a five (5) year warranty with up to $15.00 labor replacement allowance.
B. All fluorescent ballasts shall be “A” sound rated, multi-tap 120/277 V inputs, THD of less than 20%, minimum ballast facto of 0.9 and maximum crest factor of 1.7.
C. The combined use of high output long life T8 lamps and programmed start, reduced ballast factor, electronic ballasts, is intended to provide reduced overall energy usage with equal light (lumen) output to standard lamp/ballast combinations.
D. For room or areas subject to frequent ON/OFF control of lighting (i.e. occupancy sensor controls), fluorescent ballasts shall be extra high efficiency, fully electronic, programmed start, parallel wired, with reduced output ballast factor (max 0.75bf).
E. For rooms or areas where lighting is turned ON/OFF less than four times per day and burns for at least three hours per start, provide extra high efficiency Instant Start, fully electronic, parallel wired ballasts and compatible lamps for increased energy efficiency.

F. Other Acceptable Manufacturers:

1. Advance Transformer Company.
2. OSRAM

G. All ballasts of each type shall be of one manufacturer.

PART 3 - EXECUTION

3.01 SUPPORTS

A. Refer to Section 16190.

3.02 RECESSED LUMINARIES

A. Install recessed luminaries to permit removal from below, to gain access to outlet or prewired flexible box.

B. Connect recessed luminary to boxes with flexible conduit and fixture wire.

C. All materials used in ceilings for supporting of fixtures to be non-combustible.

3.03 INSTALLATION

A. As listed in fixture schedule and on plans; completely lamped with new lamps, properly operating at time of final acceptance of electrical work. Align luminaries.

B. Install surface mounted lighting fixture in accordance with Article 410-76 of N.E.C. and recessed fixtures in accordance with Article 410-16 of N.E.C.

C. Lighting fixtures shall be securely supported, the mounting height of all fixtures in any one room a uniform distance from floor, whether or not outlets or ceiling area over fixtures are level except otherwise noted. Hang surface mounted fluorescent fixtures from outlet boxes in furred ceilings. Boxes supported by bar hangers fastened to furring channels; the fixtures provided with additional supports from above.

END OF SECTION

SECTION 16720
FIRE ALARM SYSTEM

PART 1 – GENERAL

1.01 CONDITIONS AND REQUIREMENTS:

A. Refer to the General Conditions, Supplementary General Conditions and Division 1 – General Requirements.

1.02 INCORPORATED DOCUMENTS:

A. Section 01330 Submittal Procedure, Section 0170 Execution Requirements, applies to all work in this section.

B. Related work included in other sections:

1. Section 16000 - Electrical - General Requirements
2. Section 16011 - Electrical Acceptance Testing
3. Section 16111 - Conduit
4. Section 16120 - Wire and Cable
5. Section 16130 - Boxes
6. Section 16140 - Wiring Devices
7. Section 16170 – Grounding
8. Section 16190 - Supporting Devices
9. Section 16400 – Service and Distribution
10. Section 16424 - Motor Connections and Controls
11. Section 16495 - Requirements For Other Equipment

1.03 DESCRIPTION

A. This specifications intends to describe a fire alarm system which is intelligent analog detecting, low voltage and modular with multiplex communication techniques in full compliance with all applicable codes and standards. The features described in this specification are a requirement for this project and shall be furnished by the successful contractor.

1. The system shall include all required hardware, conduits, raceways, interconnecting wiring and software to accomplish the requirements of this specification and the contract drawings, whether itemized or not.

2. All equipment furnished shall be new and the latest state of the art products of a single manufacturer, engaged in the manufacturing and sale of analog fire detection devices for over ten years. The manufacturer shall have an installed base of analog systems as a reference.

3. The new equipment specified is that of the Simplex 4100U system which was selected to meet the special requirements for design of this project.

4. Modification includes, but not limited to, any components replacement, additional or deletion in the control and remote annunciation panel; addition or deletion of external alarm initiating devices, evacuation signal devices; external and internal wiring of the existing control panel; testing of all new devices and equipment , programming of the system; power booster panel and analog interfacing modules.

1.04 MATERIALS AND SERVICES

A. The system shall include the below listed component and material, but not be limited to the following elements:

1. Master system CPU including all fire detection modules.

2. Power supplies, batteries and battery chargers.

3. Equipment enclosures.

4. Intelligent addressable manual pull stations, heat detectors, smoke detectors, strobes, horn-strobe combination, horns, alarm monitoring modules, and supervised control modules;

5. Multiplex driven remote LCD Annunciator panels.

6. Software and devices as required to provide a complete functioning system.

7. Wiring, raceway, and all necessary cutting and patching.

8. Installation, testing, certification, and operator’s training.

9. Field verifying field existing conditions before doing any work.

10. Labeling each device with its specific device address with transparent labels and red markings.

11. Test the complete work. Correct any deficiencies to the satisfaction of the City of Livemore and State Fire Marshall.

1.05 APPLICABLE STANDARDS:

A. The publications listed below forms a part of this publication to the extent referenced. The publications are referenced in the text by the basic designation only. The latest version of each listed publication shall be used as a guide unless the authority having jurisdiction has adopted an earlier version.

1. Factory Mutual (FM)

2. National Fire Protection Association (NFPA)

a. NFPA 13 Standard for the Installation of Sprinkler Systems.

b. NFPA 13A Recommended Practice For the Inspection, Testing and Maintenance of Sprinkler Systems.

c. NFPA 70 National Electrical Code.

d. NFPA 72 Standard for The Installation, Maintenance And Use of Protective Signaling Systems.

e. NFPA 90A Standard For The Installation of Air Conditioning And Ventilating Systems

f. NFPA 101 Life Safety Code.

3. Underwriters' Laboratories, Inc. (UL)

4. State and Local Building Codes as adopted By the Division of the State Architect.

5. Dept. of Justice rules for Building Accessibility by The Handicapped.

6. Installation shall be in accordance with the California Administrative Code, Title 24,

1.06 QUALIFICATIONS OF THE INSTALLER:

Before commencing work, submit data showing that the contractor has successfully installed fire alarm systems of the same type and design as specified, or that they have a firm contractual agreement with a subcontractor having the required manufacturers' training and experience. The contractor shall include the names and locations of at least two installations where the contractor, or the subcontractor above, has installed such systems.

1.07 MANUFACTURER'S REPRESENTATIVE:

Provide the services of representative or technician from the manufacturer of the system, experienced in the installation and operation of the type of system provided. The technician shall supervise installation, software documentation, adjustment, preliminary testing, final testing and certification of the system. The technician shall provide the required instruction to the owner's personnel in the system operation, maintenance and programming.

1.08 SUBMITTAL:

A. The contractor shall include the following information in the equipment submittal for the Architect or Electrical Engineer:

1 Scope of project, as they relate to the fire alarm system.

2 Floor Plans Showing Fire Alarm Devices: An AutoCAD file of the Floor plans shall be provided by the Architect to the contractor. Floor plans shall indicate room identifications, the location of fire and smoke barrier walls for verification of smoke and fire smoke damper, and fire door detection and control.

3 Design and provide scaled Fire Alarm site plans showing all building devices remote annunciation panel and command center, control panel, off-building remote devices, Building Central Terminal Cabinets, conduit sizes, number of conductor and AWG sizes between them.

4 Provide a single line riser diagram to demonstrate:

a. The type of devices installed.

b. The number of devices supplied by each circuit.

c. The subdivision of zones or floors within the building.

5. Provide point-to-point diagram illustrating the wiring methods and styles used for:

a. Initiating circuits.

b. Indicating Circuits.

6. Valid and Current CSFM Listing Sheets shall be provided for every new fire alarm component to be installed within the scope of work of the project. Non-CSFM listed devices permitted to be installed shall include diagrammatic electrical drawings demonstrating their electrical isolation as prescribed in Section 208©, Article 3, Chapter 1.5. Title 19, CCR. Listing numbers noted on the device symbol legend does not meet requirement for listing verifications.

7. Power Calculations

   a. Battery capacity calculations.

   b. Supervisory power requirements for all equipment.

   c. Alarm power requirements for all equipment.

   d. Justification showing power requirements of the system power supplies.

   e. Voltage drop calculation, for wiring and in worst case condition.

8. Provide complete manufacturer's catalog data including supervisory power usage, alarm power usage, physical dimensions, finish and mounting requirements.

9. Floor plans showing all initiating, end of line, supervisory, indicating appliances and output control devices; including circuit interface panels, annunciators, printers, video display terminals, and the main CPU locations.

10. Riser shall show all Fire Alarm Control Panels installed on site and shall also be indicated on the Fire Alarm Site Drawings.

11. A symbol legend reflecting all new fire alarm system devices shall be included. This legend should be consistent with the bid document legend for device identification.

12. Elevation details for manual pull stations and visual fire warning devices. These details include the correct mounting heights in accordance to Chapter 60 of the California Building Code.

13. Design number and detail of through-fire stop systems that are to be utilized for penetrations through fire rated assemblies.

14. Sequence of Operations for the fire alarm system and its interrelated and connected system.

15. Remote annunciation panel dimension, terminals, elevation showing component identification and other pertinent information.

16. Other information as required by the local fire Marshall during application of permit by the Contractor.

   B. For use in system test, a complete operation and maintenance manual with two sets of proposed installation drawings shall be submitted.

      1. The following information shall be inscribed on the cover:

         a. "OPERATION AND MAINTENANCE MANUAL"

b. Site Name and Building location.
c. The name of the contractor, system manufacturer and system subcontractor.
d. The name and phone number of the fire department required to respond to alarms at the project location.

2. The manual shall be legible and easily read with large drawings folded and contained in pockets. Included in the manual shall be circuit drawings, wiring and control diagrams with data to explain detailed operation and control of each item of equipment and a control sequence describing start up instructions. Included shall be installation instructions, maintenance instructions, safety precautions, test procedures, performance data, and software documentation.

C. Upon completion of the installation, record drawings shall be submitted on each system before final acceptance of the work. The contractor shall furnish to the Engineer a set of record drawings including system diagrams for each system. The record drawings masters shall be on high density floppy disks in an AutoCAD Ver. 2000 format.

1.09 SYSTEM FUNCTION:

A. The system shall be a complete, electrically supervised multiplex style fire detection system with intelligent analog alarm initiation, to be device addressable and annunciated as described and shown on the drawings.

1. The maximum number of devices on a single signaling circuit shall not exceed sixty with a capacity of sixty reporting system inputs and sixty system control outputs. The maximum usage of loop addresses shall not exceed 85% of loop capacity.

a. Devices attached to the signaling circuit shall be individually identifiable at the control panel for alarm and trouble indication. Smoke detectors shall be interrogated for sensitivity settings from the control panel, logged for sensitivity changes indicating the requirement for cleaning, and tested by a single technician using the panel field test routine.
b. Sensitivity settings of individual detectors shall be automatically or manually adjustable from the control panel to reduce the incidence of false alarms caused by environmental conditions.
c. The analog signaling circuits shall be installed in the fire alarm control panel enclosure or in remote circuit interface panel enclosures.
d. Analog signaling circuits shall be selectable Style “Y” or Style “Z” wiring.

2. The system shall support intelligent analog smoke detection, conventional smoke detection, manual station, water flow, supervisory, security, Strobes, horn-strobes, horns and status monitoring devices.

3. The panel shall be UL listed as a test instrument for the measurement of the sensitivity or connected intelligent analog ionization and photoelectric smoke detectors to comply with the testing requirements of NFPA 72 E.

4. The system shall annunciate a trouble condition when any smoke detector approaches 80% of its alarm threshold due to gradual contamination, signaling the need for service and eliminating unwanted alarms.

5. Any intelligent analog smoke detector or conventional smoke detector zone shall include a selectable alarm verification capability. This feature shall provide automatic verification of smoke detector alarms as described by NFPA 72.

6. All external circuits shall be listed as power limited circuits per article 760 of the National Electric Code.

7. The system shall provide a one person field test of either the complete system or a specified area, maintaining full functions of areas not under test.

8. The system shall be programmed in the field via a laptop computer. All programmed information shall be stored in nonvolatile memory after downloading into the Fire Alarm Control Panel.

    a. During program upload or download the system shall retain the capability for alarm reporting.
    b. The system shall download to a PC for program editing. System program shall be stored on a floppy disk and all programming shall be multi-level password protected.

9. The system shall consist of a central architecture using a single centrally located control unit. The system also shall be operable in a distributed multiplex architecture using a centrally located control unit with interconnection to remote circuit interface panels containing any combination of plug in intelligent analog signaling circuits, plug in conventional initiating device circuits and plug in relays.

10. The systems as installed shall be Simplex 4100U, expandable to its predetermined maximum capacity of 2000 devices.

1.10 SYSTEM ZONING:

A. Each intelligent addressable device or conventional zone of the system shall be displayed at the fire alarm control panel and remote annunciation panel by a unique alpha numeric label identifying its location.

1.11 SYSTEM DESCRIPTION AND OPERATION:

A. Provide an addressable system that utilizes smoke detectors, heat detectors, water flow indicators, valve supervisory devices, Horns, horn-strobes, horns and controls as shown on the Drawings, a Simplex addressable 4100U system:

1. Power systems and components form DC power supplies.

2. Provide CLASS B system wiring.

B. Trouble and alarm systems shall activate the control panel devices, and remote annunciators.

C. Provide wall-mounted annunciators for any concealed smoke detectors.

1. The smoke detectors shall be individually annunciated.

2. Locate the annunciators in public areas, close to the devices, and in accordance with present life safety codes.

D. Electrically supervises alarm and initiating circuits for wiring or ground faults.

1. Any fault shall cause an audible and visual trouble indication at the control panel and the remote annunciation panel.

2. The zone or addressable device having trouble shall be identified.

3. Zone or addressable device trouble shall not affect normal operation of other system zones.

E. Provide 20% expansion space for future system upgrades.

F. Activation of any alarm initiating device shall:

1. Cause all audible alarm devices to pulse in march time until silenced at the control panel or at the remote annunciation panel;

2. Cause all alarm lamps to flash;

3. Indicate the zone or addressable device at the control panel and at the remote annunciation panel;

G. Activation of any smoke detector device shall;

1. Perform all functions of initiating devices as noted in 1.12-F and notify Fire Department.

2. Light the LED lamp on an operated smoke detectors.

3. Furnish an alarm system closure for connection to an off-site reporting device for monitoring by and call Fire Department.

H. Operation of any sprinkler water flow switch shall:

1. Perform all functions of initiated devices as noted in 1.12-F and notify fire department;

I. Operation of any sprinkler valve supervisory device such as tamper switchers and OS & Y valves shall:

1. Activate a dedicated supervisory zone at the control panel and annunciation at the remote annunciation panel.

2. Not cause evacuation alarm devices to sound.

3. Water flow alarm circuit trouble use for valve supervision is not permitted.

J. Provide audible and visual trouble indication at the control panel and the remote annunciation panel for the following conditions:

1. Removal of a detection device from the detection circuit;

2. An open or ground fault in a detector circuit or device;

3. An open, short or ground fault in an audible signal circuits;

4. Removal of a system input, output or control module;

5. Improper condition of a battery or charger.

K. Failure of AC power shall:

1. Cause the trouble signal to sound at the control panel and annunciation at the remote annunciation panel;

2. Cause the automatic transfer to stand-by battery power.

3. All system functions shall be operational, on battery power, for a minimum of 24 hours during a power failure.

L. System zone assignments shall be per drawings.

M. Fire Drill: Provide fire drill switch at the fire alarm control panel. When activated, the fire drill switch shall turn on all horns and strobes and other alarm notification devices, but it shall not call fire department.

PART 2 – PRODUCTS

2.01 FIRE ALARM CONTROL PANELS:

A. The existing addressable fire alarm control panel is manufactured by Simplex #4100U Fire Alarm Control Panel.

2.02 FIRE ALARM SYSTEM POWER SUPPLIES:

A. System primary power

1. Primary power for the FACP and the secondary power battery chargers shall each is obtained from the power panel board. Circuit breakers shall be fitted with a suitable guard, requiring removal of a screw to open, and used only for fire alarm.

2. The power supply and battery charging shall be provided by the power supply interface board and power supply module.

3. A fusible double throw AC power disconnect switch, lockable in the open and closed positions shall be provided adjacent to the Fire Alarm Control Panel.

B. Secondary power supply

1. Provide sealed gelled electrolyte batteries as the secondary power supply for the fire alarm control panel and each system circuit interface panel. The battery supply shall be calculated to operate its load in a supervisory mode for 60 hours with no primary power applied and, after that time, operate its alarm mode for five minutes.

2. Provide battery charging circuitry for each standby battery bank in the system low voltage power supply or as a separate circuit. The charger shall be automatic in design, adjusting the charge rate to the condition of the batteries. Battery charge rate and terminal voltage shall be read using the fire alarm control panel LCD display in the service mode, indicating directly in volts and amps.

2.03 INTELLIGENT DEVICE PROGRAMMER/TESTER:

Furnish as a part of the installed system, a Simplex listed programmer and tester.

2.04 SMOKE DETECTORS, PHOTO ELECTRIC:

Furnish and install Simplex, Photoelectric True Alarm Smoke Sensors, with Simplex True Alarm Detector Bases.

2.05 HEAT DETECTORS, INTELLIGENT RATE COMPENSATED:

Furnish and install Simplex, True Alarm Heat Sensors, with Simplex True Alarm Detector Bases.

2.06 ADDRESSABLE MODULE
Furnish and install Simplex Individual Addressable Module(s)

2.07 MANUAL STATIONS:

Provide and install Simplex Addressable Manual Pull Stations Single Action, with Simplex Individual Addressable Modules and Simplex Back Box for Pull Stations. . All except the Master pull stations shall be provided with an additional cover box. Manufactured by Signal Communications Corp. Front Cover Model NO.ST-FRCO1, Extender Model NO. ST KTRO1 with Alarm Module NO. ALMO1 or approved equal.

2.08 INTELLIGENT SUPERVISED INTERFACE MODULE:

Furnish and install for the control of supervised relays, contractors, audible signal circuits, visual signal circuits, Simplex individual module for, intelligent supervisory and control.

A. A single circuit intelligent signaling circuit interface module for monitoring alarm, trouble, supervisory security or status contact type devices.

2.09 DOOR HOLDERS:

Door Holders shall be LCN model No. 7850.

2.10 TAMPER SWITCH:

Tamper switch with Individual Addressable Module.

2.11. FLOW SWITCH:

Flow switch with Individual Addressable Module.

2.12 System software programming shall be performed by Simplex/Grinnell. Other vendor programming of system software is not permitted.

2.13 Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor, subject to the approval of the Architect or Electrical Engineer.

2.14 EVACUATION SIGNAL:

A. Furnish and install where show on the drawings, audible and /or visual signals, Simplex type audio visual devices with the following characteristic and capacities:

1. Electronic horn model series with a sound rating of 90 dba and temporal pattern per code, and a strobe light with an intensity of 15, 75, and 110 candela (where required).

2. Visual alarm signals model 15, 75 and 110 series shall be furnished with minimum light intensity of 15, 75, and 110 candela complying with the ADA act and the following requirements:

a. Xenon strobe with a minimum repetition rate of 1HZ, not exceeding 2 HZ and maximum duty cycle of 40% with pulse duration of .2 seconds.
b. Provide factory-made re-painted steel wire-guard to protect strobe.

3. If more than one strobe in one room or area, all strobes shall be synchronized.

PART 3 – EXECUTION

3.01 DESIGN AND INSTALLATION DRAWINGS:

Show a general layout of the complete system including equipment arrangement. It shall be the responsibility of the fire alarm contractor to verify dimensions and assure compatibility all other systems interfacing with the fire alarm system.

1. Identify on the drawings, the system address for every addressable device. Signals shall be sequentially numbered as the address of the controlling module.

2. Indicate on the point to point wiring diagrams, interconnecting wiring within the panel between modules, and connecting wiring (conduit size and conductor number and AWG size) to the field device terminals.

3. Provide mounting details of FACP and other boxes to building structure, showing fastener type, sizes, material and embedded depth where applicable.

3.02 INSTALLATION:

1. Perform work in accordance with the requirements of NEC, NFPA 70, and NFPA 72.

2. Fasten equipment to structural member of building or metal supports attached to structure, or to concrete surfaces.

   a. Use clamping devices for attaching to structural steel, or when clamping is impractical, obtain written authority to well or to drill.
   b. Fasten equipment to concrete or masonry with expansion anchors.
   c. Fasten equipment to drywall by screws into studs, and to metal wall panels by weld studs, bolts or self-taping metal screws.
   d. Do not install conduit raceways and boxes in positions that interfere with the work of other trades.
   e. Attach nameplates on panels or other components as specified.
   f. Use of plastic anchors is prohibited.

3. All fire alarm wiring shall be in conduits.

3.03 CONDUIT:

A. Design conduit run & size between device, control panel and fire alarm equipment. Minimum conduit size shall be ¾ inch.

B. Use rigid steel and 12” or less above floor where subject to mechanical damage, PVC coated rigid steel installed in concrete floors or walls, and installed exposed to the weather. Electrical metallic tubing may be used elsewhere. Schedule 40 rigid PVC conduits for underground outside of building.

C. Install #14 gage galvanized pull wire or 1/8 inch polyethylene rope in conduit installed for future use, and seal the ends.

D. Install concealed conduits as directly as possible and with bend radii as long as possible. Where allowed on drawings, install exposed conduit parallel with or at right angles to building lines. Where conditions permit, maintain continuous exposed horizontal runs along walls at minimum height of 9 feet above floor level or grade.

E. Permanently label or mark at both ends with conduit number of each wire as shown on the drawings. Conduit and junction box labels shall be permanent and conform to the requirements of the National Electric Code, Art. 760.

F. Make elbows offsets and bends uniform and symmetrical. Bend conduit with approved bending devices.

G. Cut conduit ends square, ream and remove burrs. Conduit shall be clean, dry, and free of debris. Immediately after installation, plug or cap exposed ends with standard accessories until wires are pulled.

H. Use galvanized steel lock nuts for attachments to enclosures except threaded hubs may be used where permitted by the NEC. Thread less fittings will not be permitted for rigid conduit. Use Erikson type coupling with running threads.

I. Use one-hole clamps equipped with clamp backs to secure conduits.

J. Install without moisture traps wherever possible. Where practicable, provide drain holes in pull boxes or fittings at low points in systems and remove burrs from drilled holes.

K. Use flexible conduit to made connections to equipment subject to vibrations. Use liquid tight flexible metal conduit where conduit and fittings are installed outdoors or exposed to moisture or chemical fumes indoors. Flexible conduit may be used in lengths not exceeding four feet for other equipment, with the approval of the acceptance inspector.

L. Set up joints in conduit installed in concrete, underground, or exposed to weather, with high temperature, anti-seize, conductive thread lubricant and sealant.

M. Seal openings around conduit at exterior wall penetrations and penetrations of walls forming boundaries between adjoining ventilation zones, using specified sealant. Make all seals waterproof and finish flush with surrounding wall surfaces.

N. Use hangars with 3/8 inch rods for 2 inch conduit or smaller. If conduit is suspended on rods more than 2 feet long, conduit shall be rigidly braced to prevent horizontal motion or swaying.

O. Apply sealing compound in conduit at box or enclosure nearest exterior wall penetration on both sides of wall.

P. Where routing is parallel with hot water or steam pipers, conduits shall not be installed within six inches of the pipe covering. When routing is not parallel with pipes, it is acceptable to install within six inches providing the do not touch the pipes.

Q. Use PVC coated rigid steel conduit below on-grade floor slabs.

1. Install PVC coated rigid steel conduit in accordance with the manufacturer recommendations. Coating damaged during handling or installation shall be repaired using PVC paint recommended by the conduit manufacturer.

3.04. BOXES, ENCLOSURES AND WIRING DEVICES:

A. Boxes shall be installed plumb and firmly in position.

1. Extension rings with blank covers shall be installed on junction boxes where required.

2. Junction boxes served by concealed conduit shall be flush mounted.

3. Upon initial installation, all wiring outlets, junction, pull and outlet boxes shall have dust covers installed. Dust covers shall not be removed until wiring installation when permanent dust covers or devices are installed.

4. Paint all covers of junction boxes red.

3.05 FIRE ALARM TERMINAL CABINET:

A. Provide where shown on drawings and for area larger than 10,000 square per floor, one or more central terminal cabinets location of cabinet to be approved by the Architect) for building zone area fire alarm wiring distribution. Cabinets shall be hinged, with hasp for pad locks and panel I.D.

3.06 CONDUCTORS:

A. Design and provide number conductors and AWG sizes between devices, control panel, annunciation panels and all detached fire alarm equipment.

B. Each conductor shall be identified as shown on the drawing at each with wire markers at every splice and terminal point. Attached permanent wire markers within 2 inches of the wire termination. Marker legends shall be visible.

1. All wiring shall be supplied and installed in compliance with the requirements of the National Electric Code, NFPA 70, Article 760, and that of the manufacturer.

2. All splices shall be made using solderless connectors. All connectors shall be installed in conformance with the manufacturer recommendations.

3. Crimp-on type spade lugs shall be used for terminations of stranded conductors to binder screw or stud type terminals. Spade lugs shall have upset legs and insulation sleeves sized for the conductors.

C. Permanently label or mark each conductor at both ends with permanent alphanumeric wire markers.

D. Wiring within sub panels shall be arranged and routed to allow accessibility to equipment for adjustment and maintenance.

3.07. DEVICES:

A. Relays and other devices to be mounted in auxiliary panels are to be securely fastened to avoid false indications and failures due to shock or vibration.

B. Wiring within subpanels shall be arranged and routed to allow accessibility to equipment for adjustment and maintenance.

3.08 SPLICES AND CABLE TERMINATIONS

A. All splices shall be made using solderless connectors or compression type terminal strips. Al connectors shall be installed in conformance with the manufacturer recommendations.

B. Crimp-on type spade lugs shall be used for terminations of stranded conductors to binder screw or stud type terminals. Spade lugs shall have upset legs and insulation sleeves sized for the conductors.

3.09 CERTIFICATE OF COMPLIANCE (UL):

A. Complete and submit to the Project Engineer in accordance with NFPA 72, paragraph 2.2.2. The equipment installer or supplier shall issue UL certification on the fire alarm system in accordance with the City of Livermore, Alameda County, and the State Fire Marshall requirements.

3.11 FIELD QUALITY CONTROL:

A. Testing, general

1. All intelligent analog devices shall be tested for correct address and sensitivity using test equipment specifically designed for that purpose. These devices and their bases shall be tagged with adhesive tags located in an area not visible when installed, showing the system address, initials of the installing technician and date.

   a. A systematic record shall be maintained of all reading using schedules or charts of tests and measurements. Areas shall be provided on the logging form for readings, dates and witnesses.
   b. The acceptance inspector shall be notified before the start of the required test. All items found at variance with the drawings or this specification during testing or inspection by the acceptance inspector shall be corrected.
   c. Test reports shall be delivered to the acceptance inspector as completed.

2. All test equipment, instruments, tools and labor required to conduct the system tests shall be made available by the installing contractor. The following equipment shall be a minimum of conducting the tests:

    a. Ladders and scaffolds as required to access all installed equipment.
    b. Multimeter for reading voltage, current and resistance.
    c. Intelligent device programmer/tester.
    d. Laptop computer with programming software for any required program revisions.
    e. Two way radios, flashlights, smoke generation devices and supplies.
    f. Spare printer paper.
    g. A manufacturer recommended device for measuring airflow through air duct smoke detector sampling assemblies.
    h. Decibel meter.

3. In addition to the testing specified to be performed by the installing contractor, the installation shall be subject to test by the acceptance inspector.

4. System wiring: fire alarm circuits shall be tested for continuity, grounds, and short circuits.

B. Acceptance testing

1. The engineer in accordance with NFPA will prepare a written acceptance test procedure (ATP) for testing the fire alarm system components and installation 72 and this specification. The contractor shall be responsible for the performance of the ATP, demonstrating the function of the system and verifying the correct operation of all system components, circuits, and programming.

2. A program matrix shall be prepared by the installing contractor referencing each alarm input to every output function affected as a result of an alarm condition on that input. In the case of outputs programmed using more complex logic functions involving “any”, “or”, “count”, “time”, statements; the complete output equation shall be referenced in the matrix.

3. A complete listing of all device labels for alpha-numeric annunciator displays and logging printers shall be prepare by the installing contractor prior to the ATP.

4. The acceptance inspector shall use the system record drawings in combination with the documents specified under paragraph 3.01 during the testing procedure to verify operation as programmed. In conducting the ATP, the acceptance inspector shall request demonstration of any or

all input and output functions. The items tested shall include but not be limited to the following:

a. System wiring shall be tested to demonstrate correct system response and correct subsequent system operation.
b. System evacuation alarm indicating appliances shall be demonstrated.
c. System indications shall be demonstrated as follows:
   (01) Correct message display for each alarm input at the control panel.
   (02) Correct annunciator light for each alarm input at each annunciator.
d. System off-site reporting functions shall be demonstrated.
e. Secondary power capabilities shall be demonstrated.

3.12 NAMEPLATE:

Provide nameplate as required.

3.13 DOCUMENTATION:

A. System documentation shall be furnished to the owner and shall include but not be limited t the following:

1. System record drawings and wiring details including one set of reproducible masters and drawings on 3 ½ inch floppy disks in an AutoCAD 2000.
2. System operation, installation and maintenance manuals.
3. Written documentation for all logic modules as programmed for system operation with a matrix showing interaction of all input signals with output commands.
4. The contractor shall furnish all test equipment as required to program devices and test the system, specifically an intelligent device tester and programmer.

3.14 TEST EQUIPMENT

A. The contractor shall furnish all test equipment as required to program devices and test the system, specifically an intelligent device tester and programmer.

3.15 SERVICES:

A. The contractor shall warrant the entire system against mechanical and electrical defects for a period described in the contact general conditions. This period shall begin upon completed certification and test of the system or upon first beneficial use of the system, whichever is earlier.

B. The fire alarm system subcontractor or manufacturer shall offer for the owners consideration at the time of system submittal a priced inspection, maintenance, testing and repair contract in full compliance with the requirements of NFPA 72H.

1. The services offered under this contract shall be performed at no charge during the first year after system acceptance and the owner shall have the option of renewing for single or multiple years up to five years at the price quoted upon completion of warranty period.

2. The contractor performing the contract services shall be qualified and listed to maintain ongoing certification of the completed system to the UL for specific installed system listing.

C. The successful bidder shall supply on-site training at the owner's facility. The training shall have a duration of four (4) hours and shall be conducted by a full time employee of the Fire Alarm System Manufacturer.

1. The training shall cover operation and maintenance of the fire alarm system.

END OF SECTION