PREFACE

PURPOSE OF THIS DOCUMENT

The intent of this document is to disseminate the San Francisco International Airport’s (SFO’s or Airport’s) expectations regarding the information presented to designers, engineers, general contractors and other industry specialists. The material provided in the following sections includes the minimal requirements, general information, design criteria, guide specifications and details for fire protection and fuel piping/storage at SFO. While this document addresses major areas of concern to SFO, it is not an all-inclusive document.

HOW TO USE THIS DOCUMENT

This document should be used as a resource for the development of project specific design documents including drawings, details and specifications. It is the responsibility of the design, engineering and construction professionals to adhere to all codes and regulations related to the content presented.

SCOPE

This section contains the Standards and Criteria for Fire Protection and Fuel Piping/Storage. Any questions or concerns regarding the items or equals specified must be submitted to the Standards Committee in writing. All final decisions regarding products shall be made at the Airport’s discretion. If the Engineer of Record presents items that are not specified or named equals, they must be brought to the Standards Committee for evaluation of those products.

GENERAL INFORMATION

Please refer to Appendix A: SFO Mechanical Design Guidelines.

DRAWING REQUIREMENTS

A. All design disciplines including the architectural/engineering sub-consultants and the trade bid package subcontractors shall prepare documents using Revit in the current version utilized by the Airport in compliance with the Airport’s Building Information Modeling (BIM) Requirements as described in Document 00 73 87: BIM Requirements, unless waived by the Chief Development Officer.

B. When Revit models may not be applicable, (for example, tasks with underground infrastructure beyond a building footprint), Civil 3D may be used to model utilities and applicable infrastructure if approved by the Chief Development Officer.

C. Refer to technical specifications for As-Built requirements.

D. Documents and plans submitted to SFO shall be searchable using PDFs with live text. This includes, but is not limited to, text and symbols. The document shall also provide the capability to turn layers on and off. Any project using legacy documents which may be composed image files shall be converted to live text via Optical Character Recognition (OCR).
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<thead>
<tr>
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</tbody>
</table>
# Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>PREFACE</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>SECTION 15 30 20</td>
<td>FIRE PROTECTION SYSTEM (PRE-ACTION SYSTEM)</td>
<td>4</td>
</tr>
<tr>
<td>SECTION 15 36 50</td>
<td>TOTAL FLOODING EXTINGUISHING SYSTEMS (FM 200 FIRE SUPPRESSION SYSTEM)</td>
<td>13</td>
</tr>
<tr>
<td>SECTION 21 05 10</td>
<td>BASIC FIRE PROTECTION REQUIREMENTS</td>
<td>25</td>
</tr>
<tr>
<td>SECTION 21 10 00</td>
<td>WATER-BASED FIRE SUPPRESSION SYSTEM</td>
<td>33</td>
</tr>
<tr>
<td>SECTION 21 13 29</td>
<td>WATER SPRAY FIXED SYSTEM</td>
<td>82</td>
</tr>
<tr>
<td>SECTION 21 22 00</td>
<td>CLEAN AGENT FIRE EXTINGUISHING SYSTEMS</td>
<td>97</td>
</tr>
<tr>
<td>SECTION 23 11 13</td>
<td>FACILITY FUEL OIL PIPING</td>
<td>114</td>
</tr>
<tr>
<td>SECTION 23 13 13</td>
<td>FACILITY UNDERGROUND FUEL-OIL STORAGE TANKS</td>
<td>117</td>
</tr>
<tr>
<td>SECTION 40 72 83</td>
<td>LEAK DETECTION SYSTEM</td>
<td>122</td>
</tr>
<tr>
<td>APPENDIX A</td>
<td>SFO MECHANICAL DESIGN STANDARDS</td>
<td>1–38</td>
</tr>
<tr>
<td>APPENDIX B</td>
<td>MASTER LIST OF MANUFACTURERS</td>
<td>1–7</td>
</tr>
<tr>
<td>APPENDIX C</td>
<td>ELECTRICAL CONTROL PANELS</td>
<td>1–2</td>
</tr>
</tbody>
</table>
SECTION 15 30 20 – FIRE PROTECTION SYSTEM (PRE-ACTION SYSTEM)

PART 1 – GENERAL

1.1 SUMMARY

A. The work includes, but is not necessarily limited to, the furnishing and installing of Fire Protection work, as specified herein. The following summary is included to indicate the main items. It is not necessarily all-inclusive. The Contractor shall be responsible for determining all items and quantities required.

1. Pre-Action sprinkler system, including costs and fees involved for the work.
2. Preparation of shop drawings, submitting and obtaining Fire Marshal; Water Department; Department of Public Health approvals, together with material list submittals.
3. Cutting, excavation and backfill, compaction, grouting and patching of the work. Furnishing and installation of concrete thrust blocks, strapping and earthquake bracing as required.
4. Provide sleeves, inserts, anchorage, required for system work and which embeded in work of other trades.
5. Cleaning, adjusting and testing of installed systems.
6. Provide access doors and panels required by the work.
7. Flashing and counter flashing of roof and wall penetrations required by the work.
8. Record documents and identification.
9. The new nozzle shall have a shutoff feature to provide a straight stream at the nozzle.
10. Furnish and install in each occupancy area, where the wet sprinkler system will be installed, required number of dry chemical fire extinguishers.

B. It is the requirement of these specifications that the Contractor design and install the fire protection system to meet the specifications contained herein, including the various design and performance criteria delineated and to be responsible for the actual performance of the system according to the criteria specified herein.

C. Contractor shall also provide all necessary piping, pipe hangers, valves, seismic bracing, complete Viking Firecycle III System or approved equal single manufacturer supplying all approved and compatible components in a pre-action system and perform all other work necessary for the complete installation of the Fire Protection System.

1.2 REFERENCES

A. Codes, Standards, Laws and Orders: Conform to latest applicable codes, standards, laws and orders as stated herein, including but not limited to the following:

1. American National Standard Institute (ANSI)
3. American Water Works Association (AWWA)
4. San Francisco Building Code (SFBC)
5. San Francisco Fire Department (SFFD) Codes
7. SFO Airport Building Regulations (ABR)
8. National Fire Protection Association (NFPA) latest editions of the following:
   a. California State Fire Marshall
9. All materials and equipment shall be new and listed by Underwriter’s Laboratories, Inc. (UL) or Factory Mutual (FM) Insurance Agencies unless otherwise specified.

1.3 SUBMITTALS

A. Submit product data under the provisions of the sections pertaining to Submittals.

B. Submit O&M data as per provisions.

C. Substituted equipment valves, piping, controls, miscellaneous items and incidentals shall be suitable for the intended application and shall perform as designed.

D. Shop Drawings shall include the following:
   1. Shop Drawings:
      a. Before starting Shop Drawings, submit sprinkler head layout only, on the Architectural reflected ceiling plans for review. Note that center-of-tile installation in pattern type ceiling is mandatory based on site survey and measurements by the Contractor. Contractor shall be responsible for accurate measurements. If, upon preliminary submittal of Drawings, there are corrections to be made (such as head locations, pipe location and drain locations), corrections shall be made and the corrected drawings, along with revised calculations, shall be resubmitted at no increase in Contract price. These drawings shall be corrected and reviewed before starting work.
      b. Drawings shall indicate accurate locations of piping, sprinkler heads, drain locations, and other apparatus associated with these systems in respect to any and all architectural conditions, structural conditions, lighting layouts, speaker layouts, detector layouts, duct and diffuser layouts, plumbing, mechanical and electrical layouts.
      c. Drawings shall be to the same scale, same sheet size, and shall bear a title block, in accordance with the Contract Drawings. The Airport will provide the title block sheet on floppy disk at the Contractor’s request. Architectural backgrounds shall be in accordance with the latest Architectural Drawings.
      d. Drawings shall be computerized using latest AutoCAD Version.
   2. Calculations:
      a. Calculations shall be done on standard 8.5” x 11” sheets, in accordance with NFPA 13, and shall indicate pipe numbers, beginning and ending node points, referenced on the Shop Drawings, and system demand curves. Calculations shall be bound and indexed in a loose-leaf binder same as for Operating and Maintenance Instructions.
b. Sprinkler system shall be hydraulically calculated for hazard as required by the San Francisco Fire Department and NFPA No. 13. Protection for sprinklers and piping shall conform to San Francisco Building Code Section 38.120, NFPA No. 13 edition.

3. Submit proof of all approvals to the Engineer.

E. Product Data: Provide data on piping, sprinkler heads, valves, fire hose and nozzles, fire extinguishers, and specialties, including manufacturer catalogue information. Submit performance rating, rough-in details, weights, support requirements, and piping connections.

F. Proof shall be furnished that the double check detector assembly being furnished for the project is approved by and has a current “Certificate of Approval” from the USC Foundation for Cross Connection Control and Hydraulic Research, and listed with the San Francisco Water Department.

G. Submit test results of Double Check Detector assembly from the manufacturer.

H. Submit Contractor qualifications per Article 1.10 herein.

1.4 DESIGN CRITERIA

A. Materials and Workmanship

1. Use only new materials in perfect condition. All items of similar nature shall be the same manufacturer.

2. Employ only experienced, competent, and properly equipped workers on job.

3. All work shall be performed by an experienced Fire Protection Contractor licensed by the State of California.

B. Pre-Action sprinkler work shall conform to NFPA 13

1. The fire sprinkler system design shall be in compliance with the latest edition of NFPA 13.

2. The occupancy classification of the fire sprinkler system shall be Ordinary Hazard Group 3 in anticipation of future occupancy changes.

3. The sprinkler head spacing shall not exceed the requirements of NFPA.

C. Underground work shall conform to NFPA 24.

D. Fire hose system shall conform to NFPA 14.

E. Fire alarm system shall conform to NFPA 71, 72A, 72B, 72C, and 72D.

F. In case of a conflict, the most stringent requirement will govern.

G. The Contractor shall make computerized hydraulic calculations based on an approved method. No exceptions.

1.5 COORDINATION

A. Cooperate with other trades in putting this installation in place at a time when space required is accessible, and in such a manner that all other work in this space may be installed as shown on the
Drawings. Schedule work and cooperate with others to avoid delays, interferences, and unnecessary work; conforming to the construction schedule, making the installation when and where directed.

B. Coordinate electrical connections to equipment with Division 16 pertaining to electrical requirements.

C. If required, the water meter will be furnished and installed by the San Francisco International Airport (SFO). Contact airport representative for information. The Contractor shall be responsible for the installation.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section pertaining to delivery storage and handling.

B. Store products in shipping containers and maintain in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.7 PERMITS, FEES AND INSPECTIONS

A. Provide, procure and pay for all permits, licenses, fees, etc., required to perform and complete a safe Fire Protection installation prior to starting work under this contract.

B. Contact and coordinate work with affected utility authorities and all fees and charges for this work shall be included.

C. The double check detector check backflow preventer shall be licensed by the Department of Public Health and listed with the San Francisco Water Quality Division.

D. Obtain services of a certified AWWA backflow preventer device tester to inspect and check for proper installation and operation in accordance with all applicable standards and health codes. Payment to such services shall be included in the bid package.

E. All inspections shall be by applicable codes.

F. Submit documents to the Resident Engineer for posting as proof that the required permits, inspections and code compliances have been secured.

1.8 EXTRA MATERIALS

A. Provide minimum of 3 extra sprinkler heads for each temperature rating and type used in accordance with the requirements of NFPA 13.

B. Provide suitable wrenches for each head type.

C. Furnish and install fire extinguisher cabinets: (Refer to relevant specs). Location of Fire Extinguisher shall be per Airport Fire Marshall requirement.

D. Provide 3 extra fire extinguishers.

1.9 QUALIFICATIONS
A. All work pertinent to the fire protection system shall be performed by a qualified and competent Contractor with an established reputation in the industry, and who can furnish a verified list of satisfactory installations of this type of work for a past period of 5 years.

B. The Contractor shall possess a valid C-16 California Contractor License.

1.10 PROJECT RECORD DOCUMENTS

A. Upon completion of each fire protection system, the Contractor shall provide Project Record Drawings in accordance with requirements showing actual installation details.

B. All equipment and sprinkler head locations shall be shown.

1.11 WARRANTY

A. At completion, furnish Owner with a written warranty that the work has been performed in accordance with the drawings and specifications and to replace and repair to the satisfaction of and at no expense to the Owner, any portion of work that fails within a period of 2 years after final acceptance.

B. The Contractor shall agree to replace or repair, with like workmanship and material, any part of the building or equipment, existing or installed by other trades, damaged as a result of the installation of the work.

PART 2 – PRODUCTS

2.1 SPRINKLER PIPING & FITTINGS

A. Sprinkler piping shall be Schedule 40 black steel pipe, conforming to ANSI specification B125.2 and ASTMA 120.

1. Piping shall be installed per NFPA 13. Piping shall be properly supported and braced to withstand Seismic Zone 4 earthquake forces. All hangers and supports shall have a minimum safety factor of 5 based on the ultimate tensile or compressive strength, as applicable, of the material used. Provide bracing to prevent motion of all suspended materials.

2. Pipe shall be joined with mechanical grooved fittings by a listed combination of fittings, gaskets and grooves. When grooves are cut or rolled on the pipe, they shall be dimensionally compatible with the fitting. Mechanical grooved couplings including gaskets used on dry-pipe systems shall be listed for dry-pipe service.

B. Vikings Firecycle III System

1. Furnish and install a complete approved Viking Firecycle III System or approved equal. A complete system shall be from a single manufacturer only.

2. System Description - Viking Firecycle is a fixed fire protection sprinkler system utilizing water as its extinguishing agent. It is a recycling, preaction type which automatically shuts the water off when heat is reduced below the detector operating temperature, and turns the water back on when the temperature is exceeded. A time delay feature reduces excessive cycling.

   a. The system senses a fire condition through a closed circuit electrical detector system which controls water flow to the fire automatically. Batteries supply up to 90 hour emergency power supply for system operation. The piping system is dry (until water is required) and is
monitored with pressurized air. Should any leak in the system piping occur, an alarm will sound, but water will not enter the system until heat is sensed by a Firecycle detector.

3. System Operation - Automatic Firecycle Operation - when a fire occurs, a detector is heated to its trip points. The normally closed detector circuit then opens. The relays in the control panel open, shutting off power to the solenoid valves in the trim box and sounding the electric fire alarm bell. When the solenoid valves open, the pressurized water in the top chamber of the flow control is released and the clapper opens. The system then fills almost completely with pressurized water. When the sprinkler reaches the operating temperature, it opens and sprays water on the fire. When the temperature in the fire area drops below the trip point of all detectors, the detector circuit is reclosed. A relay is closed in the panel which energizes the timer. Water will continue to discharge from the open sprinklers from 1 to 5 minutes, depending on the timer setting. When the timer cycle is complete, a relay in the control panel closes and energizes the solenoid valves in the trim box. The flow of water stops from above the clapper of the flow control valve thereby causing a pressure to build up which closes the valve clapper and stops the flow of water to the opened sprinklers. The electric fire alarm will continue to sound until the reset button is pushed. Should the temperature build to the trip point of any detector during any phase of the cycle, the system will continue to flow or immediately start the flow of water to the fire.

4. Firecycle Valve Package shall include all flow control valve, line check valve, 115 V. AC trouble horn (mounted in art storage room), revolving light beacon (mounted in supervisor room indicating sprinkler system has gone to wet condition), and all trim (FM approved Viking Valve Trim Box Model C-1) or approved equal.

5. Firecycle III System Controls shall include the FM approved Viking Firecycle III Control Panel, Battery Pack (10 Viking Gelled Electrolyte 12 V Batteries in series parallel (Power Supply), Viking Model A1 Battery Charger (Power Supply) and Viking Battery Cabinet or approved equal.

6. Firecycle Detector shall be an FM approved Viking Firecycle Detector Model B or approved equal. The detector is a heat sensitive, normally closed, electrical detector which operates at a fixed temperature. The detector is rate compensating and features automatic recycling. Temperature of the detector shall be 140 ºF.

7. Firecycle Detector Cable shall be Viking Part Number 04632-A Cable or approved equal. Cable consists of two (2) #16 conductors surrounded by a high temperature insulation encased in an aluminum sheath. See Drawing for approximate quantity. Contractor shall field verify. Cable shall be installed in approved conduit.

8. Maintenance Air Compressor shall be FM approved. Viking Maintenance Air Compressor Model D-1 Part Number 05468A or approved equal. The Air Compressor is an electric motor-driven, air cooled, single-stage, oil-less compressor. It is equipped with a check valve, centrifugal pressure and moisture unloader and pressure switch, Compressor - 1/4 Horsepower 115 V AC 60 cycle 7.4 Amp Director Drive, permanently lubricated, cylinder compressor produces 2.0 SCFM, 50 psi continuous operating pressure. Unit shall include a pressure switch range 0-65 psi. Provide stainless steel mounting bracket and straps. Air pressure maintenance device shall be Viking Part Number 0228C or approved equal.

9. Water Motor Alarm shall be Viking Model F-1 or approved equal.

10. Alarm Test Valve, alarm shut-off valve and check valve shall be installed per NFPA 13.

11. Viking Micromatic Adjustable Escutcheon Model E-1 shall be used for pendent sprinklers and firecycle detectors.
12. Sprinklers Heads: Viking’s Micromatic Sprinkler Pendant Type or approved equal. Sprinkler unit temperature shall be 155 ºF. Sprinkler shall be white color with matching Escutcheon in Communication rooms. Polish brass in equipment room.

13. Field Firecycle Tests and Operation. The Firecycle System shall be given a field operational test. Field test shall be witnessed by Engineer. 72-hour notice is required. Contractor shall provide all work and the necessary tools and instrument for test. The Contractor shall arrange for an authorized factory trained representative of the company supplying the equipment to inspect the final installation. The representative shall field adjust and test the equipment furnished to insure proper operation before final acceptance of the work by the City. The representative shall also assist in instructing and training of City operation personnel to properly operate and maintain the equipment. A minimum 4-hour training session will be required for the Airport personnel during the initial operation period.

14. Flush clean and hydrostatic test, without leaks, all new sprinkler piping 200 psi for 2 hours. All tests shall be conducted and approved by the Airport Fire Marshall.

15. Provide 6 copies of maintenance manuals and parts replacement schedules.

2.2 DOUBLE CHECK DETECTOR ASSEMBLY

A. Manufacturers:
   1. Ames Model 3000SS (2.5” thru 6”)
   2. Wilkins Model DCDA (2.5” thru 6”)
   3. Febco Model 806 YD DCDA (3” thru 10”)

B. Double check detector assembly shall consist of two independent “Y” configured main line double check assemblies in parallel with a by-pass meter assembly. All internal metal parts included in the mainline check assemblies shall be Series 300 stainless steel, and shall not contain any dissimilar metals.

C. Mainline valve bodies and covers shall be manufactured of ductile iron ASTM A536, Grade 65-45-12 and shall be designed to withstand a 10:1 safety factor over MWWP. Ductile iron bodies shall be flanged ANSI B16.1, Class 125, epoxy coated internally 10-20 mils and prime coated.

D. Head losses through the assembly shall not exceed 8 psi (4” through 8”) at velocities from 0 to and including 7.5 FPS. Flow curves shall be documented by independent laboratory testing.

E. The by-pass meter assembly shall consist primarily of a bronze double check valve, test cocks with provision to install a water meter. The by-pass double check shut-off valves and test cocks shall be resilient seated ball valves with full flow characteristics. The static pressure drop across the by-pass double check assembly shall be approximately 2 psi less than the mainline check valves to assure proper operation. All flow up to approximately 5 GPM shall be diverted through the by-pass only.

F. Mainline shut-off valves shall be resilient wedge, OS&Y, UL/FM for fire line service and are considered integral to the assembly along with full port ball valve test cocks.

G. The assembly shall meet or exceed requirements of USC Foundation for Cross Connection Control and Hydraulic Research.

2.3 FIRE DEPARTMENT CONNECTION
A. Type: Flush mounted wall type with polished chrome plated finish.

B. Outlets: Cast brass 2-way inlet body, double clapper and pin lug swivel, with 3” thread size to suit San Francisco Fire Department hardware, back outlet; threaded inlet dust cap and chain of matching material and finish.

C. Inlet dust caps shall be drilled with 1/8” holes for pressure relief in accordance with San Francisco Building code.

D. Label: “Auto. Spkr - Fire Department Connection.”

E. Manufacturers: Potter Roemer 5753, or approved equal.

2.4 FIRE ALARM BELL

A. Electrically operated, 10” red enameled gong with pressure alarm switch. Unit shall be provided with weatherproof back box, 120 VAC, 4 terminals.

B. Minimum sound pressure shall be 84 dB at 10’, rated in accordance with UL 464.

C. Unit shall be UL listed, FM and California State Fire Marshal approved.

D. Manufacturers: Potter PB, Gamewell 49564, or approved equal.

2.5 PIPE HANGERS AND SUPPORTS

A. Conform to NFPA 13.

B. Hangers for pipe sizes 0.5” to 1.5”: Carbon steel, adjustable swivel, split ring.

C. Hanger for pipe sizes 2” and over: Carbon steel, adjustable, clevis.

D. Wall support for pipe sizes to 3”: Cast-iron hook.

E. Wall support for pipe sizes 4” and over: Welded steel bracket and wrought steel clamp.

F. Vertical Support: Steel riser clamp.

G. Floor Support: Cast-iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

H. Manufacturers: Tolco, Grinnell, or approved equal.

2.6 SEISMIC BRACING

A. Manufacturers: Tolco, Grinnell, or approved equal.

2.7 FIRE EXTINGUISHER

A. Multi-Purpose Dry Chemical: Pressurized with hose and shut-off nozzle 10 lbs. capacity, with 4A:60BC rating.
B. Manufacturers: Potter Roemer, Wilkin, or approved equal.

PART 3 – EXECUTION

3.1 PREPARATION

A. Remove scale and foreign material, from inside and outside, before assembly.

B. Prepare piping connections to equipment with flanges or unions.

C. Apply strippable tape or paper cover to ensure sprinkler heads do not receive paint finish.

3.2 CLEANING & FINISHING

A. Remove all waste material, debris etc., resulting from his work, leaving everything in a complete and satisfactory condition acceptable to the Engineer.

B. Clean and protect work per the relevant sections.

END OF SECTION 15 30 20
SECTION 15 36 50 – TOTAL FLOODING EXTINGUISHING SYSTEMS  
(FM 200 FIRE SUPPRESSION SYSTEM)

PART 1 – GENERAL

1.1 SUMMARY

A. Contractor shall furnish and install:

1. Clean Agent cylinder tank as required
2. Installation labor, all mechanical and electrical installation, all detection and control equipment, agent storage containers, clean agent, discharge nozzles, pipe and fittings, manual release and abort stations, audible and visual alarm devices, auxiliary devices and controls, shutdowns, alarm interface, caution/advisory signs, functional checkout and testing, training and all other operations necessary for a complete and functional, UL Listed and/or FM approved Clean Agent Fire Suppression System as specified herein.
3. Two (2) inspections per year for the first 2 years of service.

1.2 SCOPE

A. This specification outlines the requirements for a “Total Flood” Clean Agent Fire Suppression System with automatic detection and control. The work described in this Specification includes all engineering, labor, materials, equipment and services necessary, and required, to complete and test the suppression system.

B. Obtain and pay for all the necessary permits and fees.

1.3 REFERENCES

A. The design, equipment, installation, testing and maintenance of the Clean Agent Suppression System shall be in accordance with the applicable requirements set forth in the latest edition of the following codes and standards: The standards listed, as well as all other applicable codes and standards, shall be used as “minimum” design standards. Also to be considered are good engineering practices

1. National Fire Protection Association (NFPA)
   a. No. 72 – Standard for Protective Signaling
   b. No. 72E – Automatic Fire Detectors
   c. No. 2001 – Clean Agent Fire Extinguishing Systems

2. All materials and equipment shall be new and listed by Underwriter’s Laboratories, Inc. (UL) or Factory Mutual (FM) Insurance Agencies unless otherwise specified.


5. Requirements of the Authority Having Jurisdiction (AHJ)

6. San Francisco Electrical Code (SFEC)
1.4 REQUIREMENTS

A. The Fire Suppression System installation shall be made in accordance with the Drawings, Specifications and applicable standards. Should a conflict occur between the Drawings and Specifications, the Specifications shall prevail.

1.5 SUBMITTALS

A. Six (6) sets of drawings in “D” size bond shall be submitted for the engineer’s review. Comments shall be incorporated, and the drawing(s) with comments resubmitted.

B. Final set of drawings shall be approved by the engineer prior to start of installation.

C. Material and Equipment Information: Material and equipment information shall include manufacturer’s catalog cuts, technical data for each component or device used in the system, and CSFM listing. This shall include, but not be limited to the following:
   1. Smoke Detectors
   2. Manual Discharge Switches
   3. Control Panel
   4. Release Devices
   5. Alarm Devices
   6. Clean Agent Storage Containers
   7. Mounting Brackets
   8. Nozzles and Piping
   9. Abort Stations
   10. Graphic Annunciator

D. The Contractor shall submit the following design information and drawings for approval prior to starting work on this system:
   1. Field installation layout drawings having a scale of not less than 1/8” = 1’-0” or 1:1000m detailing the location of all agent storage tanks, pipe runs including pipe sizes and lengths, control panel(s), detectors, manual pull stations, abort stations, audible and visual alarms, wiring runs/conduits, etc.
   2. Auxiliary details and information such as maintenance panels, door holders, special sealing requirements and equipment shutdowns.
   3. Separate layouts or drawings shall be provided for each level, (i.e., room, under floor, and above ceiling) and for mechanical and electrical work.
   4. A separate layout or drawing, shall show isometric details of agent storage containers, mounting details and proposed pipe runs and sizes.
   5. Electrical layout drawings shall show the location of all devices and include point-to-point conduit runs and a description of the method(s) used for detector mounting.
   6. Provide an internal control panel wiring diagram which shall include power supply requirements and field wiring termination points.
7. Complete hydraulic flow calculations, from a UL listed computer program, shall be provided for all engineered Clean Agent systems. Calculation sheet(s) must include the manufacturers name and UL listing number for verification. The individual sections of pipe and each fitting to be used, as shown on the isometrics, must be identified and included in the calculation. Total agent discharge time must be shown and detailed by zone.

8. Provide calculations for the battery stand-by power supply taking into consideration the power requirements of all alarms, initiating devices and auxiliary components under full load conditions.

9. A complete sequence of operation shall be submitted detailing all alarm devices, shutdown functions, remote signaling, damper operation, time delay and agent discharge for each zone or system.

E. Submit drawings, calculations and system component data sheets for approval to the local Fire Prevention Agency, the City (owner) Insurance Underwriter and all other Authorities Having Jurisdiction before starting installation. Submit approved plans to the Engineer for record.

F. Submit system testing procedures, sequencing and schedule for approval. Including list of testing equipment required for testing.

1.6 QUALITY ASSURANCE:

A. Manufacturer

1. The manufacturer of the Suppression System hardware and detection components shall have a minimum of 10 years’ experience in the design and manufacture of similar types of suppression systems and who refer to similar installations providing satisfactory service.

2. The Suppression System hardware and detection components shall be provided by the Suppression System manufacturer to ensure system compatibility.

3. The name of the manufacturer, part numbers and serial numbers shall appear on all major components.

4. All devices, components and equipment shall be the products of the same manufacturer.

5. All devices, components and equipment shall be new, standard products of the manufacturer’s latest design and suitable to perform the functions intended.

6. All devices and equipment shall be UL listed and/or Clean Agent Fire Suppression approved.

7. Locks for all cabinets shall be keyed alike.

B. Installation

1. The system supplier shall be responsible for the design, installation, testing and maintenance of the Suppression Systems.

2. The system supplier shall employ a special hazard designer, who will be responsible for this project.

3. The system supplier shall be an experienced firm regularly engaged in the installation of automatic Clean Agent, or similar, fire suppression systems in strict accordance with all applicable standards.
4. The system supplier must have a minimum of 5 years’ experience in the design, installation and testing of Clean Agent, or similar, fire suppression systems. A list of systems of a similar nature and scope shall be provided on request.

5. The system supplier shall maintain, or have access to, a Clean Agent recharging station. The system supplier shall provide proof of his ability to recharge the largest Clean Agent system within 24 hours after a discharge. Include the amount of bulk agent storage available.

6. The system supplier shall be an authorized stocking distributor of the Clean Agent system equipment so that immediate replacement parts are available from inventory.

7. The system supplier shall show proof of emergency service available on a 24-hour, 7-day-a-week basis.

1.7 MANUFACTURER’S SERVICES

A. The Contractor shall provide the services of an experienced and authorized manufacturer’s representative for the equipment and system specified herein who shall be present at the jobsite and/or classroom designated by the City for the minimum man-days listed for the services shown below, travel time excluded:

1. One-half (1/2) man-day for installation assistance, inspection, and certification of the installation.

2. One-half (1/2) man-day for functional testing.

3. One-half (1/2) man-day for pre-startup classroom or jobsite training.

B. Manufacturers’ Certificate

1. An authorized manufacturer’s representative shall inspect the installation of all work furnished under this Section and shall provide a certificate of satisfactory installation in accordance with the provisions of Sections pertaining Manufacturer’s And Contractor’s Services.

2. Provide 2 inspections per year during the first 2 years of service. Inspections shall be made at 6-month intervals commencing when the system is first placed into normal service.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Fike Corporation;

B. Or equal.

2.2 CLEAN AGENT SYSTEM DESCRIPTION AND OPERATION

A. The system shall provide a Clean Agent minimum design concentration of 7%, by volume, in all areas and/or protected spaces, at the minimum anticipated temperature within the protected area. System design shall not exceed the NOAEL value of 9%, adjusted for maximum space temperature anticipated, unless provisions for room evacuation, before agent release, are provided.

B. The system shall be complete in all ways. It shall include all mechanical and electrical installation, all detection and control equipment, agent storage containers, clean agent, discharge nozzles, pipe and fittings, manual release and abort stations, audible and visual alarm devices, auxiliary devices and controls, shutdowns, alarm interface, caution/advisory signs, functional checkout and testing, training
and all other operations necessary for a functional, UL Listed and/or FM approved Clean Agent Suppression System.

C. The general contractor shall be responsible for sealing and securing the protected spaces against agent loss and/or leakage during the 10-minute “hold” period.

D. The system(s) shall be actuated by a combination of ionization and/or photoelectric detectors installed at a maximum spacing of 250 sq. ft per detector, in both the room, under floor and above ceiling protected spaces. If the air flow is one air change per minute, photoelectric detectors only shall be installed at a spacing not to exceed 125 sq. ft per detector (Ref. NFPA No. 72).

E. Detectors shall be wired in FIKE’S “Sequential Detection” method of operation, standard Cross-Zoned detection, or single detector release, using either a Class “A” or Class “B” wiring arrangement. No other detection/wiring arrangements will be acceptable.

F. Automatic operation of each protected area shall be as follows:

1. Actuation of one (1) detector, within the system, shall:
   a. Illuminate the “ALARM” lamp on the control panel face.
   b. Energize an alarm bell and/or an optional visual indicator.
   c. Transfer sets of 5 Amp rated auxiliary contacts which can perform auxiliary system functions such as:
      1) Operate door holder/closures on access doors.
      2) Transmit a signal to control panel “CP-01.”
      3) Shutdown HVAC equipment.

2. Actuation of a 2nd detector, within the system, shall:
   a. Illuminate the “PRE-DISCHARGE” lamp on the control panel face.
   b. Energize a pre-discharge horn or horn/strobe device.
   c. Transfer sets of 5 amps rated auxiliary contacts which can perform auxiliary system functions such as:
      1) Close dampers.
   d. Start time-delay sequence (not to exceed 60 seconds).
   e. System abort sequence is enabled at this time.

3. After completion of the time-delay sequence, the Clean Agent system shall discharge and the following shall occur:
   a. Illuminate a “SYSTEM FIRED” lamp on the control panel face.
   b. Energize a visual indicator(s) outside the hazard in which the discharge occurred.
   c. Transfer sets of 5 amps rated auxiliary contacts which can perform auxiliary system functions such as:
      1) Transmit a contact signal to “CP-01.”
      2) Trip main circuit breaker.
3) Trip generator circuit breaker.
4) Open contact to stop/prevent generator set from running.
5) Three (3) contacts to trip UPS circuit breakers.

4. The system shall be capable of being actuated by manual discharge devices located at each
hazard exit. Operation of a manual device shall duplicate the sequence description above except
that the time delay and abort functions SHALL be bypassed. The manual discharge station shall
be of the electrical actuation type and shall be supervised at the main control panel.

2.3 MATERIALS AND EQUIPMENT

A. General Requirements: The Clean Agent System materials and equipment shall be standard products
of the supplier’s latest design and suitable to perform the functions intended. When one or more
pieces of equipment must perform the same function(s), they shall be duplicates produced by one
manufacturer.

B. Clean Agent Storage and Distribution: Each system shall have its own supply of clean agent.

1. The system design can be modular, central storage, or a combination of both design criteria.

2. Systems shall be designed in accordance with the manufacturer’s guidelines.

3. Each supply shall be located within the hazard area, or as near as possible, to reduce the amount
of pipe and fittings required to install the system.

4. The clean agent shall be stored in FIKE P/N 70 Series Agent Storage Containers. Containers shall
be super-pressurized, with dry Nitrogen, to an operating pressure of 360 psi @ 70 °F (2500 kpa at
20 °C). Containers shall be of high-strength alloy steel construction and conform to NFPA 2001.

5. Containers shall be actuated by parallel wired initiators through a FIKE P/N 10-1832 Agent
Release Module (ARM), located at each agent container.

6. Each container shall have a pressure gauge and low pressure switch to provide visual and
electrical supervision of the container pressure. The low pressure switch shall be wired to the
control panel to provide an audible and visual “Trouble” alarm in the event the container
pressure drops below 272 psi (1875 kpa). The pressure gauge shall be color coded to provide an
easy, visual indication of container pressure.

7. Each container shall have a pressure relief provision that automatically operates when the
internal temperature exceeds 150 °F (66 °C).

8. Engineered discharge nozzles shall be provided, within the manufacturers guidelines, to
distribute the Clean Agent throughout the protected spaces. The nozzles shall be FIKE P/N 80
designed to provide proper agent quantity and distribution.

a. Nozzles shall be available in pipe sizes 3/8” thru 2.0” (BPS 10 mm thru 50 mm). Each size
shall be available in 180° and 360° distribution patterns.

b. Ceiling plates, FIKE Series 02, can be used with the FIKE Series 80 nozzles to conceal pipe
entry holes through ceiling tiles.

9. Distribution piping and fittings shall be installed in accordance with the manufacturer’s
requirements, NFPA 2001 and approved piping standards and guidelines. All distribution piping
shall be installed by qualified individuals using good, accepted practices and quality procedures.
All piping shall be adequately supported and anchored at all directional changes and nozzle locations.

a. Piping support system shall conform to the requirements and shall be as reviewed by the City. The Contractor shall submit shop drawings indicating the location of seismic supports and provide a legend giving load information and model specification prior to installation.

b. All piping shall be reamed, blown clear and swabbed with suitable solvents to remove burrs, mill varnish and cutting oils before assembly.

c. All pipe threads shall be sealed with Teflon tape pipe sealant applied to the male thread ONLY.

2.4 ELECTRICAL CONTROL PANEL

A. The control panel shall be a Rhino Control System, P/N 10-2161, manufactured by Fike Protection Systems, Blue Springs, MO.

B. The Rhino Control System, and its components, shall be UL listed and FM approved for use as a local fire alarm system with releasing device service and be suitable for Deluge/Pre-action sprinkler service.

C. The Rhino Control System shall perform all functions necessary to operate the system detection, actuation and auxiliary functions, as outlined.

D. The Rhino Control System shall be capable of providing 33AH battery standby power.

E. The Rhino Control System shall consist of a combination of the following modules:
   1. Detection and Control module (DCM), Fike P/N 10-2141.
   2. Interactive Display Module (IDM), Fike P/N 10-2142.

F. The Rhino Control System shall be capable of providing detection and control for up to 39 hazards.

G. The Rhino Control System shall be microprocessor based utilizing a distributed processing concept. A single microprocessor failure shall not impact operation of additional modules on the system.

H. The Rhino Control System shall be capable of supporting Cross Zoned and/or Sequential detection schemes, per zone.

I. The DCM shall supply an integrated 2.0 amp power supply circuitry. Systems requiring multiple DCMs shall use a bus power concept to allow power sharing between modules for redundancy.

J. Each DCM shall provide 3 initiating circuits.
   1. Each circuit shall be capable of Class B (Style A).
   2. Each circuit shall be capable of operating up to 50 approved detectors with a maximum of 35 ohms line resistance.
   3. Each circuit shall be capable of monitoring contact devices configured for manual release, manual alarm, system abort, trouble input or auxiliary (non-fire) input.
   4. Each circuit shall have a user defined, custom message.
K. Each DCM shall contain 3 indicating/release circuits for annunciation and activation of an extinguishing/suppression system(s).
   1. Each circuit shall be capable of Class B (Style Y).
   2. Each output circuit shall be jumper selectable as an indicating circuit, solenoid activation or an agent release circuit.
   3. Each circuit shall be rated for 2.0 amp @ 24vdc and shall be protected from false actuation by an intelligent transistor.
   4. Each circuit shall support a user defined, custom message.

L. Each DCM shall provide an auxiliary power supply rated at 0.5 amps @ 24vdc.

M. Each DCM shall provide a SPST relay for common alarm and common trouble. Four (4) additional programmable relays can be added to each DCM by adding a RM4 Relay Module, Fike P/N 10-2143.

N. Each Rhino Control System shall require at least one (1) Interactive Display Module. The IDM shall provide an 80-character LCD display for system annunciation and configuration.
   1. The IDM shall have dedicated LEDs for Normal AC power, Alarm, Supervisory, Trouble and Silence.
   2. The IDM shall maintain a 600 event history buffer. Each history record contains a time/date stamp, a brief event description, and identification of the module and circuit involved.
   3. All programming shall be done from the IDM without requiring custom software or a computer.

2.5 DETECTORS

A. The detectors shall be spaced and installed in accordance with the manufacturer’s specifications and the guidelines of NFPA No. 72 - 1993 edition.

B. The Ionization detector shall be a FIKE P/N 67-024, with a 4” (10 mm), or a P/N 67-025 with a 6” (15 mm) base.

C. The Photoelectric detector shall be a FIKE P/N 63-024, with a 4” (10 mm) base, or a P/N 63-025 with a 6” (15 mm) base.

2.6 ELECTRIC MANUAL RELEASE

A. The electric manual release switch shall be a dual action device which provides a means of manually discharging the Suppression System when used in conjunction with the Fike Rhino Control System.

B. The Manual Release switch shall be a Fike P/N 10-1638 or a Manual Pull station, P/N 02-4110.

C. The Manual Release switch or Manual Pull station shall be a dual action device requiring two distinct operations to initiate a system actuation.

D. Manual actuation shall bypass the time delay and abort functions shall cause the system to discharge and shall cause all release and shutdown devices to operate in the same manner as if the system had operated automatically.
E. A Manual Release switch shall be located at each exit from the protected hazard and shall have an advisory sign, Fike P/N 02-3644, provided at each location.

2.7 ABORT STATION

A. The optional Abort Station shall be the "Dead Man" type and shall be located next to each manual switch.

B. The Abort Station shall be a Fike P/N 10-1639.

C. The Abort Station shall be supervised and shall indicate a trouble condition at the Rhino Control Panel, if depressed, and no alarm condition exists.

D. “Locking” or “Keyed” abort stations shall not be permitted.

E. The (optional) Abort Station shall be located adjacent to each manual station and can be furnished in combination with a Manual Release Switch or in combination with a Manual Release Switch and (optional) Digital Countdown Timer (Fike P/N 20-046).

2.8 AUDIBLE AND VISUAL ALARMS

A. Alarm audible and visual signal devices shall operate from the Rhino Control Panel.

B. The Alarm Horn and Horn/Strobe devices shall be Fike P/N's 20-107, 75 candela, or equal in quality, performance and features. A Clean Agent label shall be attached to the strobe lens when required.

C. The Alarm Bell devices shall be Fike P/N's 20-110, 6” bell, or equal in quality, performance and features. A Clean Agent label shall be attached to the strobe lens when required.

D. The visual alarm unit shall be a Fike P/N 20-093, 75 candela, Vertical Strobe device, or equal in quality, performance and features. A Clean Agent label shall be attached to the strobe lens when required.

E. A Strobe device shall be placed outside, and above, each exit door from the protected space. Provide an advisory sign, Fike P/N 02-3645, at each light location

2.9 CAUTION AND ADVISORY SIGNS

A. Provide signs, as required, to comply with NFPA 2001 and the recommendations of the Clean Agent equipment supplier:

B. Entrance sign: One (1) required at each entrance to a protected space (Fike P/N 02-3646).

C. Manual Discharge sign: One (1) required at each manual discharge station (Fike P/N 02-3644).

D. Flashing Light sign: One (1) required at each flashing light over each exit from a protected space (Fike P/N 02-3645).

2.10 SYSTEM AND CONTROL WIRING

A. All system, conduit, wiring, and appurtenances shall be furnished and installed by the Contractor to make a complete and functional system.
B. All wiring shall be installed in conduit, and must be installed and kept separate from all other building wiring, see DIV. 16 Specification.

C. All system components shall be securely supported independent of the wiring. Runs of conduit and wiring shall be straight, neatly arranged, properly supported, installed parallel and perpendicular to walls and partitions.

D. The sizes of the conductors shall be those specified by the manufacturer. Color coded wire shall be used. All wires shall be tagged at all junction points and shall be free from shorts, earth connections (unless so noted on the system drawings), and crosses between conductors. Final terminations between the Rhino control panel and the system field wiring shall be made under the direct supervision of a factory trained representative.

E. All wiring shall be installed by qualified individuals, in a neat and workmanlike manner, to conform to the SF Electrical Code, Article 725 and Article 760, except as otherwise permitted for limited energy circuits, as described in NFPA 72. Wiring installation shall meet all local, state, and federal codes.

F. The complete system electrical installation, and all auxiliary components, shall be connected to earth ground in accordance with the SF Electrical Code.

2.11 SYSTEM INSPECTION AND CHECKOUT

A. After the system installation has been completed, the entire system shall be checked out, inspected and functionally tested by qualified, trained personnel, in accordance with the manufacturer’s recommended procedures and NFPA standards.

B. All containers and distribution piping shall be checked for proper mounting and installation.

C. All electrical wiring shall be tested for proper connection, continuity and resistance to earth.

D. The complete system shall be functionally tested, in the presence of the owner or his representative, and all functions, including system and equipment interlocks, must be operational at least 5 days prior to the final acceptance tests.

1. Each detector shall be tested in accordance with the manufacturer’s recommended procedures, and test values recorded.

2. All system and equipment interlocks, such as door release devices, audible and visual devices, equipment shutdowns, local and remote alarms, etc. shall function as required and designed.

3. Each Rhino control panel circuit shall be tested for trouble by inducing a trouble condition into the system.

2.12 TRAINING REQUIREMENTS

A. Prior to final acceptance, the installing contractor shall provide operational training to each shift of the owners personnel. Each training session shall include system Rhino Control Panel operation, manual and (optional) abort functions, trouble procedures, supervisory procedures, auxiliary functions, emergency procedures, and programming of the IDM.
2.13 OPERATION AND MAINTENANCE

A. Prior to final acceptance, the installing contractor shall provide complete operation and maintenance instruction manuals, 6 copies for each system, to the City. All aspects of system operation and maintenance shall be detailed, including piping isometrics, wiring diagrams of all circuits, a written description of the system design, sequence of operation and drawing(s) illustrating control logic and equipment used in the system. Checklists and procedures for emergency situations, troubleshooting techniques, maintenance operations and procedures shall be included in the manual.

PART 3 – EXECUTION

3.1 ACCEPTANCE TESTS

A. The Contractor shall provide a “Test Plan” describing procedures to be used to test the control system(s). The Test Plan shall include a step-by-step description of all tests to be performed and shall indicate the type and location of test apparatus to be employed. The tests shall demonstrate that the operational and installation requirements of this specification have been met. All tests shall be conducted in the presence of the Owner’s Representative and shall not be conducted until the Test Plan has been approved.

B. The tests shall demonstrate that the entire control system functions as designed and intended. All circuits shall be tested: automatic actuation, solenoid and manual actuation, HVAC and power shutdowns, audible and visual alarm devices and manual override of abort functions. Supervision of all panel circuits, including AC power and battery power supplies, shall be tested and qualified.

C. A room pressurization test shall be conducted, in each protected space, to determine the presence of openings which would affect the agent concentration levels. The test(s) shall be conducted using the Retro-Tec Corp. Door Fan system, or equivalent, with integrated computer program. All testing shall be in accordance with NFPA, Appendix B.

D. If room pressurization testing indicates that openings exist which would result in leakage and/or loss of the extinguishing agent, the installing contractor shall be responsible for coordinating the proper sealing of the protected space(s) by the general contractor or his sub-contractor or agent. The general contractor shall be responsible for adequately sealing all protected space(s) against agent loss or leakage. The installing contractor shall inspect all work to ascertain that the protected space(s) have been adequately and properly sealed.

1. If the first room pressurization test is not successful, in accordance with these specifications, the installing contractor shall direct the general contractor to determine, and correct, the cause of the test failure. Copies of successful test results shall be submitted to the owner for record.

E. Upon acceptance by the owner, the completed system(s) shall be placed into service.

3.2 AS-BUILT DRAWINGS

A. Upon completion of each system, the Contractor shall provide 6 copies of system “As-Built” drawings. The drawings shall show actual installation details including all equipment locations (i.e.: control panel(s), agent container(s), detectors, alarms, manuals and aborts, etc.) as well as piping and conduit routing details. Show all room or facilities modifications, including door and/or damper installations completed. One (1) copy of reproducible engineering drawings in latest version of AutoCAD shall be provided reflecting all actual installation details.
3.3 SPECIAL REQUIREMENTS

A. System Inspections

1. The installing contractor shall provide 2 inspections of each system, installed under this contract, during the 2-year warranty period. The first inspection shall be at the 6-month interval, and the second inspection at the 12-month interval, after system acceptance. Inspections shall be conducted in accordance with the manufacturer’s guidelines and the recommendations of NFPA 2001.

2. Documents certifying satisfactory system(s) operation shall be submitted to the City (owner) upon completion of each inspection.

3.4 PAINTING

A. The Clean Agent piping system shall be painted in strict accordance with the manufacturer’s recommendations.

3.5 WARRANTY

A. The Contractor shall furnish a 2-year warranty for all the system components and the installation under this Section, shall be guaranteed against defects in design, materials and workmanship for the full warranty period which is standard with the manufacturer from the date of system acceptance.

END OF SECTION 15 36 50
SECTION 21 05 10 – BASIC FIRE PROTECTION REQUIREMENTS

PART 1 – GENERAL

1.1 APPLICABLE REQUIREMENTS

A. All work under this Section shall comply with the requirements of General Conditions, Supplemental Conditions, Special Conditions and Division 1 - General Requirements, and shall include all Division 21 and 23 Sections specified herein.

1.2 DESCRIPTION OF WORK

A. The contract documents including specifications and construction drawings are intended to include all material and labor required to renovate existing and new fire sprinkler systems, and provide complete and operable fire protection systems. The plans are diagrammatic and show generally the locations of fixtures, equipment, and pipe lines, but are not to be scaled. The Subcontractor shall be aware that complete information as to all concealed existing conditions in areas of work is not available or provided. All dimensions and existing conditions shall be verified at the buildings, prior to submitting bids.

B. The Subcontractor shall refer to the architectural floor plans, elevations, interior details, and other Contract Drawings and shall coordinate the work with that of the other trades to avoid interferences.

1.3 DEFINITIONS

A. “Above Grade”: Not buried in the ground and not embedded in concrete slab on ground.

B. “Concealed”: Embedded in masonry or other construction, installed in furred spaces, within double partitions or hung ceilings, in trenches, in crawl spaces, or in enclosures. In general, any item not visible or directly accessible.

C. “Connect”: Complete hook-up of item with required service.

D. “Exposed”: Not installed underground or “concealed.”

E. “Furnish”: To supply equipment and products as specified.

F. “Indicated,” “Shown” or “Noted”: As indicated, shown or noted on drawings or specifications.

G. “Install”: To erect, mount and connect complete with related accessories.

H. “Motor Controllers”: Manual or magnetic starters (with or without switches), individual push buttons or hand-off-automatic (HOA) switches controlling the operation of motors.

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

J. “Provide”: To supply, install and connect as specified for a complete, safe and operationally ready system.
K. “Reviewed,” “Satisfactory,” or “Directed”: As reviewed, satisfactory, or directed by or to Architect/Engineer/Design-Builder.

L. “Rough-In”: Provide all indicated services in the necessary arrangement suitable for making final connections to fixture or equipment.

M. “Shall”: An exhortation or command to complete the specified task.

N. “Similar” or “equal”: Of base bid manufacture, equal in materials, weight, size, design, and efficiency of specified products.

O. “Supply”: To purchase, procure, acquire and deliver complete with related accessories.

P. “Wiring”: Raceway, fittings, wire, boxes and related items.

Q. “Work”: Labor, materials, equipment, apparatus, controls, accessories, and other items required for proper and complete installation.

1.4 RELATED WORK SPECIFIED ELSEWHERE

A. Division 7 – Thermal & Moisture Protection

B. Division 9 – Finishes:
   1. All painting shall be performed by Division 9, except where specifically specified otherwise.

1.5 CODES AND STANDARDS

A. All work shall be in full accordance with all codes, ordinances and code rulings.

B. The Subcontractor shall furnish without any extra charge the labor and material required for the compliance of codes.

C. Perform all tests required by governing authorities and required under all corresponding Sections. Provide written reports on all tests.

D. Electrical devices and wiring shall conform to the latest standards of National Electrical Code (NEC); all devices shall be UL listed and so identified.

E. All work shall comply with applicable sections of the Americans with Disabilities Act (ADA), local and state accessibility requirement.

F. Provide in accordance with latest editions of the rules and regulations of the following as applicable:
   1. San Francisco City and County Codes and Ordinances.
   2. Local Health Department.
   3. Local and state Fire Prevention Districts.
   5. CMC - California Mechanical Code.
   6. CPC - California Plumbing Code
7. CEC - California Electric Code.
9. State Administrative Codes.

G. Provide in accordance with appropriate referenced standards of the following:
   2. ASHRAE - American Society of Heating, Refrigerating & Air Conditioning Engineers.
   3. ASME - American Society of Mechanical Engineers.
   5. AWS - American Welding Society.
   7. FM - Factory Mutual.
   8. MSS - Manufacturer's Standardization Society.
   10. SMACNA - Sheet Metal and Air Conditioning Contractors National Association.
   11. UL - Underwriter's Laboratories.

1.6 QUALITY ASSURANCE

A. Labels and Listings: Refer to Division 1 for requirements that materials, appliances and equipment provided meet the requirements of the Underwriter's Laboratories, Inc., (UL) and other standards organizations. Lettering size and style shall comply with American National Standards Institute, Inc., (ANSI) A13.1 “Scheme for the Identification of Piping Systems.”

B. Manufacturer’s Nameplates: Nameplates on manufactured items shall be aluminum or Type 304 stainless steel sheet, not less than 20 USG, riveted or bolted to the manufactured item, with nameplate data engraved or punched to form a non-erasable record of equipment data.

C. Field Installation: Field-installed nameplates shall be engraved melamine plastic laminate, 1/8” thick, engraved in block capital lettering to expose white lettering on black face. Screw or bolt to equipment. Adhesive attachment will not be permitted.

D. National Fire Protection Association (NFPA): All work provided under this contract shall meet the requirements of the NFPA. Refer to individual NFPA code sections as referenced in other sections.

E. Current Models: All work shall be as follows:
   1. Manufactured items furnished shall be the current, cataloged product of the manufacturer.
   2. Replacement parts shall be readily available and stocked in the USA.

F. Experience: Unless more stringent requirements are specified in other sections manufactured items shall have been installed and used, without modification, renovation or repair, on other projects for not less than one year prior to the date of bidding for this project.

1.7 GENERAL REQUIREMENTS

A. Examine all existing conditions at building site.
B. Review contract documents and technical specifications for extent of new work to be provided.

C. Provide and pay for all permits, licenses, fees and inspections.

D. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing. This work shall include furnishing and installing all access doors required for plumbing access.

E. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

F. Coordinate fire protection equipment and materials installation with other building components.

G. Verify all dimensions by field measurements.

H. Arrange for chases, slots, and openings in other building components to allow for fire protection installations.

I. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.

J. Sequence, coordinate, and integrate installations of fire protection materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing-in the building.

K. Coordinate the cutting and patching of building components to accommodate the installation of fire protection materials. Conform to the requirements of Division 1, 2, 3 and 4.

L. Where mounting heights are not detailed or dimensioned, install fire protection services and overhead equipment to provide the maximum headroom possible.

M. Install fire protection equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.

N. Coordinate the installation of fire sprinkler materials and equipment above ceilings with ductwork, piping, conduits, suspension system, light fixtures, cable trays, plumbing, and other installations.

O. Coordinate connection of fire protection systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

P. Coordinate with the Airport in advance to schedule shutdown of existing systems to make new connections. Provide valves in new piping to allow existing system to be put back in service with minimum down time.

Q. All materials (such as insulation, ductwork, piping, wiring, controls, etc.) located within air plenum spaces, air shafts, and occupied spaces shall have a flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E84 (NFPA 255) method. In addition, the products, when tested, shall not drip flame particles, and flame shall not be progressive. Provide Underwriters
Laboratories, Inc., label or listing, or satisfactory certified test report from an approved testing laboratory to prove the fire hazard ratings for materials proposed for use do not exceed those specified.

1.8 DESCRIPTION OF BID DOCUMENTS

A. Specifications:
   1. Specifications, in general, describe quality and character of materials and equipment.
   2. Specifications are of simplified form and include incomplete sentences.
   3. Words or phrases such as “the Subcontractor shall,” “shall be,” “furnish,” “provide,” “a,” “an,” “the,” and “all” may have been omitted for brevity.

B. Drawings:
   1. Drawings in general are diagrammatic and indicate sizes, locations, connections to equipment and methods of installation.
   2. Scaled and figured dimensions are approximate and are for estimating purposes only.
   3. Before proceeding with work check and verify all dimensions.
   4. Assume all responsibility for fitting of materials and equipment to other parts of equipment and structure.
   5. Make adjustments that may be necessary or requested in order to resolve space problems, preserve headroom, and avoid architectural openings, structural members and work of other trades.
   6. Where existing pipes, conduits and/or ducts prevent installation of new work as indicated, relocate, or arrange for relocation, of existing pipes, conduits and/or ducts.
   7. If any part of Specifications or Drawings appears unclear or contradictory, apply to the Owner for interpretation and decision as early as possible, including during bidding period.

1.9 MINOR DEVIATIONS

A. The Drawings are diagrammatic and show the general arrangements of all fire protection work and requirements to be performed. It is not intended to show or indicate all offsets, fittings, and accessories which will be required as a part of the work of this section.

B. The Subcontractor shall carefully review and study the structural and architectural conditions affecting all of their work, and it is the specific intention of this section that all such work imposed on this section by structural and architectural conditions of the Contract shall be borne by this section at no extra cost to the Owner.

C. The Subcontractor shall study the operational requirements of each system, and shall arrange his work accordingly, and shall furnish such fittings, offsets, traps, valves, supports, accessories, as are required for the proper and efficient installation of all systems from the physical space available for use by this section. This requirement extends to the Subcontractor’s coordination of this section’s work with the "Electrical Work". Should cases arise where physical conflict occurs because of the absence of part or all of these section coordination as a responsibility of the Subcontractor; the time delay, the labor and materials, and any other item of cost for time shall not be at a cost to the Owner, including demolition.
D. Minor deviations to avoid conflict shall be permitted where the design intent is not altered.

E. Advise the Owner’s Representative, in writing, in the event a conflict occurs in the location or connection of equipment. Bear all costs for relocation of equipment, resulting from failure to properly coordinate the installation or failure to advise the Owner’s Representative of conflict.

1.10 SHOP DRAWINGS AND SUBMITTALS

A. Refer to Division 1 for General Requirements.

B. Submittals shall be reviewed and approved by the Owner’s Representative. The Owner’s obligations to review shop drawings and other submittals and to return them in a timely manner are conditioned upon the prior review and approval of the shop drawings and submittals by the Subcontractor as required in the construction contract and Subcontractors’ submittals in accordance with a written schedule for distribution in advance to the Owner identifying the dates for the submittal of the various shop drawings and submittals.

C. Preliminary List of Materials and Unit Price Items: Within 30 days after awarding of the contract, submit to the Owner for preliminary approval a complete list of manufacturer and model number of proposed materials and equipment.
   1. Indicate substituted items.
   2. Identify test and balancing agency.
   3. Identify independent testing laboratory for water analysis.

D. After approval of preliminary list of materials, the Subcontractor shall submit Construction and Shop Drawings and manufacturers certified Drawings to the Owner for approval.

E. The Subcontractor shall submit approved Construction and Shop Drawings and manufacturer’s equipment cuts, of all equipment requiring connection by Division 26, to the Electrical Subcontractor for final coordination of electrical requirements. Subcontractor shall bear all additional costs for failure to coordinate with Division 26.

F. Submittals shall be submitted as a complete package bound in a 3-ring binder with tabs for each specification section. The approved submittals shall be converted into O&M Manuals at the completion of the project. Submit 6 typed copies of submittals. Construction and Shop Drawings shall be full size. Refer to Division 1 for additional requirements.

1.11 COORDINATION

A. Advise the Owner in the event any conflict occurs in the location or connection of equipment. Bear all costs for relocation of equipment, resulting from failure to properly coordinate the installation or failure to advise the Owner’s Representative of conflict.

B. Provide means of access to all valves, controllers, operable devices, and other apparatus that requires adjustment or servicing.

C. Verify in field exact size, location, invert, and conditions regarding all existing piping, conduit, equipment and apparatus, and advise the Owner of any discrepancies between that indicated on the Drawings and that existing in the field prior to any installation related thereto.
1.12 RECORD DRAWINGS

A. Before commencing installation, obtain an extra set of prints from the Owner, marked “Record.” Keep this set of Drawings at the job site at all times, and use it for no other purpose but to mark on it all the changes and revisions to the Contract Drawings resulting from coordination with other trades. At the completion of the project, obtain a clean set of drawings from the Owner, at cost plus, and transfer the revisions to these drawings in a neat and orderly fashion.

B. Mark Drawings to indicate revisions to piping, size and location both exterior and interior; including locations of valves and similar units requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned to column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located; Change Orders; concealed control system devices.

C. Mark Specifications to indicate approved substitutions, Change Orders, actual equipment and materials used.

D. Refer to Special Conditions for additional requirements.

1.13 DELIVERY, STORAGE AND HANDLING

A. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage, and handling.

B. Protect stored equipment and materials from damage. Piping shall be stored in bundles and covered. Piping showing signs of rust shall be cleaned.

1.14 TESTING

A. Refer to other Specification Sections and Division 1 for specific requirements.

1.15 CLEANING AND CLOSING

A. All work shall be inspected, tested, and approved before being concealed or placed in operation.

B. Upon completion of the work, all equipment installed as specified in this section, and all areas where work was performed, shall be cleaned to provide operating conditions satisfactory to the Owner.

C. Refer to Division 1 for additional requirements.

1.16 INSTRUCTION, MAINTENANCE, AND O&M MANUALS

A. O&M Manuals: Upon completion of the work, the Subcontractor shall submit to the Owner 6 complete sets of operating instructions, maintenance instructions, part lists, and all other bulletins and brochures pertinent to the operation and maintenance for equipment furnished and installed as specified in this section, bound in a durable binder. Refer to Division 1 for additional requirements.

1.17 ACCEPTANCE

A. Refer to Division 1.
1.18 WARRANTIES

A. Refer to the General Conditions and Division 1 for procedures and submittal requirements for warranties. All equipment shall be provided with a minimum one year warranty to include parts and labor. Refer to individual equipment specifications for extended or longer term warranty requirements.

B. Provide complete warranty information for each item, to include product or equipment, and date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

1.19 GUARANTEE

A. The Subcontractor shall guarantee and service all workmanship and materials provided and shall repair or replace, at no additional cost to SFO, any part thereof which may become defective within the period of one (1) year after the Date of Final Acceptance, ordinary wear and tear excepted.

B. The Subcontractor shall be responsible for and pay for any damages caused by or resulting from defects in their work.

1.20 SAFETY AND INDEMNITY

A. The Subcontractor shall be solely and completely responsible for conditions of the job site including safety of all persons and property during performance of the work. This requirement will apply continuously and not be limited to normal hours of work.

B. No act, service, drawing, review, or construction review by the Owner is intended to include the review of the adequacy of the Subcontractor’s safety measures, in, on, or near the construction site.

C. The Subcontractor performing work under this Division of the Specifications shall hold harmless, indemnify and defend the Airport, Architect, Engineers, and their consultants, and each of their officers and employees and agents, from any and all liability claim, losses or damage arising, or alleged to arise from bodily injury, sickness, or death of a person or persons and for all damages arising out of injury to or destruction of property arising directly or indirectly out of or in connection with the performance of the work under the Division of the Specifications, and from the Subcontractor’s negligence in the performance of the work described in the Construction Contract Documents, but not including the sole negligence of the Airport, Architect, Engineers, and their consultants, or their officers and employees and agents.
SECTION 21 10 00 – WATER-BASED FIRE SUPPRESSION SYSTEM

PART 1 – GENERAL

1.1 SUMMARY

A. This section outlines the requirements for wet based fire suppression systems. The work described in this specification includes all engineering, labor, materials, and equipment and services necessary to design, install and test the fire protection system.

1. The following are included:
   a. Automatic wet sprinkler systems.
   b. Renovation of existing fire sprinkler system.
   c. Demolition of fire hose racks.
   d. Demolition of existing exposure fire sprinkler system on the east side perimeter.
   e. Pre-action sprinkler systems.
   f. Standpipe systems.
   g. Renovation of existing standpipes.
   h. Addition of fire department connections.
   i. Renovation of existing 8” fire main.
   j. Pipe settlement joint.
   k. Water spray fixed systems.

B. Furnish labor, materials, testing, tools, equipment, services, and transportation necessary for, or reasonably incidental to, the construction and completion in working order of the fire protection work. Work materials and equipment not indicated or specified which are necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the Contract Documents shall be provided and incorporated at no additional cost to SFO. Work includes, but is not limited to, the following:

1. The design and installation of hydraulically calculated automatic wet fire sprinkler systems complete and ready for operation, for the entire building and connections to existing SFO fire water supply.

2. The design and installation of a hydraulically calculated double interlocked pre-action fire sprinkler system complete and ready for operation.

3. The design and installation of hydraulically calculated water spray fixed systems as required. Refer to specification section 21 13 29, Water Spray Fixed Systems.

4. The design and installation of a standpipe system combined with the automatic wet sprinkler system, sized to meet flow and pressure requirements per NFPA 14 and CBC requirements.

5. Water flow capacity (gpm and residual flow pressure) at existing supply mains shall be verified by flow tests.

6. Provide complete product submittals for all fire protection equipment and materials.
7. Provide coordinated Shop Drawings of the automatic wet fire sprinkler systems, pre-action fire sprinkler system, standpipe system and water spray fixed system in latest version of Autocad® Revit®, using architectural and structural backgrounds, hydraulic calculations, seismic sway bracing calculations, equipment anchorage calculations and details.

8. Provide complete as-built drawings of the fire sprinkler and standpipe systems in latest version of Autocad® Revit®, using architectural and structural backgrounds. Drawings shall include exact locations of piping, sprinkler heads, sprinkler control valve assemblies, pipe supports, seismic bracings, and other fire sprinkler equipment.

9. Obtain system approvals and pay for necessary permits and fees.

10. Testing and adjusting of completed work, inspections and instructions. Inspections, testing and maintenance work required by NFPA 25 and recommended by the equipment manufacturer shall be provided. Work shall include operation of sprinkler system alarm and supervisory devices.

11. Repair of damage done to premises as a result of this installation and removal of debris left by those engaged in this installation.

12. Excavation, trenching and backfill required in this section of work.

13. Deferred approval requirements: Contractor shall submit fire sprinkler plans, seismic sway bracing details and calculations, and hydraulic calculations to SFO Fire Marshal and SFO Building Inspection and Code Enforcement (BICE) and obtain necessary approvals for the fire sprinkler and standpipe work. Contractor to provide written response to all SFO BICE plan review comments.

1.2 REFERENCE AND STANDARDS

A. Regulatory compliance: Work performed under this division shall comply with the latest currently adopted editions of codes and regulations. The following references and standards are hereby made a part of this section and Work shall conform to applicable requirements herein except as otherwise specified herein or shown on the Drawings. Nothing in the Specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and the SFO’s Representative.

B. Codes, Standards, Laws and Orders: Conform to latest applicable codes, standards, laws and orders as stated herein, including but not limited to the following:


3. American Welding Society (AWS)

4. American Water Works Association (AWWA)

5. California Building Code (CBC)

6. California Fire Code (CFC)

7. California Plumbing Code (CPC)
8. California Electrical Code (CEC)
9. California Code of Regulations (CCR), Titles 8, 17, 19, 20, 21 and 24
10. San Francisco Fire Department (SFFD) Codes and Bulletins
11. U.S. Department of Labor, Occupational Safety & Health Administration (OSHA) Regulations for Construction and California OSHA.
13. All applicable laws and regulations and standards of Federal Aviation Administration (FAA), including airfield security requirements.
14. The Americans with Disability Act (ADA) requirements for disabled access
15. SFO Airport Building Regulations (ABR)
16. National Fire Protection Association (NFPA) latest editions of the following:
   a. Standard for the Installation of Sprinkler Systems
   b. Standard for the Installation of Standpipe and Hose Systems
   d. Standard for Installation of Private Fire Service Mains and Their Appurtenances
   e. Standard for Inspection, Testing and Maintenance of Water Based Fire Protection Systems
   f. 70 – National Electric Code
   g. 72 – National Fire Alarm Code
   h. 101 – Safety to Life from Fire in Buildings and Structures
   i. 241 – Standard for Safeguarding Construction, Alteration, and Demolition Operations
   j. 415 – Standard on Airport Terminal Buildings, Fueling Ramp Drainage and Loading Walkways
17. International Conference of Building Officials (ICBO)
18. National Association of Corrosion Engineers (NACE)
20. National Electrical Manufacturer’s Association (NEMA)
21. National Certified Pipe Welding Bureau (NCPWB)
22. All materials and equipment shall be new and listed by Underwriter’s Laboratories, Inc. (UL) or Factory Mutual (FM) Insurance Agencies unless otherwise specified.

1.3 SCOPE

A. The work includes design and installation of building fire sprinkler systems as described in this Section of the Specification and as shown on the contract drawings, including all interior sprinklers, exterior deluge systems where required for protection of exposures, and pre-Action sprinkler systems for SSR rooms in accordance with Airport Requirements, with connections to existing sprinkler feed mains and risers. The installation shall be in accordance with Airport requirements. The installation shall be in full compliance with rules, regulations, and standards as required by the Airport and other authorities having jurisdiction.
B. Provide all pipe, fittings, sprinklers, control valves, signs, flow witches, tamper switches, protective painting, test connections, drains, and tests necessary. Valve tags and instruction plates shall be mounted and/or posted per Airport requirements.

C. Fire sprinkler piping shall not be run under building unless special exceptions are complied with per NFPA 24 Chapter 8-3. Comply with all additional Airport requirements.

D. Seismic Requirements; Automatic sprinkler systems are to be seismically braced per NFPA-13.

E. The Contractor shall be responsible for determining all items and quantities required. The following summary is included to indicate main items but is not necessarily all-inclusive:
   1. Wet pipe automatic sprinkler system for ordinary hazard occupancies, including costs and fees involved for the work.
   2. Preparation of shop drawings, submitting and obtaining Fire Marshal; Water Department; Department of Public Health approvals, together with material list submittals.
   3. Cutting, excavation and backfill, compaction, grouting and patching of the work. Furnishing and installation of concrete thrust blocks, strapping, and earthquake bracing as required.
   4. Provide sleeves, inserts, anchorage, required for system work, and which embedded in work of other trades.
   5. Cleaning, adjusting, and testing of installed systems.
   6. Provide access doors and panels required by the work.
   7. Flashing and counter flashing of roof and wall penetrations required by the work.
   9. The new nozzle shall have a shutoff feature to provide a straight stream at the nozzle.
   10. Furnish and install in each occupancy area, where the wet sprinkler system will be installed, a 10 lbm multi-purpose dry chemical fire extinguisher.
   11. All sleeves and inserts.
   12. All cutting and patching.
   13. Temporary fire protection in building during construction.

F. All areas shall be sprinklered as the construction progresses.

1.4 DAMAGE BY LEAKS

A. Be responsible for damage to any part of the premises caused by leaks in the pipe or equipment installed under applicable section for a period of twelve (12) months from the date of acceptance of the work by the SFO.

1.5 HYDRAULIC DESIGN

A. System shall be designed in accordance with NFPA standards and SFO ABR, and as follows:
1. Maximum coverage area for sprinklers shall be 130 square feet, ordinary hazard (Standard Coverage Sprinklers) and 196 square feet for Extended Coverage Sprinklers or follow manufacturer’s listing recommendations.

2. Design density for Cargo Bays: Ordinary Hazard, Group 2, design for high-piled storage, Commodity Class IV materials.

3. Design density for Equipment Rooms: Ordinary Hazard, Group 2, depending on hazard.


5. Velocity in overhead piping shall not exceed 20 feet per second in overhead piping 16 feet per second in underground piping.

6. Minimum pressure for any sprinkler head shall not be less than 7 Psi; differing minimum pressure shall be per the UL listing of the sprinkler.

7. Safety Factor: 10 PSI, or 10% of static and residual pressure, whichever is greater. Sprinkler water demand shall be below the curve of the water supply.

8. Total Combined Inside and Outside Hose Allowances: Hydraulic calculations shall include an allowance of 250 GM for hose streams for ordinary hazard occupancies, added at the point of connection to the water supply.

1.6 SUBMITTALS

A. Certificates:

1. Submit final inspection certificates signed by governing authorities. Submit the following certificates:

   a. Certificate of Installation: Submit in triplicate, certificate upon completion of fire protection piping work, which indicates that work has been tested in accordance with NFPA 13, NFPA 14, and NFPA 24; and also that system is operational, complete, and has no defects.

   b. SFO Fire Marshal’s and BICE’s approvals of system.

   c. Final inspection certificate signed by governing authorities.

   d. Piping mechanical grooved joint instruction certification.

   e. Letters from manufacturers certifying their supervision of equipment installation and start-up procedures.

   f. Others as specified herein and as required.

2. Certificates shall be submitted in the following formats:

   a. Hard copies.

   b. Electronic copies: “PDF” format submitted on a CD.

B. Calculations:

1. General: Calculations shall be bound and indexed in a three ring binder matching “Product Submittals” and “Operating and Maintenance Manuals.”
2. Calculations shall be submitted in the following formats:
   a. Hard copies.
   b. Electronic copies: “PDF” format submitted on a CD.

3. Hydraulic Calculations: Hydraulic calculations shall be executed on standard 8.5” x 11” sheets, conforming to the requirements of NFPA 13, and shall include a small schematic of the system, indicating pipe numbers, beginning and end node points, referenced Shop Drawings, and system demand curves. Calculations shall be accomplished using an approved computer program based on the Hazen-Williams formula. Hydraulic calculations shall be stamped and signed by a Mechanical Engineer licensed in the State of California. The Engineer shall be the same person responsible for the sprinkler Shop Drawings and seismic sway bracing calculations. Calculations shall also be stamped with Contractor’s C-16 stamp. Hydraulic calculations shall also include source of water flow information. Calculations shall extend to the point at which the water supply data was determined. Submit to authority having jurisdiction for review and comment. Submit six approved copies, bearing stamp and/or signature of authority having jurisdiction for review and comment. If hydraulic calculations are prepared on computer programs, submit disc copies of calculations in addition to above, if requested.

4. Seismic Sway Bracing and Anchorage Calculations: Fire protection piping shall be adequately restrained to resist seismic forces in accordance with NFPA 13. Equipment anchors shall be designed for Seismic Design Category D, with a value of SDS equal to 1.0g. Seismic calculations, restraint selections, and installation details, shall be stamped and signed by a Mechanical Engineer and a Structural Engineer, both licensed in the State of California. Calculations shall also be stamped with Contractor’s C-16 stamp.
   a. Seismic Sway Bracing and Anchorage Load Calculations: The horizontal force factor used in the sway bracing load calculations shall be determined using the method outlined in ASCE 7.05 Chapter 13, Section 1632 by the Registered Structural Engineer of Record for that building. The horizontal force factor determination shall be presented in a letter that is wet stamped and signed with the Engineer’s P.E. stamp, and the letter shall be provided with the sprinkler system submittal. The sprinkler system submittal drawings shall show a copy of the stamped letter containing the horizontal force factor determination along with the sway bracing load calculations. The sway bracing load calculations shown on the drawings shall indicate the horizontal force factor used, and the load calculations shall account for the weight of the pipe fittings and sprinklers by adding in an additional weight of at least 15% of the calculated load of the pipe.

5. Thrust Block Calculations: Submit thrust block calculation in accordance with NFPA 24. If no soil report is provided, the bearing strength of 1000 lb per square foot for soft clay shall be used for calculation.

C. A copy of all the approved fire suppression system drawings and calculations listed above shall be sent to the Architect and Engineer for their records.

D. Operating and Maintenance Instructions: Provide with six sets of operating and maintenance instructions covering completely the operation and maintenance of sprinkler equipment and controls. Manual shall be assembled in a 3-ring binder and arranged in following sections:
   1. Site utilities: Drawings showing location, size, depth of all connections, valve boxes, manholes, etc., as installed.
   2. Section No. 1: A chart tabulating all types of pipe fittings, valves, and piping specialties installed in each system.
3. Section No. 2: Manufacturers’ brochures of all sprinkler heads.
4. Section No. 3: Tamper switches and flow switches.
5. Section No. 5: Fire Department connections.
6. Section No. 6: Reproducible copies of approved working drawings prepared to facilitate the actual installation of ductwork and piping. Drawings shall indicate location of all concealed valves, and other apparatus.
7. Section No. 7: Two copies of NFPA 25” Standard for Inspection, Testing and Maintenance of Water Based Fire Protection Systems.”
8. Section No. 8: Calculations.
9. Section No. 9: Certificate of Installation.
10. Section No. 10: Guarantees.
11. The Subcontractor is responsible for proper installation of SFO personnel for operation and maintenance of all material, equipment, and apparatus provided.

PART 2 – PRODUCTS

2.1 GENERAL

A. All Products to be commercial grade, new and of the manufacturer’s latest design model.

B. All products to be UL listed and/or FM approved, except for, items which are not required to be listed by code.

C. All products to be delivered and stored in original containers. Containers shall be clearly marked or stamped with manufacturer’s name and rating.

2.2 PIPE AND FITTINGS

A. Above Ground Piping:

1. General: The piping products listed below by manufacturer’s name and model numbers are the only acceptable materials. Substitutions of pipe must be submitted and approved in writing.

2. Piping or fittings that show any rust or breaks in coating will be removed and replaced. Fitting type to match pipe type.

3. Black carbon steel pipe meeting ASTM A-135 or A-795. Provide Grade A where flanging or bending of piping is required. Piping shall be UL listed, and FM approved for 300 psi working pressure. Pipes shall have a UL Corrosion Resistance Ratio, (CRR) of 1.00 or greater. This requirement is in addition to any approved or specified piping and fittings materials, since CRR ratings vary by size, not just material.

4. Sprinkler contractor shall supply mill certificates verifying that the products submitted from the manufacturer meet the above criteria.

a. Piping 2” and smaller: Schedule 40 with minimum Class 150 ANSI B16.3 cast iron threaded fittings.
b. Piping 2.5” and larger: Schedule 10 with roll grooved type fittings and couplings. Plain end
    type fittings will not be permitted.

c. Piping located at the exterior of the building and exposed to weather, unfinished level 1
    area under the building expansion, and sprinkler drain piping shall be “hot- dip” galvanized
    in accordance with ASTM A-123 zinc coating specifications. Fittings shall be galvanized
    threaded malleable iron fittings.

B. Allied, American Tube, Bullmoose, Wheatland: Schedule 40 black steel and for Grooved Pipes Schedule
    10: ASTM A-135 or ASTM A-795 stamped on pipe; Stockham, Grinnell or Warwick Class 150 threaded
    malleable, ASTM A197 or Class 125 cast iron fittings, ASTM A126; Anvil, Ward, Tyco or Smith-Cooper
    Class 300 threaded ductile iron, ASTM A536 or Class 125 cast iron fittings, ASTM A126.

C. Shop-weld thread-o-lets may be used in lieu of tee fittings, but field (site) welding will not be
    permitted.

D. Mechanical Couplings: All grooved couplings and fittings shall be new and furnished by the same
    manufacturer. Victaulic grooved coupling style 004, 07, 75 or 77, by Victaulic, Tyco, Gruvlok or Gustin-
    Bacon or equal.
    1. Mechanical Tees: Victaulic style 920 or 920N, by Victaulic, Tyco, Gruvlok or Gustin-Bacon or equal.
    2. Use rigid couplings where flexibility is not required or provide necessary sway bracing.
    3. Prohibited Piping and Fittings: Copper pipe, schedule 5, 10, 20, 30, Super 40, “Superflow”, “Dyna-
        Flow”, Thinwall, “Eddylite” by Bullmoose and Threadable Lightwall pipe are not allowed. XL, POZ-
        LOK, U-bolt Victaulic style 921 mechanical tees, Victaulic style 99 Roust-A-Bout, Victaulic style 90
        Plainlock, Hooker style fitting, quick disconnect, boltless, snap-joint, field drilling or welding of
        any main or branch lines, and any device specifically prohibited by the local governing agencies
        is not allowed. No unions shall be permitted for any size pipe. Plain end fittings are not allowed.
    4. In lieu of rigid pipe offsets or return bends for sprinkler drops, the Victaulic AquaFlex® (CSFM
        #7515-0531:0119) multiple use stainless steel sprinkler fitting system, or equal, shall be used to
        locate sprinklers as required by final finished ceiling tiles and walls. The drop system shall consist
        of a braid or unbraided (corrugated) type 304 stainless steel flexible tube, a zinc plated steel
        1” NPT male threaded nipple for connection to branch line piping, and a zinc plated steel
        reducer with a 0.5” or 0.75” NPT female thread for connection to the sprinkler head. The flexible
        drop must be listed for a minimum of 3 90° bends to assure proper installation. Union joints
        shall be provided for ease of installation. The flexible drop shall attach to the ceiling grid using
        a one-piece open gate bracket (the bracket shall allow for sprinkler installation before or after
        the bracket is secured to the sprinkler grid). The braid drop system shall be FM Approved for
        sprinkler services to 200 psi and will be capable to be installed without the use of tools, and the
        corrugated system shall be UL Listed for sprinkler services to 175 psi. Hoses shall be factory-
        pressure tested to 400 psi. The use of flexible sprinkler hose fittings are allowed as long as the
        assembly components are listed and installed in accordance with the requirements of the listing,
        including the manufacturer’s installation instructions. Flexible fittings shall be listed by the
        California State Fire Marshal.

E. Below Ground Piping:
    1. UL Listed, Class 350 Ductile Iron Pipe (DIP) with mechanical restrained joints: Pipe shall conform
        to AWWA C151, minimum Class 50. Ductile iron pipes shall be cement mortar lined in
        conformance with AWWA C104 and shall have a 1-mil thick exterior petroleum asphaltic coating.
        Pipe shall be of domestic manufacture: U.S. Pipe Tyton joint, Pacific States; or equal. The
Contractor shall furnish certification that pipe supplied has been manufactured in compliance with requirements of AWWA C151.

a. DIP Couplings and Sleeves: Ductile Iron conforming to ANSI/AWWA C153/A21.53 and shall be 250 psi pressure rated. Couplings and sleeves shall be domestic U.S. Pipe, Tyler, Union, or equal.

b. Ductile Iron and Cast Iron Fittings: AWWA C110, ductile iron or cast iron, 250 psi pressure rating; of dimension to match pipe outside diameter. Fittings to be epoxy coated and lined.
   1) Lining: AWWA C104, cement mortar.
   2) Gaskets: AWWA C111, rubber.

c. Joints: Joints for ductile pipe shall be of the mechanical or push-on type compression joints unless otherwise indicated, and shall conform to ANSI/AWWA/C111/A21.11, latest revisions. The joint and fittings shall have the same pressure rating as the pipe it shall join. Gaskets and lubricant shall be furnished with the pipe.

d. Mechanical joint restraints shall be “Mega-Lug 1100 Series” by EBBA Iron Sales, MJ Field-Lok by U.S. Pipe, or equal. Joint preparation and installation shall be in accordance with manufacturer’s recommendations.

e. Bolts, nuts, washers and rodding used for the installation of underground piping, valves and fittings from the riser flange back to, and including parts of the water main tap shall be stainless steel conforming to UNS31600 (formerly AISI Type 316). Bolts shall conform to ASTM F 593, Alloy Group 2, Condition CW1/CW2 (depending on size). Nuts shall conform to ASTM F 594, Alloy Group 2, Condition CW1/CW2 (depending on size). Individual products not identified by the applicable ASTM standard are not acceptable, regardless of composition. After installation, apply full coat of asphalt or other acceptable corrosion retarding material to surfaces of ferrous anchorages.

f. Provide concrete thrust blocks at changes in direction, changes in size, stops and dead ends, and at valves where thrusts may be expected.

F. Pre-Action Sprinkler and Water Spray Fixed System (Deluge System) Piping:

1. Galvanized black carbon steel pipe meeting ASTM A-135, A-795, and/or A53. Piping shall be UL listed, and FM approved for 300 psi working pressure. Piping shall have a Corrosion Resistance Ratio, (CRR) of 1.00 or greater, per UL listings. Piping shall be “hot-dip” galvanized in accordance with ASTM A-123 zinc coating specifications. Sprinkler contractor shall supply mill certificates verifying that the products submitted from the manufacturer meet the above criteria.
   a. Piping 2” and smaller: Schedule 40 with minimum Class 150 ANSI B16.3 cast iron threaded fittings.
   b. Piping 2.5” to 6”: Schedule 40 with roll grooved type fittings and couplings. Plain end type fittings will not be permitted.

G. Unions for piping 2” and smaller, above ground only:

1. Black Steel Pipe: 250 pound screwed black malleable iron, ground joint, brass to iron seat.
2. Galvanized Steel Pipe: 250 pound screwed galvanized malleable iron, ground joint, brass to iron seat.
3. **Dielectric Unions:** EPCO, or equal, dielectric nut type or flange type unions with gasket material suitable for service and temperature in which they are required. Install at connections between ferrous and non-ferrous piping.

4. **Dielectric Waterway Fittings:** Victaulic Style 47, or equal, zinc-electroplated steel or ductile iron body with male threaded or grooved ends. LTHS high temperature polyolefin polymer lining suitable for temperatures up to +230 °F and pressures up to 300 psig. Install at connections between ferrous and non-ferrous piping.

H. **Flanges for piping 2.5” and larger, above ground only:**

1. Raised face 150 pound class forged steel, weld, neck or slip-on type conforming to ASA B16.5 and ASTM A181. The faces of the flanges being connected to be alike in all cases. Locate flanges so that the piping can be easily disconnected for removal of the equipment or valve. Gasket material shall be of material suitting the service of the opening system in which installed and which conforms to its respective ANSI Standard (A21.11. B16.21). Provide materials that will not be detrimentally affected by the chemical and thermal conditions of the fluid being carried.
   
   a. Bolting Materials: Carbon steel Heavy Hex bolts and nuts, ASTM A307-Type B.
   
   b. Use SBR gasket, 1/16” thick, similar to Garlock No. 91, at flange connections.

2. **Dielectric Flange Insulation Kits:** Calpico, or equal:
   
   a. Dielectric Gaskets: 1/8” phenolic, temperature to 225 °F, 500 volts per mil dielectric strength, compression strength 24,000 lbs. per sq. inch, water absorbance 1.6% in accordance with ASTM-D-229.
   
   b. Dielectric Sleeve Material: 1/32” wall spiral would Mylar, 4,000 volts per mil dielectric strength, temperature to 300 °F, water absorption 0.8% maximum.

3. **Insulating Washers:** 1/8” phenolic, same as gasket material.

4. **Flange adapters for flanged components to grooved system:** Ductile iron housing conforming to ASTM A-536, grade 65-45-12, grade “E” EPDM gasket, Class 125 or 150 bolt-hole pattern. Victaulic Style 741, 744 or equal.

5. **Flange adapters for ANSI 300 flanged components to grooved system:** Ductile iron housing conforming to ASTM A-536, grade 65-45-12, grade “E” EPDM coupling gasket UL classified in accordance with ANSI/NSF 61 for cold potable water service. Victaulic Style 743, or equal.

6. Provide 300 psi or higher rated fittings where required by the system.

I. **Grooved End Fittings:**

1. Shall be ductile iron conforming to ASTM A536, short radius, full flow, FireLock® fittings, or standard ductile iron or steel fittings with factory grooved ends designed to accept Victaulic or equal couplings.

2. **Rigid Couplings:** UL listed and FM approved for use with grooved end connections. Housings shall have offsetting, angle-pattern bolt pads to provide system rigidity and support and hanging in accordance with NFPA 13. Tongue and recess rigid type couplings shall only be permitted if the contractor uses a torque wrench for installation. Required torque shall be in accordance with the manufacturer’s latest recommendations.
a. 1.25” through 4”: “Installation Ready” stab-on design, for direct ‘stab’ installation onto grooved end pipe without prior field disassembly. Victaulic FireLock® Style 009H, or equal.

b. 5” and Larger: Standard rigid couplings. Victaulic FireLock® Style 005 and Style 07 Zero-Flex®, or equal.

3. Flexible Couplings: UL listed for use with grooved end connection. Use in seismic areas and where required by NFPA 13. Victaulic styles 75, 77, 177, or equal.

a. 2” through 8”: “Installation Ready” stab-on design, for direct ‘stab’ installation onto grooved end pipe without prior field disassembly. Victaulic Style 177 QuickVic™, or equal.

b. 10” and Larger: Standard flexible couplings. Victaulic Style 75, 77, or equal.

4. Victaulic Style 009H, 005, and 07 rigid couplings, or equal, may be used with IPS steel piping systems which meet the support and hanging requirements of NFPA 13. An adequate number of Victaulic Style 177, 75 and 77 flexible couplings, or equal, shall also be used to compensate for thermal expansion/contraction of the pipe.

J. Weld-O-Lets and Thread-O-Lets may be used for non-galvanized steel piping if main pipe size is at least three standard pipe sizes larger than branch pipe, i.e. 2” main and 1” branch. Welding shall be shop welded by a certified welder. Field (site) welding will not be permitted.

K. Mechanical Tees and “Strap-O-Let” type tees are not acceptable.

L. Prohibited Fittings: XL, POZ-LOK, U-bolt Victaulic style 921 mechanical tees, Victaulic style 99 Roust-A-Bout, Victaulic style 90 Plainlock, Hooker style fitting, quick disconnect, boltless, snap- joint, field drilling or welding of any main or branch lines, and any device specifically prohibited by the local governing agencies is not allowed.

2.3 CORROSION PROTECTION FOR UNDERGROUND PIPE AND FITTINGS

A. In addition, all buried piping, castings, fittings, valves and couplings below ground shall be encased in 8 mil polyethylene tube encasement. Polyethylene wrap shall be manufactured of 0.008” (8 mils) minimum, group 2, linear low density, flat tube, polyethylene manufactured of virgin polyethylene material that meets or exceeds the specifications of the latest revision of AWWA C105 and ANSI A21.5, ASTM D4976 and NT4112. Wrappings shall be installed on site only. Minimum properties as follows:

1. Tensile Strength: 3,600 PSI minimum - ASTM D882.
2. Elongation: 800% minimum - ASTM 882.
3. Dielectric Strength: 800 V/mil, minimum - ASTM D149.
4. Impact Resistance: 600g, minimum - ASTM D1709-B.
6. Density: 0.910 to 0.935 g/cm³.

B. Color: The polyethylene film shall be black (weather-resistant) containing not less than 2 percent carbon black with an average particle diameter of 50 mm or less. Black Polyethylene film shall be naturally UV protected.

C. Markings: The polyethylene film supplied shall be clearly marked, at a minimum of every 2′ along its length, containing the following verbiage:

1. Manufacturer’s Name and Trademark.
2. Year of manufacture.
3. Minimum film thickness and material type.
5. Applicable pipe sizes.

D. Acceptable Manufacturers:
1. Christy’s.
3. Trumbull Manufacturing.
5. Or Equal.

2.4 VALVES

A. Manufacturers:
1. AGF
2. Grinnell.
5. Mueller.
6. Reliable.
7. Elkhart.
8. Victaulic.
11. Viking.
12. FPPI.
14. Or Equal.

B. Control Valve 2” or smaller: OS&Y rising stem type gate valve bronze or brass body, bonnet and disc, copper alloy stem, threaded ends, 175 PSI WOG min. Provide with tamper switch. UL Listed.

C. Control Valve 2.5” or Larger: Lug type wafer valve with tamper switch, ductile iron body, nickel plated ductile iron disc, stainless steel stem and Buna-N seat, 175 PSI WOG min.

D. Control Valve 2.5” or Larger: OS&Y rising stem type gate valve, cast iron body and bonnet, bronze stem, seat and disc, flanged ends, 175 PSI WOG min. Provide with tamper switch.

E. Gate Valves 2” and Smaller: MSS SP-80; UL listed and FM approved, 175 psi non-shock cold water, bronze body, screw-over bonnet, threaded ends, outside screw and yoke, solid wedge, bronze trim, replaceable seat rings. Provide each valve with supervisory switch. Nibco T-104- O, or equal.
F. Gate Valves 2.5” and Larger with Flanged Ends: MSS SP-70; UL listed and FM approved, 175 psi non-shock cold water, iron body, bolted bonnet, flanged ends, outside screw and yoke, solid wedge, pre-grooved stem for supervisory switch mounting, bronze trim, replaceable seat rings. Provide each valve with supervisory switch. Nibco F-607-OTS, or equal.

G. Gate Valves 2.5” and Larger with Grooved Ends: UL listed and FM approved, 250 psi CWP, ductile iron body with grooved ends, EPDM coated cast iron disc, brass stem, and cast iron bonnet, provide each valve with supervisory switch. Victaulic FireLock® Series 771 (OS&Y) and Series 772 (NRS), or equal.

H. Butterfly Valves 2” and Larger: MSS SP-67; UL listed and FM approved, California State Fire Marshal Listed, indicating type, gear operated, ductile iron lug type body, stainless steel stem, nickel plated ductile iron disc, Buena-N seat, 250 psi Non-shock cold water. Provide each valve with a supervisory switch. Nibco LD3510-8, or equal.

I. Butterfly Valves 2” and Larger with Grooved Ends: UL listed and FM approved for indoor and outdoor use, ductile iron body with grooved ends, nickel-plated ductile iron disc, stainless steel bearings with TFE lining, stainless steel stem, Nitrile seat and stem seals. Valve shall have weatherproof actuator with two built-in pre-wired supervisory switches. Victaulic FireLock® Series 705 (300 psi) and Series 765 (365 psi), or equal, supervised in the open position only.

J. Butterfly Valves 2” and Larger Normally Closed: UL listed and FM approved for indoor and outdoor use, used for fire pump metering test lines per NFPA 20. Weatherproof actuator with pre-wired supervisory switches monitoring the valve in the closed position only. Victaulic FireLock® Series 707C (300 psi) and Series 766 (365 psi), or equal.

K. Ball Valves 2” and Smaller: MSS SP-110; UL listed and FM approved, UL Listed for indoor and outdoor service, California State Fire Marshal Listed, threaded body style, full port design, hand wheel, factory installed internal supervisory switch, bronze body and stem, 300 psi non-shock cold water. Provide each valve with a supervisory switch. Nibco KT-505W-8, or equal.

L. Ball Valves; Inspector’s test and drain only-up to 2” maximum: MSS SP-110; UL listed and FM Approved, full or standard port, two piece bronze body construction, chrome plated solid bronze ball, blowout proof stem, and vinyl covered steel handle, 300 psi Non-shock cold water. Nibco KT-580/585-70-UL, or equal.

M. Globe Valves 1” and Smaller: Threaded ends, rubber disc, screw over bonnet, 175 psi non-shock cold water, UL Listed for trim and drain use. Nibco KT-65-UL (straight pattern) or KT-67-UL (angle pattern), or equal.

N. Check Valves 2” and Smaller: MSS SP-80; swing type check valve, screwed bonnet, horizontal swing, renewable disc, bronze, brass, or cast iron body, threaded ends, 200 psi non-shock cold water. 175 PSI WOG min. Nibco KT-403-W, or equal. UL listed.

O. Check Valves 2.5” and Larger: MSS SP-71; UL listed and FM Approved, swing type check valve, bolted bonnet, horizontal swing, renewable seat and disc, cast iron body, drilled and tapped for ball drip outlet, flanged ends, 175 psi non-shock cold water. Nibco F-908-W, or equal.

P. Check Valves 2.5” and Larger at Fire Department Connections: UL listed and FM Approved, ASTM A48 cast iron body, ASTM A240 stainless steel clapper, bronze seat, stainless steel disc and spring actuated, EPDM rubber facing seal and gasket, drilled and tapped for ball drip outlet, grooved ends, 250 lb. WOG. Nibco G-917-W, or equal.
Q. Check Valves 2” and Larger with Grooved Ends: Spring-loaded check valves, ductile iron body, stainless steel or EPDM coated ductile iron disc, stainless steel spring, plated nickel seat or welded-in nickel seat, grooved ends. Victaulic FireLock® Series 717H (365 psi) and Series 717 (250 psi), or equal.

R. Drain Valves and Inspector’s Test Valves: UL listed, globe, straightway or angle type, ball or butterfly, bronze body, renewable disc, threaded or grooved, 150 lb WOG or 300 psi CWP, equipped with reducer and hose connection with cap or connected to a drain line. Victaulic Style 720 TestMaster™ II, or equal.

S. Automatic Ball Drip Valve: UL listed and FM approved, automatic drain valve horizontally installed at the low point in the fire department connection piping. Water pressure from a fire department pumper automatically closes this valve. Automatically re-opens when pressure ceases, permitting piping to drain and thereby preventing freezing. Bronze body with ¾” or 0.5” NPT female inlet connection. Maximum working pressure of 175psi. Nibco Model RG22100/22100, or equal.

T. Zone Control Riser Module: UL listed and FM approved zone control riser module installed in zoned wet sprinkler systems, compact design consisting of a ductile iron module body with grooved ends, shutoff valve, test and drain valve combination with different orifice sizes, and vane type water-flow detector with sealed retard, visual switch activation, and mechanical delay adjustment. Victaulic Series 747M, AGF, or equal.

U. Drip Valve: 0.75”, cast brass automatic ball drip type, threaded ends, 175 PSI WOG min

V. Testing Valve: 1.5”, test and drain, sight glass, 0.5” test orifice, lever operated, 300 Psi WOG. Route drain to a mop sink or the drain riser.

W. Main Drain Valve: 2”, angle gate valve, with bronze body, copper alloy stem, threaded ends, 175 Psi WOG. Route drain to a mop sink or the drain riser.

2.5 STANDPIPE FIRE DEPARTMENT HOSE VALVE OUTLETS

A. Fire hose valve connection type: Fire department fire hose valve connections shall have 3” National Standard hose thread as required by the San Francisco Fire Department (SFFD).

B. Class 1 Fire Hose Valves: UL listed for individual hose stations in Class 1 and Class III standpipe systems, cast brass/bronze angle valve, 2.5” female inlet and 2.5” female outlet, MxM (NPT x NST) adapter, and 3” National Standard hose thread outlet per SFFD standards. Provide with 3” Female NST brass cap and chain. Potter-Roemer Model 4065-2.5x3, or equal.

2.6 INTEGRAL INSPECTORS ALARM TEST AND SYSTEM DRAIN

A. Combination system drain and visible orifice insert/sight glass for testing system alarm; with 1.25” inlet and outlet connections, maximum working pressure 300 Psi, 0.5” orifice insert, ductile iron housing, UL listed. Victaulic TestMaster style 718, or approved equal.

B. Water pressure gauge, range 0-300 Psi, in 5 Psi increments, brass case - 3.5” diameter, 0.25” NPT male pipe connection, UL listed. Star Sprinkler, Ashcroft or approved equal.

C. Pressure gauge test valve, brass 0.25” screwed ends, 300 Psi WOG. United or approved equal.

D. All relief, main, auxiliary and equipment drains shall be routed to approved discharge locations outside the buildings.
2.7 WATER FLOW ALARM – VANE TYPE

A. Indicator shall be for either vertical or horizontal installation. Indicator shall not be installed in a fitting that changes direction of water flow and shall have a sensitivity setting to signal any flow of water that equals or exceeds the discharge from one sprinkler head. Provide retarding device to prevent false alarms from line surges.

B. Whenever a water flow alarm is installed in the piping system, an approved control valve shall be provided upstream of the alarm indicator. In addition, a drain is required downstream of the alarm indicator.

C. Each water flow alarm shall be monitored as required by the Airport. Coordinate with Electrical and IT subcontractors to provide conduit and wiring from switch(es) to panel in SSR-ER for monitoring.

D. Airport A&E Standards

2.8 ROOF FIRE DEPARTMENT OUTLET CONNECTIONS

A. Provide for standpipe roof outlet connection by the fire department. Outlets shall provide the minimum flow per outlet per NFPA 14 and local fire department requirements. Roof outlet connection shall have a cast iron body with female NPT inlet and male NPT outlets. Type and size of inlet and number of outlets to suit installation. Provide with Class 1 fire hose valves for each outlet.

   1. Wall Mounted Type: Two-way, 6” female NPT back inlet with two 2.5” male NPT outlets on fitting. Provide Class 1 angle type fire hose valves on each outlet. Valve outlet shall face forward. Potter Roemer Model 5872, or equal.

2.9 HANGERS AND SUPPORTS

A. Hangers and seismic sway bracing shall be designed and installed as required by NFPA 13 and NFPA 14 (including appendices), and by the California Building Code. Provide steel bracing as to resist earthquake loads as required for Seismic Design Category D, with an SDS value of 1.0g.

B. Hangers and components shall be U.L. listed and/or FM approved. Hanger and support components including seismic sway bracing components shall be of the same manufacturer.

C. Hanger Rods: Hanger rod size shall be no less than the standard rod sizes listed on the MSS SP-69. Rods shall be steel rods, threaded at ends only with a minimum safety factor of 5 over the imposed load, Tolco Fig. 103, or equal. Where rod stiffeners are required, use Tolco Fig. 98, or equal.

D. Where beam clamps are used, provide beam clamp retaining strap.

E. Powder-driven and explosive type fasteners are not allowed.

F. Horizontal Pipe Attachments:

   1. Two inches (2”) and smaller: Adjustable swivel loop hanger, Tolco Fig. 200, or equal.

   2. Two and a half inches (2.5”) and larger: Standard clevis hanger with clevis bolt spacer, Tolco Fig. 1, or equal.

G. Pipe clamp for sway bracings: Tolco Fig. 4A and 4B pipe clamps, Tolco Fig. 25 surge restrainer, or equal.
H. Sway brace attachments: Tolco Fig. 907 4-way longitudinal sway brace attachment, Tolco Fig. 909 no-thread swivel sway brace attachment, Tolco Fig. 910 swivel sway brace fitting, Tolco Figure 1000 fast clamp, or equal.

I. The end sprinkler on a branch line shall be restrained against excessive vertical and lateral movement by use of a wrap-around hook or by other approved means per NFPA 13.

J. When static pressure exceeds 100 psi, arm over and drops 12" and over requires a hanger.

K. Where beam or joist thickness will not accommodate a fastener of a required length, through bolt with the required diameter of the bolt and washer will be acceptable. All thread rods is not acceptable for the required bolt.

2.10 SEISMIC EXPANSION LOOPS

A. Sprinkler pipe passing through or crossing building seismic joints, shall contain a flexible expansion loop designed for seismic movement. Flexible loops shall impart no thrust loads to system support anchors or building structure. Loops shall be located at, or near, the building seismic joint. A vertical support hanger, located within 4 pipe diameters, shall be installed on each side of the flexible loop. Each hanger to be transversely and longitudinally braced per code. Seismic bracing shall not pass through building seismic joint and shall not connect or tie together different sides or parts of building structure. Flexible loops shall be capable of movement in the ±X, ±Y, ±Z planes.

B. Movement requirements and location, relative to seismic separation, shall be determined by system design engineer. Flexible loops may be installed to accommodate thermal expansion, seismic movement, and building settlement. Unless specified otherwise by system design engineer or governing codes, flexible loop connections to sprinkler piping shall be installed, inspected, and tested in accordance with current NFPA-13 standards.

C. Flexible expansion/seismic loops shall consist of two flexible sections of hose and braid, two 90° elbows, and a 180° return assembled in such a way that the piping does not change direction, but maintains its course along a single axis. Flexible loops shall have a factory supplied, center support nut located at the bottom of the 180° return, and a drain/air release plug. Flexible loops shall impart no thrust loads to system support anchors or building structure. Flexible loops may be installed to accommodate both thermal and seismic motion. Materials of construction and end fitting type shall be consistent with pipe material and equipment/pipe connection fittings. Flexible expansion/seismic loops to be “Metraflex(r) Fireloop(tm) as manufactured by The Metraflex Company, or equal.

D. Loops installed hanging down shall have a drain plug. Loops installed up shall be fitted with an automatic air release valve to purge air from the high point of the loop. Loops installed in any position other than hanging down must have the 180° return bend supported. Install loop within 4 pipe diameters, both upstream and downstream, from a pipe guide or anchor.

E. In grooved piping systems, seismic motion can be accommodated by installing swing joints consisting of flexible couplings, pipe nipples and elbows that provide simultaneous movement in all directions, or other seismic movement compensation devices such as loops, offsets, or Victaulic Style 155 expansion joints, or equal, when in-line device is required, to provide flexibility to the system and help reduce pipe stresses. Refer to Victaulic design submittal #26.12.
1. Grooved pipe expansion loops shall consist of 8 Victaulic, or equal, flexible couplings, four 90° elbows, and 3 grooved end pipe spools in water systems up to +250°F (121°C) in accordance with manufacturer’s recommendations for expansion compensation.

2.11 EXPANSION SETTLEMENT JOINTS

A. General: Flexible connections shall be provided to accommodate a minimum of 12” of differential settlement and accompanying lateral movement for pipes entering or leaving buildings and at other transition conditions where differential settlement may occur.

B. Flexible expansion joints shall be manufactured of ductile iron conforming to the material requirements of ASTM A536 and ANSI/AWWA C153/A21.53. Foundry certification of material shall be readily available upon request.

C. Each flexible expansion joint shall be pressure tested prior to shipment against its own restraint to a minimum of 350 psi (250 psi for flexible expansion joints 2” and larger.) A minimum 2:1 safety factor, determined from the published pressure rating, shall apply. Factory Mutual Approval for the 3” through 12” sizes is required.

D. Each flexible expansion joint shall consist of an expansion joint designed and cast as an integral part of a ball and socket type flexible joint, having a minimum per ball deflection of: 20º, 2”-12”; 15º, 14”-36”; 12º, 48” and 4” minimum expansion. Additional expansion sleeves shall be available and easily added or removed at the factory or in the field. Both standardized mechanical joint and flange end connections shall be available.

E. All internal surfaces (wetted parts) shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213 and shall be holiday tested with a 1500 volt spark test. Sealing gaskets shall be constructed of EPDM. The coating and gaskets shall meet ANSI/NSF-61. Exterior surfaces shall be coated with a minimum of 6 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C116/A21.16.

F. Appropriately sized polyethylene sleeves, meeting ANSI/AWWA C105/A21.5, shall be included for direct buried applications.

G. Manufacturer’s certification of compliance to the above standards and requirements shall be readily available upon request. The purchaser (or SFO) shall reserve the right to inspect the manufacturer’s facility for compliance.

H. Furnish with mechanical joint and connections conforming to the dimensional requirements of either ANSI/AWWA C111/A21.11 or ANSI/AWWA C153/A21.53 depending on size.

I. Basis-of-Design Product: Subject to compliance with requirements, provide EBBA Iron, “Flex Tend;” or a comparable product by one of the following:
   1. Ebba Iron “FlexTend.”
   2. Hyspan.
   3. Star Pipe Products “StarFlex.”
   4. Or approved equal.

J. When mechanical joints are used: Mechanical joint restraint shall be incorporated into the design of the follower gland. The restraining mechanism shall consist of individually actuated wedges that
increase their resistance to pull-out as pressure or external forces increase. The device shall be capable of full mechanical joint deflection during assembly and the flexibility of the joint shall be maintained after burial. The joint restrain ring and its wedging components shall be made of Grade 60-42-10 ductile iron conforming to ASTM A536. The wedges shall be ductile iron heat treated to a minimum hardness of 370 BHN. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell conforming to ANSI/AWWA C111/A21.11 and ANSI/AWWA C153/A21.53. Torque limiting twist-off nuts shall be used to insure proper actuation of the restraining wedges. Unit shall have a rated working pressure of 350 psi in sizes 16” and smaller. Devices shall be listed by UL up through the 24” size and approved by Factory Mutual up through the 12” size. Restraint shall be Series 1100 “Megalug,” or equal.

2.12 SLEEVES AND ESCUTCHEONS

A. Provide sleeves for each pipe passing through footings, foundations, walls, partitions, floors, (except drop nipples for sprinklers), roofs and other locations where needed, whether shown or not. Sleeves shall extend a minimum of 1” above floors and be flush with walls, ceilings, and partitions. In concrete construction, sleeves shall be set in forms prior to pour. Clearance between sleeves and pipes shall be 1” for pipes up to 3.5”, 2” for pipe sizes 4” and greater, and 3” for seismic joints.

B. Piping penetrating exterior walls, below grade exterior walls and floors shall be sleeved and made watertight. Seals shall be modular mechanical type consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and the opening, zinc galvanized plated bolt and nut, Thunderline Corporation “Link-Seal”, or equal, with “Link-Seal” WS series steel wall sleeve, or equal.

C. Sheet metal pipe sleeves: Fabricate from galvanized sheet metal; round tube closed with snap lock joint, welded spiral seams, or welded longitudinal joint. Fabricate from the following gauges: 3” and smaller, 20 gauge; 4” to 6”, 16 gauge; over 6”, 14 gauge. Adjustocrete, sleevecrete, or equal. Fabricate from the following gauges:
1. 3” and smaller: 20 gauge.
2. 4” to 6”: 16 gauge.
3. Over 6”: 14 gauge.

D. Set pipe sleeves and inserts in place before concrete is poured. Coordinate the placing of these items to avoid delaying concrete placing operations.

E. Sleeves for piping shall be of adequate size to accommodate the pipe with clearance for packing and caulking. Provide galvanized steel pipe sleeve, minimum 18 gauge. Provide UL rated ceramic fiber packing. Pack space between sleeve and insulation with packing and seal ends with UL approved seal. Seal shall be positively fastened using metal plates, or escutcheons. Commercial pipe sleeve assemblies, which are UL rated, and which have been approved by the Fire Marshal for this purpose shall be used. Pipe Shields Inc. F1000 series or equal. Use only assemblies, which have been designed for the service on which they are to be used.

F. Caulk space between sleeve and pipe or pipe covering through rated walls, partitions, and floors with fire rated, incombustible, UL listed, permanently plastic, waterproof non-staining compound leaving a finished, smooth appearance. Fire stopping shall be in accordance with fire stopping specifications. Provide supporting backing to secure material in place.

G. Provide sleeves as follows:
<table>
<thead>
<tr>
<th>Sleeve Location</th>
<th>Sleeve Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interior Wall, Partitions</td>
<td>Galvanized sheet metal</td>
</tr>
<tr>
<td>Membrane Waterproof Floor, and Roof Construction</td>
<td>Standard weight black steel pipe with flashing clamp device welded or threaded to pipe sleeve. Flashing clamp device J.R. Smith Fig. 1720, Zurn Fig. Z195, or Wade.</td>
</tr>
<tr>
<td>Non-Membrane Floor Construction</td>
<td>Standard weight black steel pipe.</td>
</tr>
<tr>
<td>Footings &amp; Foundation</td>
<td>Schedule 40 galvanized steel pipe.</td>
</tr>
<tr>
<td>Exterior Walls</td>
<td>Standard weight galvanized steel pipe with a continuously welded water stop of 0.25” steel plate extending from outside of sleeve a minimum of 2” all around.</td>
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</table>

H. Escutcheons, Finish and Plates:
1. Smooth up rough edges around sleeve with plaster.
2. Provide escutcheon plates where exposed pipes pass through walls, ceilings, or floors, in finished rooms and conspicuous locations. Provide chrome or nickel plated plates sized to fit pipe and pipe covering and give a finished appearance. Escutcheons held in place by set screws allowing enough clearance to care for expansion and shall be sufficient size to cover the opening around the pipe. Provide plates on pipes extending through sleeves.

2.13 ACCESS DOORS AND PANELS

A. Furnish under this Division where shown, specified, where required by Regulatory Agencies and for access of concealed valves, unions, and other fire protection items, even though access doors are not shown for Fire Protection work. Doors shall be in accordance with requirements of Section pertaining to “Access Doors and Panels.”
1. Doors in this Division and Division 8 sections pertaining to “Access Doors and Panels” shall be from same manufacturer for identical appearance and keying.
2. Sizes: Use size as required for unobstructed access to item being served. 24” x 24” minimum for ceilings and 12” x 12” minimum for walls.
3. Furnish fire rated doors when located in fire rated construction.
4. Deliver doors for installation under Division 8 sections pertaining to “Access Doors and Panels.” Mark each door to accurately establish its location.
5. Provide safety chain on swing-down ceiling type access panels.
6. Keying shall be as specified in Division 8 sections pertaining to “Access Doors and Panels.”

B. Non Rated Access Doors (Walls and Ceilings): Access door and frame shall be fabricated from 14-gage galvanized steel with a prime coat finish and will require final field painting. The door shall have a 16 gage vertical reinforcement channel, rounded safety corners and a concealed hinge. Frame shall be one piece construction with no miters or welds on the face. Latch shall be cylinder lock operated. Provide Elmdor SLK Series dry wall access door, Mifab, or equal.
C. Fire Rated Wall Access Doors: Access door and frame shall be fabricated from 16-gage galvanized steel with a prime coat finish and will require final field painting. Hinge shall be concealed type. The door shall have a heavy duty spring to provide positive latching when closed, and interior latch release slide enabling door to be opened from the inside. Door shall be fire rated by UL for 1.5 hours, “B” label, and meet ANSI-UL10B standard. Exterior latch shall be recessed and operated using ring attached to the sliding bolt. Latch shall be cylinder lock operated. Provide Elmdor FR Series, Mifab, or equal.

D. Fire Rated Ceiling Access Doors: Access door frame shall be fabricated from 16 gage galvanized steel with a prime coat finish and will require final field painting and provided with masonry anchors and bolt holes. Access door panel shall be fabricated from 20 gage galvanized steel with a prime coat finish and will require final field. The door shall be filled with 2” thick fire rated insulation, and be welded pan type. Access door shall have automatic closer, be self-latching bolt, operated by mortise cylinder lock. Door shall be fire rated by UL for 1.5 hours, “B” label, and meet ANSI-UL10B standard. Provide Elmdor FRC Series for ceilings, Mifab, or equal.

2.14 PRESSURE GAUGES

A. U.L. listed and labeled for fire protection sprinkler service, 3.5” dial, 0-300 psi scale with 5 psi increments, dual range twice the system working pressure, moisture and weather resistant, 0.25” bottom connection, shut-off valve, phosphor bronze tube, and brass socket. Mount pressure gauge on 0.5”, 3-way valves.

2.15 WATER FLOW SWITCHES

A. UL listed, California State Fire Marshal listed, and FM Approved, vane type flow switch with retard mechanism or manual adjustment to prevent false alarm, listed for indoor/outdoor use and have tamperproof cover. Provide each with two sets of SPDT contacts and conduit connection for wiring to remote alarm system, Potter Electric Signal Co., VSR, System Sensor WFD Series, or equal. Coordinate installation with Division 26.

2.16 SUPERVISORY (TAMPER) SWITCHES

A. UL listed, California State Fire Marshal listed, and FM Approved. Switches shall be listed for indoor/outdoor use, 120 VAC/30 VDC, have tamperproof cover, each with two sets of SPDT contacts and conduit connection for wiring to remote alarm system. Coordinate installation with Division 26.

1. OS&Y gate valves: Switches shall be Potter Electric Signal Co., OSYSU-2, System Sensor OSY2, or equal.


3. “Normally Closed” OS&Y valves: Switches shall be System Sensor PSP1 plug-in special purpose supervisory switch, or equal.

B. Switch shall be mounted so as not to interfere with normal operation of the valve and be adjusted to operate when handle of valve has traveled more than one-fifth the distance of its normal operating position. Coordinate with Electrical and IT subcontractors to provide conduit and wiring from switch(es) to panel in SSR-ER for monitoring.
C. Housing shall be of aluminum, acid-treated, primed and finished in baked red enamel. Removal of housing shall cause switch to operate. Inside shall be a single pole, double throw micro switch with connection for electrical conduit.

D. Install on all control valves for monitoring as required by the Airport.

E. Manufacturer: Potter-Roemer, Notifier, Simplex, or approved equal.

2.17 PIPING IDENTIFICATION

A. Piping are to be identified as follows: Brady Perma-Code, MSI Marking Services Inc., or equal, pressure sensitive self-sticking pipe markers consisting of pipe content wording and arrow indicating directions of flow on ANSI color background. Arrow and wording are two separate markers which shall be placed immediately adjacent to each other. Provide at each end of each marker, 2.25” wide self-sticking clear tape around periphery of pipe or insulation to further secure marker. Markers shall be applied to clean surfaces free of dust, grease, oil or any other material which will prevent adhesion. Install after cleaning, painting and insulation is complete. Pipe identification shall comply with ANSI/ASME A13.1 "Scheme for the Identification of Piping Systems" latest Standard.

B. Location and visibility for pipe identification:
   1. On horizontal runs spaced 20’-0” maximum but not less than once in each room at entrance and exit of each concealed space.
   2. At each riser takeoff.
   3. Within 1’-0” of each valve and control device.
   4. At every change in directional flow.
   5. At every pipe passage through wall, floor and ceiling construction.
   6. Where capped piping is provided for future connections, provide legible and durable metal tags indicating symbol identification.
   7. At wall and ceiling access panel/doors.
   8. Near major equipment items and other points of origination and termination.
   9. Pipe identification of sprinkler branch piping is not required.
  10. Attention shall be given to visibility with reference to pipe markings. Where pipelines are located above or below the normal line of vision, the lettering shall be placed below or above the horizontal centerline of the pipe.
  11. Fire sprinkler mains shall be labeled with the sprinkler zone that it serves. Example: “SZ-1A”.

C. Piping Color Coding

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<thead>
<tr>
<th>ANSI Fluid Service</th>
<th>Background Color Field</th>
<th>Color of Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire Protection Water Fire</td>
<td>Red</td>
<td>White</td>
</tr>
<tr>
<td>Auto Sprinklers</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Division 21 – Fire Suppression
A&E Standards: Building Systems
Fire Protection and Fuel Piping/Storage
Version 3.1 | March 2018
Page 53
D. Legend Letters Size

<table>
<thead>
<tr>
<th>Outside Diameter of Pipe or Covering</th>
<th>Minimum Length of Color Field</th>
<th>Minimum Size of Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.75” to 1” – 1.25”</td>
<td>8”</td>
<td>0.5”</td>
</tr>
<tr>
<td>1.5” to 2”</td>
<td>8”</td>
<td>0.75”</td>
</tr>
<tr>
<td>2.5” to 6”</td>
<td>12”</td>
<td>1.25”</td>
</tr>
<tr>
<td>8” to 10”</td>
<td>24”</td>
<td>2.5”</td>
</tr>
</tbody>
</table>

2.18 BURIED UTILITY WARNING AND IDENTIFICATION TAPE

A. Underground piping shall be identified with underground warning pipe markers as follows as follows: Brady Perma-Code, MSI Marking Services Inc., or equal, non-adhesive 4 mil polyethylene plastic tape manufactured specifically for warning and identification of buried utility lines. Tape shall be of the type provided in rolls, 6” minimum width, color coded for the utility involved, with warning and identification imprinted in bold black letters continuously and repeatedly over entire tape length. Warning and identification for lines shall be “CAUTION FIRE PROTECTION WATER LINE BURIED BELOW.” Code and letter coloring shall be permanent, unaffected by moisture and other substances contained in trench backfill material.

B. During back-filling of fire line systems, install continuous underground type plastic line markers. Run detector tape continuously along pipe and terminate in adjacent valve boxes or other suitable facilities. No splices will be allowed. Protect tape from damage during installation and backfilling. Tape that is broken, cut or crumpled shall be completely replaced. Install 12” above the top of the respective pipe and 12” below the surface during backfill. Provide detectable type for buried non-metallic pipes.

C. Color Code of underground tape shall be as follows:

<table>
<thead>
<tr>
<th>ANSI Color Service</th>
<th>Color of Color Field</th>
<th>Color of Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire Protection Water</td>
<td>Red</td>
<td>White</td>
</tr>
</tbody>
</table>

2.19 VALVE TAGS
A. Valves shall have brass identification tag as follows: Brady Perma-Code, MSI Marking Services Inc., or equal, Brass valve identification tag secured with brass chain and “S” hook. Tags shall bear the service identification and numerical identification of the valve.

B. Engrave identification tags with “normally open” (green) or “normally closed” (red).

C. Tags:
   1. Minimum 2” square for fire protection.
   2. No. 19 BS gauge brass with stamped numbers and letters filled in with black enamel paint. Engraving, ink, dye and vinyl fill are not acceptable.
   3. Identifying number and system letter. Top line shall be 0.25” characters and should abbreviate the service. Example: Fire Sprinkler - SPR. The second line shall be 0.5” characters and should list the valve number. Example: 1st floor shall begin 101, second floor shall begin 201.
   4. Attach 6”-12” of brass jack chain around bonnet or stem of the valve in a way that it cannot accidentally come off. Attach appropriate size brass “S” hook to the chain in the most conspicuous location. Hang valve tag from the “S” hook. Valve tag should not be attached to the wheel causing interference with valve operation.
   5. Provide on: Valves and controls.

2.20 VALVE AND EQUIPMENT CHARTS

A. Provide five typewritten schedules giving numbers, service and locations, and notations of open or closed, of tagged valves. Enclose each schedule in separate transparent plastic binder. List piping systems with symbol and color coding on pipe identification chart. List valve model numbers and symbol for service corresponding to piping symbol on valve identification chart. Provide small “key plan” identifying valves as related to column lines. Schematic flow diagrams of each piping system indicating:
   1. Location and function of each tagged valve.
   2. Type, size and essential features of each system.

B. Submit drafts of valve schedule for review before preparing final sets.

C. Frame five copies of reviewed schedule under glass, mount where directed.

D. Provide typewritten list of equipment in triplicate, indicating location, service for each piece of equipment, suitably framed, with glass front.

2.21 IDENTIFICATION SIGNS

A. Provide systems with identification signs as specified and as required by NFPA 13, NFPA 14 and SFO fire department requirements.

B. Fire sprinkler signs shall be made of 18-gauge minimum baked enamel aluminum and meet NFPA 13. Signs shall be printed red on white background or white on red background. Each sign shall have holes or slots to facilitate field attachment. Signs shall be secured by the use of corrosion-resistant wire, chain, tamper-resistant screws, or other approved means.
2.22 SPRINKLER HEADS

A. General Requirements:

1. Fire sprinklers shall be of one manufacturer throughout building. No mixing of sprinkler brands shall be permitted. Sprinkler heads shall be of the types indicated on the drawings, with ordinary temperature rating except as required otherwise by NFPA 13 for sprinklers in the vicinity of heat producing equipment and/or in special occupancy areas, or as otherwise noted on the drawings.

2. Sprinkler heads shall be regular automatic closed-type heads.

   a. Exception: For special sprinklers not available by one manufacturer.

3. Sprinklers shall be of all brass frame construction with a coated metal-to-metal seating mechanism. Sprinklers utilizing non-metal parts in the sealing portion of the sprinkler are strictly prohibited. Sprinklers shall be UL listed for working water pressures up to 175 PSI.

4. Quick response sprinkler heads shall be installed in new construction accordance with the requirements in NFPA 13.

5. Temperature ratings for sprinkler heads shall be in accordance with NFPA 13.

   a. The minimum sprinkler head temperature rating for “Ordinary” sprinkler temperature classification shall be 155 °F.

   b. The minimum sprinkler head temperature rating for “Intermediate” sprinkler temperature classification shall be 200 °F.

6. Provide sprinkler heads with Teflon or Nickel-Teflon coating for corrosion resistance for sprinkler heads located at exterior areas, exposed to weather, moisture or corrosive vapors.

7. The sprinkler bulb protector must remain in place until the sprinkler is completely installed and before the system is placed in service. Remove bulb protectors carefully by hand after installation. Do not use any tools to remove bulb protectors.

8. The Subcontractor shall provide spare heads of each temperature rating and type used in a suitable metal cabinet with red enamel finish, cabinet to be located at the direction of SFO’s Representative. Number of spare heads in accordance with NFPA 13. The heads shall be representative of, and in proportion to, the number of each type and temperature rating sprinkler head installed. In addition to the spare heads, furnish not less than two special sprinkler head wrenches.

9. Center of tile installation is mandatory.

10. Symmetrical sprinkler head layouts are mandatory.

11. Coordination of location of sprinkler piping is critical.

   a. Where ceiling space is at a minimum under beams location of ductwork takes precedence, coordinate accordingly. Install heads as required for full floor coverage.

   b. Include in required number of 2-hour coordination meetings for coordination of sprinkler pipe routing.

   c. Coordinate beam and shear wall penetrations, if required, with Structural Engineer. Obtain written approval for all beam penetrations from the required personnel.
12. Sprinkler heads installed shall be upright or pendent, as conditions require, and shall be of the following types and finish for the areas designated. All pendent sprinklers located within 7’ of floor shall be provided with sprinkler guards. Sprinkler escutcheons shall be of metal construction. Adjustable sprinkler drops are not allowed.

13. Submit samples of each head for review with equipment submittals.

14. Submit for approval.

<table>
<thead>
<tr>
<th>Building Area</th>
<th>Sprinkler Head Type</th>
<th>Sprinkler Finish</th>
<th>Escutch. Finish</th>
<th>Temp. Deg.</th>
<th>Orifice In.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cargo Area</td>
<td>ESFR, Upright/Pendent</td>
<td>Brass</td>
<td>None</td>
<td>155 °F</td>
<td>as reqd</td>
</tr>
<tr>
<td>Other areas with Unfinished Ceiling</td>
<td>Upright</td>
<td>Brass</td>
<td>None</td>
<td>155 °F</td>
<td>0.5”</td>
</tr>
<tr>
<td>Mechanical Rooms</td>
<td>Upright/Pendent</td>
<td>Brass</td>
<td>None</td>
<td>155 °F</td>
<td>0.5”</td>
</tr>
<tr>
<td>Electrical Rooms</td>
<td>Upright / Pendent</td>
<td>Brass</td>
<td>None</td>
<td>200 °F</td>
<td>0.5”</td>
</tr>
<tr>
<td>Elevator Pits (if required), and Elevator Machine Rooms</td>
<td>Sidewall/Upright</td>
<td>Brass</td>
<td>None</td>
<td>175 °F</td>
<td>0.5”</td>
</tr>
<tr>
<td>Finished Ceiling with Surface Mounted Light Fixtures</td>
<td>Pendant on Drop Escutcheon</td>
<td>Chrome</td>
<td>White Enamel</td>
<td>155 °F</td>
<td>0.5”</td>
</tr>
<tr>
<td>Finished Ceiling with Recessed Mounted Light Fixtures</td>
<td>Recessed Pendant</td>
<td>Chrome</td>
<td>White Enamel</td>
<td>155 °F</td>
<td>0.5”</td>
</tr>
</tbody>
</table>

B. Special Requirements:

1. Sprinklers equipped with “O-ring” water seals shall not be utilized.

2. For sprinkler heads in mechanical rooms, attic spaces, electrical rooms, elevator machine rooms, elevator hoist ways, dimmer room, MDF, Server and IDF rooms, and where required by NFPA; provide 200 °F “intermediate” temperature rated heads.

3. For sprinkler heads at skylights provide 286 °F “high” temperature rated heads.

4. Provide UL listed sprinkler head guards for exposed pendent/upright sprinkler heads in the following areas. Head guards shall be factory painted red enamel.
   a. Mechanical rooms.
   b. Electrical rooms and closets.
   c. Elevator machine rooms and elevator pits.
   d. Generator room.
   e. Storage rooms.
   f. Shop areas.
   g. Substation, switchgear and load distribution rooms.
   h. IDF equipment rooms.
i. UPS room.

j. Areas where sprinkler heads may be subjected to mechanical damage from routine activity such as equipment rooms, and the like.

k. Any sprinkler lower than 7’ 0” above the floor.

C. Sprinkler Types as Follows:

1. Interior Exposed Structure Ceiling: UL listed, standard coverage, quick response pendent or upright type with brass finish, 0.5” orifice, K=5.6, glass bulb. Viking “Microfast” (VK300 upright/VK302 pendent) quick response sprinkler, or equal. Chrome finish in areas visible to the public.

2. Interior Finished Ceilings and Soffits (Ordinary Hazard Application – Standard Coverage): UL listed, standard coverage, quick response pendant type, 0.5” orifice, K=5.6, glass bulb, with concealed type flat cover plate assembly, finish as selected by Architect. Viking “Mirage” (VK462) quick response concealed sprinkler, or equal.

3. Interior Finished Areas Requiring Sidewall Heads: UL listed, standard coverage, quick response horizontal sidewall type, 0.5” orifice, K=5.6, glass bulb, with flat concealed type flat cover plate assembly, finish as selected by Architect. Viking “Mirage” (VK408) quick response concealed horizontal sidewall sprinkler, or equal.

4. Skylights (Where pendent/upright head is required): UL listed, standard coverage, quick response pendent or upright type with white polyester finish, 0.5” orifice, K=5.6, 286°F high temperature classification, glass bulb. Viking “Microfast” (VK300 upright/VK302 pendent) quick response sprinkler, or equal.

5. Skylights (Where sidewall head is required): UL listed, standard coverage, quick response horizontal sidewall type, 0.5” orifice, K=5.6, 286 °F high temperature classification, glass bulb, with recessed escutcheon plate, white polyester finish. Viking “Microfast” (VK305) quick response horizontal sidewall sprinkler with Model F-1 adjustable escutcheon with white polyester finish, or equal.

6. Level 1 unfinished areas under the building expansion: Corrosion protected sprinkler heads.

D. Basis of design sprinkler heads are specified as a standard. Acceptable equivalent manufacturers for sprinkler heads as follows:

1. Tyco.
2. Victaulic.
3. Viking.
4. Or equal.

2.23 FIRE DEPARTMENT CONNECTIONS

A. Fire department connection type: Existing to remain.

2.24 FIRE HOSE VALVE CABINETS

A. Furnish and install recessed valve cabinets for fire department hose valves where indicated on the drawings. Cabinets shall be custom fabricated, stainless steel finish with No. 4 finish, and be a minimum 22 gauge box, 20 gauge tubular steel door with 20 gauge frame and continuous stainless
steel hinge. Steel corner seam welded and ground smooth. Potter Roemer 1800 Series valve cabinets, or equal.

1. Size for Fire Hose Valve: Cabinet overall size to house a Class 1 pressure regulating fire hose valve with clearance for spanner wrench for cap removal and meet local fire department requirements. Cabinets shall be a minimum 30” x 30” x 12” deep but in no case less than what is required for components to fit and operate properly.
   a. Door: Provide flush solid metal door, complete with cam latch and identifying red lettering “FIRE DEPARTMENT VALVE.”

2. Size for Fire Hose Valve and Fire Hose Valve Test Drain Connection: Cabinet overall size to house a Class 1 pressure regulating fire hose valve and a hose valve test drain connection with clearance for spanner wrench for cap removal and meet local fire department requirements. Cabinets shall be a minimum 32” x 32” x 12.5” deep but in no case less than what is required for components to fit and operate properly.
   a. Door: Provide flush solid metal door, complete with cam latch and identifying red lettering “FIRE DEPARTMENT VALVE”.

3. Finish: Components including door and frame shall be 304 stainless steel with No. 4 satin finish.

4. Valve: Provide with Class 1 fire hose valve/Class 1 pressure regulating fire hose valve, complete with cap and chain. Refer to valve section paragraph 2.04 “Standpipe Fire Hose Valves.”

5. Fire-Rated Cabinet: Provide fire rated, UL Classified 7N43 cabinets where cabinet is installed in a fire rated wall construction.

2.25 PRE-ACTION VALVE ASSEMBLY AND CABINET

A. General: Provide a self-contained preaction cabinet double interlocked with electric release and control panel, containing all hydraulic and electrical components required for the control of a preaction system. Pre-Action sprinkler system(s) for SSR room(s) shall utilize an electric controlled deluge valve controlled by detection and alarm system(s) provided by the fire alarm contractor. Piping to be pneumatically pressurized for supervisory purposes only. Upon loss of pressure, an alarm will sound and a signal sent to the fire alarm panel. Coordinate with Division 26 work. System will be from one manufacturer. The pre-action system shall be a Viking TOTALpAC2® “Surefire” Integrated double interlocked pre-action system as manufactured by Fire Flex Systems Inc. and distributed by Viking Corp., Victaulic, or equal.

B. System Components

1. Deluge Valve.
2. Deluge Valve Trim Including:
3. Test Drain Valve.
4. Auxiliary Drain Valve.
5. Drain Cup.
6. Drip Check.
7. Alarm Test Shut Off Valve.
8. Strangler Orifice Check Valve.
9. Pressure Operated Relief Valve.
12. Priming Pressure Gauge and Valve.
13. Water supply Pressure gauge and valve.
15. Alarm Pressure Switch.
16. Riser Valves:
17. Water Supply Control Valve.
18. Rubber Seat Check Valve.
19. System Main Drain Valve.
20. System Air Supply Trim:
21. System Pressure Gauge and Valve.
22. Soft Seat Check Valve.
23. Air Supervisory Pressure Switch.
26. Release Trim
27. Strainer.

C. A fail-safe double interlocked pre-action system shall be provided with the method of release being an electric solenoid valve. The electric solenoid valve will open upon activation of the electrical supplemental detection system. This event must occur before the deluge valve will open. The riser shall be a listed and approved assembly provided with necessary appurtenances to complete the system. The system check valve shall be internal to the deluge valve. If the AC Power fails or the battery backup power expires before an alarm is detected, the pre-action system shall “fail-safe” and function as a dry pipe system. The opening of an automatic sprinkler or damage to system piping will cause the system to fill and flow water until it is manually shut-off. Solenoids normally energized closed when the system is in the set position shall not be utilized for system release.

1. The systems shall be installed in conformance with the in-force edition of NFPA 13, Standard for Installation of Sprinkler Systems and manufacturer’s guidelines.
2. System design densities shall be selected per NFPA 13, Occupancy Hazard requirements. System design areas shall be increased 30% to allow for delay in water delivery.
3. Provide pre-action system protection in the areas indicated on the drawings and specifications.
4. Systems shall be provided with a listed quick-opening device where system capacity exceeds 500 gal.
5. Gridded or looped piping configurations will not be allowed.
6. Supply and install an independent circuit, 120 VAC, 60Hz for each system releasing panel.
7. Supply and install an independent circuit from the same power source, 120 VAC, 60Hz for the air compressor.
D. Listings and Approvals: Equipment and devices shall be UL listed and FM Approved for fire protection. The integrated unit shall be California State Fire Marshal Approved, c-UL-us Listed and FM Approved as an assembled unit. All system components shall be “compatible”, UL/ULC listed and FM approved. Note: The word compatible used in this specification means that the items concerned have been tested and listed and/or approved for their use together.

E. Cabinet: Fail-safe self-contained unit double interlocked pre-action cabinet containing all hydraulic and electrical components required for the control of a fail-safe pre-action system. The cabinet assembly must be pre-assembled, pre-wired and factory tested under ISO-9001 conditions, as a System. It shall also be California State Fire Marshal Approved, c-UL-us Listed and FM Approved as an assembled unit. It shall also be OSHPD Approved for seismic requirements per California Building Code 1708A.4 Seismic certification of nonstructural components. The cabinet shall include the following:

1. Sturdy free-standing 14-gauge steel cabinet.
2. Textured rust proof coating, inside and outside, fire red, oven baked polyester powder on phosphate base (powder coated).
3. Two locked access doors to reduce front area required for opening, easily removable without tools to allow easy installation & servicing.
4. Individual access doors for the hydraulic and electrical sections and the emergency release with a neoprene gasket to avoid vibrations.
5. Pre-action Deluge Valve: Viking Deluge Valve model E, complete with releasing trim rated at 250 psi and all the necessary accessories. Trim shall include a mechanical latching device to prevent system from resetting in case of loss of power to the release solenoids. Systems provided with solenoids only, without this mechanical latching device, shall not be accepted. Every valve shall be clearly identified as to its operation with arrows indicating all positions to facilitate system operation.
6. Pressure gauges to indicate water supply, priming water and air pressures of the system. Each pressure gauge must be provided with its own shut-off valve and shall be clearly identified on the outside of the cabinet front door.
7. Schedule 40 galvanized steel release trim with solenoid valves and every supervisory and alarm device required.
8. Schedule 40 steel pipe header painted fire red, with grooved ends to be connected to supply water from either side.
9. Schedule 40 steel pipe drain manifold of 2” diameter painted fire red, with grooved ends for drain connections from either side.
10. Properly identified contractor test ports factory mounted into the trim piping to facilitate system testing and commissioning.
11. Viking VFR-400 integrated control panel with emergency batteries, in a top mounted enclosure including its own access door and a spare sprinklers storage rack (see art. 2.3 for details).
12. Field wiring terminal strips integrated with the cabinet for connection of field wiring for auxiliary contacts and power supply for the optional air compressor.
13. Required Option: Provide a listed and approved isolation butterfly valve installed on the system riser inside the cabinet for full flow test purposes. The valve shall be supervised by the same
supervisory circuit as the system main water supply valve tamper and wired at the factory. An
integrated sight glass shall be part of this arrangement for visually confirming water flow
through the main drain upon system actuation. A detailed instructions placard must be provided
inside the cabinet door for easy reference.

F. Integrated Control Panel:

1. The release control panel must be fully integrated to the cabinet and installed in its own
enclosure, mounted at the factory on top of the trim enclosure. Standard wall enclosure
normally provided with control panels shall not be used and this arrangement shall be fully
Listed & Approved as part of the integrated unit. Panels provided with their regular wall
mounted enclosure fitted in the front door of the cabinet will not be considered as fully
integrated and shall not be acceptable.

2. The control panel shall be FM Approved and c-UL-us Listed to the new UL 864-9 standard. Panel
shall include four programmable Class B, Style B initiating zones, two class B supervisory zones,
and 4 programmable output circuits. Onboard, menu-driven programming with twelve pre-
installed programs for ease of set-up must also be provided. The panel must be compatible with
many different initiating devices including linear heat detection, smoke and heat detectors,
water flow indicators, low air pressure switches, and manual pull stations.

3. The control panel should include both an LCD Annunciator describing all system conditions (16
characters on 2 lines) and a set of red & yellow LED lamps identifying each separate alarm and
trouble conditions. Easy to operate control buttons shall also be included for the operation of
the panel various functions.

4. The control panel should be pre-wired at the factory to a set of industrial grade wiring terminals
used for power feed, separate from the terminals used to power the optional air compressor.
External wiring to field devices (outside the cabinet) should be wired directly to the control panel
module by the installing contractor on-site.

5. A set of emergency batteries should be provided with the control panel. Batteries should be
calculated to provide emergency power for a specific duration after which they shall be able to
provide 5 minutes of alarm and activation of the solenoid valve(s).

G. Detectors:

1. Provide cross zoned smoke detection system. All detectors shall be supported by 4” base 63-
1055/1061, or 6” base 63-1054/1060, or equal.

2. Analog Photoelectric Sensors:
   a. The Photoelectric sensors shall be Fike's 63-1052/1058 series, or equal.
   b. Each sensor shall store the sensor address and operating characteristics in non-volatile
memory at the sensor. The sensor shall use a threshold received from the control unit to
determine when an alarm condition exists.
   c. Each sensor shall have two alarm LEDs for 360 viewing. The alarm LEDs shall flash when
communicating with the control panel, and shall illuminate steady during alarm
conditions.
   d. Sensitivity settings for photoelectric sensors shall be set and displayed on the LCD in %
obscuration per foot
e. Each sensor shall be capable of compensating for dust and dirt accumulation within the sensing chamber.

f. A calibrated light source shall be used to calibrate the fire level of the photoelectric sensor. Sensors that use a fixed fire level limit are not acceptable.

H. Compressed Air Supply:
1. The automatic sprinkler piping is supervised by compressed air from a source installed inside the pre-action cabinet.

2. An air supply capable of restoring system pressure within 30 minutes shall be provided. Acceptable air supply arrangements is a tank mounted air compressor with an air maintenance device between the air compressor and the air supply inlet on the system riser.

3. Quick Opening Device: If required by the size of the piping network, an accelerator device, Viking Model E-1 shall be factory installed in the air trim with its own pressure gauge and bypass valve, designed to increase the operating speed of the system. The device shall be an accelerator of the same manufacturer as the deluge valve.

I. System Drain:
1. The single drain collector of the system shall be connected to an open drain (open end pipe with an air gap around the drain pipe or equivalent). The drain piping shall not be restricted or reduced and shall be of the same diameter as the drain collector. It shall also be arranged to avoid back-pressureizing the drain trim. Multiple drain collectors and open drain cups inside the cabinet are not acceptable.

2. Manifolding of multiple units is permitted provided the manufacturer’s recommendations are carefully followed and complied with.

PART 3 – EXECUTION

3.1 GENERAL

A. The system to be installed by an experienced firm regularly engaged in the installation of automatic sprinkler system as specified by the requirements of the Specifications.

3.2 SPRINKLER SYSTEM DESIGN

A. Building(s) shall be fully protected by a hydraulically calculated automatic wet sprinkler system in accordance with the requirements in NFPA 13 and SFO ABR.

B. Sprinkler Zones: Automatic sprinkler system zones shall be established by the installation of floor control valve assemblies for all floors including basements. Each sprinkler zone shall coincide with each smoke zone and fire alarm zone.

C. Base system design hydraulic calculations using the area/density method on the following criteria and in accordance with NFPA 13. Hydraulic designs of the sprinkler systems shall incorporate a safety factor of 10 percent of the available water pressure at system demand flow rate. Should indicated densities conflict with codes and standards, the most stringent density shall be used. Contractor is responsible to obtain current water flow information as required to perform hydraulic calculations. Flow capacity (gpm and residual flow pressure) at existing supply mains shall be verified by flow tests.

<table>
<thead>
<tr>
<th>Design Occupancy Classification</th>
<th>Design Density</th>
<th>Hose Stream Area</th>
<th>Allowance</th>
<th>Duration of Supply</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(gpm/ft²)</td>
<td>(ft²)</td>
<td>(gpm)*</td>
<td>(min)</td>
</tr>
<tr>
<td>Ordinary Hazard Group 2</td>
<td>0.20</td>
<td>1,500</td>
<td>250*</td>
<td>90</td>
</tr>
</tbody>
</table>

* Combined Inside/Outside

E. Total Combined Inside and Outside Hose Allowances: Hydraulic calculations shall include an allowance for inside and outside hose streams to the sprinkler requirements for hose streams added at the point of connection to the water supply.

F. The calculated demand including hose stream requirements shall fall no less than 10% below the available supply curve.

G. The arrangements, positions, and connections of pipes, drains, etc., shall be as required by NFPA 13, however, the right is reserved by the SFO to change the location of any item to accommodate conditions which may arise during the progress of the work without additional compensation for such changes, provided that no additional heads are required and provided that changes are requested prior to installation of work.

1. The following requirement takes precedence over the requirements in NFPA: Sprinkler system control valves shall be located in accessible spaces and shall not be located in above ceiling spaces.

H. Special Fire Protection Requirements:

1. Elevator Systems: Conform to the requirements of NFPA 13, ANSI/ASME Standard A17.1 and the CBC.
   a. Each elevator machine room shall be provided with a wet sprinkler system.
   b. Elevator hoist ways do not require sprinkler protection provided that the hoist way and elevator cars are of non-combustible construction and meets the flame and smoke spread requirements of ASME A17.1, and does not contain hydraulic fluids.
   c. The sidewalk elevators are hydraulic units and will require sprinkler protection. The height of the sprinkler should not exceed 24" above the pit floor.
   d. The sprinkler system for the elevator machine room shall be provided with separate manual isolation valves located outside the room in an accessible location. Tamper switch shall be provided on all such valves.
   e. Sprinkler protected elevator machine rooms containing elevator control equipment shall be provided with a means to disconnect automatically the main power supply to the affected elevator prior to the application of water in accordance with the requirements in NFPA 72. Heat detectors with shunt trip provided under Division 26 scope of work.
   f. Sprinkler heads installed in elevator machine rooms and hoist ways shall be equipped with sprinkler head guards to provide protection against accidental damage.

2. Electrical Equipment Rooms and Electrical Closets: The following requirements take precedence over the requirements in NFPA 13:
a. Electrical switchgear rooms and transformer vault rooms shall be provided with a wet sprinkler system and shall be provided with a separate manual isolation valve located outside the room in an accessible location. Tamper switches shall be provided on all such valves. Each room shall be zoned independently of one another.

b. Sprinkler heads installed in electrical equipment rooms and electrical closets shall be equipped with sprinkler head guards to provide protection against accidental damage.

3.3 STANDPIPE SYSTEM DESIGN

A. Building(s) shall be fully protected by a hydraulically calculated combination standpipe system in accordance with the requirements in NFPA 14 and SFO Department requirements.

B. Fire department standpipe hose valve design criteria require outlet pressures of 100-125 psi residual pressure flowing 250 gpm and 75-100 psi residual pressure when flowing 500 gpm from the roof manifold of the hydraulically remote standpipe and 250 gpm for each additional standpipe. The maximum static pressure must not exceed 150 psi.

C. Minimum Pressure: The minimum pressure for any 3" hose valve shall be 100 psi at the valve outlet while flowing 250 gpm through the fire pump and valve. The minimum pressure while flowing the required standpipe flow (500 gpm from the hydraulically most remote standpipe and 250 gpm for each additional standpipe, up to a maximum of 1,000 gpm for fully sprinklered buildings) shall be 75 psi at any valve outlet while flowing 250 gpm through that valve. Therefore, the minimum hose valve outlet pressure at maximum standpipe flow is 75 psi.

3.4 DRAWINGS AND SITE

A. Drawings:

1. Scaled and figured dimensions are approximate and are given for estimate purposes only. Before proceeding with work, carefully check and verify dimensions, sizes and lengths.

2. So far as possible the work has been indicated on the drawings in such positions as to suit and accommodate the work of the other trades, but the work as indicated is largely diagrammatic and is shown primarily for clarity. Contractor is responsible for the correct placing of their work and the proper location and connection of work in relation to the work of other trades.

3. Where apparatus and equipment have been indicated on the drawings, dimensions have been taken from typical equipment of the class indicated. Carefully check the drawings to see that the equipment will fit into the spaces provided.

4. Where equipment is furnished by others, verify dimensions and the correct locations of this equipment before proceeding with the roughing-in of connections.

5. Contact SFO's Representative before digging and investigate and confirm existing conditions. Secure permit from SFO's Representative prior to initiation of underground excavation.

3.5 PERFORMANCE OF WORK

A. Examine areas and conditions under which materials are to be installed. Layout the system to suit the different types of construction and equipment as indicated on the drawings and in accordance with NFPA Pamphlet No. 13.
B. Work to start immediately after authorization has been given to proceed so that the overall progress of the construction is not delayed.

C. Coordinate with other trades as necessary to properly interface components of the sprinkler system.

D. Follow manufacturer’s directions and recommendations in all cases.

E. The omission from the drawings or Specifications of any details of construction, installation, materials, or essential specialties shall not relieve the Subcontractor from furnishing the same in place for a complete system.

3.6 PREPARATION

A. Sprinkler heads in finished areas shall be installed on a true axis line in both directions with a maximum deviation from the axis line of plus or minus 0.5”. At the completion of the installation, if any heads are found to exceed the above-mentioned tolerance, such heads shall be removed and satisfactorily reinstalled. In areas with ceiling tiles, fire sprinklers shall be installed in center of tiles.

B. Sprinkler head locations shown on architectural reflected ceiling plans show head locations in architecturally sensitive areas required by the Architect. Head locations shown are approximate and for intent of pattern layout only. It is not the intent to show all heads. Number of heads shown may be in excess of minimum code requirements, but in no case shall the Contractor furnish less heads than or spaced greater than required by code. Where heads are not shown, location is per code requirement and left to the discretion of the Contractor. Before starting Shop Drawings, submit drawings showing only the proposed head layout on architectural reflected ceiling plans.

C. Locate pipe and sprinkler heads fully coordinated with grilles, diffusers, reflected ceiling plans, ducts, conduits, light fixtures, curtain tracks and other ceiling elements. Maintain proper code clearances from ceiling obstructions and symmetrical layout.

3.7 GENERAL INSTALLATION

A. Fire safety during construction shall comply with the requirements in the California Building Code (CBC), California Fire Code (CFC), and National Fire Protection Association (NFPA) 241.

B. Light fixtures and other potential obstructions shall not interfere with the engineered spray patterns of sprinkler heads. The sprinkler contractor shall insure that the type and location of potential obstructions is considered in the design and installation of the system. The sprinkler contractor is responsible for coordinating and resolving conflicts in coverage patterns.

C. System valves and gauges shall be accessible for operation, inspection, tests, and maintenance.

D. No valve and no piece of equipment or trim shall support the weight of any pipe.

E. No cutting, drilling or taping of structural members shall be done without prior written approval of the structural engineer.

F. Powder actuated fastening will not be allowed. Embeds, beam clamps, or drilled fasteners will be required, unless otherwise noted.

G. Install access doors in ceilings of rooms where above ceiling access is required. Comply with the requirements of Division 8 sections pertaining to “Access Doors and Panels”.
H. Prepare piping having welds for SFO Fire Marshal inspection prior to installation.

I. Any modifications to system required by field conditions, physical equipment changes or compliance with code regulations shall be made promptly without any cost to the SFO.

J. Fire protection system shall be installed in accordance with the approved Drawings. Finished ceilings are not to be installed until all fire protection piping has been installed, tested, and inspected.

K. The arrangement of all pipes shall conform to all architectural requirements and field conditions, shall be as straight and direct as possible, forming right angles or parallel lines with building walls and other pipes, and shall be neatly spaced. Offsets will be permitted only where required to permit the pipes to follow the walls. Standard fittings shall be used for offsets. All risers shall be erected plumb and true, shall be parallel with the walls and other pipes, and shall be neatly spaced. All work shall be coordinated with HVAC, Plumbing, Electrical and Structural work in order to avoid interference and unnecessary cutting of floors or walls. All underground or concealed work shall be before the construction is closed up.

L. Sprinkler heads in all finished areas are to be installed on a true axis line in both directions, with maximum deviation from the axis line of 2” plus or minus and shall be plus or minus 2” within center of tile. At the completion of the installation, if any heads are found to exceed the above mentioned tolerance, they shall be removed and reinstalled.

M. All areas without ceilings shall have rough brass upright or pendent heads.

N. The arrangement, positions, and connections of pipes, drains, valves, etc., shall be as required by NFPA Pamphlet #13 for all areas to be sprinklered. However, the right is reserved to change the location of any item to accommodate conditions which may arise during progress of the work, without additional compensation for such changes provided that no additional heads are required prior to the installation of the work.

O. Piping shall be installed concealed in building construction and to obtain adequate headroom.

P. All pipe throughout the job shall be reamed smooth before being installed. Pipe shall not be split, bent, flattened, or otherwise injured either before or during installation.

Q. Provide protective pans under pipes passing over high voltage electrical bus duct or switchgear equipment. The pan shall be constructed of 12-gauge black iron with a 6” lip, the corners being welded to make the pans watertight. Each pan shall be given three coats of Rust-Oleum paint and shall be supported by pipe hangers. The pan shall drain clear of the bus duct or switchgear.

R. All pipe interiors shall be thoroughly cleaned of foreign matter before installation, and shall be kept clean during installation by plugging or other approved means. Piping shall be covered during storage. Piping that shows signs of rusting will be removed from job site and replaced.

S. Interference: No piping or sprinkler devices shall interfere with the operations of any door, window or mechanical and electrical systems. No part of this system shall visibly be installed in the physical parameter of any window.

T. Threaded Pipe: Threads shall be clean cut, standard and tapered. Threads shall be made up using flaked graphite and lubricating oil or a piping compound applied to the male threads only.
U. Grooved Pipe: Installation shall be as prescribed in the Victaulic Piping Manual only. Holes in the piping are to be made in the fabrication shop, not at the job site. Subcontractor shall provide at the project site a sample of each type of coupling (threaded, standard grooved coupling and mechanical type), showing complete assembly with pipe connections. Couplings will not be installed until the samples are approved by the authority having jurisdiction.

V. Keep all pipe and other openings closed to prevent entry of foreign matter. Cover all equipment and apparatus to protect against dirt, water, chemical or mechanical damage, before and during construction period. Restore to original condition all apparatus and equipment damaged prior to final acceptance, including restoration of damaged shop coats of paint.

W. Elevator Sprinklers: Provide sprinkler heads in elevator pits per elevator code

3.8 PIPING INSTALLATION

A. Carry exposed and concealed horizontal lines of pipe on specified hangers properly spaced and set to allow the pipe to adjust for expansion and contraction.

B. Check piping runs beforehand with other trades. Run piping to maintain proper clearance for maintenance and to clear opening in exposed area. Run piping in strict coordination with mechanical piping, ducts, and equipment, plumbing work, electrical conduit and equipment, structural, and architectural conditions. Where work of other trades prevents installation of the piping as shown on the Drawings, reroute piping at no extra cost. Piping shall be installed within designated finished ceiling height as noted on the architectural drawings.

C. Install pipe with necessary offsets and fittings to conform to the structure. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid obstruction, preserve headroom, maintain required accessibility, keep openings and passages clear, and satisfy the requirements of the governing codes and standards of good practice. The locations of piping and mounting heights of sprinkler heads and equipment shall be coordinated with the architectural plans and room elevations.

D. Install exposed piping parallel to or at right angles with building walls and tight to walls or ceilings wherever possible, except where otherwise shown on the Drawings. Piping shall be arranged to form a symmetrical pattern. Horizontal piping shall be supported at intervals not to exceed spacing permitted by NFPA 13 & 14. Vertical risers shall be supported at the base and at each floor level with clamps and hangers.

E. Provide sleeves wherever pipes are run through walls, footings, and slabs, to allow large enough openings for the passage of the pipe. Holes for pipes shall be sleeved with sleeves as specified in the plumbing system section. Set sleeves in forms before concrete is poured. Sleeve size shall be not less than a nominal diameter 2” larger than the nominal diameter of piping 3.5” and smaller, and a nominal diameter 4” larger than the nominal diameter of piping 4” and larger. The space between each pipe and sleeve shall be completely closed by packing with code approved mineral fiber materials with a suitable binder or other approved packing material. Piping through rated walls and floors shall be sealed with UL fire rated fireproof material in accordance with code requirements. Pipes through underground exterior walls shall be sealed watertight. Provide link seal protection at sleeves in underground exterior walls and as noted on the drawings.

F. Clearance from structural members not penetrated or used, collectively or independently, to support the piping shall be at least 2”.
G. Fire stop pipes penetrating fire rated construction in accordance with required specification section.

H. Where exposed pipes pass through walls, ceilings, or floors, fit in finished rooms and conspicuous locations with escutcheon plates. Escutcheon plates must be securely held in position allowing enough clearance to allow for expansion and shall be sufficient size to cover the opening around the pipe.

I. Support pipe from the building structure so that there is no apparent deflection in pipe runs. Fit piping with steel sway braces and anchors to prevent vibration and/or horizontal displacement under load when required. Do not support pipe from or brace to ducts, other pipes, conduit, or any materials shown on the Drawings. Piping or equipment shall be immobile and shall not be supported or hung by wire, rope, plumber's tape or blocking of any kind.

J. Rubber-gasket joints shall be so made that when the pipe is laid and the joint completed, the gasket will be completely enclosed. The rubber gasket shall be the sole element for water tightness of joints. Lubricant shall be in accordance with recommendations of the pipe manufacturer.

K. Screw joints shall be American Standard pipe thread, graphite and oil compound, or an approved pipe thread sealing tape shall be applied to the male threads only.

L. Arrange riser and piping to maintain a minimum clear width at stairways of 44” and with minimum headroom of 7’-6” for piping.

M. Do not run piping through elevator hoist ways, elevator machine rooms, elevator machinery spaces and enclosures unless piping is serving these spaces. Branch sprinkler piping serving these spaces shall be provided with a supervised branch shut-off valve located at an accessible location outside these spaces. Provide supervisory switch on the branch shut-off valve. These valves shall control sprinklers in the elevator spaces only.

N. Do not run piping through stairways, transformer vaults, MDF/Server equipment rooms, electrical rooms and other electrical or electronic equipment spaces and enclosures unless piping is serving these spaces. Coordinate piping layout to prevent installation directly over electrical equipment. If pipe routing is unavoidable, provide galvanized sheet metal drain pans under piping to prevent leaking pipe drips from damaging equipment while maintaining sprinkler coverage.

O. Piping shall not be installed within the vertical space above electrical switchboards, panel boards, distribution boards, or battery charging panels (see Section 384-4, National Electrical Code).

P. Clean pipe and fittings and keep interiors clean throughout installation. Provide caps on ends of cleaned piping. Use full pipe lengths; random lengths joined by couplings will not be accepted.

Q. Provide for expansion and contraction of pipes and for seismic movement.

R. Provide reducing fittings for changes in pipe size; provide fittings for changes in pipe direction. Reductions in pipe sizes shall be made using one-piece reducing fitting. Bushings are not acceptable, except when standard fittings of proper size are not manufactured. Riser piping shall be installed plumb with offset fittings used where alignment adjustment is necessary.

S. Provide unions for pipe sizes smaller than 2” and flanged or grooved fittings for sizes 2” and larger.

T. Provide dielectric fittings where dissimilar piping materials are joined.
U. Piping arrangement shall avoid beams, columns, ducts, lighting fixtures, doors, windows, and similar obstructions and openings.

V. When a wet pipe sprinkler system is the water supply source for a pre-action system, the wet pipe sprinkler system shall be provided with a non-paddle-type (alarm check valve) water flow alarm indicator. If this is not possible, the pre-action system must be supplied with water from a connection to a riser or a wet or combination standpipe, upstream of the paddle-type water flow alarm indicator.

3.9 INSTALLATION OF FLEXIBLE SPRINKLER HOSE FITTINGS

A. The use of flexible sprinkler hose fittings are allowed as long as the assembly components are listed and installed in accordance with the requirements of the listing, including the manufacturer's installation instructions. Additionally, flexible fittings used in San Francisco shall be listed by the California State Fire Marshal.

B. Compliance with NFPA 13 are required:

1. When installed and supported by suspended ceilings, the ceiling shall meet ASTM C635, Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings, and shall be installed in accordance with ASTM C636, Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.

2. Where flexible sprinkler hose fittings exceed 6 ft. in length and are supported by a suspended ceiling, a hanger(s) attached to the structure shall be required to ensure that the maximum unsupported length does not exceed 6 ft.

3. The suspended ceiling anchoring components shall be attached to the ceiling support with tamper resistant self-tapping zip screws.

C. Special Requirements:

1. Submitted plans utilizing listed flexible sprinkler hose fittings installed and supported by suspended ceilings shall include a stamped signed letter from a licensed structural engineer, stating that the specified ceiling meets ASTM C635 and C636.

2. After installation and prior to final inspection, a special inspection report shall be submitted to the department of building inspection in accordance with the 2010 California Building Code Section 1704A to ensure that the suspended ceiling complies with ASTM C635 and ASTM C636. A courtesy copy of this report shall be provided to the district fire inspector prior to sign-off of the system.

3.10 INSTALLATION OF DRAINS, TEST PIPES AND ACCESSORIES

A. Drains, Test Pipes and Accessories: Piping shall be installed to permit draining. Provide a drain at the base of risers, drain connection on valved sections, and drains at other locations for complete drainage of the system. Provide valve in drain lines and connect to central drain riser. Route the drain pipes for each sprinkler riser and test connections to the building sanitary sewer system. Discharge riser indirectly over an approved indirect waste receptor as furnished by plumbing section, or as indicated. The main drain shall be capable of full discharge test without allowing water to flow onto the floor. If terminating over an indirect waste receptor, verify that receptor is adequately sized to handle flow discharge rate. Install auxiliary drain valves for trapped lines in accordance with NFPA 13.
B. Drains: Piping shall be installed to permit draining. Provide a main drain at the base of risers, auxiliary drains at all low points in the system on each floor, drain connection on valved sections, and drains at other locations for complete drainage of the system. Route the drain pipes for each sprinkler riser and test connections to the building sanitary sewer system. Discharge riser indirectly over an approved indirect waste receptor as furnished by plumbing section, or as indicated. The main drain shall be capable of full discharge test without allowing water to flow or splash onto the floor. When terminating over an indirect waste receptor, verify that drain line is adequately sized to handle flow discharge rate. Install auxiliary drain valves for trapped lines in accordance with NFPA 13.

1. Inspector’s Test Drain:
   a. Install inspector’s test drain in accordance with NFPA 13 and locate at main riser assembly in an accessible location. A sight glass with built-in orifice of the appropriate size shall be installed adjacent to each valve.

2. Auxiliary Drains:
   a. 5 gallons or greater: Provide minimum 1” globe valve with hose adapter and cap.
   b. Less than 5 gallons: Provide minimum 1” nipple and cap.
   c. Five or fewer trapped heads may be drained through a plugged fitting.

C. Flushing Connections: Provide threaded, capped nipple or mechanical groove end cap on ends of cross mains. If nipple provided, diameter shall be same as pipe, but not larger than 2”.

3.11 INSTALLATION OF UNDERGROUND PIPE AND PIPE FITTINGS

A. Ductile Iron Pipe: Install in accordance with AWWA C600 “Standard for Installation of Ductile Iron Water Mains and Their Appurtenances” and in accordance with manufacturer’s instructions.

B. Depth of Cover: Provide minimum depth of cover over underground piping in accordance with NFPA 24, “Recommended Depth of Cover Above Top of Underground Yard Mains.” Underground piping shall have a minimum of 36”. Cover shall be measured from finished grade to top of pipe.

C. Piping shall be laid straight and level. Deflection shall not be allowed in the couplings. Changes in elevations or direction shall be accomplished with fittings approved for the application.

D. Anchorages: Tees, wyes, crosses, plugs, caps, bends, valves, and hydrant branches shall be restrained against movement. Pipe clamps and tie rods, thrust blocks, locked mechanical or push on joints, mechanical joints utilizing set screw retainer glands, or other approved methods or devices shall be used. The type of pipe, soil conditions, and available space determine the method. After installation, apply full coat of asphalt or other acceptable corrosion retarding material to surfaces of ferrous anchorages. For thrust blocks: Thrust blocks shall be calculated as required by NFPA 24 section 8-6.2. Calculations shall be shown on the plans. Provide access to thrust blocks and corrosion-coated parts prior to backfill for inspection.

E. When the system riser is close to building foundations, underground fittings such as an “In- Building Riser” of proper length shall be used to avoid pipe joints being located in or under the foundation. When the connection passes through a foundation wall below grade, 1” to 3” clearance shall be provided around the pipe, and the clear space shall be made water-tight using an approved mechanical seal, or similar flexible waterproofing material. No joints in the piping system shall be installed under the building.
F. Floor cores and sleeves in floors at grade, or in exterior walls below grade, shall be made water-tight using an approved mechanical seal, installed flush with the top of the sleeve at floors; flush with the outer surface at walls.

G. Underground piping shall terminate in a welded or cast flanged fitting 6" minimum above finished floor.

H. Buried piping, castings, fittings, valves and couplings below ground shall be encased in 8 mil polyethylene tube encasement.

3.12 INSTALLATION OF POLYETHYLENE ENCASEMENT

A. Provide polyethylene encasement for buried piping. The polyethylene encasement shall prevent contact between the pipe and the surrounding backfill and bedding material but is not intended to be a completely air and watertight enclosure. Overlaps shall be secured by the use of polyethylene adhesive tape, plastic string or other non-degradable material and be capable of holding the encasement in place until backfilling operations are completed. Pipe and fittings shall be wrapped with polyethylene prior to pouring concrete thrust blocks.

B. Install in accordance with manufacturer’s installation instructions and reference standards. Install polyethylene encasement using Method A - For use with Polyethylene Tubes.

C. Repair cuts, tears, punctures, or damage to polyethylene with polyethylene adhesive tape or with a short length of polyethylene sheet or a tube cut open, wrapped around the pipe to cover the damaged area, and secured in place.

D. Where polyethylene-wrapped pipe joins an adjacent pipe that is not wrapped, extend the polyethylene wrap to cover the adjacent pipe for a distance of at least 3’. Secure the end with circumferential turns of tape. Service lines and other attached lines of dissimilar metals shall be wrapped with polyethylene or a suitable dielectric tape for a minimum clear distance of 3’ away from the ductile-iron pipe.

E. Backfilling for Polyethylene-Wrapped Pipe:
   1. Use the same backfill material as specified for pipe without polyethylene wrap, exercising care to prevent damage to the polyethylene wrapping when placing backfill material.
   2. Backfill material shall be free from cinders, refuse, boulders, rocks, stones, or other material that could damage the polyethylene. Backfill shall be as specified for the pipe without polyethylene encasement.

3.13 GROOVED JOINT INSTALLATION

A. Grooved joint piping systems shall be installed in accordance with the manufacturer’s guidelines and recommendations. Grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be molded and produced by Victaulic, or equal. Grooved end shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket sealing. A factory-trained field representative shall provide on-site training for contractor’s field personnel in the proper use of grooving tools and installation of grooved piping products. Factory-
trained representative shall periodically review the product installation. Contractor shall remove and replace improperly installed products.

3.14 INSTALLATION OF VALVES

A. Install valves for proper operation of piping and equipment, including valves in branch lines to isolate sections of piping. Locate valves so as to be accessible and so that separate support can be provided when necessary.

B. Install valves with stems pointed up in vertical position where possible, or in horizontal plane if necessary, but in no case with stems pointed downward from horizontal plane unless absolutely unavoidable.

C. Install swing check valves in horizontal position, unless otherwise shown on the drawings, with hinge pin horizontally perpendicular to center of pipe. Install for proper direction of flow. Installations on vertical piping must be with up flow only. Vertical installation allowed only when acceptable to valve manufacturer.

D. Ball and butterfly valves shall not be used on incoming water service, and on the suction and discharge side of either the fire pump or jockey pump. Butterfly valves only allowed for use as a floor or zone control valve.

E. Valves installed higher than 7'-0 shall be equipped with chain operators, or equivalent.

F. Sprinkler system control valves must be located in accessible locations. Sprinkler system control valves are not permitted in above ceiling spaces.

G. Coordinate the location, signage, keying, and access of fire sprinkler shut off and zone valves with the local fire authorities. Access and signage shall be obvious. Visibility shall not be blocked by equipment.

3.15 INSTALLATION OF PRESSURE GAUGES

A. Provide a pressure gage on the system side of control valves, at the top of each sprinkler or standpipe riser, and on the suction and discharge of a fire pump, and where indicated on the drawings.

3.16 INSTALLATION OF SUPERVISORY SWITCHES AND WATER FLOW SWITCHES

A. Supervisory Switches: For each indicating valve, sprinkler system riser, sprinkler zone, standpipe system riser, main service entrance, fire pump supply and discharge, jockey pump supply, PIV (post indicator valve), control valve, and where indicated on the drawings, provide a supervisory switch that is connected to the fire alarm system. Standpipe hose valves and test and drain valves shall not be provided with supervisory switches.

1. Coordinate installation with Division 28 – Fire Alarm and Detection System.

B. Water Flow Switches: A water flow switch shall be provided for each sprinkler zone, each standpipe riser and where indicated on drawings. Install water flow switch in easily accessible locations. Each water flow switch shall be annunciated at the main fire alarm control unit and required annunciators.

1. Coordinate installation with Division 28 – Fire Alarm and Detection System.
3.17 INSTALLATION OF STANDPIPE FIRE HOSE VALVE OUTLETS

A. Each standpipe shall be equipped with approved outlet valves which discharge horizontally. Outlets shall be placed so that the doors or walls do not interfere with the use of the valve. Standpipe outlets shall be located as follows:

1. Recommended Height: 42" from the finish floor to the centerline of the valve outlet.

2. Minimum Height: Not less than three feet above the level of the floor. Measurement to be taken from the finished surface to the handle or outlet.

3. Maximum Height: Not more than five feet above the level of the adjoining ground. Measurement to be taken from the finished surface to the handle or outlet.

4. Clearances: Provide a minimum of 6" on all sides of the handle and 18" on all sides of the threaded outlet.

5. Coordination: Coordinate exact locations with Architect.

3.18 INSTALLATION OF PRE-ACTION SYSTEM

A. The proper operation and coordination for the system’s installation, including the automatic sprinkler system, detection system, signaling system and initial start-up are all under the responsibility of the fire protection contractor.

B. Riser must be installed in an area not subject to freezing.

C. Pre-action system alarm, supervisory and trouble signals shall be transmitted to the main fire alarm panel by way of relay contacts in the releasing control panel.

D. This system contains an additional pressure switch and solenoid valve. Each must be wired exactly as indicated on the wiring diagram or the system will not function properly.

E. Branch lines shall be pitched at least 0.5" per 10' and mains shall be pitched at least 0.25" per 10'.

F. Where the capacity of trapped sections of piping is less than 5 gallons, an auxiliary drain consisting of not less than a 0.5" valve and plug shall be provided. Where the capacity of trapped sections of piping is more than 5 gallons, a drain consisting of two 1" valves and a 2" by 12" condensate nipple (drum drip) shall be provided.

G. Inspector’s test piping shall be the same size as its associated branch line and terminate in a smooth bore corrosion-resistant orifice that is representative of sprinklers installed on the system.

H. The inspector’s test piping shall be connected to the end of the most hydraulically remote sprinkler line and shall be equipped with readily accessible, fully ported ball valve. Globe valves will not be accepted.

I. Piping and attached appurtenances subject to system working pressure shall be hydrostatically tested at 200 psi. Portions of the system normally subject to working pressures in excess of 150 psi shall be tested at a pressure of 50 psi in excess of the system working pressure.
Section 21 10 00 | Water-Based Fire Suppression System

J. In addition to the above mentioned hydrostatic test, an air pressure leakage test at 40 psi shall be conducted for 24 hours. Leakage that results in a loss of pressure in excess of 1.5 psi during the 24 hours shall be corrected.

K. Final acceptance testing shall include full-flow trip testing initiated by opening of the inspector’s test connection. Water delivery to the inspector’s test connection shall occur within one minute of fully opening the connection for pre-action systems regardless of system capacity.

3.19 SLEEVES AND FLASHINGS

A. Wherever pipes are exposed and pass through walls, floors, partitions, or ceilings, they shall be fitted with chromi um plated steel escutcheons held in place with set screws. Care shall be taken to protect the escutcheons during the course of construction.

B. Penetrations through fire rated walls and floors shall be sealed with listed mastic of similar fire rating.

3.20 HANGERS, INSERTS, SUPPORTS, AND SWAY BRACING

A. Hangers and supports shall be installed per NFPA #13 sections on Hangers and Protection of Piping Against Damage Where Subject to Earthquake. Provide restraint from movement at end sprinkler on branch line per NFPA 13 Section A.

B. Bending of threaded hanger rod is not allowed. Powder driven anchor pins in concrete are not allowed.

C. Provide swing joints per NFPA 13, or UL approved expansion loops at all building seismic joints.

3.21 FLUSHING, TESTING AND ADJUSTING

A. Test automatic sprinkler system in accordance with NFPA 13. Test standpipe system in accordance with NFPA 14. Test private service mains in accordance with NFPA 24.

B. Perform tests in the presence of authorities having jurisdiction. Provide labor, materials, equipment and connections and submit results for review. Repair or replace defective work and pay for restoring or replacing damaged work, due to tests, as directed. Equipment required for testing, including fittings for additional operating shall be provided by the Contractor.

C. System Piping Flushing: Underground mains and lead-in connections to system risers shall be completely flushed before connection is made to sprinkler piping. The flushing operation shall be continued for a sufficient time to ensure thorough cleaning. The minimum flow rate shall be not less than the hydraulically calculated water demand rate of the system including hose requirements, or a flow necessary to provide a velocity of not less than 10’ per second (3 meters per second), or the maximum flow rate available to the system under fire conditions. After fire sprinkler piping installation has been completed and before piping is placed in service, flush entire sprinkler system to remove foreign substances, under pressure as specified in NFPA 13 and NFPA 24. Continue flushing until water is clear, and check to ensure that debris has not clogged sprinklers. While conducting the flushing operation, the Contractor shall exercise care that the water does not create any damage. The Contractor shall be responsible for damage caused by this operation.

1. Flow required to produce a velocity of 10’ per second:
   a. 4" – 390 gpm.
b. 6" – 880 gpm.
c. 8" – 1,560 gpm.

D. Hydrostatic Testing: After flushing system, test fire sprinkler piping and standpipe piping hydrostatically as required by NFPA 13, 14, and 24, but not less than for a period of 2 hours at 200 PSIG, or at 50 PSI above maximum static pressure if it is greater than 150 PSI. Check system for leakage of joints. Measure hydrostatic pressure at low point of each system or zone being tested. Hydrostatic test preparation:

1. Underground, rooftop, and other piping directly exposed to the exterior environment during testing shall be filled with water for 24 hours preceding hydrostatic testing.
2. Interior piping shall be filled with water for 2 hours preceding hydrostatic testing.
3. Piping shall be purged of all air and other gases prior to hydrostatic testing. Pressure increase during testing shall constitute test failure.
4. Underground piping shall be center loaded and fittings, strapping, and thrust blocking shall be exposed for hydrostatic pressure testing and inspection.
5. Above grade and interior piping, fittings, and supports shall be exposed for inspections and hydrostatic testing. Testing shall include finished drops and sprinklers. Incremental testing may be approved, at Contractor’s request and expense, by the SFO, for the purpose of expediting project progress—this shall not, however, take the place of a final test of the entire system.
6. Threaded fittings and grooved couplings, as well as a minimum of 2” of the pipe connected to such fittings and couplings, shall be unpainted at the time of the test.

E. Underground Piping Tests: Underground piping shall be hydrostatically tested in accordance with NFPA 24. The allowable leakage shall be within the limits prescribed by NFPA 24 and shall be recorded on the test certificate. Conduct piping tests before joints are covered, and after thrust blocks have sufficiently hardened. Fill pipeline with water 24 hours prior to testing, and apply test pressure to stabilize system.

F. Fire department connections and piping shall be included in the hydrostatic testing and shall also be back flushed.

G. Standpipes shall be flow tested in accordance with NFPA 14 to confirm with hydraulic performance requirements.

H. Repair or replace piping system to eliminate leakage in accordance with NFPA standards for "little or no leakage" and retest as specified to demonstrate compliance.

I. Water remaining in normally dry piping shall be evacuated at completion of testing.

J. The inspection, hydrostatic test and flushing of the sprinkler system shall be witnessed by the authority having jurisdiction, and SFO’s Representative. No underground piping shall be covered with earth or hidden from view until the fire department’s representative has been notified and given no less than 48 hours in which to inspect such installations.

K. Provisions shall be made for the proper disposal of water used for flushing or testing.
L. Provide complete adjustment of sensitivity of water flow and supervisory (tamper) switches. Coordinate with Division 28 Contractor.

M. After the inspection has been approved, the Contractor shall certify in writing the time, date, name and title of the person reviewing the test. This shall also include the description and what portion of the system has been approved.

N. After final installation, all backflow prevention devices shall be field tested by a certified technician certified with the San Mateo County of Health. The technician shall be hired by the Contractor. A copy of the test results submitted to the SFO Water Service Inspector and Plumbing Inspector for approval. A San Mateo County tag shall be affixed to the backflow prevention device after approval is given. The backflow prevention assembly shall be forward flow tested to ensure proper operation. The minimum flow rate shall be the system demand, including hose stream demand where applicable.

O. A complete record shall be maintained of testing that has been approved, and shall be made available at the job site.

P. Upon completion of the work, records and certifications approving testing requirements shall be submitted to the SFO’s Representative and before final payment is made.

Q. Defective work or material shall be replaced or repaired, as necessary, and the inspection and test repeated, at Contractor’s cost. Repairs shall be made with new materials.

R. No part of work shall be covered until after it is inspected, tested, and approved.

3.22 TESTS AND VERIFICATIONS FOR PRE-ACTION SYSTEM

A. Hydrostatic tests must be performed on the entire pre-action sprinkler piping system as required by NFPA 13 and project specifications.

B. In addition to the standard hydrostatic test, an air pressure leakage test at 40 psi (2.8 bars) shall be conducted for 24 hours. Any leakage that results in a loss of pressure in excess of 1.5 psi during the 24 hours shall be corrected.

C. A drain test using the auxiliary drain valve fully open (drain located on water supply side, deluge valve inlet) must be performed to make sure that no back pressure in drain piping exists, which could affect the proper operation of the pre-action system.

D. An air supply test must be performed to confirm that normal air pressure can be restored within 30 minutes.

E. The verification of the fire alarm system must be done in accordance with NFPA 72.

F. An inspection report and a certificate must be supplied at the completion of the project. All tests results shall be duly registered in a booklet to be included with the inspection report.

3.23 SAFETY TESTING AND VERIFICATION

A. Flush, test, and inspect sprinkler piping systems according to NFPA 13 Chapter “System Acceptance.” Notify SFO Plumbing Inspector 48-hours minimum in advance of flushing and testing.
B. Provide NFPA 13 Contractor’s Material & Test Certificate Form 85A for above ground piping and Form 85B for underground piping.

C. Provide manpower to test the function and performance of all components and devices in accordance with the Airport’s requirements.

3.24 INSPECTION

A. All inspections, examinations, and tests required by the authorities or agencies specified in this Section shall be arranged and paid for by the Fire Protection Subcontractor, as necessary, to obtain complete and final acceptance of the fire protection system. The Fire Protection Subcontractor shall deliver certificates of all such inspections to the Airport Representative.

B. After completion of the fire protection installation and at the start of the guarantee period, execute the National Automatic Sprinkler and Fire Control Association, Inc. standard form of Inspection Agreement, at no increase in Contract Sum, calling for 4 inspections of the sprinkler system during the guarantee year, plus the following maintenance to be performed during the course of the 4th inspection:

1. Operating of control valves.
2. Lubrication of operating stems of control valves.
3. Operating of electrical alarms.
5. Lubrication of Fire Department hose connection inlets.
6. Main drain test.

C. Fill out Inspection Agreement in triplicate after each inspection and send copies to the Airport Representative.

3.25 PROTECTION, CARE AND CLEANING

A. Provide adequate means for, and fully protect, finished parts of the materials and equipment against physical damage from whatever cause during the progress of this work and until final completion.

B. During construction, properly cap lines and equipment nozzles so as to prevent entrance of sand, dirt, and the like. Protect equipment against moisture, plaster, cement, paint or other work of other trades by covering it with polyethylene sheets.

C. Thoroughly clean exterior and interior of piping, equipment, and materials before systems are put into operation. Systems of any nature shall be thoroughly cleaned and flushed of pipe contaminants such as cuttings, filings, lubricant, rust, scale, grease, solder, flux, welding residue, debris, and other foreign substances. Any piece of equipment or part of any system which malfunctions or is damaged due to failure or neglect on the part of this Division to observe this paragraph shall be repaired or replaced to the satisfaction of the SFO by and at the total expense of this Contract.

D. After installation have been completed, clean systems.

1. Piping and Equipment: Clean exterior thoroughly to remove rust, plaster, cement, and dirt before insulation is applied.
2. Piping and Equipment to Be Painted: Clean exterior of piping, and equipment, exposed in completed structure, removing rust, plaster, cement and dirt by wire brushing. Remove grease, oil, and similar materials by wiping with clean rags and suitable non-toxic solvents. Touch up primer coat as required.

3. Items with Factory Finish: Remove grease and oil, and leave surfaces clean and polished.


5. Factory Finished Items: Remove grease and oil and leave surfaces clean and polished.

6. Code stamps and nameplates shall be protected from damage and must be clean and legible before final inspection.

3.26 PAINTING, LABELING AND IDENTIFICATION

A. After completion of hydrostatic tests, system piping exposed to view in or on the building shall be painted. Coordinate work with painting contractor.

1. Piping exposed in non-public spaces such as mechanical rooms and crawl spaces shall be painted “Red.” Color to comply with ANSI A13.1 “Scheme for the Identification of Piping Systems.”

2. Piping exposed to public view such as stairways and exposed canopies, shall be painted to match adjacent surfaces.

3. Piping concealed in walls and ceiling spaces need not be painted.

4. Exposed piping supplying chrome plated hose valves or fire department connections shall be painted (color to be approved by Architect). Chrome plated wall or floor escutcheons shall be provided at point of concealment.

B. Valve hand wheels shall be painted red enamel.

C. Provide sprinkler head protection from overspray from painting. Cover heads with paper or plastic bags prior to painting. Immediately remove only after painting is complete and paint is dry.

D. Provide pipe, valve, and equipment identification, and signage in accordance with referenced standards, codes and specifications. Signs should identify the type of equipment and service. The tag shall be secured by a brass chain. Furnish four schedules of valves so tagged. There shall be furnished four diagrammatic charts showing schematically the complete sprinkler system with major control valves and numbers thereof. One set of Schedules and charts shall be mounted in glazed framed located where directed.

E. Provide hydraulic design information signage as required by NFPA 13.

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

G. In addition to the requirements of the General Requirements, provide pipe markers every 40’, once in every room, and at each building level traversed, minimum.

3.27 INSTALLATION OF IDENTIFICATION SIGNS
A. Provide identification signs in accordance with referenced standards, to include, but not be limited to: the fire department connection(s), control valves, each standpipe isolation valve, each main or auxiliary drain valve, test connection valves, each inspector's test valve, and, for hydraulically-designed systems, a hydraulic system calculation nameplate. In addition, provide signs identifying access panels concealing sprinkler control or test valves. Provide a sign on or directly below the local water flow alarm.

B. Sprinkler and standpipe control valves shall be provided with identification signs at each valve to indicate its function and what it controls. Also, sprinkler control valves, including pressure regulating control valves (PRV's), shall be provided with a permanent label/tag which provide the static pressure and residual pressure at a particular flow that is available at the valve outlet.

C. Note: Field adjustable pressure regulation valves (PRV's) for sprinkler systems and standpipes, including fire pump suction and discharge PRV's, must have a permanent tag which indicate the setting/pressure setting, i.e. for standpipe fire hose valves it would be the setting in inches and for fire pump PRV's the pressure setting.

D. A permanently installed, metal calculation plate shall be attached at the sprinkler riser indicating sprinkler specifications as required by NFPA 13. Use of plastic tape shall not be permitted on the calculation plate.

E. Approved identification signs shall be provided for outside alarm devices such as alarm bells, and the like. The sign shall be located near the device in a conspicuous position and shall be worded as follows: “SPRINKLER FIRE ALARM – WHEN BELL SOUNDS CALL 911.”

3.28 EXCAVATION AND TRENCHING

A. Trenches for underground piping shall have uniform grades same as for pipe. Pipe shall be embedded in 6” minimum layer of clean sand all around.

B. Loose earth shall be tamped solid around sides and on top of sand-covered pipe and remainder thoroughly compacted to prevent settlement of the surface. After completion of backfill, the grade shall be finished to match the existing, or as directed. Paving and walkways shall be finished to match the existing.

C. Provide and maintain dewatering pumps as required. After piping has been installed, it shall be inspected and approved by the authority having jurisdiction before backfilling. Backfill shall not be placed on or around piping for 24 hours after pipe joints have been made and before lines are properly tested and approved.

D. Provide barricades, signs, lanterns, shoring, sheeting and pumping as part of Work in this Division to insure safe conditions. Provide shoring and cross bracing of sufficient strength to properly support the walls of excavations at depth of 4'-0” or more to protect personnel, and as required by OSHA.

E. Minimum bury for piping exterior to the building shall be 36” minimum cover from top of pipe to finished grade except as otherwise shown, or as determined by invert elevations. Contractor shall verify piping elevations, and invert elevations before starting work.

F. Excavation and pipe installation on public property shall be fully coordinated for timing and procedures with the authorities having jurisdiction. Work shall conform to local Public Work rules and
regulations. Paved areas and concrete sidewalks damaged during this work shall be repaired to match existing when new to the satisfaction of the governing authorities.

G. Dispose of surplus excavation material and seepage water as directed by General Contractor and in accordance with local codes and applicable laws.

H. Water piping shall not be run in the same trench with sewer or drainage piping unless separated as required by the plumbing code.

3.29 BACKFILL

A. Trenches: Do not place backfill in trenches until pipe installation has been reviewed and approved by AHJ.

B. Within 24 hours or as soon as pipe has been laid and inspected, place backfill in layers to the elevation at which excavation was begun, or to a height of 6" from rocks or lumps greater than 4" in any dimensions. Place backfill in 6" layers and bring up evenly and tamp continually on both sides of pipe. Use excavated materials or other approved materials as directed. Tamp by hand or with pneumatic tampers. Machine tamping and compaction by flooding or puddling will not be accepted.

C. Compaction: Relative compaction of backfilling for pipe trenches and concrete structures shall be not less than 90% in accordance with Test Method No. Calif. 216 and ASTM D1557-58T. Fills below structures and the upper 18" of sub-grade beneath areas to be paved shall be compacted to 95%.

D. Settling: Backfill which subsides or settles below finish grades or adjacent ground during warranty period shall be removed to top of pipe and replaced with compacted fill as specified.

END OF SECTION 21 10 00
SECTION 21 13 29 – WATER SPRAY FIXED SYSTEM

PART 1 – GENERAL

1.1 SUMMARY

A. This specification section outlines the requirements for a water spray fixed system deluge fire suppression system(s) with open sprinklers/nozzles, including an addressable detection and controls system. The work described in this specification includes all engineering, labor, materials, and equipment and services necessary to design, install and test the fire protection and controls system.

1.2 REFERENCE AND STANDARDS

A. Regulatory compliance: Work performed under this division shall comply with the latest currently adopted editions of codes and regulations. The following references and standards are hereby made a part of this section and Work shall conform to applicable requirements herein except as otherwise specified herein or shown on the Drawings.

B. Codes, Standards, Laws and Orders: Conform to latest applicable codes, standards, laws and orders as stated s, including but not limited to the following:

1. California Building Code
2. California Fire Code
3. California Electrical Code
6. Occupational Safety and Health Regulations (OSHA) for Construction of U.S. Department of Labor and California.
8. All applicable laws and regulations and standards of Federal Aviation Administration (FAA), including airfield security requirements.
9. The Americans with Disability Act (ADA) requirements for disabled access.

C. In addition to previously mentioned, work shall comply with the following:

1. SFO Airport Building Regulations (ABR)
2. National Fire Protection Association (NFPA)
   a. 13 - Standard for the Installation of Sprinkler Systems
   b. 15 - Standard for Water Spray Fixed Systems for Fire Protection
   c. 25 - Standard for the Inspection, Testing and Maintenance of Water Based Fire Protection Systems
   d. 70 - National Electric Code
e. 72 - National Fire Alarm Code
f. 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations
g. 415 - Standard on Airport Terminal Buildings, Fueling Ramp Drainage and Loading Walkways

3. NEMA 250: Enclosures for Electrical Equipment (1000 Volt Maximum).
7. NEMA National Electrical Manufacturer’s Association
8. NCPWB National Certified Pipe Welding Bureau
9. International Conference of Building Officials (ICBO)
10. Occupational Safety & Health Administration (OSHA)
11. Factory Mutual (FM)
13. American Society of Mechanical Engineers (ASME)
15. American Welding Society (AWS)

D. In addition to the above, all construction shall be done in conformance with rules, regulations, and requirements established by SFO relating to the safety and convenience of the public, to the safeguarding and protection of Airport property, and to Airport operations.

E. Minimum requirements: The requirements of these Specifications are the minimum that will be allowed, unless such requirements are exceeded by applicable codes or regulations, in which the local regulatory code or regulation requirement of this competition shall govern.

F. Nothing in the Specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and the SFO Standards Committee.

1.3 QUALITY ASSURANCE

A. Manufacturer’s Qualifications:

1. The manufacturer of the fire suppression system hardware and detection components shall have a minimum of 10 years’ experience in the design and manufacture of similar types of suppression systems. The manufacturer shall be able to refer to similar installations providing satisfactory service.

2. All materials, devices and equipment installed as part of this work shall be new, and the manufacturer’s current model. All equipment and other devices shall be UL listed and/or FM approved.
3. The name of the manufacturer, part numbers and serial numbers shall appear on all major components.

4. All devices, components and equipment installed as part of this work shall be new, the standard products of the manufacturer’s latest design, suitable to perform the functions intended. All products shall be of the same manufacturer.

5. All fire system control panels shall meet the requirements of the current UL Standard 864.

6. Locks for all cabinets shall be keyed alike.

7. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.

8. The products and execution of work specified in Division 21 shall conform to the referenced codes and standards as required by the specifications. Local codes and amendments shall be enforced by B.I.C.E if required by local authorities.

B. Fire Suppression System Contractor’s Qualifications:

1. The water spray sprinkler system contractor shall be experienced with the requirements of SFO Airport Building Regulations (ABR).

2. The installing contractor shall be an experienced firm, with a minimum of 10 years’ experience, regularly engaged in the design, installation and testing of a water spray fixed deluge fire suppression system and controls in strict accordance with NFPA standards.

3. The installing fire suppression contractor shall be responsible to design, install, test and maintain the water spray fixed deluge fire suppression systems including the detection and controls for these systems.

4. The installing contractor shall employ a NICET, Level IV, certified special hazard designer, who will be responsible for this project.

5. Installing contractor shall submit a resume of the engineer, project manager, site foreman and commissioning technician, showing experience in similar projects. Resumes to be submitted.

6. The installing contractor shall show evidence that they carry a minimum required amount of liability and completed operations insurance policy. Due to the critical function this system serves these limits shall supersede limits required in the general conditions of the specifications if less stringent.

1.4 SYSTEM DESCRIPTION AND OPERATION

A. Detection:

1. The system shall be complete in all ways. It shall include all mechanical and electrical installation, all detection and control equipment, system riser, sprinklers, pipe and fittings, auxiliary devices and controls, alarm interface, functional checkout and testing, training and all other operations necessary for a functional, UL Listed and/or FM approved system.

2. The system(s) shall be actuated by IR Multispectrum Fire and Flame Detector, Model X3301, as manufactured by Detector Electronics Corporation, or equal.

3. The signal processing circuitry shall compare infrared sensing in the CO2 emission band region and reject infrared energy without compromising detection capabilities.
4. The detector shall be certified to reliably detect a 2’ x 2’ JP-5 pan fire at 210’ on the central axis and 180’ 45° off-axis.

5. The detector shall have a 90° horizontal cone of vision and maintain a minimum of 70% of the central axis detection distance at 45° off-axis.

6. The detector shall not respond to radiation generated by sunlight, flashlights, fluorescent lights, and black body infrared sources.

7. The detector shall be able to detect a fire in the presence of radiation generated by sunlight, flashlights, fluorescent lights, and black body infrared sources.

8. The detection system design analysis for the water spray system shall include consideration of false alarms and detector time response.

B. Deluge Fire Sprinkler System Description:

1. The deluge system shall be with electric release containing all hydraulic and electrical components required for the control of a deluge system.

2. The system shall be controlled and monitored by the deluge system control panel. Activation of the detection condition is necessary to cause the water to discharge.

3. The system shall be of the open head deluge type and shall meet the requirements of NFPA 15, Standard for Water Spray Fixed Systems for Fire Protection.

4. The system shall be designed for:
   a. A minimum density of at least 0.25 gpm/ft² over the exterior surface area of the glazing material.
   b. Where multiple systems are used, the water supply shall be capable of supplying all systems that could be expected to operate as a result of one fire incident.

C. Sequence of Operation:

1. Actuation of an optical detector, within the system, shall:
   a. Provide an alphanumeric LCD display indicating the alarm at the deluge releasing control panel.
   b. Send an alarm signal to the building fire alarm panel.

2. The activation of the detection condition will activate the solenoid valve and depressurize the priming chamber of the deluge valve, causing the system to fill the piping network with water and spray through all open type sprinklers or nozzles. This will activate alarm and water flow switch contacts connected to the remote control panel and sound an alarm.

3. Operation of the emergency manual release will depressurize the priming chamber of the deluge valve, causing the system to fill the piping network with water, spray water through all open type sprinklers or nozzles, and activate alarm and water flow contacts connected to the pre-action deluge releasing control panel and transmitted to the building fire alarm panel.

4. Activation of deluge tamper or flow switch, shall:
   a. Provide an alphanumeric LCD display indicating “Trouble” for the tamper switch and “Alarm” for the water flow switch.
b. Activate relays to a trouble condition to the building life-safety system or central station. A flow switch activation, however, will send an alarm signal.

c. Actuation of a water flow switch shall cause an alarm bell to sound, and send an alarm signal to the deluge control panel.

PART 2 – PRODUCTS

2.1 GENERAL

A. All materials and equipment shall be standard products, of the manufacturer's latest design, and shall be suitable to perform the functions intended. When one or more pieces of equipment are used for the same function, they shall be the same model number and be from the same manufacturer.

B. All references to model numbers and other pertinent information herein are intended to establish standards of performance, quality and construction. These model numbers are based on equipment manufactured by Fike Corporation. Equivalent products may be considered if adequate information is submitted to the specifying engineer 2 weeks prior to bid date.

2.2 DELUGE VALVE ASSEMBLY CABINET

A. General: The deluge system shall be a Viking TOTALpAC2® Deluge system as manufactured by Fire Flex Systems Inc. and distributed by Viking Corp., Victaulic, or equal.

B. The cabinet shall be provided fully pre-wired to a terminal panel within the cabinet for connection to a remote controlled releasing control panel unit. The detection and control system shall be a Fike Cheetah releasing control panel, or equal.

C. Listings and Approvals: Equipment and devices shall be UL listed and FM Approved for fire protection. The integrated unit shall be California State Fire Marshal Approved, C-UL-us Listed and FM Approved as an assembled unit. All system components shall be “compatible,” UL/ULC listed and FM approved. The word compatible used in this specification means that the items concerned have been tested and listed and/or approved for their use together. It shall also be OSHPD Approved for seismic requirements per California Building Code 1708A.4 Seismic certification of nonstructural components.

D. Cabinet: Self-contained deluge cabinet, with electric release, containing all hydraulic and electrical components required for the control of a deluge system. The cabinet assembly must be pre-assembled, pre-wired and factory tested under ISO-9001 conditions, as a System. The cabinet shall include the following:

1. Sturdy free-standing 14-gauge steel cabinet.
   a. 57”H x 46”W x 24”D (for 4” & 6” systems).

2. Textured rust proof coating, inside and outside, fire red, oven baked polyester powder on phosphate base (powder coated).

3. Two (2) locked access doors to reduce front area required for opening, easily removable without tools to allow easy installation & servicing.

4. Deluge Valve: Viking Deluge Valve model E, complete with releasing trim rated at 250 psi and all the necessary accessories. Trim shall include a mechanical latching device to prevent system from resetting in case of loss of power to the release solenoids. Systems provided with solenoids...
only, without this mechanical latching device, shall not be accepted. Every valve shall be clearly identified as to its operation with arrows indicating all positions to facilitate system operation.

5. Field wiring terminal strips integrated with the cabinet for connection of field wiring for detection system interface.

6. Pressure gauges to indicate water supply and priming water pressures of the system. Each pressure gauge must be provided with its own shut-off valve and shall be clearly identified on the outside of the cabinet front door.

7. Schedule 40 galvanized steel release trim with solenoid valves and every supervisory and alarm device required. Black pipe will not be accepted.

8. Schedule 40 steel pipe header painted fire red, with grooved ends to be connected to supply water from either side.

9. Schedule 40 steel pipe drain manifold of 2” diameter painted fire red, with grooved ends for drain connections from either side.

10. Properly identified contractor test ports factory mounted into the trim piping to facilitate system testing and commissioning.

11. Required Option: Provide a listed and approved isolation butterfly valve installed on the system riser inside the cabinet for full flow test purposes. The valve shall be supervised by the same supervisory circuit as the system main water supply valve tamper and wired at the factory. An integrated sight glass shall be part of this arrangement for visually confirming water flow through the main drain upon system actuation. A detailed instructions placard must be provided inside the cabinet door for easy reference.

E. System Drain:

1. The single drain collector of the system shall be connected to an open drain (open end pipe with an air gap around the drain pipe or equivalent). The drain piping shall not be restricted or reduced and shall be of the same diameter as the drain collector. It shall also be arranged to avoid back-pressurizing the drain trim. Multiple drain collectors and open drain cups inside the cabinet are not acceptable.

2. Manifolding of multiple units is permitted provided the manufacturer’s recommendations are carefully followed and complied with.

2.3 DELUGE SYSTEM CONTROL PANEL

A. Control panels shall be listed and approved by U.L 864, 9, no exceptions. Control panels, which are not U.L. 864 approved, will become obsolete per NFPA 72, causing hardship to the client when components need to be replaced in the near future.

B. The addressable control panel shall be a Cheetah Xi - Fire Detection and Control System PN 10-068 manufactured by Fike Corporation, Blue Springs, MO., or equal.

C. The control panel and its components shall be UL Listed and FM approved for use as a local fire alarm system, and/or releasing of clean agent, deluge and pre-action fire suppression systems.

D. Control panels shall use extreme intelligence with peer-to-peer operation. Intelligence shall be in the field devices, not just the control panel, thus eliminating a potential single point of failure.
E. Control panels shall be capable of releasing a minimum of 3 pre-action systems from a single panel.

F. Control panels shall be capable of networking with similar panels to allow for internal and external NOC communications.

G. Control Panel Capacity and General Operation:

1. The panel shall be capable of communicating and controlling up to 1,016 addressable analog devices and sensors.

2. The panel shall support up to 254 software zones for configuring initiating devices and output functions.

3. The panel shall respond to an alarm-initiating device, including analog smoke sensors in as little as 0.25 second. Response times shall be measured from the activation of the initiating device to the activation of the associated notification devices.

4. The panel shall provide two configurable notification appliance circuits. Each circuit shall be rated for 2.0 amps @ 24 VDC.

5. The panel shall include a full-featured operator interface control and annunciation panel that shall include a LCD display, 10 individual color-coded system status LEDs and an alpha numeric keypad for field programming of the system.

6. All programming or editing of the existing configuration program in the system shall not require use of special equipment, such as a laptop or external computer. Access to the configuration program shall be limited by use of a password security system. Three (3) levels of access shall be used to isolate user, maintenance and configuration operating portions of the system.

H. The control panel shall provide the following features:

1. Drift compensation for analog sensors.

2. Maintenance alert for sensors with excessive accumulations of dust or dirt.

3. Alarm verification with individual counters for each sensor.

4. Periodic calibration of smoke sensors.

5. Day/Night automatic smoke sensor sensitivity adjustments.

6. One-man walk test with optional notification appliance testing.

7. Two (2) levels of adjustable pre-alarm for advanced warning.

8. 3200 event history buffer, with dedicated 600-event alarm event buffer.

9. Communicate with both non-isolator and isolator version addressable devices.

I. Signaling Line Circuits:

1. Each SLC shall provide power and communication with up to 254 analog or addressable devices. The basic system shall consist of 2 SLC (508 devices total) with expansion to 4 SLC (1016 devices total).

2. Each SLC shall be capable of meeting the wiring requirements of NFPA 72, Style 4, 6 and 7.

3. Each SLC shall communicate using a completely digital communication method to provide a more reliable, noise immune communication system. All communication between an addressable device or sensor shall use a validation method, such as providing a checksum for
each message, to validate the integrity of each message. Systems, which use a hybrid analog and digital communication scheme, will not meet the requirements of this section.

4. Each SLC shall use an interrupt driven communication scheme to rapidly identify alarm conditions of any connected device. The normal polling scheme of the system shall be interrupted by a device in alarm. Identification of the alarming device shall be announced at the control system display within 3 seconds of activation.

J. Power Supplies:

1. The power supply shall operate upon either 120 VAC or 240 VAC, 50/60 Hertz and shall provide all power necessary to operate the control system.

2. The power supply shall provide 6.0 amps of power for use on notification appliance circuits or auxiliary power circuits.

3. Capability to supply an additional 6.0 amps of power shall be provided, bringing total output power capacity to 12.0 amps at 24 VDC.

4. Each power supply shall provide battery charger capacity to sufficiently recharge a depleted set of 7, 18, 40, or 75 AH batteries within 48 hours.

5. Auxiliary power output circuits shall be provided for 4-wire detectors or addressable control modules. A separate circuit shall be provided to allow resetting the auxiliary power during a system reset. All auxiliary power circuits shall be power limited.

2.4 DETECTORS

A. IR Multispectrum Flame Detection:

1. The IR Multispectrum flame detector shall be a Model X3301, as manufactured by Detector Electronics Corporation, or equal.

2. A minimum of 3 detectors per zone shall be provided at the roof level to view the fueling areas.

3. The optical flame detector shall be a unitized device with the detector housing containing all sensors, signal processing hardware, and visual indicators.

4. The detector shall be certified for use in Class 1, Division 1 and Class 1, Division 2. Hazardous areas, and shall be completely compatible as part of an NFPA 72 compliant Class A initiating device circuit.

5. The detector shall provide an automatic calibrated optical integrity (Oi) test to evaluate the sensors for loss of detection range. The automatic Oi test shall be performed once per minute, and indicate a fault condition after three consecutive Oi failures. A manually-initiated Oi test option via an internal magnetic switch, or remotely located switch shall also be supported.

6. The detector shall provide a single, tricolor LED on the detector face for visual annunciation of detector status. The LED indicator shall indicate normal operation, fire alarm, and fault conditions via the colors Green, Red, and Amber, respectively.

7. The detector housing shall be a weatherproof epoxy-coated, copper-free aluminum rated to NEMA 4X/IP66 and shall provide a sealed internal wiring termination compartment free of any electrical components. The wiring compartment shall provide four (4) ¾” NPT conduit entries.
8. A 316 stainless steel detector mounting bracket/arm shall be provided to ensure vibration-free detector mounting is achieved, and shall enable field of view alignment adjustments in the horizontal and vertical axis’s, and shall enable locking of the final alignment angle.

9. The detector shall be rated for an operating temperature range of -40 °F to +167 °F (-40 °C to +75 °C) and a storage temperature of -67 °F to +185 °F (-55 °C to +85 °C) and operate over a humidity range of 0 to 95% relative humidity (non-condensing).

10. A laser aiming accessory device shall be provided to enable evaluation and validation of proposed detector mounting locations and optical alignment angles.

11. The detector and mounting bracket/arm shall meet the vibration requirements of FM Approval Standard 3260 (2003), MIL-STD 810C (Curve AW), DNV Note 2.4 (Class B).

12. Detector Test Lamps shall be provided for manual testing.

2.5 ADDRESSABLE MODULES

A. Monitor Module (MM):
   1. MM shall be Fike’s P/N 55-041/045/046/050, or equal.
   2. MMs shall provide monitoring of dry contacts as initiating devices.
   3. Each MM shall store the sensor address and operating characteristics in non-volatile memory at the module.
   4. An isolation option shall be available.
   5. The MM shall be mounted to a standard junction box and provide visual indication of status via a status LED. Optional mounting shall be available to allowing mounting the module in a junction box with a monitored contact.
   6. Each MM shall monitor normally open or normally closed contacts and shall be programmed for a variety of input types as defined in the programming manual.

B. Supervised Control Module (SCM):
   1. SCM’s shall be Fike’s P/N 55-042/047, or equal.
   2. Each SCM shall be rated to operate listed notification appliances.
   3. Circuit shall be rated for 2.0 amps @ 24 VDC.
   4. An isolation option shall be available.
   5. Each SCM shall store the sensor address and operating characteristics in non-volatile memory at the module.
   6. Each SCM shall be individually selectable for silencing and walk test. A module programmed to operate during walk test will initiate the programmed pattern for 4 seconds when the appropriate initiating conditions are satisfied.
   7. Each SCM shall operate under 16 different conditions occurring in the system. These conditions include combining various zones and zone states.

C. Releasing Control Module (RCM):
1. RCM shall be Fike's P/N 55-052/053, or equal.
2. Circuit shall be rated for 2.0 amps @ 24 VDC.
3. Each module shall store the sensor address and operating characteristics in non-volatile memory at the module.
4. The module shall be capable of actuating a listed solenoid or an agent release circuit.
5. The module shall be protected from false actuation by an intelligent transistor.
6. The RCM shall be capable of releasing in one of two modes:
   a. Connection to a single compatible solenoid.
   b. Connection to up to six (6) Agent Release Modules – Fike P/N 101932, or equal.

D. Relay Module (RM):
   1. Relay module shall be Fike's P/N 55-043/048, or equal.
   2. The module shall provide an independently operating and configurable relay.
   3. Each relay shall be rated for 2.0 amps @ 30 VDC.

2.6 AUXILIARY PANELS

A. Remote Display Panel: Fike P/N 10-2276 shall be located outside the protected room in a location as shown on the drawings. It shall use the latest in LCD technology. Its large viewing area allows for the simultaneous display of multiple conditions occurring at the Cheetah control panel. The Remote Display will show the trouble/alarm event with a custom message. Operation of the panel switches allows the user to perform functions such as acknowledge, reset and silence.

B. Graphic Map: The graphic map shall be a full color image on a white background mounted on rigid backing and laminated. Provide a concealed secured hanging system. The graphic map shall include, but not limited to:
   1. Building outline, including address, and adjacent streets.
   2. Map shall be to scale.
   3. All exterior door and doors exiting the protected room.
   4. Fire suppression control panel.
   5. Pre-action sprinkler riser.
   6. Compass direction and the map shall be oriented to the room when mounted. “You Are Here” shall be indicated.
   7. Zone area separations and designations.
   8. Legend of devices and other symbols.
   9. Addresses at each addressable device.

2.7 AUTOMATIC SPRINKLERS (SPRAY NOZZLE)

A. Supply and install all required deluge open head sprinklers.

B. Exposure protection of windows, walls, and roofs shall be accomplished by utilizing an automatic deluge system with automatic detection and open window sprinklers/nozzles. The sprinklers/nozzles...
installed shall be listed and approved for such use. Sprinklers with a nominal orifice smaller than 3/8” will only be installed on systems equipped with an approved strainer. The window sprinklers will have a brass finish:

1. **Window Sprinkler**: Brass nozzle body, non-automatic open “outside” sprinklers intended for protection of window, wall, and roofs against exposure fires. Directional discharge to produce a flat 180° fan shaped spray pattern. Window sprinkler shall be Viking Model “C-1”:

<table>
<thead>
<tr>
<th>Model</th>
<th>Orifice</th>
<th>spray</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>SIN VK790</td>
<td>1/4” orifice</td>
<td>1.5K</td>
<td></td>
</tr>
<tr>
<td>SIN VK791</td>
<td>5/16” orifice</td>
<td>2.1K</td>
<td></td>
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<tr>
<td>SIN VK792</td>
<td>3/8” orifice</td>
<td>3.0K</td>
<td></td>
</tr>
<tr>
<td>SIN VK793</td>
<td>7/16” orifice</td>
<td>4.3K</td>
<td></td>
</tr>
<tr>
<td>SIN VK794</td>
<td>1/2” orifice</td>
<td>5.8K</td>
<td></td>
</tr>
<tr>
<td>SIN VK795</td>
<td>5/8” orifice</td>
<td>6.9K 3/4” NPT</td>
<td></td>
</tr>
<tr>
<td>SIN VK796</td>
<td>3/4” orifice</td>
<td>7.7K 3/4” NPT</td>
<td></td>
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</tbody>
</table>

   Or equal.

2. **Spray Nozzle**: Brass body, non-automatic open type spray nozzle designed for directional spray applications in fixed fire protection systems, with an external deflector that discharges a solid uniform cone spray of low to medium velocity droplets. Orifice size and spray angle to meet design application requirements, 0.5” NPT external pipe thread. Viking Model “E” Series spray nozzle, or equal.

2.8 **PIPE AND FITTINGS**

   A. Refer to specification section 21 10 00 – Water Based Fire Suppression System for pre-action fire sprinkler pipe and fitting materials.

2.9 **HANGERS AND SUPPORTS**

   A. Refer to specification section 21 10 00 – Water Based Fire Suppression System for hangers and supports.

2.10 **PIPING, VALVE AND EQUIPMENT IDENTIFICATION**

   A. Refer to specification section 21 10 00 – Water Based Fire Suppression System for piping and piping, valve and equipment identification.

2.11 **IDENTIFICATION SIGNS**

   A. Refer to specification section 21 10 00 – Water Based Fire Suppression System for identification signs. Provide systems with identification signs as specified and as required by NFPA 13 and with referenced standards.

**PART 3 – EXECUTION**

3.1 **DRAWINGS AND SITE**

   A. Drawings:

   1. Scaled and figured dimensions are approximate and are given for estimate purposes only. Before proceeding with work, carefully check and verify dimensions, sizes and lengths.
2. So far as possible the work has been indicated on the drawings in such positions as to suit and accommodate the work of the other trades, but the work as indicated is largely diagrammatic and is shown primarily for clarity. Contractor is responsible for the correct placing of their work and the proper location and connection of work in relation to the work of other trades.

3. Where apparatus and equipment have been indicated on the drawings, dimensions have been taken from typical equipment of the class indicated. Carefully check the drawings to see that the equipment will fit into the spaces provided.

4. Where equipment is furnished by others, verify dimensions and the correct locations of this equipment before proceeding with the roughing-in of connections.

3.2 GENERAL INSTALLATION

A. Fire safety during construction shall comply with the requirements in the California Building Code (CBC), California Fire Code (CFC), and National Fire Protection Association (NFPA) 241.

B. System valves and gauges shall be accessible for operation, inspection, tests, and maintenance.

C. No valve and no piece of equipment or trim shall support the weight of any pipe.

D. No cutting, drilling or taping of structural members shall be done without prior written approval of the structural engineer.

E. Powder actuated fastening will not be allowed. Embeds, beam clamps, or drilled fasteners will be required, unless otherwise noted.

3.3 WATER SPRAY FIXED SYSTEM PIPING INSTALLATION

A. Distribution piping, and fittings, shall be installed in accordance with the manufacturer's requirements, NFPA 13 and approved piping standards and guidelines. Qualified individuals using good, accepted practices and quality workmanship procedures shall install all distribution piping. All piping shall be adequately supported and anchored at all directional changes.

B. Carry all exposed and concealed horizontal lines of pipe on specified hangers properly spaced and set to allow the pipe to adjust for expansion and contraction.

C. Check all piping runs beforehand with all other trades. Run piping to maintain proper clearance for maintenance and to clear opening in exposed area. Run piping in strict coordination with mechanical piping, ducts, and equipment, plumbing work, all electrical conduit and equipment, structural, and architectural conditions. Where work of other trades prevents installation of the piping as shown on the Drawings, reroute piping at no extra cost. All piping shall be installed within designated finished ceiling height as noted on the architectural drawings.

D. Install all exposed piping parallel to or at right angles with building walls and tight to walls or ceilings wherever possible, except where otherwise shown on the Drawings. Piping shall be arranged to form a symmetrical pattern. Horizontal piping shall be supported at intervals not to exceed spacing permitted by NFPA.

E. Fire stop all pipes penetrating fire rated construction.

F. Where exposed pipes pass through walls, ceilings, or floors, fit in all finished rooms and conspicuous locations with escutcheon plates. Escutcheon plates must be securely held in position allowing
enough clearance to allow for expansion and shall be sufficient size to cover the opening around the pipe.

G. Support all pipe from the building structure so that there is no apparent deflection in pipe runs. Fit piping with steel sway braces and anchors to prevent vibration and/or horizontal displacement under load when required. Do not support pipe from or brace to ducts, other pipes, conduit, or any materials shown on the Drawings. Piping or equipment shall be immobile and shall not be supported or hung by wire, rope, and plumber's tape or blocking of any kind.

H. Clean pipe and fittings and keep interiors clean throughout installation. Provide caps on ends of cleaned piping.

I. Use full pipe lengths; random lengths joined by couplings will not be accepted.

J. Provide for expansion and contraction of all pipes and for seismic movement.

K. Piping arrangement shall avoid beams, columns, ducts, lighting fixtures, doors, windows, and similar obstructions and openings.

L. Locate pipe and discharge nozzles fully coordinated with grilles, diffusers, reflected ceiling plans, ducts, conduits, light fixtures, curtain tracks and all other ceiling elements. Maintain proper code clearances from all ceiling obstructions.

M. Light fixtures and other potential obstructions shall not interfere with the engineered spray patterns of discharge nozzles. The contractor shall insure that the type and location of potential obstructions is considered in the design and installation of the system. The contractor is responsible for coordinating and resolving conflicts in coverage patterns.

N. System valves and control panels shall be accessible for operation, inspection, tests, and maintenance.

O. No valve and no piece of equipment or trim shall support the weight of any pipe.

P. No cutting, drilling or taping of structural members shall be done without prior written approval of the SFO's Representative.

Q. Powder actuated fastening will not be allowed. Embeds, beam clamps, or drilled fasteners will be required, unless otherwise noted.

3.4 FIRE SUPPRESSION SYSTEM CONTRACTOR

A. Obtain system approvals from local authorities and pay for all permits and fees.

B. Review all project drawings to become familiar with the items that affect the deluge system and consider them in its design.

C. Provide coordination for all interfacing trades to ensure that the pre-action system will operate as engineered.

D. The proper operation and coordination for the detection/control system's installation, including the deluge system, detection system, signaling system and initial start-ups are all under the responsibility of the fire protection contractor.
3.5 SYSTEM AND CONTROL WIRING

A. All fire suppression system wiring, in this section, shall be furnished and installed by the fire suppression system contractor.

B. All wiring shall be installed in electrical metallic tubing (EMT) or conduit.

C. All system components shall be securely supported independent of the wiring. Runs of conduit and wiring shall be straight, neatly arranged, properly supported, and installed parallel and perpendicular to walls and partitions.

D. The sizes of the conductors shall be those specified by the manufacturer. Color codes shall be used. All wires shall be tagged at all junction points and shall be free from grounds and crosses between conductors. Final connections between equipment and the system wiring shall be made under the direct supervision of a factory-trained representative.

E. All wires shall be tagged at all junction points and shall be free from grounds and crosses between conductors.

F. Final connections between equipment and the system wiring shall be made under the direct supervision of a factory-trained representative.

G. All wiring shall be installed by qualified individuals, in a neat and workman like manner, to conform to the National Electrical Code, Article 725, for Class 1 Signal Systems, except as otherwise permitted for limited energy circuits, as described in NFPA 72. Wiring installation shall meet all State and local codes. Wire shall be a minimum No. 14 AWG copper wire conforming to the requirement, with an insulation rating of 600 volts and temperature rating of 105 Celsius. UL listed wire shall be used. Provide power limited fire protective signaling cables conforming to National Electric Codes, Article 725 and 760, Type FPLR. Unavoidable splices shall be crimp-connected. Wire nuts are not acceptable. Wiring installation shall meet all State and local codes.

H. The complete system electrical installation, and all auxiliary components, shall be grounded in accordance with the California Electrical Code.

3.6 TESTING

A. Fire suppression system contractor shall coordinate field test with other trades to verify proper field operation.

B. Perform tests in the presence of authorities having jurisdiction. Provide all required labor, materials, equipment and connections and submit results for review. Repair or replace defective work and pay for restoring or replacing damaged work, due to tests, as directed. All equipment required for testing, including fittings for additional operating shall be provided by the Contractor.

C. After the inspection has been approved, the Contractor shall certify in writing the time, date, name and title of the person reviewing the test. This shall also include the description and what portion of the system has been approved.
D. A complete record shall be maintained of all testing that has been approved, and shall be made available at the job site.

E. Upon completion of the work, all records and certifications approving testing requirements shall be submitted to SFO’s Representative and before final payment is made.

F. Defective work or material shall be replaced or repaired, as necessary, and the inspection and test repeated, all at Contractor's cost. Repairs shall be made with new materials.

G. No part of any work shall be covered until after it is inspected, tested, and approved.

3.7 SYSTEM FUNCTIONAL TESTING – PRELIMINARY TESTS

A. After the system installation has been completed, the entire system shall be checked out, inspected and functionally tested by qualified, trained personnel, in accordance with the manufacturer’s recommended procedures and NFPA standards. This test shall be conducted prior to the acceptance test with the approving authorities. This shall include:

1. Piping distribution, size and sprinkler type shall match the drawings and hydraulic calculations.

2. Check that all pipes are securely fastened.

3. All electrical wiring shall be tested for proper connection, continuity and resistance to ground.

4. The complete system shall be functionally tested and all functions, including system and equipment interlocks, must be operational at least 5 days prior to the final acceptance tests.

5. All electrical wiring shall be tested for proper connection, continuity and resistance to ground.

6. The complete system shall be functionally tested and all functions, including system and equipment interlocks, must be operational at least 5 days prior to the final acceptance tests.

7. Each detector shall be tested in accordance with the manufacturer’s recommended procedures, and test values recorded.

8. All system and equipment interlocks, such as door release devices, audible and visual devices, local and remote alarms, etc. shall be tested to function as required and designed.

9. Each control panel circuit shall be tested for trouble by inducing a trouble condition into the system.

10. A drain test using the auxiliary drain valve fully open (drain located on water supply side, deluge valve inlet) must be performed to make sure that no back pressure in drain piping exists, which could affect the proper operation of the deluge system.

END OF SECTION 21 13 29
SECTION 21 22 00 – CLEAN AGENT FIRE EXTINGUISHING SYSTEMS

PART 1 – GENERAL

1.1 SCOPE

A. This specification outlines requirements for “Total Flood” Clean Agent Fire Suppression Systems with automatic detection and control, which shall include all engineering, labor, materials, equipment and design services necessary, and required, to replace existing Halon fire suppression systems.

B. Obtain and pay for all the necessary permits and fees.

C. This Section shall also include the complete removal of existing Halon Fire Suppression Systems as indicated on the Drawings and in accordance with all applicable standards.

D. The Contractor shall furnish and install: Clean Agent cylinder tank, Installation labor, all mechanical and electrical installation, all detection and control equipment, agent storage containers, clean agent, discharge nozzles, pipe and fittings, manual release and abort stations, audible and visual alarm devices, auxiliary devices and controls, shutdowns, alarm interface, caution/ advisory signs, functional checkout and testing, training and all other operations necessary for a complete and functional, UL Listed and/or FM approved Clean Agent Fire Suppression System as specified herein. Two (2) inspections per year for the first 2 years of service.

1.2 REFERENCES

A. The design, equipment, installation, testing and maintenance of the Clean Agent Suppression System shall be in accordance with the applicable requirements set forth in the latest edition of the following codes and standards. The standards listed, as well as all other applicable codes, standards, and good engineering practices shall be used as “minimum” design standards.

1. National Fire Protection Association (NFPA)
   a. No. 2001 - Clean Agent Fire Extinguishing Systems
   b. No. 70 - National Electrical Code
   c. No. 72 - Standard for Protective Signaling

2. Factory Mutual (FM) Approval Guide

3. UL Listings


5. California State Fire Marshal (CSFM) Listing

6. Requirements of the Authority Having Jurisdiction (AHJ).

1.3 REQUIREMENTS
A. The Suppression System installation shall be made in accordance with the drawings, specifications and applicable standards. Should a conflict occur between the drawings and specifications, the specifications shall prevail.

1.4 EXCLUSIONS

A. The work listed below shall be provided by others, or under other Sections of this specification:

1. 120 VAC or 220 VAC power supply to the system control panel.
2. Interlock wiring and conduit for shutdown of HVAC, dampers and/or electric power supplies, relays or shunt trip breakers, including terminations of field equipment to be shut down and shutdown verification testing of affected equipment.
3. Connection to local/remote fire alarm systems, listed central alarm station(s) or sprinkler preaction/deluge valve actuation.

1.5 QUALITY ASSURANCE

A. Manufacturer

1. The manufacturer of the suppression system hardware and detection components shall be ISO 9000 registered and have a minimum of 10 years of experience in the design and manufacture of similar types of suppression systems who refer to similar installations providing satisfactory service.
2. The Suppression System hardware and detection components shall be provided by the Suppression System manufacturer to ensure system compatibility.
3. The name of the manufacturer, part numbers and serial numbers shall appear on all major components.
4. All devices, components and equipment shall be the products of the same manufacturer.
5. All devices, components and equipment shall be new, standard products of the manufacturer’s latest design and suitable to perform the functions intended.
6. The name of the manufacturer shall appear on all major components.
7. All devices, components and equipment shall be the products of the same manufacturer.
8. All devices, components and equipment shall be new, standard products of the manufacturer’s latest design and suitable to perform the functions intended.
9. All devices and equipment shall be U.L. listed and/or FM approved.
10. Locks for all cabinets shall be keyed alike.

B. Installer

1. The subcontractor shall be trained by the supplier to design, install, test and maintain fire suppression systems.
2. The subcontractor shall employ a NICET certified special hazard designer, Level II or above, who will be responsible for this project.
3. The subcontractor shall be an experienced firm regularly engaged in the installation of automatic Clean Agent, or similar, fire suppression systems in strict accordance with all applicable codes and standards.

4. The subcontractor must have a minimum of 5 years’ experience in the design, installation and testing of Clean Agent, or similar, fire suppression systems. A list of systems of a similar nature and scope shall be provided on request.

5. The subcontractor shall show evidence that his company carries a required amount of liability and completed operations insurance policy. These limits shall supersede if higher limits are required in the general conditions of the specifications.

6. The subcontractor shall maintain, or have access to, a Clean Agent recharging station. The subcontractor shall provide proof of his ability to recharge the largest Clean Agent system within 24 hours after a discharge. Include the amount of bulk agent storage available.

7. The subcontractor shall be an authorized stocking distributor of the Clean Agent system equipment so that immediate replacement parts are available from inventory.

8. The subcontractor shall show proof of emergency service available on a 24-hours-a-day, 7-days-a-week basis.

C. SUBMITTALS

1. Six (6) sets of drawings in “D” size bond shall be submitted for the engineer’s review. Comments shall be incorporated, and the drawing(s) with comments resubmitted. Final set of drawing shall be approved by the engineer prior to the start of installation. The subcontractor shall submit the following design information and drawings for approval prior to starting work on this project:

   a. Field installation layout drawings having a scale of not less than 1/8” = 1'-0” or 1:100 detailing the location of all agent storage tanks, nozzles, pipe runs including pipe sizes and lengths, control panel(s), detectors, manual pull stations, abort stations, audible and visual alarms, etc.

   b. Auxiliary details and information such as maintenance panels, door holders, special sealing requirements and equipment shutdown.

   c. Separate layouts, or drawings, shall be provided for each level, (i.e., room, under floor, and above ceiling) and for mechanical and electrical work.

   d. A separate layout or drawing shall show isometric details of agent storage containers, mounting details, proposed pipe runs and sizes, and symbol legend. Electrical layout drawings shall show the location of all devices and include point-to-point conduit runs and a description of the method(s) used for detector mounting.

   e. Provide an internal control panel wiring diagram which shall include power supply requirements and field wiring termination points.

   f. Separate drawing providing symbol legend to identify all symbols used.

   g. Annunciator wiring schematics and dimensioned display panel illustration shall be provided. (Optional device.)

   h. Complete hydraulic flow calculations, from a UL listed computer program, shall be provided for all engineered Clean Agent systems. Calculation sheet(s) must include the manufacturers name and UL listing number for verification. The individual sections of pipe
Section 21 22 00 Clean Agent Fire Extinguishing Systems

and each fitting to be used, as shown on the isometrics, must be identified and included in the calculation. Total agent discharge time must be shown and detailed by zone.

i. Provide calculations for the battery stand-by power supply taking into consideration the power requirements of all alarms, initiating devices and auxiliary components under full load conditions.

j. A complete sequence of operation shall be submitted detailing all alarm devices, shutdown functions, remote signaling, damper operation, time delay and agent discharge for each zone or system.

2. Submit drawings, calculations and system component data sheets for approval to the Airport Commission, the local Fire Protection Agency, the City Insurance Underwriter, and all other Authorities having jurisdiction, before starting installation. Submit approved plans to the Engineer for record.

3. Material and Equipment Information:
   a. Material and equipment information shall include manufacturer’s catalog cuts, technical data for each component or device used in the system, and CSFM listing. This shall include, but not be limited to the following:
      1) Smoke Detectors.
      3) Control Panel.
      4) Release Devices.
      5) Clean Agent Storage Containers.
      6) Mounting Brackets.
      7) Nozzles and Piping.
      8) Abort Stations.
      9) Graphic Annunciator.

4. Submit system testing procedures, sequencing, and schedule for approval. Including list of testing equipment required for testing.

5. The subcontractor shall submit certificate(s) showing a required amount of liability and completed operations insurance.

1.6 MANUFACTURER’S SERVICES

A. The Contractor shall provide the services of an experienced and authorized manufacturer’s representative for the equipment and system specified herein who shall be present at the jobsite and/or classroom designated by the City for the minimum man-days listed for the services shown below, travel time excluded:
   1. 1/2 man-day for installation assistance, inspection, and certification of the installation.
   2. 1/2 man-day for functional testing.
   3. 1/2 man-day for pre-startup classroom or jobsite training.

B. Manufacturers’ Certificate
1. An authorized manufacturer’s representative shall inspect the installation of all work furnished under this Section and shall provide a certificate of satisfactory installation.

2. Provide 2 inspections per year during the first 2 years of service. Inspections shall be made at 6-month intervals commencing when the system is first placed into normal service.

### 1.7 WARRANTY

A. System shall be warranted against defects in design, materials and workmanship for the full warranty period which is standard with the manufacturer, but in no case less than one (1) year from the date of system acceptance by the Airport Commission.

### PART 2 – SYSTEM REQUIREMENTS

#### 2.1 MANUFACTURERS

A. Fike Corporation or equal

#### 2.2 SYSTEM DESCRIPTION AND OPERATION

A. The system shall be a Total Flood ECARO Suppression System.

B. The system shall provide an ECARO minimum design concentration of 7.17% by volume for Class A hazards and 9.0% by volume for Class B hazards, in all areas and/or protected spaces, at the minimum anticipated temperature within the protected area. System design shall not exceed 10.5% for normally occupied spaces, adjusted for maximum space temperature anticipated, with provisions for room evacuation before agent release.

C. The system shall be complete in all ways. It shall include all mechanical and electrical installation, all detection and control equipment, agent storage containers, ECARO agent, discharge nozzles, pipe and fittings, manual release and abort stations, audible and visual alarm devices, auxiliary devices and controls, shutdowns interface points, alarm interface, caution/advisory signs, functional checkout and testing, training and all other operations necessary for a functional, UL Listed and/or FM approved ECARO Clean Agent Suppression System.

D. Provide 2 inspections during the first year of service. Inspections shall be made at 6-month intervals commencing when the system is first placed into normal service. Provide written reports of inspections to the Airport Commission.

E. Sealing and securing the protected spaces against agent loss and/or leakage during the 10-minute “hold” period shall be done.

F. The system(s) shall be actuated by a combination of ionization and/or photoelectric detectors installed for maximum area coverage of 250 sq. ft. (23.2 m²) per detector, in both the room, under floor and above ceiling protected spaces. If the airflow is one air change per minute, photoelectric detectors only shall be installed for maximum area coverage of 125 sq. ft. (11.6 m²) per detector. (Ref. NFPA No. 72)

G. Detectors shall be wired in FIKE’S “Sequential Detection” method of operation Cross-Zoned detection requiring two detectors to be in alarm before release. Use Class “A” or Class “B” wiring arrangement. No other detection/wiring arrangements will be acceptable.
H. Automatic operation of each protected area shall be as follows:

1. Actuation of one (1) detector, within the system, shall:
   a. Illuminate the “ALARM” lamp on the control panel face.
   b. Energize an alarm bell and/or an optional visual indicator.
   c. Transfer auxiliary contacts which can perform auxiliary system functions such as:
      1) Operate door holder/closures on access doors
      2) Transmit a signal to a fire alarm system
      3) Light an individual lamp on an optional annunciator.

2. Actuation of a 2nd detector, within the system, shall:
   a. Illuminate the “PRE-DISCHARGE” lamp on the control panel face.
   b. Energize a pre-discharge horn or horn/strobe device.
   c. Shut down the HVAC system and/or close dampers.
   d. Start time-delay sequence (not to exceed 60 seconds).
   e. System abort sequence is enabled at this time.
   f. Light an individual lamp on an optional annunciator.

3. After completion of the time-delay sequence, the ECARO Clean Agent system shall discharge and the following shall occur:
   a. Illuminate a “SYSTEM FIRED” lamp on the control panel face.
   b. Shutdown of all power to high-voltage equipment
   c. Energize a visual indicator(s) outside the hazard in which the discharge occurred.
   d. Energize a “System Fired” audible device. (Optional)
   e. Transmit a signal to a fire alarm system.
   f. Trip main circuit breaker.
   g. Trip generator circuit breaker.
   h. Open contact to stop/prevent generator set from running.
   i. Three (3) contacts to trip UPS circuit breakers.

4. The system shall be capable of being actuated by manual discharge devices located at each hazard exit. Operation of a manual device shall duplicate the sequence description above except that the time delay and abort functions shall be bypassed. The manual discharge station shall be of the electrical actuation type and shall be supervised at the main control panel.

2.3 MATERIALS AND EQUIPMENT

A. General Requirements

1. The ECARO Clean Agent System materials and equipment shall be standard products of the supplier’s latest design and suitable to perform the functions intended. When one or more pieces of equipment must perform the same function(s), they shall be duplicates produced by one manufacturer.
2. The system design can be modular, central storage, or a combination of both design criteria.

3. Systems shall be designed in accordance with the manufacturer’s guidelines.

4. Each supply shall be located within the hazard area, or as near as possible, to reduce the amount of pipe and fittings required to install the system.

5. The clean agent shall be stored in FIKE Agent Storage Containers. Containers shall be superpressurized with dry nitrogen to an operating pressure of 360 psi @ 70° F (24.8 bar at 20° C). Containers shall be of high-strength low alloy steel construction and conform to NFPA.

6. Containers shall be actuated by a resettable electric actuator with mechanical override located at each agent container or connected bank of cylinders. Non-resettable or explosive devices shall not be permitted.

7. Each container shall have a pressure gauge and low pressure switch to provide visual and electrical supervision of the container pressure. The low-pressure switch shall be wired to the control panel to provide an audible and visual “Trouble” alarms in the event the container pressure drops below 247 psi (17 bar). The pressure gauge shall be color coded to provide an easy, visual indication of container pressure.

8. Each container shall have a pressure relief provision that automatically operates before the internal pressure exceeds 750 psi (51.7 bar).

9. Engineered discharge nozzles shall be provided within the manufacturer’s guidelines to distribute the ECARO agent throughout the protected spaces. The nozzles shall be designed to provide proper agent quantity and distribution.
   a. Nozzles shall be available in 3/8 in. through 2 in. (BPS 10 mm through 50 mm) pipe sizes. Each size shall be available in 180° and 360° distribution patterns.
   b. Ceiling plates can be used with the nozzles to conceal pipe entry holes through ceiling tiles.

10. Distribution piping, and fittings, shall be installed in accordance with the manufacturer’s requirements, NFPA and approved piping standards and guidelines. All distribution piping shall be installed by qualified individuals using accepted practices and quality procedures. All piping shall be adequately supported and anchored at all directional changes and nozzle locations.
   a. Piping support system shall conform to the requirements and shall be as reviewed by the City. The Contractor shall submit shop drawings indicating the location of seismic supports and provide a legend giving load information and model specification prior to installation.
   b. All piping shall be reamed, blown clear and swabbed with suitable solvents to remove burrs, mill varnish and cutting oils before assembly.
   c. All pipe threads shall be sealed with Teflon tape pipe sealant applied to the male thread only.

C. System and Control Wiring

1. All system wiring shall be furnished and installed by the subcontractor/Contractor to make a complete functional system.

2. All wiring above ceilings, concealed spaces and/or other indoor locations where not subject to damage shall be installed in electrical metallic tubing (EMT) or conduit, and must be installed and kept separate from all other building wiring. Wiring in exposed locations, equipment rooms, etc., outside, and/or in other locations where subject to damage shall be in conduit.
3. All system components shall be securely supported independent of the wiring. Runs of conduit and wiring shall be straight, neatly arranged, properly supported, and installed parallel and perpendicular to walls and partitions.

4. The sizes of the conductors shall be those specified by the manufacturer. Color-coded wire shall be used. All wires shall be tagged at all junction points and shall be free from shorts, earth connections (unless so noted on the system drawings), and crosses between conductors. Final terminations between the control panel and the system field wiring shall be made under the direct supervision of a factory-trained representative.

5. All wiring shall be installed by qualified individuals, in a neat and workmanlike manner, to conform to the National Electrical Code, Article 725 and Article 760, except as otherwise permitted for limited energy circuits, as described in NFPA 72. Wiring installation shall meet all local, state, province and/or country codes.

6. The complete system electrical installation, and all auxiliary components, shall be connected to earth ground in accordance with the National Electrical Code.

D. Caution and Advisory Signs

1. Signs shall be provided to comply with NFPA, the recommendations of the FM-200 equipment supplier, and the recommendations of the Clean Agent equipment supplier
   a. Entrance sign: One (1) required at each entrance to a protected space. (Fike P/N 02-3646).
   b. Manual discharge sign: One (1) required at each manual discharge station. (Fike P/N 02-3644)
   c. Flashing light sign: One (1) required at each flashing light over each exit from a protected space. (Fike P/N 02-3645).

2.4 CONTROL PANEL – FIKE Cheetah XI CONTROL SYSTEM:

A. The control panel shall be a FIKE Cheetah XI and shall communicate with and control the following types of equipment used to make up the system: smoke detectors, manual release/abort stations, alarm notification appliances, releasing components and other system controlled devices.

B. System Capacity - The control panel shall include two Style Y/Z (Class A/B) notification circuits, two releasing circuits, Form-C alarm and trouble contacts, four Style B/D (Class A/B) initiating circuits, one Style B/D (Class A/B) manual release circuit, and a Style B (Class B) abort circuit.

C. System Display - The system display shall indicate the status of the following system parameters:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>LED Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC POWER</td>
<td>Green</td>
</tr>
<tr>
<td>SYSTEM ALARM</td>
<td>Red</td>
</tr>
<tr>
<td>RELEASE</td>
<td>Red</td>
</tr>
<tr>
<td>SUPERVISORY</td>
<td>Yellow</td>
</tr>
<tr>
<td>SYSTEM TROUBLE</td>
<td>Yellow</td>
</tr>
<tr>
<td>CIRCUIT TROUBLE</td>
<td>Yellow</td>
</tr>
<tr>
<td>ALARM SILENCED</td>
<td>Yellow</td>
</tr>
<tr>
<td>POWER TROUBLE</td>
<td>Yellow</td>
</tr>
</tbody>
</table>

D. System Control Switch Operation
1. **Acknowledge Switch**: Activation of the control panel acknowledge switch in response to alarms, troubles, and supervisory conditions shall silence the local panel piezo electric signal and change the system alarm or trouble LED from flashing mode to steady ON mode. Occurrence of any new alarm or trouble conditions in the system shall cause the control panel to resound the local piezo sounder and repeat the alarm or trouble sequence.

2. **Alarm Silence Switch**: Activation of the alarm signal silence switch shall cause all alarm notification appliances to return to the normal condition after an alarm condition.

3. **System Reset Switch**: Activation of the system reset switch shall cause all electronically-latched initiating devices, appliances as well as all associated output devices and circuits, to return to their normal condition.

### E. System Operation

1. **Zone Status LEDs**: The alarm, supervisory or trouble LED(s) shall flash until event(s) has been acknowledged. Any subsequent new alarm, supervisory or trouble condition will resound all indications and flash new events.

2. **Supervisory**: A short circuit on this zone shall cause the supervisory LED to flash. The tone silence switch shall silence the piezo causing the supervisory LED to illuminate steady. An open circuit shall report as a zone trouble.

3. **System History Recording and Reporting**: The FACP shall contain a history buffer that will be capable of storing up to 2,400 system alarms/troubles/operator actions. Each of these activations will be stored and time-and-date stamped with the actual time of the activation.

4. **The non-erasable history buffer shall be maintained which will provide the last 2,400 system events.**

5. **The history buffer shall use non-volatile memory. Systems that use volatile memory for history storage are not acceptable.**

### F. Optional modules shall include:

1. Optional module for zone/function relays

2. Optional Class A adapter module for initiating circuits

### G. The control panel shall also include the following functions:

1. **Output circuits shall be protected against false activations by using a 2-step electronic activation circuit.**

2. **Battery/earth fault supervision shall be provided.**

3. **Adjustable delay timer shall be available, zero to sixty seconds.**

4. **Cross zone option shall be selectable (two zones in alarm before release).**

5. **Three abort functions options shall be selectable: One (1) Standard UL method; 2 IRI method; and 3 local AHJ method.**

6. **A second release circuit may be selected in place of the supervisory circuit.**

7. **A supervised manual release circuit shall be provided which, when activated, shall override the Abort.**
8. 7 AH to 12 AH battery options shall be available providing up to 90 hours standby.
9. A watchdog timer to supervise microprocessor shall be provided.
10. Slide-in zone identification labels shall be provided.
11. Capable of protecting up to 254 hazards for suppression release.

H. Power Supply
1. The power supply shall be integral to the control panel and provide all control panel and peripheral device power needs.
2. Input power shall be 120 VAC, 60 Hz. The power supply shall provide an integral battery charger for use with batteries up to 18 AH.
3. The power supply shall also provide 2.25 amperes of regulated 24 VDC power for release circuits and alarm notification devices, four-wire smoke detector power of 24 VDC up to 200 ma, non-resettable power of 24 VDC up to 200 ma.
4. The power supply shall be designed to meet UL and NFPA requirements for power-limited operation on all notification and initiating circuits.
5. Positive-temperature-coefficient thermistors, circuit breakers, fuses, or other over-current protection shall be provided on all power outputs.

I. Mechanical Design
1. The control panel shall be housed in a cabinet designed for mounting directly to a wall or vertical surface. The back box and door shall be constructed of .060 steel with provisions for electrical conduit connections into the sides and top. The door shall provide a key lock and include a glass or other transparent opening for viewing of all indicators. The cabinet shall be approximately 5” (127 mm) deep, and 14.5” (368 mm) wide, and 16” (406 mm) high. An optional trim ring shall be used for flush mounting of the cabinet. Space shall be provided in the cabinet for 7 AH or 12 AH batteries.

J. Batteries
1. Batteries shall be 2 - 12 volt, Gell-Cell type providing 24 VDC.
2. Batteries shall have sufficient capacity to power the fire alarm system for not less than 24 hours in standby plus 5 minutes of alarm upon a normal AC power failure.
3. The batteries are to be completely maintenance free. No liquids are required. Fluid level checks, refilling, spills and leakage shall not be accepted.

2.5 SMOKE DETECTORS

A. Smoke detectors shall be 24 VDC and shall be UL listed and FM approved.

B. The detectors shall be spaced and installed in accordance with the manufacturer’s specifications and the guidelines of NFPA No. 72.

C. Each detector shall include a visual status indicator, provide remote LED output, and include a built-in test capability.
D. The sensitivity shall be factory set per UL 268.

E. The detector cover and screen shall be easily removable for field cleaning.

F. A special vandal-resistant locking screw shall be provided to lock the head to the base.

G. The head-to-base connection shall be made by use of bifurcated contacts. Terminal connections to the base shall be the screw types that are accessible with the base installed on the mounting box.

H. Where specifically identified on the contract drawings, detector bases shall incorporate a relay with Form C contacts rated at 1 amp, 120 VAC or 28 VDC for remote LED alarm annunciation of the detector.

I. Ionization-type smoke detector shall be the dual chamber type and compatible with the FIKE control system. The detector shall have an LED in its base which is illuminated in a steady-on mode when in alarm and pulse mode when in standby. Reset of the detector shall be performed by the control unit reset switch. The Ionization detector shall be a FIKE P/N 67-024, with a 4” (10 mm), or a P/N 67-025 with a 6” (15 mm) base.

J. The design of the ionization detector compensating circuits shall provide stable operation with regard to minor changes in temperature, humidity and atmospheric conditions.

K. Photoelectric-type smoke detector shall be the light reflective type and compatible with the Ansul control system. The detector shall have an LED in its base, which is illuminated in a steady-on mode when in alarm and pulse mode when in standby. Reset of the detector shall be performed by the control unit reset switch. The Photoelectric detector shall be a FIKE P/N 63-024, with a 4” (10 mm) base, or a P/N 63-025 with a 6” (15 mm) base.

L. The design of the photoelectric detector compensating circuits shall provide stable operation with regard to minor changes in temperature, humidity and atmospheric conditions.

M. Photoelectric-type smoke detector with heat detector shall be the light reflective type and compatible with the FIKE control system. The detector shall have an LED in its base which is illuminated in a steady-on mode when in alarm and pulse mode when in standby. Reset of the detector shall be performed by the control unit reset switch.

2.6 INDICATING APPLIANCES

A. Sounder/Strobe Combination
   1. The sounder/strobe combination shall operate on 24 VDC and shall be approved for use with the listed control system.
   2. The sounder/strobe combination shall be polarized and powered from the control unit.
   3. The strobe shall be listed to UL Standard for the Hearing Impaired, approved for Fire Protective Service, and rated at either 15 cd or 75 cd.

B. Strobe
   1. The strobe shall operate at 24 VDC and shall be approved for use with the listed control system.
   2. The strobe shall be polarized and powered from the control unit.
3. The strobe shall be listed to UL Standard for the Hearing Impaired, approved for Fire Protective Service, and rated at either 15 cd or 75 cd.

C. Sounder
1. The sounder shall operate at 24 VDC and shall be approved for use with the listed control system.
2. The sounder shall be polarized and powered from the control unit.

2.7 MANUAL PULL STATIONS

A. The manual pull stations shall be provided for the release (electrical) of the fire suppression system in case of an emergency.

B. Manual stations shall be metal with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front and both sides of the stations.

C. Operation shall require 2 actions.

D. The Manual Release switch shall be a Fike P/N 10-1638 or a Manual Pull station, P/N 02-4110.

E. Manual actuation shall bypass the time delay and abort functions shall cause the system to discharge and shall cause all release and shutdown devices to operate in the same manner as if the system had operated automatically.

F. A Manual Release switch shall be located at each exit from the protected hazard and shall have an advisory sign, Fike P/N 02-3644, provided at each location.

2.8 ABORT SWITCH:

A. The Abort Station shall be a Fike P/N 10-1639.

B. The abort switch shall be used where an investigative delay is desired between detection and actuation of the fire suppression system.

C. This switch shall be a momentary contact "dead-man" type switch requiring constant pressure to transfer one set of contacts. Clear operating instructions shall be provided at the abort switch.

D. This switch shall be rated at 28 VDC @ 1.1 amp make/break or 6 amp continuous carry.

E. The terminal connections shall be of the screw type.

F. "Locking" or "Keyed" abort stations shall not be permitted.

G. The (optional) Abort Station shall be located adjacent to each manual station and can be furnished in combination with a Manual Release Switch or in combination with a Manual Release Switch and (optional) Digital Countdown Timer (Fike P/N 20-046).

2.9 MAINTENANCE LOCK-OUT SWITCH:

A. The maintenance lock-out switch shall be used where it is desired to disable the fire suppression system during routine maintenance.
B. This switch shall be key operated allowing removal of the key in either the “Normal” or “Lock-Out” position. A red indicator lamp shall be included on the switch assembly to be illuminated when in the “Lock-Out” position. The control unit is to indicate a trouble condition when in the “Lock-Out” position.

C. The switch shall include one (1) set of normally open and one (1) set of normally closed contacts rated at 28 VDC @ 1.1 amp make/break or 6 amp continuous carry.

D. The terminal connections shall be of the screw type.

2.10 CONTROL PANEL – FIKE Cheetah XICONTROL SYSTEM:

A. The Fire Alarm Control Panel (FACP) shall be a FIKE Cheetah XI and shall contain a microprocessor based Central Processing Unit (CPU). The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent detectors, addressable modules, and other system controlled devices.

B. System Capacity and General Operation
   1. The FACP shall be capable of expansion to 1,016 intelligent/addressable devices.
   2. The system shall include Form-C alarm and trouble relays rated at a minimum of 2.0 amps @ 30 VDC. It shall also include four Class B (NFPA Style Y) programmable notification appliance circuits.
   3. The system shall support up to 99 programmable 55-043 relays for an overall system capacity of 301 circuits.
   4. The FACP shall include a full featured operator interface control and annunciation panel that shall include a backlit liquid crystal display, individual, color coded system status LEDs, and an alphanumeric keypad for the field programming and control of the fire alarm system.
   5. All programming or editing of the existing program in the system shall be achieved without special equipment and without interrupting the alarm monitoring functions of the FACP.
   6. The FACP shall provide the following features:
      a. Drift Compensation to extend detector accuracy over life.
      b. Sensitivity Test meeting requirements of NFPA 72.
      c. Maintenance Alert to warn of excessive smoke detector dirt or dust accumulation.
      d. System Status Reports to display or printer.
      e. Alarm Verification with verification counters.
      f. PAS presignal, meeting NFPA 72 requirements.
      g. Rapid manual station reporting (under 2 seconds).
      h. Non-Alarm points for general (non-fire) control.
      i. Periodic Detector Test conducted automatically by software.
      j. Pre-alarm for advanced fire warning.
      k. Cross Zoning with the capability of: counting two detectors in alarm, two software zones in alarm, or one smoke detector and one thermal detector in alarm.
      l. March time and temporal coding options.
      m. Walk Test with check for two detectors set to same address.
n. UL 1076 Security Monitor Points.
o. Control-By-Time for non-fire operations, with holiday schedules.
q. Device Blink Control for sleeping areas.

C. Batteries
1. Batteries shall be 12 volt, Gell-Cell type (two required).
2. Batteries shall have sufficient capacity to power the fire alarm system for not less than 24 hours in standby plus 5 minutes of alarm upon a normal AC power failure.
3. Batteries are to be completely maintenance free. No liquids are required. Fluid level checks, refilling, spills and leakage shall not be accepted.

2.11 MANUAL RELEASE STATION
A. Double action manual releasing stations shall be addressable using 20-1063 module.
B. Stations shall be suitable for surface mounting or semi-flush mounting as shown on the plans, and shall be installed not less than 42” (1.06 m), and not more than 48” (1.22 m) above the finished floor.

2.12 ABORT STATION
A. Abort station shall be addressable using 55-045 monitor module.
B. Stations shall be suitable for surface mounting or semi-flush mounting as shown on the plans, and shall be installed not less than 42” (1.06 m), and not more than 48” (1.22 m) above the finished floor.

2.13 FIRST ALARM BELL:
A. Alarm bell shall be UL Listed or FM Approved and operate on 24 VDC nominal.
B. The appliance shall be placed 80 in. (2 m) above the highest floor level within the space, or 6 in. (152 mm) below the ceiling, whichever is the lower.

2.14 AUDIBLE/VISUAL PRE-DISCHARGE DEVICE:
A. Audible/Visual device shall be UL Listed or FM Approved and operate on 24 VDC nominal.
B. The appliance shall be placed 80 in. (2 m) above the highest floor level within the space, or 6 in. (152 mm) below the ceiling, whichever is the lower.

2.15 AUDIBLE AND VISUAL ALARMS
A. The Alarm Horn and Horn/Strobe devices shall be Fike P/N’s 20-107, 75 candela, or equal in quality, performance and features. A Clean Agent label shall be attached to the strobe lens when required.
B. The Alarm Bell devices shall be Fike P/N’s 20-110, 6” bell, or equal in quality, performance and features. A Clean Agent label shall be attached to the strobe lens when required.
C. The visual alarm unit shall be a Fike P/N 20-093, 75 candela, Vertical Strobe device, or equal in quality, performance and features. A Clean Agent label shall be attached to the strobe lens when required.
D. A Strobe device shall be placed outside, and above, each exit door from the protected space. Provide an advisory sign, Fike P/N 02-3645, at each light location.

2.16 DISCHARGE STOBE DEVICES:
A. Discharge strobe shall be UL Listed or FM Approved and operate on 24 VDC nominal.
B. The appliance shall be placed 80 in. (2 m) above the highest floor level within the space, or 6 in. (152 mm) below the ceiling, whichever is the lower.

2.17 ANALOG ADDRESSABLE PHOTOELECTRIC SMOKE DETECTOR:
A. The detectors shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.

2.18 ANALOG ADDRESSABLE IONIZATION SMOKE DETECTOR:
A. The detectors shall use the dual-chamber ionization principal to measure products of combustion and shall, on command from the control panel, send data to the panel representing the analog level of products of combustion.

2.19 ISOLATOR MODULE:
A. Isolator modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC loop. The isolator module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC Loop. At least one isolator module shall be provided for each protected zone of the building.

PART 3 – TESTING AND DOCUMENTATION

3.1 SYSTEM INSPECTION AND CHECKOUT
A. After the system installation has been completed, the entire system shall be checked out, inspected and functionally tested by qualified, trained personnel, in accordance with the manufacturer’s recommended procedures and NFPA standards.
1. All containers and distribution piping shall be checked for proper mounting and installation.
2. All electrical wiring shall be tested for proper connection, continuity and resistance to earth.
3. The complete system shall be functionally tested, in the presence of the Airport Commission Inspector, and all functions, including system and equipment interlocks, must be operational at least 5 days prior to the final acceptance tests.
   a. Each detector shall be tested in accordance with the manufacturer’s recommended procedures, and test values recorded.
   b. All system and equipment interlocks, such as door release devices, audible and visual devices, equipment shutdowns, local and remote alarms, etc. shall function as required and designed.
c. Each control panel circuit shall be tested for trouble by inducing a trouble condition into the system.

3.2 TRAINING REQUIREMENTS

A. Prior to final acceptance, the subcontractor shall provide operational training to each shift of SFO personnel. Each training session shall include control panel operation, manual and (optional) abort functions, trouble procedures, supervisory procedures, auxiliary functions, programming, and emergency procedures.

3.3 OPERATION AND MAINTENANCE

A. Prior to final acceptance, the subcontractor shall provide complete operation and maintenance instruction manuals, 6 copies for each system. All aspects of system operation and maintenance shall be detailed, including piping isometrics, wiring diagrams of all circuits, a written description of the system design, sequence of operation and drawing(s) illustrating control logic and equipment used in the system. Checklists and procedures for emergency situations, troubleshooting techniques, maintenance operations and procedures shall be included in the manual.

3.4 AS-BUILT DRAWINGS

A. Upon completion of each system, the subcontractor shall provide 4 copies of system “As-Built” drawings. The drawings shall show actual installation details including all equipment locations (i.e.: control panel(s), agent container(s), detectors, alarms, manuals and aborts, etc.) as well as piping and conduit routing details. Show all room or facilities modifications, including door and/or damper installations completed. One (1) copy of reproducible drawings in AutoCAD format Version 12 or later shall be provided reflecting all actual installation details. In addition, provide one (1) scanned copy of all drawings on CD.

3.5 ACCEPTANCE TESTS

A. At the time “As-Built” drawings and maintenance/operations manuals are submitted, the subcontractor shall submit a “Test Plan” describing procedures to be used to test the control system(s). The Test Plan shall include a step-by-step description of all tests to be performed and shall indicate the type and location of test apparatus to be employed. The tests shall demonstrate that the operational and installation requirements of this specification have been met. All tests shall be conducted in the presence of the Airport Commission Inspector and shall not be conducted until the Test Plan has been approved.

B. The tests shall demonstrate that the entire control system functions as designed and intended. All circuits shall be tested: automatic actuation, solenoid and manual actuation, HVAC and power shutdowns, audible and visual alarm devices and manual override of abort functions. Supervision of all panel circuits, including AC power and battery power supplies, shall be tested and qualified.

C. A room pressurization test shall be conducted, in each protected space, to determine the presence of openings which would affect the agent concentration levels. The test(s) shall be conducted using the Retro-Tec Corp. Door Fan system, or equivalent, with integrated computer program. All testing shall be in accordance with NFPA.

D. If room pressurization testing indicates that openings exist which would result in leakage and/or loss of the extinguishing agent, the subcontractor shall be responsible for coordinating the proper sealing of the protected space(s) by the general contractor or his sub-contractor or agent. The general
contractor shall be responsible for adequately sealing all protected space(s) against agent loss or leakage. The subcontractor shall inspect all work to ascertain that the protected space(s) have been adequately and properly sealed. THE SUPPRESSION SYSTEM SUBCONTRACTOR SHALL BE RESPONSIBLE FOR THE SUCCESS OF THE ROOM PRESSURIZATION TESTS. If the first room pressurization test is not successful, in accordance with these specifications, the subcontractor shall direct the general contractor to determine, and correct, the cause of the test failure. The subcontractor shall conduct additional room pressurization tests, at no additional cost to the Airport Commission, until a successful test is obtained. Copies of successful test results shall be submitted for record. Upon acceptance by the Airport Commission, the completed system(s) shall be placed into service.

3.6 SYSTEM INSPECTIONS

A. The subcontractor shall provide 2 inspections of each system installed under this contract during the one-year warranty period. The first inspection shall be at the 6-month interval, and the second inspection at the 12-month interval, after system acceptance. Inspections shall be conducted in accordance with the manufacturer’s guidelines and the recommendations of NFPA.

B. Documents certifying satisfactory system(s) operation shall be submitted to the Design-Builder and Airport Commission upon completion of each inspection.

3.7 PAINTING

A. The Clean Agent piping system shall be painted in strict accordance with the manufacturer’s recommendations.

3.8 WARRANTY

A. The Contractor shall furnish a 2-year warranty for all the system components and the installation under this Section, shall be guaranteed against defects in design, materials and workmanship for the full warranty period which is standard with the manufacturer from the date of system acceptance.

END OF SECTION 21 22 00
SECTION 23 11 13 – FACILITY FUEL OIL PIPING

PART 1 – GENERAL

1.1 SCOPE OF WORK

A. The work under this section consists of furnishing all materials, labor and equipment necessary to install support equipment for the Fuel Piping as shown on the drawings and specified herein.

1. Piping and pipe fittings
2. Pipe Coating and Painting
3. Pipe Hangers and Supports

1.2 REFERENCES

A. Underwriters Laboratories Inc. (UL): Building Materials Directory

1.3 QUALITY ASSURANCE

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

B. Supply all products (equipment and accessories) new, free from defects.

C. Provide all electrical equipment and accessories new, free from defects and listed by Underwriters Laboratories, Inc., or bearing its label.

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

1.4 SUBMITTALS:

A. Submit the following to the Engineer: Six (6) copies for approval prior to field installation.

1. Manufacturer’s name, brand name and catalog reference of equipment supplied. Submit complete material and equipment list prior to submittal of shop drawings.

2. Drawings pertinent to deviations from the Contract. Satisfy earthquake requirements for the State of California. Coordinate with other trades and field conditions and show dimensions and details including building construction and access for servicing.

3. Perform tests as specified or noted in presence of Engineer and authorities having jurisdiction. Provide all required labor, materials, equipment and connections and submit results for review. Repair or replace defective work and pay for restoring or replacing damaged work, due to tests, as directed.

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

5. Operations and Maintenance instructions for pumps and exhaust fans. Contractor shall submit the preventative maintenance (PM) program for each pump and fan to Engineer for approval.
The (PM) program shall be done in the format developed for EPIX Computer based Preventative Maintenance System West. See Appendix A for sample format.

6. List of manufacturer’s recommended spare parts and address of nearest representative.

7. Shop Drawings:
   a. Fuel Oil Piping (Flexible Pipe, Fiberglass Pipe)
   b. Pipe and Fittings

PART 2 – PRODUCTS

2.1 PIPING AND PIPE FITTING

A. General: All piping furnish shall be compatible for use with diesel fuel oil and waste oil.

B. Fuel Piping/Waste Oil - Buried Piping: The underground fuel piping system shall be comprised of a flexible Primary Fuel Pipe within a flexible Secondary Access/Containment pipe. All primary piping connections shall be contained within piping sumps and be accessible from the surface. The primary pipe shall be completely accessible from the surface for inspection, repair, or replacement without requiring excavation.
   1. Primary pipe shall be of a fully-bonded, multi-layer, flexible thermoplastic construction with a smooth bore inner core tube and a working pressure of 75 psig.
   2. Primary pipe and coupling shall be UL listed per 971.
   3. Primary pipe couplings shall be permanently swaged onto the primary pipe
   4. Secondary Access/Containment pipe shall be of a crush resistant, double-wall construction with a semi-smooth inner liner.
   5. Secondary Access/Containment pipe shall be fully air testable to 5 psig.
   6. Piping and conduit entries into sumps shall be made with watertight Entry Fittings that require a single hole to be drilled in the sump wall and that can be repaired or replaced from inside the sump without requiring excavation.
   7. Manufacturer: Pisces by OPW or approved equal.

C. Fuel Piping – Above Ground:
   1. All new fuel piping shall be flexible pipe; retractable, jacketed primary pipe inside crush resistant access pipe by OPW’s Pisces or approved equal.

D. Vent Piping
   1. Horizontal and Underground: Fiberglass, manufactured by Ameron (Duraloy 3000/L), with flexible connectors manufactured by Titeflex, Model Fail Safe APC at the connection to the vent riser. Connection points shall be made a minimum of 12: below grade.
   2. Portion of the vent risers that are below grade shall be protected from corrosion by wrapping as specified herein.
   3. Vent pipes inside accessible sump or above ground: Stainless steel, standard schedule, threaded joints.
E. Pipe Identification
   1. All new pipe above and below grade and in accessible trenches shall be properly identified (fuel supply, return, vent, etc.) to the east or west tanks as applicable.

2.2 PIPE COATING AND PAINTING
   A. All buried, metal tank fittings and accessories, and piping in settlement vaults (except flexible connectors) shall be cleaned, coated with a synthetic primer followed by a minimum of 3/32" coat of plasticized coal tar enamel, reinforced with glass cloth. The pipe shall then be wrapped with a 15-pound glass fiber impregnated with coal tar. All irregular metal surfaces which cannot be taped shall be given 2 heavy coats, approximately 30 mils each, of Tapecoat TC Mastic. New piping installed in pump house shall receive 1 coat Fuller's Chex-Rust Metal Primer - 121-00, 1 coat Fullers Enamel Undercoat - 220-07, and 2 coats finish to match that of adjacent piping or as directed by the Engineer.
   B. Vent piping above grade shall receive 1 coat Fuller’s Zinc Dust Zinc Oxide Primer - 121-00 and 2 coats Fuller’s House & Trim Paint, color as selected by the Engineer.
   C. Surface preparation and application of products shall be in accordance with the manufacturer's written recommendations.

2.3 PIPE HANGERS AND SUPPORTS
   A. All pipe support shall be fabricated from Type 316 stainless steel and anchored with Type 316 stainless steel concrete anchor bolts.
   B. Support piping against wall or structural support every 4-feet.
   C. Support free standing piping as recommended by the Contractor’s Structural Engineer.
   D. Manufacturer: Unitstrut or approved equal.

PART 3 – EXECUTION

3.1 INSTALLATION
   A. Install and connect material and equipment as per drawings.

END OF SECTION 23 11 13
SECTION 23 13 13 – FACILITY UNDERGROUND FUEL-OIL STORAGE TANKS

PART 1 – GENERAL

1.1 SCOPE OF WORK

A. The work under this section consists of furnishing all materials, labor and equipment necessary to install support equipment for the diesel underground fuel tank as shown on the drawings and specified herein.
   1. Double Wall Steel Tank (Underground Tank)
   2. Tank Bottom Protector
   3. Ball Valves
   4. Overfill Prevention Valves
   5. Ground Level Spill Containment
   6. Spill Containment Manhole

B. Contractor installing the diesel fuel tank shall have Hazardous Substance Removal Certification with the State of California.

1.2 REFERENCES

A. It is to be understood that all work shall be performed in conformity with the best accepted construction practice and in accordance with the applicable sections of the current standards of:
   1. Steel Below the Ground Tanks for Flammable and Combustible Liquids.
   2. NFPA Standards:
      a. 30: Flammable and Combustible Liquids Code.
      b. 30A: Automotive and Marine Service Station Code
      c. 31: Standard for the Installation of Oil-Burning Equipment
      d. 70: National Electrical Code.
   3. Uniform Fire Codes and EPA 280.20.
   4. UL
      a. 58 for maximum strength thickness.
      b. 58 Type 1 double wall construction, steel outer tank.
   5. San Francisco Fire Code, Article 79.
   6. California Underground Storage Tank Regulations

1.3 QUALITY ASSURANCE
A. All equipment and accessories to be the product of a manufacturer regularly engaged in its manufacture.

B. Supply all products (equipment and accessories) new, free from defects.

C. Provide all electrical equipment and accessories new, free from defects and listed by Underwriters Laboratories, Inc., or bearing its label.

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

1.4 SUBMITTALS

A. Submit the following to the Engineer: Six (6) copies for approval prior to field installation.
   1. Manufacturer’s name, brand name and catalog reference of equipment supplied. Submit complete material and equipment list prior to submittal of shop drawings.

B. Drawings pertinent to deviations from the Contract. Satisfy earthquake requirements for the State of California. Coordinate with other trades and field conditions and show dimensions and details including building construction and access for servicing.
   1. Perform tests as specified or noted in presence of Engineer and authorities having jurisdiction. Provide all required labor, materials, equipment and connections and submit results for review. Repair or replace defective work and pay for restoring or replacing damaged work, due to tests, as directed.
   2. Detailed description of items supplied, including specifications, performance characteristics, materials, wiring diagrams and schedules.
   3. Operations and Maintenance instructions for pumps and exhaust fans. Contractor shall submit the preventative maintenance (PM) program for each pump and fan to Engineer for approval. The (PM) program shall be done in the format developed for EPIX Computer based Preventative Maintenance System West.
   4. List of manufacturer’s recommended spare parts and address of nearest representative.
   5. Shop Drawings:
      a. Double Wall Steel Tank (Underground Tank)
      b. Diesel-Generator Day Tank & Accessories
      c. Fuel Oil Piping (Flexible Pipe, Fiberglas Pipe)
      d. Fuel Dispensing System & Accessories
      e. Pipe and fittings
      f. Valves
      g. Pumps

PART 2 – PRODUCTS

2.1 DOUBLE WALL STEEL TANK (UNDERGROUND TANK)

A. Work Included: The contractor shall furnish and install:
   1. Double wall steel tank.
2. All tap, fitting and man ways as shown on drawings.

3. The manufacturer shall furnish all materials: All materials shall be in accordance with the requirements as set forth in these specifications or on the drawings.

B. Steel Tank:

1. Tank shall be a carbon steel horizontal atmospheric type.
2. Tank shall be of welded construction of commercial quality uncoated steel. Only new material shall be used.
3. Testing: tank shall withstand a test pressure of not less than 5 psig nor more than 7 psig internal air pressure. Test prior to installation, or with tank in installed position.
4. Nominal outside diameter of the tank shall be 68” for 1500 U.S. gallon tank.
5. Approximate overall length of the tank shall be 9’-6” for 1500 gallon tank.
6. Tank shall be designed to support accessory equipment such as manholes, ladders, fill-tubes and etc. as indicated on drawings.
7. Tank shall have minimum 30 year warranty. And Tank warranty shall be by third party insurance coverage in addition to manufacturer’s warranty.
8. Tank shall have a built-in protector plate under all openings.
9. Manufacturer: Modern Welding Co., Inc. or approved equal.

C. Accessories:

1. Underwriter’s Laboratory certification plate shall be permanently affixed to the tank.
2. Standard threaded fittings (NPT) shall be 4” in diameter
3. Normal vent shall be 2” OPW 23 or approved equal.
4. Refer to drawing for location.

D. Coating

1. Surface Preparation
   a. All weld spatter shall be removed and all rough welds and edges shall be ground smooth. All surfaces shall be solvent cleaned in accordance with SSPC-SP-1 and then abrasive blast cleaned to white metal in accordance with SSCP-SP-5.

2. Coating Application
   a. General: All coating shall be over clean dry surfaces and any contamination shall be removed as required above. Unless otherwise specified, coating application shall be in strict accordance with the manufacturer’s recommendations.
   b. Interior: The interior surfaces shall have no coating.
   c. Exterior: The exterior shall be coated with a multilayer fiberglass resin coating. 100 mils minimum.
3. All defects in film thickness or continuity shall be repaired at the expense of the manufacturer. The manufacturer shall provide suitable means of transportation so that the coatings will not be
damaged during delivery. Any damage or defects found upon delivery shall be corrected by the manufacturer including additional surface preparation as required in accordance with the coating manufacturer’s recommendation for repair and over-coating of old fully cured coating.

E. Inspection: All prepared surfaces will be inspected before application of any coating. Surface preparation and coating which may be done other than at the job site will be inspected and the cost accounted for according to the following:

F. Field Testing: The double wall fuel tank shall undergo test as required by the manufacturer and all agencies having jurisdiction. All tank pressure and leak tests and Holiday Tests shall be witnessed by the Engineer and inspectors from agencies having jurisdiction. The contractor shall give the Engineer at least 48 hours’ notice prior to testing.

2.2 TANK BOTTOM PROTECTOR

A. The tank bottom protector shall consist of drop tube with attached sliding ring to assure retrieval of tank protector when drop tube is pulled.

B. The tank protector base shall have a rubber pad to absorb impact shock and protects the storage tank bottom.

C. The materials shall be aluminum.

D. Manufacturer: Pomeco No. 6111-1400 or approved equal.

2.3 BALL VALVE

A. Ball valve shall be threaded ends, bronze body, PTFE seat ring, rated 150 pound SWP. The valve shall be compatible with diesel fuel oil.

B. Manufacturer: Crane or approved equal.

2.4 OVERFILL PREVENTION VALVES

A. Body design shall be able to accommodate both dual and coaxial drop tube applications.

B. The valve shall have vertical slide internal float design which eliminates any chance of the floats getting caught on the tank walls or the riser pipe.

C. Construction materials shall be as follows:

```
<table>
<thead>
<tr>
<th>Materials</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Body</td>
<td>Anodized Aluminum</td>
</tr>
<tr>
<td>Floats</td>
<td>High-Density Polyethylene</td>
</tr>
<tr>
<td>Poppet Seal</td>
<td>Viton</td>
</tr>
<tr>
<td>Drain Poppet</td>
<td>Aluminum</td>
</tr>
</tbody>
</table>
```

D. Manufacturer: Emco Wheaton No. A1100 or approved equal.

2.5 GROUND LEVEL SPILL CONTAINMENT
A. Spill containment box shall have 4 legs with height adjustment and continuously sloped bottom to sump for drainage.

B. The containment box shall have a hinged access door with records storage slot.

C. Capacity: TBD

D. The construction materials shall be all welded 16 GA steel. Exterior and interior shall have a fuel and corrosion resistant powder coat epoxy.

E. Manufacturer: Baker Industries Northwest, Inc. No. 700 Series or approved equal.

2.6 SPILL CONTAINMENT MANHOLE

A. Flush mounted man-way with a spill containment cell with a TBD gallon capacity.

B. The TBD gallon containment bucket consists of internal drain valves.

C. Manhole cover size shall be 42" and shall meet H-20 load rating requirements.

D. The Manhole cover configuration shall have single port for fill and one monitoring port with 5" diameter. The port cover shall be rain tight.

E. Manufacturer: Pomeco No. 311 or approved equal.

2.7 FUEL

A. Supply 1350 gallons of NO. 2 diesel fuel

PART 3 – EXECUTION

3.1 INSPECTIONS AND TESTING

A. Tank installation including Holiday test shall be witnessed by the San Mateo Environmental Health County Inspector, the Airport Fire Marshal and the Airport Plumbing Inspector.

B. All piping and fittings tests, lake test of the sump, and leak detection monitoring system test shall be witnessed by the San Mateo Environmental Health County Inspector.

C. Precision testing of the tank and the piping results shall be performed and results delivered to the Engineer and the San Mateo County Environmental Health County Inspector.

D. All testing and permits required by San Mateo County shall be paid for by the contractor.

3.2 INSTALLATION

A. Install and connect material and equipment per drawings.

END OF SECTION 23 13 13
SECTION 40 72 83 – LEAK DETECTION SYSTEM

PART 1 – GENERAL

1.1 SCOPE OF WORK

A. The work to be performed under this contract includes all components, materials, labor, functional and operational testing as required to provide complete and functional level detection system as shown in the drawings. See Electrical Design for electrical requirements. Leak Detection System and Automated Tank Gauge System shall be Incon, Caldwell Systems Corp or approved equal.

B. Communications Accessories

1.2 QUALITY ASSURANCE

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

B. Supply all products (equipment and accessories) new, free from defects. And all products shall be factory tested for accuracy, repeatability and range of controlled variable.

C. Provide all electrical equipment and accessories new, free from defects and listed by Underwriters Laboratories, Inc., or bearing its label.

D. All items of given type shall be the products of the same manufacturer in order to achieve standardization for operation, maintenance and installation of this type of system.

PART 2 – PRODUCTS

2.1 INCON TS SERIES AUTOMATIC TANK GAUGE SYSTEM

A. The system shall be capable of meeting or exceeding the EPA requirements for periodic monitoring; and also for annual tightness testing. This standard requires a minimum accuracy standard of detecting a “leak” at a rate of .1 gph with a 95% (or greater) probability of detecting leak and a 5% (or less) probability of false alarm.

B. The system shall be based on the Magnetostrictive principle of operation. The system magnetostrictive probes shall each incorporate a minimum of 5 RTD’s (temperature sensors) so as to maximize accuracy.

C. The system shall be “approved” by the State of California Water Resources Agency for use in the State of California & San Mateo County.

D. The console display shall be readable by a person with normal vision at a distance of at least 10’.

E. The console will have externally visible indicators of alarm condition for leak test, alarm, and low battery.
F. The console will employ keys and password function for access to the programming features of the console.

G. The console will employ a password function (different than the password used for programming) for alarm acknowledgment and clearance.

H. The console shall include a printer using thermal paper. The printer paper shall be replaceable from the outside without need to open the door to the console.

I. The console shall be supplied with 2 communications ports.

J. The console will have battery support for power failure conditions. The unit shall incorporate two battery holders; allowing replacement battery replacement prior to removing the older battery.

K. A phenolic operators instruction panel will be supplied for wall mounting near the console.

L. Adequate reporting capabilities shall be incorporated that will provide onsite reports typically needed to operate a fuel monitoring program. The option shall exist to have these same reports available remotely by Telecommunications. These reports shall include an estimated duration of a leak test.

M. Reports shall include both fuel oil level and fuel oil volume.
   1. Unit programming will allow for “calibration of probe sensitivity” and include compensation for offset (tilt) of tank level, the theft detection shall be included in system capabilities.
   2. High level points shall be programmable in inches. Low level points shall be programmable in volume (gallons).

2.2 HAZARDOUS MATERIAL DISPOSAL AND/OR DECONTAMINATION

A. All external tank surfaces and fittings shall be examined for evidence of hole or leakage. All excavation surfaces shall be inspected for strained soil, areas of free product, strong petroleum order, etc. The results of such inspection shall be documented in writing, with photographs where appropriate. Submit all evidence of leakage to Airport for review.

B. If obviously stained or contaminated areas exist, soil samples shall be analyzed from these obviously stained or contaminated areas. All soil samples obtained shall be collected by an acceptable EPA method which reduces the loss of volatile components. Formal, signed chain-of-custody records shall be maintained for each sample.

C. Soil samples are to be analyzed by a laboratory that has been certified by the California State Department of Health Services to perform analysis on hazardous wastes for total fuel hydrocarbon in accordance to EPA methods (EPA Manual SW-846, April 1994).

<table>
<thead>
<tr>
<th>SOIL SAMPLE</th>
<th>WATER SAMPLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasoline</td>
<td>EPA Method 5030</td>
</tr>
<tr>
<td>Jet Fuel</td>
<td>EPA Method 5030</td>
</tr>
<tr>
<td>Diesel</td>
<td>EPA Method 3550</td>
</tr>
<tr>
<td>Waste Oil</td>
<td>EPA Method 3550</td>
</tr>
</tbody>
</table>

D. Analysis: Flame Ionization Detection with BTX Quantification.
E. Copy of testing results shall be submitted to the Engineer for review.

F. Excavation shall remain open until all testings are done. For safety measure, Contractor shall provide all necessary barricades, flashing lights, rope, tape, etc. to secure the job site.

G. If the fuel constituents found in the soil sample are greater than 1000 ppm, Contractor shall remove all contaminated soil/water within in the sheet piling and to the depth not exceeding the bottom working slab of the concrete vault.

H. If not disposed of immediately, all hazardous soil/water shall be stored temporarily in storage bin(s) tank(s) adjacent to the jobsite at the location approved by the Engineer. The contaminated soil shall be removed and disposed of in a State approved Class I dump site.

I. If the soil and water sample testing results are less than 100 ppm of fuel constituents, the excavating may be backfilled with imported sand or other approved material as required. The backfill shall be compacted to 95% density or to the maximum density as determined by the Engineer. All painted stripping and markings damaged or removed by the Contractor’s operations shall be replaced to match existing.

J. The expenses of all tests, handling, storage, transportation and any related material, equipment, labor, etc., which are required to accomplish this work are included in this Contract. The City has no liabilities for any extra Payment.

2.3 AUTOMATIC TANK GAUGE SYSTEM (ATG)

A. The work under this section consists of installation and testing of the Automatic Gauge System, as shown on the drawings and specified herein.

B. Material shall be included as the following:

1. Automatic Tank Gauge
2. Liquid Level Probe and Probe Installation Kit
3. Modem
   a. Capable of auto-answer operation.
   b. Can be mounted directly to ATG’s RS-232 connectors.
   c. Shall include a 10 ft. standard telephone wall jack.
   d. Shall comply with V.22 BIS standard.
   e. Shall operate with any other Modem which meets the standards mentioned above.
   f. Capable of both pulse and touch tone dialing.
   g. Reconfigured for use with ATG.

4. Leak Monitoring System includes computer assemblies, accessories, MODEMS and related cables. Contractor shall provide and install the monitoring system, make test and all other work necessary to provide complete and functional leak monitoring system.

C. Automatic Tank Gauge (ATG) Console Assembly

1. The ATG must have 4 or 8 channels (depending on the tank numbers) equipped to accept four or eight in-tank probes with volumetric leak detection and liquid sensing. Must be able to
communicate with the computer in other location, with complete remote operation, data collection, multiple number autodialing, and RS-232 compatibility. The ATG must be “INCON TS-1001” for 4 channels.

D. Functions and Capabilities Shall Include:
   1. Programmable alarms - high level, low level, high-high level, low-low level, high water, theft, leak system errors. All settings shall be made by the direction of Engineer.
   2. Records of alarms and delivery history.
   3. Programmable schedule for reports and leak tests.
   4. Alarm relay contact output and built-in audible alarm.
   5. Integral printer.
   6. Automatic detection and recording of deliveries.
   7. Automatic theft detection.
   8. 46 pre-programmed standard tank tables.
  10. Water contents level
  11. Advance RS-232 communications for MODEM connection.
  12. True volumetric temperature compensating to API tables.
  13. Full remote PC-based console capability.
  14. Programmable alarm set up can tie to combination of alarms to output relays or audible alarm.
  15. Four number auto-dialer can be connected to call different numbers when alarms, deliveries or leaks occur.

PART 3 – Execution

3.1 INSTALLATION
   A. Manufacturer’s Directions: Follow in all cases where manufacturer’s articles used furnish directions covering points not specified or shown.

   B. Supplier: The supplier shall be the product manufacturer’s authorized distributor who shall provide equipment as specified, initial start-up services and perform acceptance testing and training. The supplier shall have factory-trained service technicians who are qualified to isolate and correct malfunction of the system control, automatic gauging system, and implement repair.

3.2 GROUNDING
   A. Equipment enclosures, raceways, conduits and other conductor enclosures: Grounding in accordance with N.E.C.

3.3 FIELD TESTING
   A. The unit shall be tested at the jobsite and witnessed by Airport Engineer unless other arrangements are made in advance.

   B. All parameters mentioned in the factory test requirements shall be checked at 1-minute intervals.
C. Each site shall have a warranty registration service and start-up performed by a manufacturer’s trained and certified technician to program the system, to train airport personnel and verify that the system has been installed to the latest manufacturer’s Installation Requirements.

D. A final 2-hour test for satisfactory operation shall be performed under any available condition.

E. The monitored inventory in all tanks and produce a combination of automatic and manual reports which include the following information:
   1. Fuel Volume
   2. Fuel Height
   3. Water Height
   4. Fuel Temperature
   5. Ullage
   6. Temperature compensated fuel volume
   7. Last inventory increase amount
   8. Last in-tank leak test result
   9. Time and Date
   10. Tank Identification
   11. Fuel Identification
   12. 90% Ullage

3.4 SHOP DRAWINGS

A. Six (6) copies of shop drawings and manufacturer’s data of the following equipment and material shall be submitted to the Engineer 2 weeks prior to shop fabrication or field installation.
   1. Leaks Alarm System
   2. INCON TS Series Automatic Tank Gauge Systems Probe Assembly and Installation Kits.

3.5 AS-BUILT DRAWINGS

A. Upon completion of the work, Contractor shall furnish to the Engineer for approval. No final payment will be made without the Engineer approved as-built drawings or equivalent micro floppy disks. See related Division 1 sections.

3.6 OPERATING AND MAINTENANCE MANUAL

A. Operations and Maintenance Manual for Automatic Tank Gauge System. Complete with preventive maintenance manual. Six (6) sets shall be furnished in hard bond cover or 3-ring binders. The manuals shall show schematic wiring, and single line piping for the system. Also furnish 6 sets of repair manuals in hard bond cover or three-ring binders. The repair manual shall cover the following subjects:
   1. System
   2. Troubleshooting
   3. Repair

B. This manual shall describe in detail the methods recommended, complete with comprehensive pictures for all phases of the repair.
C. See Engineer for form which shall be filled out for the Automatic Gauge System as part of the Preventive Maintenance.

D. The Contractor shall cooperate with the manufacturer to arrange and provide a four (4) hours minimum training course for operating and service of the system constructed to the Airport employees prior to the final payment of the contract.

3.7 PREVENTIVE MAINTENANCE LIST

A. As part of the maintenance manual, the Contractor shall submit to the Engineer a separate list of their recommended preventive maintenance program, such as schedule and frequency of inspection, kind of lubricant and etc. for the following machinery and equipment. Contractor shall also submit completed form (see Engineer for form) for each item.

1. Automatic Tank Gauge System
2. Leak Alarm System

END OF SECTION 40 72 83
San Francisco International Airport

Mechanical Design Standards

Rev. 11/15/2017
# TABLE OF CONTENTS

## CHAPTER 1 – GENERAL
- Section 101 – General................................................................. 1
- Section 102 – Design Criteria..................................................... 2
- Section 103 – Submittals............................................................. 5

## CHAPTER 2 – HVAC SYSTEM
- Section 201 – HVAC System Description....................................... 7
- Section 202 – Special Systems.................................................... 9
- Section 203 – Ventilation Systems............................................... 10
- Section 204 – Heating, Ventilation, Exhaust Systems....................... 11
- Section 205 – Equipment Identification......................................... 13
- Section 206 – PC Air Systems.................................................... 13
- Section 207 – Equipment Supports............................................. 13
- Section 208 – Energy Solutions & System Alternatives..................... 13

## CHAPTER 3 – AIR DISTRIBUTION SYSTEMS
- Section 301 – Air Distribution Systems......................................... 14

## CHAPTER 4 – HYDRONIC SYSTEMS
- Section 401 – Overview........................................................... 16
- Section 402 – Equipment.......................................................... 16
- Section 403 – Design Criteria.................................................... 18

## CHAPTER 5 – CONTROLS
- Section 501 – General............................................................... 21
- Section 502 – Energy Management Control System (EMCS)................ 22
- Section 503 – Control Components............................................ 23

## CHAPTER 6 – SPACE REQUIREMENTS AND MAINTAINABILITY
- Section 601 – General............................................................... 25
- Section 602 – Design Requirements............................................ 25
- Section 603 – Space Requirements.............................................. 26

## CHAPTER 7 – PLUMBING REQUIREMENTS
- Section 701 – Plumbing Systems............................................... 27
- Section 702 – Plumbing Design Parameters.................................... 27
- Section 703 – Plumbing Systems............................................... 29
- Section 704 – Plumbing System Components................................ 31
- Section 705 – Energy Conservation in Plumbing System Design........ 32
- Section 706 – Natural Gas......................................................... 33

## CHAPTER 8 – ENERGY ANALYSIS
- Section 801 – General............................................................... 34
- Section 802 – Energy & Atmosphere........................................... 34
- Section 803 – Indoor Air Quality............................................... 37
- Section 804 – Water Efficiency.................................................. 37

Rev. 11/15/2017
CHAPTER 1
GENERAL

SECTION 101 - GENERAL

101.1 INTENT
The Mechanical systems consist of HVAC, Plumbing, and Automatic Controls located in the Terminal Building, Concourses and Auxiliary Buildings. The goals and objectives are to develop a Mechanical design to achieve an efficient, economical, maintainable and reliable installation consistent with the long term goals and objectives of the San Francisco International Airport (SFIA). This is not intended to be a code review or master specification.

The space environment shall be designed to be controllable within acceptable year around comfort and health levels. The Design Engineer shall utilize the latest state-of-the-art, energy conservative, readily available equipment and components based on proven design techniques.

The design guide is intended to supplement California Building Codes, City and County of San Francisco (CCSF) regulatory requirements, Net Zero Energy Standards and Objectives, and design specifications. It is not intended to override or void any codes, regulatory or design. The standards are intended to provide basis of design and design criteria to support programming, planning and establish general design objectives. This is not to simply the design process but rather to establish a baseline for design evaluation, system assessment, value engineering, and overall challenge points to achieve exceptional design.

Deviation from the design criteria must be submitted for review. Design options, value engineering, and alternative systems must be submitted with engineering justification.

101.2 GENERAL
The designer shall prepare the design, construction documents, drawing and specifications for HVAC equipment, ductwork and piping, exhaust equipment, controls, insulation, structural, plumbing, fire protection, automatic control systems and operational services such as aircraft and vehicle fuel and glycol systems. The designer shall coordinate the Mechanical design with the applicable sections of the Architectural, Electrical, Structural, Civil and SFIA standards and criteria.

Mechanical systems must be coordinated and integrated with all other building systems and features. Mechanical systems shall be adapted to support all performance objectives, typically involving sustainability, workplace performance (productivity and efficiency), fire safety, security, historic preservation, and improved operations and maintenance.

All Construction Documents shall be developed by the designer and reflect a complete engineered design. The installing contractor may perform certain engineering tasks, such as the Fire Protection, but the designer is responsibility for the total overall design.

101.3 SFIA MECHANICAL ENGINEER
All references in this document to the “SFIA MECHANICAL ENGINEER” refer to the individual listed below. For questions, updates or requests for deviations to this document contact:

John Chinn, PE
Senior Mechanical Engineer
P.O. Box 8097
San Francisco, CA 94128

Email: john.chinn@flysfo.com
Phone: (605)821-7807
Cell: (650)821-7838

101.4 REGULATORY REQUIREMENTS
Specify that work shall be per Underwriters, Public Utility, Local, State and Federal Codes, Ordinances and applicable regulations. Work shall also comply with latest editions of all applicable codes, ordinances and regulations in effect as of the date of the Contract Documents. If discrepancies occur between the Contract Documents and any applicable codes, ordinances, acts, or standards, the most stringent requirements shall apply.

Drawings will be reviewed for code compliance and permitted through SFIA Building Inspection and Code Enforcement (BICE).
SFIA Mechanical Design Standards

SECTION 102 - DESIGN CRITERIA

102.1 SYSTEM CRITERIA
The mechanical systems for all facilities at the San Francisco International Airport are to be based on straight-forward, proven design techniques utilizing the latest state-of-the-art development in readily available equipment and hardware. The overriding criteria for the use of systems and equipment shall be safety, sustainability, reliability, life cycle cost, and the comfort of the traveling public.

It is most important that the systems installed serve the public well, are readily serviceable and maintainable, are stable, reliable, and direct in their operation, and provide flexibility for future change and development. All equipment, appurtenances, and hardware shall be accessible for adjustment and maintenance. Suitable access is required to permit removal and replacement of equipment items. Provisions are to be made for centralization of operating and maintenance diagnostics, controls, measuring, monitoring, alarms, and trending analytics.

It is anticipated that there will be changes and development in many areas of the airport facilities and the mechanical systems will have to be revised or expanded to accommodate these changes. In addition, development in state-of-the-art technology may suggest updating systems and system components in the future. All designs of mechanical systems must include built-in flexibility in keeping with the nature of change that is ever present for air transportation facilities.

In addition, energy conservation and cost savings will also be guiding criteria in the design of mechanical systems. All facilities must meet the energy conservation requirements included in these standards. Both initial system and equipment costs and life cycle owning and operating costs are to be important considerations in concept design efforts and these considerations must be carried through final design and construction. Life-cycle cost analysis requires a minimum of 2 options for comparison. All new central systems must be justified with a life-cycle analysis. Modifications of existing systems do not require life-cycle analysis.

102.2 MECHANICAL DESIGN CRITERIA - FLEXIBILITY
Special provisions are to be made in determining terminal and concourse building heating and air conditioning load requirements to properly allow for the dynamic nature of the application of these loads. During normal operation these loads can vary dramatically from zone to zone and the peak load can fluctuate significantly within each zone. This is due to the rapid mass movement of people within the building, as well as, the shifting solar load on glass walls, infiltration loads associated with people and baggage movement in and out of the building, and outside air ventilation requirements.

Heating and air conditioning system controls must provide system flexibility so as to be able to deal with the shifting internal cooling loads as well as coordinating for future interconnection with planned development of existing systems. The HVAC system must be able to handle varying perimeter loads during heating and cooling seasons while the internal and other loads fluctuate between no load and peak conditions. In addition, appropriate air quality conditions must be maintained in the spaces while the natural ambient (outside) conditions are very often of less than ideal quality.

102.3 DESIGN PARAMETERS

A. Indoor Design Temperatures: It is intended that the mechanical systems (in general) maintain indoor design conditions in all occupied spaces normally accessible to the public as follows (unless specified otherwise):
   1. Summer: 72 degrees F, 50% percent maximum relative humidity
   2. Winter: 68 degrees F

B. Outdoor Design Temperatures: Outdoor design conditions to be used for system designs are as follows:
   1. Summer: 83 degrees F dry bulb/ 64 degrees F wet bulb.
   2. Winter: 35 degrees F

These design criteria conditions are based on the recommended conditions listed for San Francisco in the ASHRAE Fundamentals Handbook at the 0.5% summer condition and the 99.8% winter condition. That is, based on historical data, the outdoor temperatures can be expected to exceed the summer design conditions 0.5% of the time and exceed the winter design conditions 0.2% of the time. The more stringent design condition is required for winter criteria due to inherent outdoor infiltration condition present in most airport situations. The standards establish only baseline criteria for equipment sizing.
Net Zero Energy goals and operational goals should be evaluated as part of the Energy Model to achieve Sustainability goals. See Standards & Criteria for Thermal Comfort Modeling in the SFO Net Zero Energy Standards for alternative design parameters.

102.4 VENTILATION STANDARDS
Ventilation Standards for occupied spaces are to be based upon the latest revision of ASHRAE Standard 62, “Ventilation for Acceptable Indoor Air Quality.” The minimum required ventilation rate of outdoor air per person is to be 15 CFM per person, with several special use areas in the buildings having significantly higher requirements.

Design engineer shall investigate increasing outdoor air ventilation rates to all occupied spaces by at least 30% above the minimum rates for LEED Indoor Environmental Quality credits.

102.5 ENERGY EFFICIENCY REQUIREMENTS
Energy efficiency is an important consideration in the design of the mechanical systems for all SFO International Airport facilities. Heating, ventilating and air conditioning systems are to be designed to exceed the requirements of the latest revision of ASHRAE Standard 90.1 - “Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings,” and the San Francisco Building Code. Refer to the latest SFO Sustainability Design Guide. All new facilities must be certified as LEED Gold at a minimum. All Commercial Interior renovations over 5,000SF must be certified as LEED Gold at a minimum and reach Net Zero Energy objectives.

Equipment selections must be specified to meet or exceed these standards. The equipment and systems described herein must be selected to obtain the optimum in conserving owning and operating costs considering energy efficiency, initial costs, maintainability, and comfort. Energy use budgets and criteria are described in detail in this section of the Mechanical Design Standards.

102.7 NOISE CRITERIA
The mechanical (HVAC) system shall be designed to minimize noise in the occupied space. The system and components shall be designed so as not to transmit or generate sound above a specified noise level in the space. Sound attenuators, duct liner, lower duct velocities and appropriate ductwork fittings and components shall be utilized as required to attain acceptable sound levels. Vibration isolation shall also be evaluated and utilized. Sound attenuators shall be isolated from the building structure.

Sound tests shall be conducted in accordance with accepted procedural standards in and around all major sound producing equipment to either confirm adequate attenuation or to identify problem areas requiring additional modifications as required by the Project Manager.

Maximum noise levels in the occupied space produced by HVAC equipment shall be in accordance with the following NC (noise criteria) curves.

<table>
<thead>
<tr>
<th>Category</th>
<th>NC Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Offices</td>
<td>NC-30</td>
</tr>
<tr>
<td>B. Terminals &amp; Concourses</td>
<td>NC-40</td>
</tr>
<tr>
<td>C. Maintenance Facilities</td>
<td>NC-40</td>
</tr>
<tr>
<td>D. Mechanical Equipment Rooms</td>
<td>NC-50</td>
</tr>
<tr>
<td>E. Museum</td>
<td>NC-25</td>
</tr>
<tr>
<td>F. Exercise Rooms</td>
<td>NC-30</td>
</tr>
<tr>
<td>G. Conference Rooms</td>
<td>NC-30</td>
</tr>
<tr>
<td>H. Lobbies, Corridors and Waiting Areas</td>
<td>NC-40</td>
</tr>
<tr>
<td>I. Quiet Rooms and Meditation Rooms</td>
<td>NC-25</td>
</tr>
</tbody>
</table>

Where mechanical noise is to be utilized for sound masking, RC (room criteria) curves shall be utilized as described in the ASHRAE Handbook, "Fundamentals."

Equipment and ductwork noise levels to permit attaining sound pressure levels in all 8 octave bands in Tenant occupied spaces shall conform to noise criteria NC-35 curves. Motor drives for pumps or any equipment shall operate with noise levels not exceeding OSHA 8 hour 90dBA Time Weighted Average (TWA). Noise levels shall be determined in accordance with IEEE Standard #85 Test "procedure for Air-Borne Noise Measurements on Rotating Electric Equipment."
Engineering Firms will be required to submit sound attenuation analysis.

102.8 SUPPORTS AND PENETRATIONS
All supports for mechanical and plumbing equipment shall be designed, detailed and specified by a California licensed Structural Engineer. Penetrations and reinforcement of penetrations through structural floors and/or walls shall be designed, detailed and specified by a California licensed Structural Engineer.

102.9 HVAC COMPUTER BASED LOAD ANALYSIS
The HVAC loads calculations shall be performed with a computer-based program using the latest ASHRAE Handbook of Fundamentals Heat Balance Method (HB), Radiant time Series (RTS) Method, or Transfer Function Method (TFM), developed for the hourly analysis of heating and cooling loads in commercial buildings. Preferred program is Carrier HAP. All projects are required to submit load calculations.

The program shall be capable of calculating each zone’s peak heating and cooling load as well as the whole-building “block” loads. The program shall, at a minimum, calculate: solar gains through fenestration, internal gains from occupants including latent heat for cooling purposes, internal gains from lighting and equipment, outside air loads (sensible and latent) from ventilation and infiltration, and heat gains or losses through fenestration, walls, floors and roofs. The heating load calculations must be done without credit for occupants and internal gains.

The HVAC loads calculations report shall include all input and output used in the heating and cooling calculation program, and shall include zone peak heating and cooling loading results, and whole building “block” loads, air-handling unit coil selections, and psychrometric process charts.

102.10 PREDICTIVE ENERGY MODELING
A building energy analysis shall be performed to demonstrate that the building design meets or exceeds the energy performance goals established for the project. Predictive Energy Modeling will be required to support Net Zero Energy objectives. Iteration process to support design collaboration, engineering, life cycle cost, and integrated design across all aspect of the new space will be required. See Chapter 8 for Energy Analysis.

The building energy analysis shall be performed using the ASHRAE Standard 90.1 Energy Cost Budget methodology, and must demonstrate compliance with the latest editions of ASHRAE Standard 90.1. The analysis shall be included in each design submission. Predictive Energy Modelling program shall be Integrated Environmental Solutions – Virtual Environment (IES VE).

The analysis shall evaluate the energy performance of the building design including the proposed building envelope, HVAC systems and components, the lighting systems, and domestic hot water systems, as well as the proposed control strategies for these building systems. The analysis shall be based on actual parameters and values found in the proposed building design and not simply on defaults assigned by the simulation program. The analysis shall be performed using a simulation program. The simulation program shall be a computer-based program for the analysis of energy in buildings. Simulation programs must be capable of simulating: 8,760-hours per year, hourly variations in occupancy, lighting power, miscellaneous equipment power, thermostat setpoints, and HVAC system operation defined separately for each day of the week and holidays, thermal mass effects, the number of required HVAC zones, part-load performance curves for mechanical equipment, capacity and efficiency correction curves for mechanical equipment, air-side and water-side economizers, and temperature controls. Public domain or commercial software shall utilize the IES VE modeling software. Alternative simulation programs, meeting the above stated requirements, may be used with prior approval. The building energy analysis report shall include all input and output used in the simulation programs, including: established energy goals for the project, detailed descriptions of the budget and proposed building models, actual local utility rates, descriptions of any and all energy conservation measures, an analysis of results with final conclusions and recommendations.

102.11 MAINTENANCE SERVICE
A. Service Access. Space shall be provided around all HVAC system equipment as recommended by the manufacturer and in compliance with local code requirements for routine maintenance. Access doors or panels shall be provided in ventilation equipment, ductwork and plenums as required for in-site inspection and cleaning. Equipment access doors or panels shall be readily operable and sized to allow full access. Large central equipment shall be situated to facilitate its replacement. The HVAC design engineer shall be cognizant of the necessity to provide for the replacement of major
equipment over the life of the building and shall insure that provisions are made to remove and replace, without damage to the structure, the largest and heaviest component that cannot be further broken down.

In addition, adequate methods of access shall be included for items such as: chillers, boilers, air-handling units, heat exchangers, cooling towers, reheat coils, VAV terminals, pumps, water heaters and all devices that have maintenance service requirements.

To facilitate equipment access, maintenance, removal and replacement, a freight elevator stop shall be provided to serve each floor housing HVAC systems and equipment.

Where stairs are required, they must allow for safe transport of equipment and components. Ship’s ladders are not permitted for access and maintenance of any equipment.

B. Vertical Clearances. Mechanical equipment rooms shall have clear ceiling heights of not less than 12 feet. Catwalks with stairways shall be provided for all equipment that cannot be maintained from floor level. Where maintenance requires the lifting of heavy parts (100 lbs. or more), hoists and hatchways shall be installed.

C. Horizontal Clearances. Mechanical rooms shall be configured with clear circulation aisles and adequate access to all equipment. The arrangement shall consider the future removal and replacement of all equipment. The mechanical rooms shall have adequate doorways or areaways and staging areas to permit the replacement and removal of equipment without the need to demolish walls or relocate other equipment. Sufficient space areas (noted by outlining manufacturer’s recommendations) for maintenance and removal of coils, filters, motors, and similar devices shall be provided. Air-handling units require a minimum clearance of 2'-6” in on all sides, except the sides that filters and coils are accessed, where clearance shall be equal to the length of the coils plus 2'-0”.

1. Housekeeping Pads. Housekeeping pads shall be at least 6 inches wider on all sides than the equipment they support and shall be 6 inches thick.

2. Mechanical Rooms. All mechanical rooms must be mechanically ventilated to maintain room space conditions as indicated in ASHRAE 62 and ASHRAE 15. Water lines shall not be located above motor control centers or disconnect switches and shall comply with requirements of NFPA 70. Mechanical rooms shall have floor drains in proximity to the equipment they serve to reduce water streaks or drain lines extending into aisles. Mechanical rooms shall not be used as return air, outdoor air, or mixing plenums. Mechanical equipment rooms must be designed in accordance with the requirements of ASHRAE Guideline15: Safety Code for Mechanical Refrigeration.

3. Electrical Equipment Rooms. No water lines are permitted in electrical rooms, except for fire sprinkler piping. Avoid placing restrooms, kitchens or utility rooms above Electrical Equipment Rooms.

4. Communications Closets. Communications closets must be cooled in accordance with the requirements of EIA/TIA Standard 569. Closets which house critical communications components shall be provided with dedicated air-conditioning systems that shall be connected to the emergency power distribution system.

5. Elevator Machine Rooms. A dedicated heating and/or cooling system must be provided to maintain room mechanical conditions required by equipment specifications. In the event the building is equipped throughout with automatic sprinklers, hoist way venting is not required.

6. Emergency Generator Rooms. The environmental systems shall meet the requirements of NFPA Standard 110: Emergency and Standby Power Systems and meet the combustion air requirements of the equipment. Rooms must be ventilated sufficiently to remove heat gain from equipment operation. The supply and exhaust louvers shall be located to prevent short circuiting. Generator exhaust shall be carried up to roof level in a flue or exhausted by way of compliance with the generator manufacturer’s installation standards. Horizontal exhaust through the building wall shall be avoided.

SECTION 103 - SUBMITTALS

103.1 DESIGN SUBMITTALS
Regardless of requirements outlined by the Design Analysis Report, or lack of, the Designer shall submit the following at the 100% phase of the project to the SFIA Mechanical Engineer:

1. Space load calculations shall be modeled.

2. Ventilation calculations defined by ASHRAE 62.
3. Equipment sizing and selection (AHU, FCU, Pump, Expansion tank, water heater, etc.)
4. Duct sizing and static pressure analysis
5. Hydronic piping sizing and static pressure analysis
6. Plumbing sizing and code analysis
7. Building pressurization analysis
8. Smoke Control Analysis
9. REVIT Building Model
10. Energy Analysis, Building Performance Energy Model
11. Life cycle cost analysis
12. Displacement Ventilation Air Flow, Computational Fluid Dynamics
13. Building Air Flow Modeling, Computational Fluid Dynamics
15. Additional calculations as requested by the SFIA Engineering Group

Each item shall be included as a single, book-marked PDF file. No paper copies are required or will be accepted. All equipment shall be labeled as identified on the contract drawings. Each filename should include the contract number.

103.2 AS-BUILT SUBMITTALS
The Engineer shall submit the information outlined, with corrections made due to field changes in Construction.
SECTION 201 – HVAC SYSTEM DESCRIPTION

This Chapter outlines basic HVAC system parameters and options. All sustainability based system upgrades or alternative solutions shall be evaluated to best achieve Net Zero Energy program objectives. It is the responsibility of design professionals to provide a collaborative solution with all aspects of building and system design.

201.1 AIR HANDLING SYSTEMS

The most appropriate designs for an airport terminal necessitate that the space conditioning system be flexible and responsive to wide swings in thermal loads. Factors include constantly changing people loads, high people door usage, air infiltration, shifting passenger densities, shifting solar loads, and baggage handling transfers in and out of the building. These items change in timing and intensity depending on changes in aircraft schedules and special peak passenger periods.

The air handling unit selection must consider the primary system design. For the San Francisco International Airport, the air handling units will utilize hot and chilled water from a four-pipe distribution system. Separate cooling and heating coils shall be required. The heating coils shall be selected for a minimum 20 degrees F temperature differential (180 degrees F to 160 degrees F). The cooling coils shall be selected for an approximate 10 degrees F temperature differential (42 degrees F to 52 degrees F) or as required by the psychometrics of the specific system design. This criterion shall be coordinated with the Central Plant.

Packaged air handling units should be used for applications below 25,000 CFM. Customized, built-up air handling units may be used in applications above 25,000 CFM.

Cooling and heating coils are to be sized and arranged for water velocities in the 6 fps range. Air cooling coils shall be designed to have a maximum air face velocity of 600 fpm. Air heating coils shall have a maximum air face velocity not to exceed 800 fpm. Fin spacing shall be as wide as possible to provide the specified leaving coil conditions. Condensate traps shall be 1 inch deeper than suction pressure. Drain pans shall be sloped to center.

DX cooling coils shall be row split (in lieu of face split) where multiple coil sections are required. All supply air handling units shall be draw-through, built-up systems except in instances where sound control would favor the application of blow-through units. Each unit shall consist of a non-overloading supply air fan with selected for maximum efficiency. Fan selection shall be based on noise criteria requirements. Fan walls are the preferred system type, however, other fan type may be considered if economy, efficiency and noise criteria parameters can be assured. Fan static pressure shall be based on final filters at end of life and pre-filters at midlife. Fan walls shall be provided with variable frequency drive (VFD) and redundant back-up VFD.

In addition, each air handling unit system shall contain separate cooling and heating coils (includes cooling only units), a final filter section, a throwaway filter section, a photo catalytic oxidation (PCO) filter, an air blender section to eliminate air stratification, a mixed air plenum for outside air and return air duct damper connections, and a sound attenuation section if required. Integral face and bypass dampers shall be considered for pre-heat coils in appropriate areas. Each air handling unit section shall be provided with an access door and non-breakable plenum light (coordinate with corresponding electrical designs). Heating coils shall be located upstream of the cooling coils, with space in between the two coil sections to facilitate access for maintenance and inspection. Air-tight shutoff type dampers shall be provided for the outside air damper.

The following air handling systems may be used for various applications at the San Francisco International Airport terminal and concourse areas. These include single-zone systems, Multi-zone systems, variable volume systems, heat pump systems, and roof-top HVAC systems.

All equipment visible from public line of sight shall be reviewed by the SFIA Architectural review committee. Non-standard equipment color and finishes may require additional screening.

201.2 DESIGN SUBMITTAL REQUIREMENTS

A. Provide load calculations or building performance model
B. Provide performance data sheets and air handler shop drawings
C. Provide selection fan curves
D. Sound spectrum for air handler inlet and outlet conditions
201.3 SINGLE-ZONE SYSTEMS
Single-zone type air handling systems will effectively handle any particular local area (zone) of a facility. However, a multitude of different temperature zones may necessitate a high number of single-zone air handling units. The disadvantages of such a design would be the requirement for more mechanical room space, higher maintenance costs, and increased capital cost due to the number of individual units that would be required. The use of single-zone air handling units on a large scale is not economical. A multitude of single zone units serving large, main spaces would also reduce the flexibility required to accommodate future space modifications.

Single-zone air handling units do have suitable application, however, to serve certain perimeter zones of the terminal building and concourses. They also have application in many areas in the various support facilities, where their use would prove to be the most suitable solution.

201.4 HEAT-PUMP SYSTEMS
Heat-pumps are a viable alternative for decentralized buildings.

201.5 ROOF-MOUNTED HVAC SYSTEMS
Another alternative, viable in many building applications, is the decentralized, roof mounted, packaged HVAC system. Rooftop HVAC equipment shall not be incorporated into the designs for the San Francisco International Airport terminals. This equipment does have application however, for some of the support facilities. Whenever a roof-top unit is utilized in the mechanical design of a building, the following concerns should be addressed in detail:
   A. Maintenance - is the equipment readily accessible?
   B. Energy Efficiency - select equipment to be energy efficient.
   C. Noise and Vibration - proper vibration isolation is usually not provided unless special requirements are specified.
   D. Aesthetics - this equipment can have a negative impact on the appearance of a building, depending on the elevation of other buildings or facilities in the vicinity. An architectural enclosure shall be provided around roof-mounted mechanical equipment.

201.6 VARIABLE AIR VOLUME SYSTEMS
In a variable air volume (VAV) system, the air volume supplied to the conditioned space is modulated to maintain the space temperature utilizing a constant supply air temperature. This system can offer the best approach to meet two major goals; energy efficiency and moderate initial capital costs.

The VAV system shall contain the air-handling system components described above for air handling systems, plus fan inlet vane controls or variable frequency fan motor drives. The air distribution system shall be of a single design. The appropriate variable volume terminal boxes shall then be provided to control the airflow to the space.

It is important with VAV systems that proper outside air ventilation rates be maintained, as well as building pressurization. Additional HVAC equipment or controls may be required with VAV systems to control pressurization. This issue will be addressed in the temperature control system requirements. The advantages of VAV systems both in flexibility and energy efficiency outweigh the additional control requirements.

Variable air volume systems are recommended for a number of areas in the San Francisco International Airport terminal buildings and in office areas, concourses and many other interior zone applications.

Systems shall be designed to deliver a minimum 0.5" WC at the most remote VAV box

201.7 PERIMETER SYSTEMS
Any expanse of exterior glass wall area, in the Terminal, Concourses, or other areas will require a perimeter thermal conditioning system. These systems are to be designed to handle at least the conduction and infiltration loads of the perimeter walls plus potentially some radiant solar and internal loads near the perimeter, depending on the application.

There are three suitable methods to handle the perimeter loads.
   A. A perimeter finned-tube hot water radiation system.
   B. Radiant slab system.
C. A forced air system at the perimeter. Air circulation at the perimeter reduces pockets of stagnant hot or cold air.

If a perimeter forced air system is to be provided it should be a constant volume system in order to provide the necessary "throw" at the sill diffusers during mild weather. The perimeter system is preferably located at the sill rather than overhead to counteract down-draft at the windows during the winter. Some perimeter areas with low ceilings (9 ft. or less above finished floor) may use ceiling supply for the perimeter system; in addition these areas could be VAV with reheat if the system supplies only the perimeter and can handle both heating and cooling peak load conditions.

Perimeter finned-tube hot water radiation systems can be used to meet the perimeter loads. Ensure that the perimeter radiation system and forced air distribution systems don’t work against each other causing them both to constantly cycle. Caution should be used in providing sill system components so that they do not easily collect trash.

201.8 HVAC FOR UNFINISHED (TENANT) AREAS
HVAC systems for unfinished future tenant areas shall be designed to provide for heating and cooling. The interior space(s), (defined as that space 12 +/- feet from the exterior wall) shall be designed for VAV with only cooling primary air ductwork routed to the terminal units. The VAV units shall be sized to deliver approximately 1.25 CFM of supply air per square foot. Prior to setting air flows the anticipated use of tenant areas shall be reviewed for functions that may require airflow rates above this amount (i.e. kitchens, bars, etc.). Additional CFM shall then be built into the air handling system design to easily handle these special areas. Controls will be connected to the VAV terminal unit only if some cooling or ventilation is required in the space.

The exterior glass walls shall utilize a perimeter forced air system as described previously. The perimeter system shall be complete in the unfinished area. The interior system shall be complete only to the VAV terminal system components.

SECTION 202 – SPECIAL SYSTEMS

202.1 AIR CURTAINS
Air curtains, plastic curtains and rapid operation doors are to be considered for use at doors and openings at all maintenance type facilities and also at baggage doors and openings.

Overhead fan-coil units or fan powered terminal boxes may be used as a modified type of air curtain at each concourse jetway entrance. The fan-coil units shall be activated, if not already in operation, whenever the jetway door is opened utilizing a 30-second time delay, and the supply air temperature is to be controlled from a space thermostat.

Air curtain type units shall be used at all terminal entrance vestibules. These air curtain units are controlled by vestibule thermostats.

202.2 CATALYTIC AIR CLEANING SYSTEM
Air filtration is an important consideration in the design of HVAC systems to serve airport facilities. Provide a catalytic air cleaning system in all new air handling units, which consists of MERV 13 rated filters, Ultraviolet Germicidal Irradiation (UVGI) and Photocatalytic Oxidation (PCO).

Ultraviolet Germicidal Irradiation (UVGI) is used to damage or kill various organisms on surfaces on the evaporator coil and surface in the air handler. Photocatalytic Oxidation (PCO) render bacteria cells, mold spores, and viruses inactive and accelerates the breakdown most volatile organic compounds (VOCs).

The key benefits of this system are:
- Significant reduction of microbiological elements (viruses, bacteria and fungi/mold).
- The reduction of organic odors caused by VOCs, like engine exhaust fumes.
- Highly efficient particle removal.

202.3 SPLIT DX SYSTEM
Provide an independent Split DX to serve Special System Rooms (SSR), Server Rooms and Elevator Machine Rooms. Systems shall be sized to serve the cooling load in the room.
SECTION 203 - VENTILATION SYSTEMS

203.1 OUTDOOR AIR REQUIREMENTS
Outside air shall be brought in through the air handling systems to satisfy minimum ventilation requirements plus provide building pressurization and minimize air infiltration at building entrance door areas.

Existing outdoor air requirements on air handling equipment in the terminals were designed around previous revisions of ASHRAE Standard 62. Minimum outside air ventilation amounts shall be provided in accordance with the latest revision to ASHRAE Standard 62 and California Mechanical Code, there may be a conflict in the required amount of outdoor air. The Engineer shall coordinate those requirements with the Building Inspection and Code Enforcement (BICE) Department and provide electronic copies of correspondence and documentation of final design direction to the Project Manager. It is the responsibility of the Engineer to provide documentation that the existing equipment can comply with any modifications in outdoor air.

Outside air intakes shall be located high and away from landside vehicle traffic and airside jet exhaust to the greatest extent possible, a minimum of seven feet above grade. Most ventilation air will be brought in through air intakes in the mechanical penthouses. Computerize Fluid Dynamics modelling shall be utilized to validate intake air locations. All effort shall be made to provide distance and dilution as primary air quality solutions. See 202.2 and 203.5 for air quality controls and filtration.

203.2 CO₂ MONITORING
Monitor CO₂ concentrations within all densely occupied spaces. CO₂ monitors must be between 3 and 6 feet above the floor. CO₂ monitors must have an audible or visual indicator or alert the building automation system if the sensed CO₂ concentration exceeds the setpoint by more than 10%. Calculate appropriate CO₂ setpoints using methods in ASHRAE 62.1–2010, Appendix C.

For spaces where air contaminants are likely, evaluate potential sources of additional air contaminants besides CO₂. Develop and implement a materials-handling plan to reduce the likelihood of contaminant release. Install monitoring systems with sensors designed to detect the specific contaminants. An alarm must indicate any unusual or unsafe conditions.

203.2 AIR ECONOMIZER CONTROL
All air-handling units over 4,000 CFM capacity shall be equipped with air side, dry-bulb economizer cycle operation. The control system for this operation must be arranged to modulate outside and return air dampers to maintain a mixed air set point temperature. Outside air dampers will close to the minimum position and return air dampers open when the outside air is 75ºF or higher (adjustable).

It may not be appropriate to provide air handling units to be located on the apron level and similar areas with 100 percent outdoor air capability due to the air quality in these areas. Therefore, some air handlers shall be provided with continuous minimum outside air levels. These units shall utilize water-side economizer cycles (if applicable).

203.3 RETURN AIR \\ TRANSFER AIR
Return air from the conditioned space back to the air handling unit should be via ductwork and ceiling plenums. The pressure drop in the return air system shall be minimized in the design. Return air fans shall not be required in most cases. Maximum velocity shall be 500 fpm over net free area for general return and transfer air and 200 fpm over net free area for smoke control areas.

Eggcrate grilles shall be used in return air plenums that are used for smoke control. Perforated face grilles shall not be used.

203.4 VENTILATION RATES
As described earlier in this document, the outside air ventilation rate shall be as recommended in the latest edition of ASHRAE Standard 62. Careful consideration shall be given to these new recommended rates, particularly considering recent attention in the HVAC industry to indoor air quality. A summary of the applicable rates published in ASHRAE Standard 62, as applicable to airport building spaces, is presented below:
Outside air requirements, unless otherwise specified, shall be as follows for "normal" occupancy levels.

The occupancy load in many public areas of the airport (i.e., concourses, hold rooms, ticketing areas, baggage claim, etc.) is highly variable. As an alternate to the ventilation air flows indicated as based on "normal" occupancy levels, it is acceptable to calculate the minimum ventilation rate on 10 CFM per person, based on peak load occupancy; unless exhaust requirements override this amount.

203.5 FILTRATION

Air filtration is an important consideration in the design of HVAC systems to serve airport facilities. Air should be brought in at the roof or penthouse level wherever possible in an attempt to use the highest quality air available. As a minimum, outside air is to be filtered by the use of 2" dry type pre-filter sections having a minimum rating of Minimum Efficiency Reporting Value, MERV 8 (30% - 35% efficient with a maximum allowable particle size of 10.0 micron), 12" dry type filter section having a minimum rating of MERV 13 (89% - 90% efficient with a maximum particle size of 1.0 micron), ultraviolet germicidal irradiation (UVGI) and photocatalytic oxidation (PCO). Filters for small air-handling units serving maintenance or non-public areas should be provided with 4" dry type pre-filter section having a minimum rating of MERV 10 (50% - 55% efficient with a maximum particle size of 3.0 micron).

Ventilation shall be provided in all ground level spaces that may have occasional or full-time occupancy. This ventilation shall be such as to minimize any possibility of an accumulation of radon gas; however, shall not be less than one (1) air change per hour.

Unoccupied crawl spaces in contact with the ground, shall be ventilated likewise to eliminate radon gas hazards at a rate of one (1) air change per hour - on a time clock to run not less than four one-hour periods in each 24-hour day.

SECTION 204 - HEATING, VENTILATION, EXHAUST SYSTEMS

204.1 GENERAL

This section covers areas of the building that are primarily mechanically heated and/or ventilated only; no air conditioning to be included. Basically, ventilation rates, filtration etc., mentioned previously for HVAC systems will apply unless otherwise indicated. Special exhaust requirements are also discussed.

204.2 BAG MAKEUP AND TUG DRIVE AREA

A. Ventilation: These spaces shall be maintained under a negative pressure in relation to the main terminal (public space) area. This will be accomplished with the use of exhaust fans. The exhaust shall exceed the 100% O.A. make-up air quantities by approximately 10 percent in the bag make-up area. Ventilation rates shall be a minimum of 6 air changes per hour in the bag make-up area and 10 air changes per hour in the tug drive area, if internal combustion engines are utilized. If all electric vehicles are utilized, the air change rate may drop to 2.0 air changes per hour of makeup air.

B. Heating: The bag make-up area shall have a 100% outside air make-up unit filters and with heating coils or indirect gas-fired equipment. In addition hot water unit heaters or low intensity infrared heaters shall be strategically located throughout the area and near overhead doors to maintain space temperature. Consideration will be given to providing low intensity infrared heat in lieu of some unit heaters, depending on overhead door activity. This will be based on input from the individual airlines which will utilize this space. Consideration shall also be given to recover heat from the exhaust air stream.

C. The tug drive shall be tempered with low intensity infrared heaters placed at bag drop-off areas.

204.3 TRUCK DOCK VENTILATION

An exhaust system shall be provided to ventilate truck docks on the apron level. This exhaust system shall provide 10 air changes per hour in the truck dock area. This ventilation system will provide the added benefit of creating air movement and reducing carbon monoxide build up.
204.4 TOILET EXHAUST
The ventilation (exhaust) rate for all toilet room facilities shall be a minimum of 2.0 CFM/SF of floor space or 15 air changes per hour, whichever is the larger requirement. Toilets with extremely high traffic, such as those located in concourse areas, should have a minimum daytime exhaust rate of 2.5 CFM/SF or 19 air changes per hour, whichever is the larger requirement.

Under no circumstance shall a positively pressurized toilet exhaust duct run through a return air plenum or occupied space.

204.5 KITCHEN EXHAUST
All kitchens shall be air conditioned. The exhaust requirements shall be based on the number and size of the exhaust hoods installed within the facility. All ovens, fryers and grilles shall have dedicated exhaust hoods serving the equipment. Kitchen exhaust systems shall be designed in accordance with NFPA 96, "Standard for the Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment." Heat recovery from kitchen hood exhaust should be considered in the final design if grease build up or collection can be avoided. In addition, make-up air systems for large kitchens must be evaluated. Make-up air should be supplied at the kitchen hoods. Packaged, factory designed and NFPA approved kitchen exhaust hoods with make-up air systems are acceptable.

Under no circumstance shall a positively pressurized kitchen or hood exhaust duct run through a return air plenum or occupied space.

204.6 SERVICE LEVEL
A. Ventilation: Provide dampered air intakes and exhaust fans in all electrical and mechanical equipment rooms for adequate ventilation. Air intakes should be from the ramp or apron area. Compliance with applicable fire codes is essential.
B. Heating: Provide hot water or gas-fired unit heaters to heat the storage and equipment room areas where a heat loss is involved.

204.7 ATRIUM/HIGH-BAY AREAS
The atrium of the terminal building shall contain a relief air system in the high bay area which will relieve air to exterior due to pressure or temperature build up. A make-up air unit shall also serve the high bay area to provide ventilation air and pressurization when required. These systems shall also be incorporated into a smoke removal system as required by NFPA and the California Building Code for high rise structures.

204.8 DISPLACEMENT VENTILATION
Displacement ventilation (DV) is a means of providing cool supply air directly to the occupants in a space. The fresh air, supplied near the floor at a very low velocity, falls towards the floor due to gravity and spreads across the room until it comes into contact with heat sources. It is ideal for high-bay areas for cooling and ventilation only.

Diffusers shall be mounted near the floor level deliver 65°F supply air at less than 75 fpm velocity. Air flow causes a thermally stratified space and vertical air movement towards the return located high in the space.

A single air handling unit shall not be used for displacement ventilation and an overhead forced air system. They should have different supply air temperatures.

204.9 AIR INTAKE MINIMUM SEPARATION DISTANCES
Provide separation between exhaust outlet and outside air intakes. Minimum separation distances in Table 204.9.

<table>
<thead>
<tr>
<th>Exhaust Discharge</th>
<th>Distances to Nearest Outside Air Intake*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aircraft Jet Engine Exhaust</td>
<td>25</td>
</tr>
<tr>
<td>Cooling Tower</td>
<td>20</td>
</tr>
<tr>
<td>Fan Exhaust</td>
<td>15</td>
</tr>
<tr>
<td>Plumbing Vents</td>
<td>15</td>
</tr>
<tr>
<td>Kitchen Exhaust</td>
<td>25</td>
</tr>
<tr>
<td>Generator Stack</td>
<td>25</td>
</tr>
</tbody>
</table>

*Minimum separation between exhaust and outside air intake in feet.
SECTION 205 - EQUIPMENT IDENTIFICATION

205.1 GENERAL
All major air handling equipment shall have a unique equipment designation. Engineer shall obtain designation from the SFIA Mechanical Engineer (or the SFIA Mechanical Maintenance group).

SECTION 206 - PC AIR SYSTEMS

206.1 GENERAL
All gates shall be furnished with a stand-alone, DX PC Air unit. When replacement units are installed that are of larger capacity than the original, a hydronic and load analysis shall be performed by the Engineer to verify piping, pumping and chiller capacity. Design calculations and report shall be submitted to the SFIA Mechanical Engineer.

SECTION 207 - EQUIPMENT SUPPORTS

207.1 DESIGN
All equipment supports shall be manufactured systems or designed and detailed by a Professional Engineer licensed in the State of California. Supports shall be coordinated with Architectural and Structural disciplines. Under no circumstances shall the Construction Documents direct a Contractor to provide supports without detailed performance specifications outlining criteria and requirements of supports and their design and installation.

SECTION 208 - ENERGY SOLUTIONS & SYSTEM ALTERNATIVES

208.1 MECHANICAL SYSTEM ALTERNATIVES
As part of the Net Zero Energy program objectives, HVAC system and control alternatives must be evaluated against baseline systems. Such alternative systems shall include but is not limited to the following:

1. Slab hydronic heating and cooling systems
2. Stack natural ventilation and cooling systems
4. Local heat pump systems
5. Heat pump systems with geothermal condenser systems
6. Heat Recovery chillers and tank system storage systems
7. Chilled Beam systems
8. Radiant and convection heating
9. Ventilation alternatives for air quality control
10. Passive systems
11. Non-distributed systems
12. Heat recovery systems
13. Advanced control, technology, and sequencing systems

These systems are only examples of alternatives that should be evaluated as part of the Net Zero Energy program objectives. Coordinate with all disciplines in collaboration to determine the best value using Predictive Energy Modelling.
CHAPTER 3
AIR DISTRIBUTION SYSTEMS

SECTION 301 - AIR DISTRIBUTION SYSTEMS

301.1 DUCTWORK DESIGN
Ductwork layout and sizing shall be done using the best practices to ensure minimum energy loss by thermal transfer and friction. Ductwork shall generally be designed for low pressure, i.e., 2.0 in. w.g. or less. In no instance shall the pressure exceed 4.0 in. w.g. All medium pressure ductwork shall be sized based on the static regain method. All low pressure ductwork shall be sized using either the static regain method or the equal friction method. Existing main ductwork upstream of VAV boxes is considered medium pressure. All ductwork systems shall be designed to minimize noise transmission through the ductwork and avoid noise generation from components or fittings.

Ductwork air velocities shall not exceed the following limits:

A. Mains (equipment rooms and non-occupied spaces) 3000 fpm
B. Mains (occupied spaces) 2000 fpm
C. Branch (or mains w/diffuser connection) 1200 fpm
D. Branch with diffusers 1000 fpm
E. Aspect ratios shall not exceed 4:1 for mains.

Exceptions shall be submitted for review. Allowances can be acceptable depending on the design options and cost impact.

301.2 DUCTWORK REQUIREMENTS
Ductwork shall be either rectangular or round (spiral) as appropriate for the specific application. All designs shall be in accordance with SMACNA "HVAC Duct Construction Standards" and the technical criteria in this manual. All supply air distribution ductwork shall be galvanized sheet metal with flanges, seams, supports, etc., to match the appropriate duct classification as defined by SMACNA unless moisture in the system dictates the use of aluminum or stainless steel materials. Kitchen exhaust ductwork shall be welded stainless steel. Ductwork shall be designed in classification and maximum air velocities for all accordance with ASHRAE: Handbook of Fundamentals, ductwork. Duct Design Chapter, and constructed in accordance with the ASHRAE: HVAC Systems and Equipment Handbook, Ductwork construction shall be tested for leakage prior Duct Construction Chapter, and the SMACNA Design to installation.

Ductwork Classification - Static Pressure Air Velocity Duct Class:

- 250 Pa (1.0 in W.G.) < 10 m/s DN < (2000 FPM DN) Low Pressure
- 500 Pa (2.0 in W.G) < 10 m/s DN < (2000 FPM DN) Low Pressure
- 750 Pa (3.0 in W.G.) < 12.5 m/s DN < (2500 FPM DN) Medium Pressure
- 1000 Pa (+4.0 in W.G) < 10 m/s DN > (2000 FPM UP) Medium Pressure

Although SMACNA allows spin-in fitting for medium pressure ductwork, the fact they are difficult to differentiate in field inspections from low pressure fitting, spin-in fittings are not allowed at SFIA. Spin-in fittings shall not be represented on plans or sketch for medium pressure systems. Spin-in fittings are allowed on low pressure systems.

All branch take-offs shall be with a 45 degree boot or tap.

Exposed ductwork used as an architectural feature shall be round and constructed of sufficient gage metal to prevent dings or dents. Ductwork material shall be either aluminum finish or suitable for painting. No external insulation shall be provided on architecturally exposed ductwork. Lined ductwork shall be used in exposed areas when radiated sound level exceeds that required.

All 90 degree elbows in both medium and low pressure ductwork shall contain double-walled, air foil type turning vanes, unless long radius elbows are used. Ductwork near air-handling units and outside air ductwork will be lined, as required for thermal performance, noise control and condensation control. The Design Consultant shall designate the calculated duct static pressure on the drawings to establish duct construction classification.
Flexible round duct shall be a maximum of 7 feet in length and be of a material acceptable by the San Francisco Building Code. Elbow into diffusers with flex is acceptable with a long radius turn. Crimping the flex duct at the elbow or under obstructions is prohibited. Aluminum flex duct is prohibited.

**301.3 DAMPERS**

All volume control dampers shall be opposed-blade type and isolation/shut-off dampers shall be parallel blade type. Outside air intake dampers shall have air-tight seals at both the edges and ends of the blades. The seals shall be of a material that will not disintegrate with exposure to jet exhaust fumes.

Control dampers shall be provided on all main branch take-offs and on the main ductwork downstream of a branch take-off.

All fire dampers shall be U.L. listed and conform to the standards and requirements of the California Building Code. Fire dampers shall be located at all fire zone penetrations and will have access doors provided for service and maintenance.

All combination fire-smoke dampers (FSD) shall be U.L. listed and conform to the standards and requirements of the California Building Code. Fire-smoke dampers shall be located were required by code and have access doors provided for service and maintenance. FSD shall feedback to building Fire Alarm System.

**301.4 DIFFUSERS**

Various types of diffusers are to be considered based on architectural input. Consideration shall be given to quality, durability, capacity, aesthetics, throw and noise level. Coordinate with the architect all diffuser types and locations. Linear slot diffusers shall be individual, 4-foot maximum sections with individual supply boots. Perforated face diffusers are not to be used.

Sidewall and perimeter diffusers shall be selected based on quality, durability, aesthetics, capacity, throw and noise level. Coordinate with architect all diffusers types and locations. Continuous linear slot diffusers shall be individual 4 (four) foot maximum sections with an individual supply boot. NC levels at the diffuser and at the neck connection should be consistent with design sound levels in rooms.

**301.5 GRILLES**

Standard core 1/2" x 1/2" x 1/2" eggcrate grilles shall be used in return air plenums/systems. Eggcrate grilles shall have a minimum free area of 90%. Perforated face, louvered-face or other face types shall not be used in return air systems in smoke control areas.

**301.6 TRANSFER AIR**

Transfer air openings are required in all walls to structure in return air plenums and smoke control zones. Transfer air openings shall be sized for a maximum velocity of 200 fpm in smoke zones and 500 fpm in return air plenums that are not used for smoke control. Sizing shall accommodate the entire return air/smoke control system to the point of installation.

**301.7 VAV TERMINAL AIR UNITS**

Designer shall ensure all components of VAV terminals are completely accessible for maintenance and no additional HVAC or Tenant equipment is required to be removed from operation in order to complete maintenance activities. Control modules shall have a minimum twenty-four (24) inches of clear space to allow for maintenance activities.

**301.8 SECURITY GRATES**

Security grates shall be installed on all ductwork and transfer air openings larger than 144 square inches between public spaces and private spaces. All roof penetrations larger than 144 square inches with a direct path of access to indoors shall be required to have a security gate.
SECTION 401 – OVERVIEW

401.1 EXISTING CAMPUS HEATING/COOLING SYSTEMS OPERATION
Chilled water and heating hot water for the HVAC systems in the Terminal buildings are supplied from the Central Plant.

SECTION 402 – EQUIPMENT

402.1 CHILLED WATER SYSTEM
The chilled water system shall be configured with multiple water circulation loops. The primary loop is the “chiller loop”, which uses chiller pumps in parallel and header to circulate water through the chillers which are piped in parallel.

The second circulation loop shall be a variable flow system. The secondary loop distributes the chilled water from the primary “chiller” loop to the terminal buildings. Pumps in parallel supply the distribution piping with chilled water. The pumps shall be staged on and off based on chilled water demand.

Variable chilled water flow is provided in response to signals from differential pressure controllers in the secondary loop circuit. The controllers shall cycle the secondary loop pumps to maintain sufficient pressure differences between the secondary supply and return mains to provide chilled water to the most remote tertiary sub-circuit.

The water service to the end use equipment is provided from the tertiary loop variable chilled water flow pumps which are provided at each tertiary equipment area. These systems to be equipped with differential pressure controllers and the tertiary pumps shall vary to provide adequate flow to the most remote sub-circuit.

Flow measuring devices will be required in each loop and sub-circuit.

402.2 HEATING SYSTEM
Heating in all building spaces shall be provided by high-temperature hot water from hot water generators (boilers) located in the Central Plant. The hot water system will consist of a primary “boiler” loop; a secondary high-temperature hot water distribution loop; heat exchangers and a tertiary distribution loop serving the Terminals. Hot water boiler pumps shall be equal in number to the boilers and shall circulate and maintain a constant temperature in the primary boiler loop (reset with outside temperature). The secondary loop will consist of pumps in parallel supplying a variable flow as required by demand and differential pressures. The tertiary loop pumps shall provide a variable flow sufficient to maintain a differential pressure between supply and return legs of the most remote unit on the tertiary loop.

402.3 HYDRONIC REQUIREMENTS
Chilled or Heating Water shall be sized for a maximum of 10 feet pressure drop per 100 feet of equivalent pipe for any run, but no more than an average of 4 feet pressure drop per 100 feet of equivalent pipe for the entire connected system. Circuit setters or balancing valves shall not be used for equipment isolation.

A. Hydronic design temperatures for Secondary Loops:
   1. Chilled Water Supply Temperature: 40°F
   2. Chilled Water Return Temperature: 60°F
   3. Heating Water Supply Temperature: 300°F
   4. Heating Water Return Temperature: 200°F

B. Hydronic design temperatures for Building Tertiary Loops:
   1. Chilled Water Supply Temperature: 40°F
   2. Chilled Water Return Temperature: 60°F
   3. Heating Water Supply Temperature: 180°F
   4. Heating Water Return Temperature: 140°F

402.4 PIPING AND VALVES
Piping for both the central plant and the distribution systems shall be designed to minimize pressure losses and maximize energy use efficiency. Valves to be specified for equipment servicing shall be selected to minimize losses while open, and have suitable pressure drop characteristics for intended use. The piping shall be designed to allow for central plant equipment expansions.

Control valves shall be sized for the correct and appropriate Cv value at the design flow rate. All valves shall be suitable for extended service operation without extensive requirements for lubrication or servicing. Control valves shall be Flow Control Industries Delta P valves.

Tees, valves and blind flanges shall be provided to allow for additions of equipment and piping to the central plant without interruption of services. Double block and bleed valves required for high pressure systems. Piping systems shall be sized for ultimate loads. Tees, valves and blind flanges shall be provided on distribution piping systems for expansion of distribution systems; sectional valves shall be provided in the distribution piping for piping system repairs and at key locations to provide isolation and servicing of equipment. On compressed air lines, quick disconnect connections shall be installed down stream of sectional valves to enable use of portable compressors in emergencies. The piping design and materials selection shall be in accordance with ANSI/ASME Standard B31.9 Building Services and ANSI/ASME Standard B31. Power Piping.

402.5 PUMPS
Pumps shall be selected for maximum operating efficiency, (i.e., slightly to the right of maximum efficiency point on the pump curve). The motor shall exceed BHP by a minimum of 10%. The preferred operating motor speed is 3500rpm.

Single pumps to be used in throttling applications without variable speed drives shall have relatively flat performance curves and be selected for operation on the pump performance curve to the right of the point of highest efficiency. Multiple pumps for parallel operation shall have relatively steep performance curves. Multiple pumps for series operation shall have relatively flat performance curves. Pumps for variable speed drive (VSD) applications shall have relatively steep performance curves. All pumps shall be specified with suction and discharge flange taps for pressure gauge connections. Provide all VSD pumps with matching VSD compatible motors. Pumps VSD shall be mounted close to pump motor.

The final selection of pump types and the application arrangement shall be made to maximize pump efficiency without excessive initial pump costs. All pumps that are selected for both current and future needs will be sized for the future requirements, where practical, and equipped with the necessary accessories. The lower initial performance requirement will be met by balancing valves or by the use of a trimmed impeller to provide energy efficient operation in start-up performance.

Standby pumps and accessories shall be provided for both heating and cooling systems. Pumps shall be arranged in a parallel configuration and header so as to maximize pumping flexibility.

Generally: Vertical turbine pumps shall be used for pumping cooling tower water. Hydronic water applications shall use end suction pumps for flow rates below 500 GPM. Horizontal split-case, double suction pumps shall be used for flow rates above 500 GPM.

Vertical split case, double suction pumps will be allowed for use with flow rates above 500 GPM, only in existing rooms when adequate space for horizontal arrangements does not exist.

Mount pumps to housekeeping pad with seismic isolation. Pump installation shall include inlet isolation valve, outlet isolation valve, suction diffusers, triple-duty valves with inlet strainer, inlet pressure gauge, outlet isolation gauge and temperature gauges. Double block and bleed valves required for high pressure systems. All valves shall be accessible and gauges shall be readable.

402.6 MOTORS
Electric motors shall conform to NEMA Standards. All 3-phase motors shall be high efficiency type. Motors shall not be selected for operation in the service factor range.

The minimum system installed power factor shall be 90% with a goal to attain a 95% system power factor. Motors larger than 15hp shall have power factor correction.

Motors shall be specified to be provided with adequate thermal protection, integral or external control and branch circuit protection, and starters suitable for use with the motors. Motor and starter types shall be selected to minimize voltage
fluctuations and current surges. Motors and starters shall be provided with auxiliary contacts for control and operation interface with the central Energy Management Control (EMC) system and any other control functions included.

402.7 WATER TREATMENT
Chemical treatment systems shall be provided at the Central Plant for the protection of the chilled water, condenser water and hot water systems from scale, corrosion, biological growths and suspended solids.

Any system connecting shall not have glycol or separate chemical treatment system. Any chilled water, condenser water and/or hot water systems not connected to the Central Plant hydronic distribution system shall have a chemical treatment system.

SECTION 403 - DESIGN CRITERIA

403.1 GENERAL REQUIREMENTS
The hydronic systems design shall be based upon the criteria following:
A. Piping shall be designed in accordance with the technical criteria in Section IV of this manual. Water pipe sizing shall be based on the stricter of the two following parameters:

<table>
<thead>
<tr>
<th>Pipe Size*</th>
<th>Max. Velocity (fps)</th>
<th>Max. Pressure Drop** (ft per 100ft pipe)</th>
<th>Materials</th>
<th>Fittings</th>
<th>Isolation Valve</th>
</tr>
</thead>
<tbody>
<tr>
<td>½&quot; thru 2&quot;</td>
<td>4</td>
<td>8.5</td>
<td>Type K Copper</td>
<td>Soldered</td>
<td>3-Piece Ball Valve</td>
</tr>
<tr>
<td>2-½&quot; thru 4&quot;</td>
<td>6</td>
<td>4.5</td>
<td>Type K Copper</td>
<td>Soldered</td>
<td>3-Piece Ball Valve</td>
</tr>
<tr>
<td>6&quot; thru 12&quot;</td>
<td>8.5</td>
<td>2.5</td>
<td>Sch 40 Steel Welded/Flanged***</td>
<td>Lug Butterfly Valve</td>
<td></td>
</tr>
<tr>
<td>14&quot; thru 20&quot;</td>
<td>10.5 (14)***</td>
<td>2.5</td>
<td>Sch 40 Steel Welded/Flanged***</td>
<td>Lug Butterfly Valve</td>
<td></td>
</tr>
<tr>
<td>24&quot; thru 42&quot;</td>
<td>11 (14)***</td>
<td>1.5</td>
<td>Sch 40 Steel Welded/Flanged***</td>
<td>Lug Butterfly Valve</td>
<td></td>
</tr>
</tbody>
</table>

* Minimum ½" for coil connection only. Provide ¾” minimum for branch lines.
** Based on new, clean steel pipe
*** Number in parenthesis is velocity limit applicable to long straight runs where noise is not critical (such as pipe tunnels, etc.). Maximum pressure drop still applies.
**** Mechanical coupling is an option for CHW only in mechanical rooms.

B. Due to availability issues and relative cost, 5-inch piping and valves shall not be used.
C. Pressure drops in piping systems shall be calculated to allow for aging and corrosion of the interior surface. Therefore, all water piping systems shall be designed with the following friction factors (*C* values) based on the Hazen Williams Friction Factor formula.

<table>
<thead>
<tr>
<th></th>
<th>&quot;C&quot; Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Closed Water Systems</td>
<td>120</td>
</tr>
<tr>
<td>Closed, Treated Water Systems</td>
<td>130</td>
</tr>
<tr>
<td>Open Water Systems</td>
<td>100</td>
</tr>
<tr>
<td>(New clean steel pipe)</td>
<td>(140)</td>
</tr>
</tbody>
</table>

D. Hot and chilled water distribution systems should be designed for variable volume flow.
E. Hydronic systems should be designed for widest practical delta T and the closest possible approach of the return water temperature to the terminal equipment supply air temperature.
F. The terminal equipment must be selected not only for its full load capacity, but also for its performance over the full range of partial loads. Laminar fluid flow in the coils shall be avoided.
G. Integral face and bypass coils should be utilized with preheat coils.
H. The impact of the change in volume due to thermal expansion of the distribution system fluids during all operations must be addressed in the design process. Show anchorage points, pipe guides, flex joints and expansion loops.
I. Control valves in hydronic systems must not be oversized. The flow characteristics and pressure drops are to be selected for the appropriate Cv value corresponding to the design flow to be controlled.
J. Provide automatic air vents at all coils and at the high points of all piping. Provide drains at the low points of all piping. Vents shall be accessible and well-marked.
K. Provide isolation shutoff valves at all equipment and branch lines. Double block and bleed valves required for high pressure systems. All isolation valves shall be accessible.
L. Hydronic systems controls shall be automatic and adjustable to optimize pumping and thermal efficiency.
1. When close control is essential, do not use three-way valves either for output control in constant-volume-flow systems or for blending control in any variable-volume-flow systems, since their characteristics are of the linear type. Provide equal-percentage valves.

2. When using three-way valves for throttling, avoid pressure under one port being significantly higher than under the other.

3. Use mixing three-way valves with caution for flow diversion or diverting valves for mixing since the valves have tendencies to slam shut at reduced flows.

4. Use two-way valves at terminal coils in variable flow systems.

5. Hot water coil valves shall fail to the open position.

403.2 EXPANSION REQUIREMENTS

In modular buildings that are designed for to be expanded as the Airport capacity increases (such as Concourses and the Terminal) all hydronic systems shall be sized for the maximum build out of the facility. Piping flow diagrams shall indicate all calculated flow rates of all general spaces anticipated for future construction.

403.3 CHILLED WATER SYSTEM

The chilled water system is configured with multiple water circulation loops. The primary loop is the "chiller loop", which uses chiller pumps in parallel and header to circulate water through the chillers which are piped in parallel.

The pumps are connected in parallel on suction and discharge headers with a 1-to-1 ratio of chiller pumps to chillers. Pumps provide a constant flow to each chiller.

The secondary circulation loop shall be a variable flow system. The secondary loop distributes the chilled water from the primary loop to the secondary loop which loops through the terminals and concourses. Pumps in parallel supply the distribution piping with chilled water. The pumps shall be staged on and off based on chilled water demand (based on differential pressure).

Variable chilled water flow in the secondary loop is provided in response to signal/signals from differential pressure controllers in the secondary loop circuit. The controllers shall cycle the secondary pumps to maintain sufficient pressure differences between the secondary supply and return mains.

The tertiary circulation loop shall be a variable flow system. The tertiary loop distributes the chilled water from the secondary loop to the terminal building, concourses and areas to be served with Central Plant cooling. Tertiary pumps are located in terminal mechanical rooms. Pumps in parallel supply the distribution piping with chilled water. The pumps shall be staged on and off based on chilled water demand.

Variable chilled water flow in the tertiary loop is provided in response to signal/signals from differential pressure controllers in the tertiary loop circuit. The controllers shall control the tertiary loop pumps to maintain sufficient pressure differences between the tertiary supply and return mains to provide chilled water to the most remote sub-circuit.

Flow measuring devices will be required in each loop and sub-circuit. For each new tertiary loop provide a BTU meter with data logging.

403.4 HEATING SYSTEM

Heating in all building spaces shall be provided by high-temperature hot water from boilers located in the Central Plant. The hot water system will consist of a boiler loop; a secondary high-temperature hot water distribution system loop and heat exchanger with tertiary distribution loop serving the terminal units. Hot water boiler pumps are equal in number to the boilers and circulate and maintain a constant temperature in the boiler loop. The secondary loop consists of pumps in parallel supplying a variable flow, as required by demand and differential pressures, to the secondary loop.

The water service to the end use equipment is provided from the tertiary loop variable hot water flow pumps which are provided at each tertiary equipment area. These pumps are to be controlled to maintain supply water temperature in the tertiary loop, with these systems to be equipped with differential pressure controllers to insure adequate flow to the most remote sub-circuit. Provide one stand-by pump for each loop system. Tertiary loops reduce the hot water temperature to 180/140 degrees F (supply/return) through heat exchangers.
SFIA Mechanical Design Standards

Flow measuring devices will be required in each loop and sub-circuit. For each new tertiary loop provide a BTU meter with data logging.
SFIA Mechanical Design Standards

CHAPTER 5
CONTROLS

SECTION 501 – GENERAL

501.1 GENERAL
A complete system of automatic controls shall be provided to maintain space conditions within allowable limits. When heating and cooling is incorporated in one system for personnel comfort, the automatic temperature controls shall not be capable of simultaneous heating and cooling and shall provide a "dead band."

The system shall consist of all necessary control devices, control valves, control dampers, damper motors, electric switches, relays, gages, panel boards, and fittings, including all necessary accessories required for a complete and operative control system. All control wiring and control system electric power is to be furnished to provide a complete of environmental control and central panel functions.

Control systems shall be electronic, digital systems controlling all HVAC equipment utilizing local microprocessor control panels located in the applicable adjacent equipment rooms. The field panels shall be capable of interfacing with central (EMCS) equipment provided by a different vendor.

The local field panels shall be tied to the master Energy Management Control System (EMCS) server, but capable of stand-alone operation.

501.2 EMCS LEVELS AND ARCHITECTURE
EMCS shall be Direct Digital Control (DDC) based system for providing lower operating costs and ease of operation. The BAS (Building Automation System) shall adjust building systems to optimize their performance and the performance with other systems in order to minimize overall power and fuel consumption of the facility.

BAS shall utilize ‘open’ communication protocols, such as BACnet, to minimize the costs of providing integration and to allow interoperability between building systems and control vendors. A/E to specify and include functional design manual, hardware manual, software manual, operation & maintenance manual, and as-built drawings with sequence of operations. BAS shall have energy management and monitoring software.

EMCS Architecture shall include standalone zone or terminal controls with local control panel (LCP) for centralize HVAC equipment. Building level controls (BLC) shall integrate all LCP in the building, Boarding Area, and Terminal. The all new projects shall provide full communication with the EMCS system. Projects must provide fiber, server, address, graphics, and programming to integrate new HVAC control systems with the existing EMCS system.

501.3 INTEGRATION:
All BLC systems shall be capable for standalone operation at the local level. And all BLC systems shall be coordinated and provided with full integration, control, communication, monitoring, and connectivity to the front end SFIA EMCS. Design and coordination shall be indicated in drawings and in control architectural diagrams. Details of IT network connections and server addresses must be specified with communication fiber routing as part of the BLC system design. Front end EMCS graphic upgrades and additions must be included as part of every new BLC. For all integration work, drawings and/or specifications shall clearly state responsibility of each contractor as follows:

Controls System ‘A’ will be the lead system for this integration. Controls System ‘B’ will need to be compatible with the protocol used by Controls System ‘A’. Manufacturer of Controls System ‘B’ will be responsible for ensuring this compatibility.”

501.4 ENHANCED COMMISSIONING
Enhanced Commissioning is mandatory on all LEED projects. The intent of Enhanced Commissioning is to further support the design, construction, and eventual operation of a project that meets the owner’s project requirements for energy, water, indoor environmental quality, and durability.
As part of Enhanced Commissioning the following activities must be completed for mechanical, electrical, plumbing, and renewable energy systems and assemblies in accordance with the latest revisions of ASHRAE Guidelines for HVAC&R systems, as they relate to energy, water, indoor environmental quality, and durability.

A. Develop/Review Owner’s Project Requirements (OPR), Basis of Design (BOD), and project design.
B. Develop/Implement a Commissioning (Cx) Plan.
C. Confirm incorporation of Cx requirements into the construction documents.
D. Develop construction checklists.
E. Develop a system test procedure and verify system test execution.
F. Maintain an issues and benefits log throughout the Cx process.
G. Prepare a final Cx process report.
H. Review contractor submittals.
I. Verify systems manual updates and delivery.
J. Review building operations 10 months after substantial completion.
K. Develop an on-going commissioning plan.
L. Front End EMCS control and integration

501.5 MEASUREMENT AND VERIFICATION
Measurement and Verification (M&V) is mandatory on all LEED projects. The intent of M&V is to provide for the ongoing accountability of building energy consumption over time.

Develop and implement a Measurement and Verification (M&V) plan consistent with the International Performance Measurement & Verification Protocol (IPMVP). The M&V period must cover at least 1 year of post-construction occupancy. Provide a process for corrective action if the results of the M&V plan indicate that energy savings are not being achieved.

SECTION 502 - ENERGY MANAGEMENT CONTROL SYSTEM (EMCS)

502.1 ENERGY MANAGEMENT CONTROL SYSTEM (EMCS)
New EMCS systems shall be a direct digital controls system. New EMCS shall be open-communication protocol BACNET and be manufactured by commercial manufacturer. Each new control loop shall be a standalone system designed to be programmed and operated from a building PLC work station. All mechanical rooms will be equipped with local equipment level PLCs. All zone level controls shall be standalone loops and designed to communicate back to the equipment level PLCs.

Building PLCs shall communicate information, control functions, alarms, and monitoring data back to the Front End. EMCS Architecture and IT servicer interface must be integrated as part of the renovation or new building project. Cable, conduit, fiber, and switch, IT server, and address shall be provided as part of the new project. It is the responsibility of the of the new building or renovation project to provide the communication and integration back to the EMCS server. All work shall be provided such that new EMCS shall be monitored, controls, alarmed, and programmable from the master workstation. Provide all front end programming, graphics, and hardware to suit the new EMCS installed as part of the building renovation or new building design. For all integration work, drawings and/or specifications shall clearly state responsibility of each contractor as follows:

“Controls System ‘A’ will be the lead system for this integration. Controls System ‘B’ will need to be compatible with the protocol used by Control System ‘A’. Manufacturer of Control System ‘B’ will be responsible for ensuring this compatibility."

Additional requirements for the EMCS are detailed below in the following subsections.

502.2 EMCS NAMING STANDARD
All points within the EMCS shall comply with SFO Naming Convention. SFO Engineer shall provide the most current SFO Naming Convention to the Contractor. If Naming Convention for a system does not exist, Contractor shall provide a submittal of all points to SFO Engineering for review and approval prior to starting construction. Comply with latest SFO Information Infrastructure Management (IIM) standards.

502.3 EMCS GRAPHICS
Comply with latest Energy Management Control System (EMCS) specification.
502.4 SOFTWARE
The EMCS and all equipment under its control must follow ASHRAE Guideline 36P High Performance Sequence of Operation for HVAC Systems. The Design Consultant shall review the current stage in the development of universal protocol and make every practical effort to incorporate this into the temperature control automation system.

The software shall have, but are not limited to, the following capabilities:

A. Run Time
B. Optimum Start/Stop
C. Economizer Controls
D. Time of Day Scheduling
E. Chilled Water Outdoor Air Reset
F. Hot Water Outdoor Air Reset
G. Variable Condenser, Hot, and Chilled Water Pumping
H. Night Set Back
I. Status
J. Change of Status
K. Smoke Venting and Control
L. Ambient High/Low Alarms
M. Energy Totalizing
N. Electrical System Monitoring
O. Maintenance and Alarm Reports
P. Heating/Cooling Mode

502.5 TREND LOGGING AND GRAPHING
Trend logs and graphing capability shall be provided.

502.6 ALARM PRINTOUTS
All alarms shall be on the display monitor, providing information on the type of alarm, time and date of occurrence. Change of state alarms are to be programmed to be disabled or enabled at the option of the operator.

502.7 SYSTEM ACCESS CONTROL
Provide access control (passwords) for system operation.

502.8 REPORT CAPABILITY
The software shall be capable of being user programmed to generate custom user designed reports.

Basic Report Printouts required are as follows:
A. Alarm Summary
B. Run Time Summary
C. Maintenance Reports
D. Energy Usage Reports
E. Utility Consumption Reports

502.9 Automated Fault Detection and Diagnostics (AFDD)
The EMCS software and sequence of operations shall comply with all Automatic Fault Detection and Diagnostics (AFDD) requirements in ASHRAE Guideline 36P High Performance Sequence of Operations for HVAC Systems. The AFDD system must detect faults based on sensor inputs, as well as suggest likely cause(s) based on fault condition. The AFDD logic must send direct errors from the EMCS Front End to SFO Main Saver work order system for maintenance, troubleshooting and/or calibration.

SECTION 503 – CONTROL COMPONENTS

503.1 THERMOSTATS
Zone thermostats mounted in public areas shall be sensors only with controllers. Zone thermostats in private areas shall be programmable.
503.2 CARBON MONOXIDE AND NITROGEN DIOXIDE SENSORS
Carbon monoxide and nitrogen dioxide sensors shall be provided in the service drive or wherever internal combustion engine traffic is utilized in an enclosed space. Sensors shall increase air flow and/or alarm out-of-tolerance conditions.
CHAPTER 6
SPACE REQUIREMENTS AND MAINTAINABILITY

SECTION 601 – GENERAL

601.1 GENERAL
Mechanical equipment and layout shall be selected to maximize equipment performance, and minimize equipment servicing, repair and maintenance. Equipment selection shall also consider durability, reliability, maintainability and serviceability. Equipment arrangement and layout shall allow for safe and efficient accessibility for equipment removal, replacement, repair and maintenance. Provide sufficient service corridors, pathways, fall protection, and door access to deliver replacement equipment and parts.

During the design phase, coordination with other design disciplines is essential to provide for the necessary access to equipment. All otherwise inaccessible equipment and equipment components shall be provided with OSHA approved catwalks, platform, or etc. to allow maintenance. The catwalks, platforms, and adequate lighting, etc. shall provide for maximum safety to both personnel and equipment while allowing access for equipment maintenance. Standardization of equipment and materials shall be used to the maximum extent possible. Standardization and interchangeability will minimize the space and expense of the maintenance spare parts inventories. Items for consideration for standardization shall include, but not be limited to: Air handling units and components, terminal units, control components, heat exchangers, pumps, valves, and fans.

SECTION 602 - DESIGN REQUIREMENTS

602.1 DESIGN
The design shall, in general, include equipment layouts with maintenance and repair clearances indicated. Special maintenance items or equipment, or necessary auxiliary equipment shall be specified to be provided and installed with the equipment it is to serve. Avoid locating equipment requiring frequent service or repair above ceilings or in occupied spaces. Hydronic systems and associated gauges check valves, and shutoff valves all need to be design for ease of access, inspection, and maintenance. Air side systems and components should also be designed and configured for ease of access inspection, and maintenance.

602.2 EQUIPMENT SELECTION
Equipment shall be selected for stable operation at both full and part-load conditions. Equipment selections shall be below maximum limits for capacity, speed, temperature and pressure. The equipment installation design and specification shall include sufficient instrumentation for measuring, indicating, monitoring, operating and servicing at full and part loads.

602.3 BEARINGS
Use permanently lubricated bearings on fans, if available. Equipment which cannot be furnished with permanently lubricated bearings shall have lubrication lines extended to the exterior of the unit.

602.4 CONSTRUCTION REQUIREMENTS
Require the contractor to include in the shop drawing submittals manufacturers recommended spare parts lists, maintenance and service clearances, special maintenance equipment or requirements and recommended maintenance schedules. Conflicts between equipment and maintenance requirements or clearances shall be submitted, along with contractors’ solutions to the conflicts, for approval. Approval of conflict resolution shall be required before equipment installation.

Require the contractor to revise all flow diagrams, control diagrams and additional information to reflect any revisions to designed systems and/or required performance capabilities to suit the actual equipment installed. Require the contractor to provide instruction for operating personnel on the operation, attendance and maintenance of equipment. Include all data necessary to establish an efficient and effective preventive maintenance program.

602.5 FAN HOUSING
All supply fan housings shall have ladder rungs mounted on the side of each unit next to the coil pipe connections to provide access to the top of each unit without stepping on insulated pipes.
602.6 ACCESS DOORS
All air handling units shall be equipped with access doors for each compartment (coils, filter, fan, etc.), with piano hinges, door handles, and a viewing window in each compartment access door. The doors should be sturdy enough to permit opening the door using one handle.

Provide in accessible locations access doors of adequate size at all fire damper locations for the purpose of inspection as well as for replacing fusible links.

For combination fire-smoke dampers (FSD) provide ceiling access doors and duct access doors. Access doors shall be properly located and size for adequate access to the FSDs. Duct access doors shall be properly labeled.

SECTION 603 - SPACE REQUIREMENTS

603.1 MECHANICAL ROOMS
Mechanical room space requirements and dimensions shall be coordinated with the architect so that appropriate space is provided for the equipment and its service and maintenance.

603.2 MECHANICAL CHASES
Mechanical chase space requirements shall also be determined and coordinated, including space for supply and return air ductwork, outside ventilation air, exhaust air, hot and chilled water piping, domestic water piping, sanitary drainage, and roof drains, etc. All chases with plumbing equipment shall have a minimum one floor drain.

603.3 EQUIPMENT CLEARANCE
Provide a minimum of four feet (clear space) around all sides of boilers and chillers, plus tube pull space. Provide three feet (clearance space) around all sides of pumps, and air handling equipment. These are minimum design requirements, if manufacturers recommendations exceed these values, Design Consultant shall comply with the more stringent requirement.

All rooftop equipment shall be serviceable through existing roof access.

Drawings shall show minimum clearances for service and access to equipment.

603.4 CONVEYOR RIGHT OF WAY
In certain areas baggage conveyors will be routed through ceiling plenums. The space requirement for these conveyors will be approximately 4 feet deep by 4 feet wide per conveyor, plus the additional space needed for personnel cat walks (preferable 4 feet wide). Therefore, all ductwork must be routed to avoid conveyors and structural members. Physical space may prohibit ductwork crossing baggage conveyors. Careful coordination is required.

Design Consultant shall coordinate with all systems and disciplines throughout the design process to insure adequate space is available and to avoid interferences.
SECTION 701 - PLUMBING SYSTEMS

701.1 GENERAL
This section applies to the systems used to receive, transport or discharge liquid waste or sewage; the systems used to receive and distribute potable water; the systems used to receive and distribute fuel gas; the systems used for the collection and transport of rain water and cooling coil condensate drains, etc.

701.2 DESIGN SUBMITTAL REQUIREMENTS
A. Provide enlarged detailed plumbing plans for restroom and concession areas.
B. Provide pipe elevations including invert elevations and slopes on all drainage piping.
C. Reference related civil utility drawings for continuation of piping connecting to drainage stub-outs connecting to site utility mains.
D. Provide a pipe size and drainage fixture unit table, calculation, and piping diagrams indicating pipe sizes and drainage fixture unit loading for the sanitary soil, waste and vent system(s).
E. Provide existing system load analysis to validate tie-in connections and existing system capacity to support new work and new loads.
F. Provide piping diagrams indicating pipe sizes and water supply fixture unit loading for the domestic cold water, domestic hot water and recycled water systems.
G. Provide natural gas piping diagram showing pipe sizes, developed lengths of pipe lengths and gas loads in (BTUH/CFH) for each equipment connection, pipe main and branch lines. Diagram to include all meters, gas valves, regulators, gas vent pipes and related equipment.
H. All data such as ultimate water and gas service demand, sanitary and storm analysis report shall be submitted for review.

701.3 SYSTEM REQUIREMENTS
A. Facilities for the physically handicapped shall be provided in all public building restrooms.
B. Provision shall be made within the terminal building and each of the concourses for future expansion of the plumbing systems at such time that the complex is expanded to meet increased usage.
C. Buildings, in the Terminals and Concourse areas, shall be provided with roof drains and a drainage collection system. The roof drainage system shall be connected to the exterior storm sewer system. Overflow roof drain system shall be piped separately and terminated at grade level.
D. An industrial waste sewer shall be provided for all liquid wastes that would be detrimental to the public sewer system or detrimental to the operation of a sewage treatment plant. Industrial waste shall be collected, treated and disposed of as required by the authority having jurisdiction.
E. Reclaim water system shall be provide for all new restroom facilities.
F. Plumbing systems are defined to be within the building up to 5 feet from the building perimeter. All systems beyond this point shall comply with utilities design guides and specifications.

SECTION 702 - PLUMBING DESIGN PARAMETERS

702.1 GENERAL
All plumbing systems shall conform to the requirements of the codes and standards.

702.2 FIXTURE COUNT
To determine the minimum number of fixtures required for the terminal and concourse areas a plumbing fixture count method shall be used. The plumbing fixture method is a method of adjusting the numbers of people on which the number of fixtures are determined in setting the design for the plumbing facilities. After the numbers of people are appropriately adjusted, the fixture per persons for the type of building or occupancy from the uniform plumbing code shall be used for determining the minimum plumbing facilities.

The plumbing fixture method typically allows for additional fixtures for peak loads not adequately accounted for by the codes. The basis for the plumbing fixture count method is based on historical airport experience and the following criteria:
A. Projected Peak Occupancy (per area).
B. Thirty-three percent of passengers and 15 percent of visitors will use concourse facilities. (Departures and arrivals levels.)
C. Fifteen percent of visitors and fifteen percent of passengers will use terminal building facilities.
D. The percentage of men and women of total occupancy is estimated at 50 percent male/50 percent female.
E. Each level and area shall be sub-divided into terminal public space, restaurant, office and retail to determine fixture count for each particular occupancy.
F. Urinals shall be utilized in lieu of water closets in men’s toilets to the maximum ratio allowed by code.

Fixture counts and/or flow rates shall be shown on all isometric drawings.

702.3 CALCULATIONS
Design calculations shall be based on ASPE Data Book (Chapter 8) and the California Plumbing Code, latest edition. Recognized acceptable engineering practices shall be applied for areas where design criteria have not been established specifically by these codes and standards.

Several areas of the Terminal and Concourses experience dramatic pressure fluctuations. The engineer shall make every effort to ensure that new designs do not amplify current conditions. In these areas, static and dynamic pressure calculations shall be performed and submitted.

No assumptions shall be made on plumbing system capacities. All connections to existing plumbing systems shall have capacity calculations proving capacity. The design consultant shall submit all calculations directly to the SFIA Mechanical Engineer in PDF format.

702.4 TERMINAL
The terminal building plumbing facilities shall be designed for optimum passenger use and the total future terminal size to prevent under-sizing of initial terminal building plumbing facilities.

702.5 CONCOURSES
The plumbing facilities in the concourses shall be designed for the current initial passenger use. Expansion in concourse passenger service will be in conjunction with concourse construction expansions. Those expansions will include the necessary additional plumbing facilities. Plumbing utility systems (pipe sizes and arrangement) shall be designed to allow for future facilities expansion.

702.6 SAND TRAPS
Sand or dirt from plumbing fixtures or floor drains shall be connected and disposed of by means of sand traps prior to flow entering Airport system. Design capacity and accessibility shall be subject to SFIA approval.

702.7 INDUSTRIAL WASTE
Industrial waste sewer shall be provided for areas where fueling of aircraft and vehicles take place.

702.8 GREASE AND OIL SEPARATORS
Grease, fats and oils in waste water from kitchen sinks, dishwashers, floor drains or other fixtures, shall be collected and intercepted with grease or oil separator prior to entering Airport sanitary sewer system.

Location of grease or oil separator shall be such that hot grease, fats or oils, shall have adequate time to cool and separate out before waste water enters Airport system. Separators shall be easily accessible for proper cleaning.

702.9 FLOOR DRAINS
Buildings shall be provided with floor drains that have traps and cleanouts. The location and types of all cleanouts shall be noted on the drawing. All drains exiting the building shall have a double cleanout so that the drain line may be cleaned into and out of the building.

Mechanical rooms shall contain general area floor drains and equipment drains for condensate and other miscellaneous drainage. Equipment drains shall not serve dual duty.
All floor drains in chases, basement areas, restrooms, mechanical rooms and entry vestibules shall have trap primers.

702.10 BACKFLOW PREVENTION
The potable water supply system shall be designed, installed and maintained in such a manner as to prevent the contamination from non-potable liquids, solids or gases being introduced into the potable water system through cross-connections or any other connections to the system. Protective measures and the requirement for backflow prevention devices shall meet or exceed the requirements of the California Plumbing Code, San Francisco Building Code Amendments and the requirements of water utility. If there is any conflict between these requirements the most stringent requirement shall apply in the design and/or modification to the existing potable water system. Should existing systems be found that do not comply with the latest backflow prevention requirements, the design will include upgrading the backflow prevention of that system being renovated, added to and/or constructed. All domestic water connections to mechanical, plumbing and fire protection systems, including lawn sprinkling systems, shall be protected from backflow by use of backflow preventers installed in the piping. Plumbing designs shall meet best management practices for cross connection control.

702.11 COORDINATION
It is the responsibility of the plumbing engineer/designer to provide design, specification and detail of all plumbing connections to systems outside of the building (IE: water, storm drainage, sanitary sewer, natural gas, etc). The interface point shall note elevations (building reference and civil reference), sizes and acceptable means of connection of differing materials and allowable tolerances of connection. "See Civil" notes shall not be used to solely identify this connection.

SECTION 703 – PLUMBING SYSTEMS

703.1 STORM DRAINAGE SYSTEM
A. Storm Drainage piping system shall consist of roof drains, overflow drains, area drains, and storm sewer building mains and branch lines for roof drains/overflow drains discharging into a gravity drainage piping system, settlement joints, and connection to the existing pipes and site sewer mains.
B. Horizontal storm drain and overflow drain lines including roof drain bowl shall be wrapped with 1/2" thick fiberglass insulation to prevent condensation. Exception, pipes located above the vehicle service roads.
C. Storm water pipe sizing shall be per the California Plumbing Code with the rainfall intensity based on a 1.6 inches per hour rainfall intensity.
D. A minimum slope of one-eighth (1/8") inch per foot or 1% for gravity storm drainage shall be used.
E. Due to ground settlement, all underground storm drain piping shall be supported from the underside of the floor slab and the vertical faces of the pile caps using Type 316 stainless steel hangers.

703.2 SANITARY SOIL WASTE AND VENT SYSTEM
A. Sanitary sewer system shall consist of sanitary soil, waste and vent connections to plumbing fixtures with gravity drainage piping system for the plumbing fixtures, stub-outs for future tenants including connections to existing pipes, pipe settlement joints, pipe supports, seismic bracings, and connections to site sewer.
B. Underground piping shall be wrapped with 8 mil polyethylene tube encasement in accordance with AWWA C105.
C. A minimum slope of one-fourth (1/4") inch per foot or 2% for gravity sanitary sewer lines shall be used where possible.
D. Due to ground settlement, all underground soil, waste and vent piping shall be supported from the underside of the floor slab using Type 316 stainless steel hangers, supports and anchors.

703.3 GREASE WASTE SYSTEM
A. Provide 4 inch grease waste line stub-outs for food concession tenants located below the footprint of each food concession space. Provide grease waste piping from the stub-out to the location of future above ground grease interceptor. Provide 4 inch sanitary waste and 4 inch vent stub-outs for future grease interceptor installation.
B. Provide grease interceptor for the Airside Loading Dock floor drains including H20 rated manholes. Grease interceptor shall be supported from the floor slab with type 316 stainless steel supports.
C. Due to ground settlement, all underground grease waste drain piping shall be supported from the underside of the floor slab and/or the vertical faces of the pile caps using Type 316 stainless steel hangers, supports and anchors. Underground piping shall be wrapped with 8 mil polyethylene tube encasement in accordance with AWWA C105.
SFIA Mechanical Design Standards

703.4 DOMESTIC COLD WATER SYSTEM

A. Water Pressure: The available water pressure is in the range of 120-125 psi. Domestic water system pressure shall be limited to 65 PSI through an existing pressure reducing station on the existing incoming cold water main. Existing pressure reducing station to remain as is.

B. Water flow velocity: To avoid any erosion, corrosion and excessive noise generation, the domestic cold water piping shall be sized for a maximum flow velocity of 4 feet per second (FPS) for pipes two inches and smaller, and 6 feet per second (FPS) for larger pipes.

C. System Sizing and Estimated Loads: The domestic water main shall be sized to accommodate the water loads serving fixtures with potable water connections. Plumbing fixtures requiring potable water connections are sinks, lavatories, janitor sinks, hose bibbs, trap primers, drinking fountains and bottle fillers, water heaters, and emergency showers/eyewashes, passenger boarding bridges’ cabinets, and concession plumbing fixtures/equipment. Refer to paragraph for recycled water system. Allowances shall be provided in the domestic water main pipe sizing to accommodate for mechanical make-up water, concession areas and jet bridges.

D. Plumbing fixtures to include sinks, lavatories, drinking fountains and bottle fillers. Refer to paragraph for recycled water system. Allowance shall be provided in the domestic water main pipe sizing to accommodate for mechanical make-up water, concession areas and jet bridges.

1. Toilet Rooms, Janitor Closets, Drinking Fountains and Break Rooms: Allowance shall be provided in the domestic water main pipe sizing to accommodate for public toilet rooms, janitor closets, break rooms, drinking fountains and bottle fillers.

2. Concession Areas: Allowance shall be provided to accommodate future concession areas. Domestic cold water for each future concession tenant shall be metered.

3. Jet Bridges: Allowance shall be provided to accommodate a water supply for jet bridges. Each jet bridge shall be provided with a 1½” cold water supply line, water meter, combination emergency shower/eyewash, and a 1”water line with a backflow preventer for the water cabinet.

4. Mechanical make-up water: Allowance shall be provided to accommodate mechanical make-up water supply for chilled water and heating hot water systems.

5. Provide isolation valve for each battery of water closets, urinals, lavatories; each group of fixtures and for each isolated fixture. Valves shall be located in the plumbing chase and in accessible locations. Provide access panel were required.

E. Smart domestic water meters shall be connected to EMCS. Meters shall record in units of one hundred cubic feet (hcf).

F. Per SFO Mechanical Engineering, installation of water meters are “Owner-provided and Contractor-installed”. SFO Mechanical Engineering will procure water meter hardware from SFPUC. After procurement, the Contractor shall provide all additional material and labor to install the SFO provided water meter, including but not limited to, communication, power and integration into the EMCS. All Contractor supplied materials and labor shall be submitted and approved by SFO Mechanical Engineering prior to procurement and construction.

703.5 DOMESTIC HOT WATER SYSTEM

A. General: Domestic hot water for the restrooms, janitor sinks and break room sink shall be provided by an electric water heater located in a janitor room adjacent to the restrooms. Plumbing fixtures shall be supplied with hot water from a pumped re-circulating hot water supply line.

B. Domestic hot water supply and return lines shall be insulated in accordance with Title 24.

C. Temperature: Hot water shall be produced and stored at a minimum of 140°F to prevent the growth of Leginollia. The hot water shall be tempered down to 120°F by use of an ASSE 1017 thermostatic mixing valve installed adjacent to the water heater. Hot water distribution shall be provided with a re-circulating line and pump to provide on-demand hot water to the lavatory faucets. Circulating lines shall be piped close to the hot water supply line to the lavatories, maximum distance shall be 2’-0” from the angle supply stops. Provide balancing valve for each circulating loop.

D. Lavatories: Water supply to lavatories shall be supplied with tepid water. Plumbing code required point of use ASSE 1070 thermostatic mixing valve shall be used to temper the water. Specified faucet is furnished with an ASSE 1070 device.

E. Flow velocity: To avoid any erosion, corrosion and excessive noise generation, the domestic hot water piping system shall be sized for a maximum flow velocity of 4 feet per second (FPS) for pipes two inches and smaller; and 5 feet per second (FPS) for larger pipes. 5 FPS is the code maximum per CPC.
703.6 RECLAIM WATER SYSTEM
A. General: A recycled water piping system shall be provided for flushing of water closets, and urinals. Currently there is no on-site recycled water supply but a recycled water system will be provided by SFO in the future. The recycled water piping system shall be temporarily connected to the existing domestic water main downstream of the existing water meter assemblies. A reduced pressure backflow preventer shall be provided at the point of connection to the domestic water system to prevent a cross connection between the recycled water system and the domestic water system.
B. Recycled water signage, pipe identification and valve identification tags shall be provided in accordance with the CPC.
C. System Sizing and Estimated Loads: The recycled water main shall be sized to accommodate the water closet and urinal fixture loads.
D. Flow velocity: To avoid any erosion, corrosion and excessive noise generation, the recycled water piping system shall be sized for a maximum flow velocity of 4 feet per second (FPS) for pipes two inches and smaller; and 6 feet per second (FPS) for larger pipes.

703.7 CONDENSATE DRAINAGE SYSTEM
A. Mechanical AC Units: Condensate drain lines from Mechanical AC units to approved indirect waste receptors such as floor sinks or funnel drains shall be provided. Condensate drain lines shall be wrapped with ½” thick insulation to prevent condensation.
B. Provide pumped condensate drainage system and 1 inch stub-outs for each Passenger Boarding Bridges including condensate lines terminated at floor sinks.

SECTION 704 - PLUMBING SYSTEM COMPONENTS
704.1 GENERAL
A. It has not been determined how many water services or meters will be provided, however, it is preferred that the terminal building complex should be provided with one central water meter, with the main water entrance located at the terminal building with branch services to each of the concourses. Remote buildings may have separate meters.
B. Electric (instantaneous type or small storage tank) domestic water heaters shall be provided at each toilet room. Larger requirements for domestic hot water such as restaurants, etc., shall have gas-fired or steam hot-water heaters. No central hot water system shall be provided in the terminal building complex or in the concourses.
C. Exterior grease traps and grease separators shall be provided for fixtures in kitchen and food service concessions areas as these facilities may require.
D. All water supply to fixtures shall be protected by an approved vacuum breaker.
E. A detailed area chart/plan shall be prominently displayed in the main equipment rooms showing the locations of all main piping and valves.

704.2 PLUMBING FIXTURE AND EQUIPMENT
A. Plumbing fixtures shall be commercial grade and water conservation type. Vitreous china fixtures, flushometer valves, lavatory sensor faucets and soap dispensing system shall be TOTO, or equal. High efficiency low consumption plumbing fixtures shall be provided for the restrooms. Lavatory and break room sink faucets and electric water coolers shall conform to lead free law and water efficiency standards. ADA compliant fixtures shall be provided at accessible locations.
B. An accessible plumbing chase shall be provided for maintenance access to the plumbing behind a battery of water closets, urinals and lavatories. A minimum inside clearance of 36” on single side and 48” on back to back assemblies shall be provided and an access door shall be provided to enter the chase.
C. Water-closets shall be high-efficiency 1.28 gallons per flush water closets shall be provided. Fixture shall be wall mounted white vitreous china commercial grade type water closets with white elongated open front seats with concealed sensor operated (hydropower self-generating) piston type flushometers.
D. Urinals shall be high-efficiency 0.125 gallon per flush urinals. Fixture shall be wall mounted white vitreous china commercial grade type with concealed sensor operated (hydropower self-generating) piston type flushometers.
E. Urinals shall connect directly downstream of water closet sanitary sewer main for allowance of future low flow fixtures.
F. Lavatories shall be white vitreous china under counter mounted commercial grade type. Wall mounted at single toilet rooms. Lavatory faucets shall be chrome plated sensor operated (hydropower self-generating) metering faucets. Maximum discharge of 0.09 gallons per 10 second cycle. Grid drains shall be provided for and p-trap and water supplies shall be wrapped with preformed insulation. Locate lavatory sensor faucet controller in the plumbing chase directly behind each lavatory.
G. All lavatory faucets in public and private toilet rooms shall be provided with flow restricting devices on all outlets. Provide single tempered water faucet at lavatories with 105°F supply temperature.

H. All lavatories (including physically handicapped) can be wall hung or counter mounted. Wheelchair access must be provided for handicapped fixtures. A minimum 29” clear knee space is required with maximum 34” rim height or as defined by the latest version of the ADA.

I. Janitor mop sinks shall be 24” x 24” x 12” high floor mounted square terrazzo type with stainless steel caps on all sides. Faucet shall be a wall mounted service sink faucet with vacuum breaker spout with pail hook and wall brace.

J. Electric water coolers with bottle filler (hydration stations) shall be provided and located adjacent public/staff toilet rooms and as indicated on architectural floor plans. ADA compliant height units shall be provided.

K. Break room sinks shall be a under counter mounted single compartment sink, type 304 stainless steel with satin finish. Sink shall be furnished with a single lever faucet and a ¾ HP food waste disposal. Flow on sink faucet shall be limited to 1.5 gpm.

L. Emergency safety fixtures shall be provided as follows:
   1. Janitor Closets: Provide emergency eyewash/drench hose unit in each janitor closet.
   2. Jet Bridges: Provide emergency safety station. Combination emergency shower with eye/face wash at each jet bridge for ground personal use.

M. Floor drains with a trap priming device shall be provided for the following areas:
   1. Toilet rooms containing two or more water closets or a combination of one water closet and one urinal.
   2. Janitor rooms.
   3. Mechanical rooms.
   4. Loading docks.
   5. Trash rooms.
   6. Other areas as needed.

N. Stop valves shall be provided on all fixtures including water coolers.

O. All fixture types shall be located in the design documents and called out on the contract drawings.

P. Roof vents (DMV) shall be of 3-inch diameter minimum.

Q. Drains from service and slop sinks shall be minimum of 3-inch diameter.

R. Minimum potable water line size shall be 3/4-inch except for branch to fixture which may be 1/2-inch.

S. Provide a floor drain below all non-carpeted interior vestibule areas. (Drain shall be located below steel mat.)

T. A minimum of one hose bibb shall be located in each mechanical and pump room for general wash down.

U. All sump pumps must have a remote alarm, strobe/light, and sign in a nearby occupied area.

704.2 PIPING
Refer to the specifications for pipe material types. PVC shall not be used inside the building without written permission of the SFIA Mechanical Engineer and BICE Inspector. All sanitary sewer piping shall slope at no less than ¼” per linear foot for allowance of future low flow fixtures.

704.3 EXPANSION SETTLEMENT JOINTS
   A. Expansion settlement joints for incoming and outgoing underground building utility mains shall be provided. Flexible connections shall be provided to accommodate a minimum of twelve inches (12”) of differential settlement and accompanying lateral movement for pipes entering or leaving the building and at other transition conditions where differential settlement may occur.
   B. Expansion settlement joints shall be wrapped with 8 mil polyethylene tube encasement in accordance with AWWA C105. All necessary supports, hangers and anchors shall be Type 316 stainless steel.

SECTION 705 - ENERGY CONSERVATION IN PLUMBING SYSTEMS DESIGN

705.1 HOT WATER
Hot water for domestic water use shall be designed in accordance with ASHRAE 90.1 and OSHA requirements. ASHRAE 90.1 establishes minimum requirements for hot water generator recovery efficiency, storage tank insulation, pipe insulation, temperature controls, pump operation, equipment automatic shutdown and conservation of hot water.

705.2 TEMPERATURE
The domestic hot water system shall be designed for a supply temperature of 120°F for circulated systems and 140°F for storage systems per OSHA requirements. For the public spaces provide lavatories with 105°F water at each point of use.
705.3 SAFETY DEVICES
Safety devices shall be provided on the hot water generators and storage devices. Safety devices shall be as required by code and as a minimum shall include energy cut-off devices, relief valve and/or temperature or combination temperature and pressure relief valves. All water heaters, regardless of size, shall have an expansion tank on the domestic cold water inlet.

SECTION 706 - NATURAL GAS

706.1 SIZING
Gas piping shall be sized per the requirements of the California Plumbing Code.
   A. Gas specific gravity: 0.65
   B. Gas thermal capacity: 834 BTU per 1,000 cubic feet

706.2 METERING
Smart metering for all buildings shall be connected to EMCS.

706.3 GAS SYSTEMS PROTECTION
Architect and Engineer of Record for design of facilities shall design protective measures for all gas piping systems at SFIA. Protective measures shall be coordinated with the utility company so that all gas systems above ground level are provided for the entire gas system, including upstream and downstream piping from the meter.

All gas piping, meters, pressure regulators, appurtenances and systems shall be fully protected from possible collisions with vehicles, baggage cart tugs, support equipment, etc. To the greatest extent possible, gas systems shall be located away from areas where it is possible for vehicles and/or equipment to strike it directly and/or indirectly through adjacent walls that offer inadequate protection from such vehicle strikes. In addition, gas systems shall be protected from grade level to ceiling as strikes can occur at nearly all elevations that are not either protected and/or concealed in ceilings.

As part of the Net Zero Energy program, all efforts shall be made to avoid and eliminate the use of natural gas in all new facilities. Optional sources of heating shall be assessed and reviewed to comply with Net Zero Energy and Carbon Neutrality objectives.
CHAPTER 8
ENERGY ANALYSIS

SECTION 801 - GENERAL
There are many factors unique to the airport terminal and other airport buildings that enter into the design of an energy efficient facility. These factors include architectural, mechanical and electrical considerations – all interrelated. The process of Energy Analysis shall comply with the guideline outlined in the Net Zero Energy program. Collaborative, iterative, and comprehensive approach must be utilized to capture an optimized balance of energy efficiency, lifecycle cost analysis, and sustainability objectives.

The San Francisco International Airport terminal, concourses and other buildings shall include design features that emphasize energy conservation. Some of these features have been outlined earlier but will be summarized in this section for emphasis.

Buildings in excess of 5,000 square feet shall have a computer energy model performed to establish energy consumption. Energy budgets shall be established and shall meet the requirements of ASHRAE 90.1. This standard allows tradeoffs between mechanical and electrical systems and the building envelope. These tradeoffs shall supersede specific requirements presented in following discussion. See Section 102 for Predictive Energy Modeling and Section 208 for HVAC System Alternatives.

801.1 CODES AND STANDARDS
All Energy Conservation Analyses shall meet the requirements of:
A. California Building Code
B. California Energy Code
C. California Green Building Code (CalGreen)
D. San Francisco Green Building Code
E. San Francisco Energy Code
F. California Title 24
G. ASHRAE 90.1
H. ASHRAE Guideline 36P High Performance Sequence of Operation for HVAC Systems
I. Net Zero Energy Standard

Where the requirements of this chapter or the Codes and Standards themselves deviate from one another, the more stringent of the two shall apply.

801.2 LEADERSHIP IN ENERGY & ENVIRONMENTAL DESIGN (LEED)
The Consultant shall review the current LEED Rating System and develop design strategies for maximizing the project’s energy efficiency. Following the LEED Rating System, the Consultant and The City shall determine which level of LEED Green Building Certification is achievable for the project. At a minimum all new construction projects and tenant improvement projects over 5,000 SF must be LEED Gold. Following this decision, the Consultant shall tailor the design documents to achieve this certification. The LEED Rating System document can be obtained at the following website: http://www.usgbc.org

Consult the San Francisco Green Building Code for mandatory LEED credits that must be achieved in addition to the prerequisites.

SECTION 802 – ENERGY & ATMOSPHERE

802.1 OPTIMIZE ENERGY PERFORMANCE
Reduce the environmental and economic harms of excessive energy use by achieving energy efficiency for the building and its systems. Analyze efficiency measures during the design process and account for the results in design decision making. Project potential energy savings and holistic project cost implications related to all affected systems.

Complete a whole-building energy simulation that demonstrates an improvement of 20% for new construction, 15% for major renovations, or 15% for core and shell projects in the proposed building performance rating compared with the baseline building performance rating. Calculate the baseline building performance according to ASHRAE Standard 90.1. Such analysis shall include all on-site building energy use, including exterior and security lighting, elevators, all process loads, and receptacle loads.
802.2 ADVANCED ENERGY METERING

Install energy meters on all whole-building energy sources used by the building. Install individual energy end uses that represent 10% or more of the total annual consumption of the building.

Meters must be permanently installed, record at intervals of 15 minutes, and transmit data to a remote location. Either the meters or the data collection system must be capable of reporting hourly, daily, monthly, and annual energy use. The system must be capable of storing all meter data for at least 36 months. The data must be remotely accessible and interface with the EMCS. Device names and data point names must follow SFO naming convention standard.

Metered information must transmit data using open-protocol programming and communication such as BACnet or SFO-approved equal. Mechanical equipment must transmit data into EMCS. Natural Gas meters must transmit data into EMCS. Domestic Water meters must transmit data into EMCS. All electrical equipment must transmit data into the SFO Electric Shop Schneider Electric Power Monitoring Expert (PME) server. All metered data must eventually transmit data into ITT Data Lake and Message Bus.

Access to each utility’s data management system must be available remotely via mobile phones, computers, and tablets for monitoring, reporting, and alarming. All meters shall be tested, calibrated and commissioned. Provide all meters with isolation valves for servicing or replacement.

Mechanical energy consumption must be recorded using BTU meters at the following locations:

A. Each chiller
B. Main chiller loop supplying the terminals
C. Chilled water usage at each pump room
D. Each boiler
E. Main boiler loop supplying the terminals
F. Heating hot water usage at each pump room

Electricity meters must record both consumption and demand. Whole-building electricity meters should record the power factor, if appropriate. Disaggregation of loads should be separated into the following categories:

A. Each tenant (for billing). Refer to SFO Electric Metering Shop Requirements for more details
B. All circuits under 100 Amps inside power distribution panels shall be measured and tracked with Branch Circuit Power Meters (BCPMs)
C. HVAC (VFDs, fans, pumps, and all other major mechanical equipment)
D. Plumbing loads
E. Interior Lighting
F. Exterior Lighting
G. Plug loads
H. 400 Hz (airplane charging system)
I. Pre-Conditioned Air (PCA) system
J. Photovoltaic (PV) solar renewable energy
K. Baggage handling system
L. People-moving equipment (elevators, escalators, and other associated equipment)
M. Other renewable energy sources
N. Security systems
O. Communications
P. Fire & Life Safety
Q. Electrical equipment

Electrical metering shall be provided and installed by Electrical subcontractor. Meters shall be integrated into SFO Electric Metering Shop’s Schneider Electric Power Monitoring Expert (PME) Server. Refer to SFO Electric Metering Shop Requirements for more details.

Natural Gas meters must record consumption for each tenant (if applicable) and each central plant boiler.
Domestic Water meters must record consumption at each gate and tenant. Additionally, consumption must be recorded at the main pipe feeding each boarding area and walkway between boarding areas. See Section 804.2 for additional metering requirements.

The data collection system must use a local area network, building automation system, wireless network, or comparable communication infrastructure. The system must be capable of storing all meter data for at least 36 months. The data must be remotely accessible and interface with the EMCS.

802.3 ENHANCED COMMISSIONING & MONITOR BASED COMMISSIONING
Enhanced Commissioning and Monitor Based Commissioning are mandatory on all LEED projects. The intent of Enhanced Commissioning is to further support the design, construction, and eventual operation of a project that meets the owner’s project requirements for energy, water, indoor environmental quality, and durability.

As part of Enhanced Commissioning the following activities must be completed for mechanical, electrical, plumbing, and renewable energy systems and assemblies in accordance with the latest revisions of ASHRAE Guidelines for HVAC&R systems, as they relate to energy, water, indoor environmental quality, and durability.

A. Develop/Review Owner’s Project Requirements (OPR), Basis of Design (BOD), and project design.
B. Develop/Implement a Commissioning (Cx) Plan.
C. Confirm incorporation of Cx requirements into the construction documents.
D. Develop construction checklists.
E. Develop a system test procedure and verify system test execution.
F. Maintain an issues and benefits log throughout the Cx process.
G. Prepare a final Cx process report.
H. Review contractor submittals.
I. Verify systems manual updates and delivery.
J. Verify operator and occupant training delivery and effectiveness.
K. Verify seasonal training.
L. Review building operations 10 months after substantial completion.
M. Develop an on-going commissioning plan.

Monitoring Based Commissioning involves developing procedures and identifying points to be measured and evaluated to assess performance of energy and water consuming systems. Include the procedures and measurement points in the commissioning plan. Address the following:

A. Establish roles and responsibilities.
B. Establish measurement requirements (meters, points, metering systems, data access).
C. Develop list of points to be tracked, with frequency and duration for trend monitoring.
D. Set the limits of acceptable values for tracked points and metered values (where appropriate, predictive algorithms may be used to compare ideal values with actual values).
E. Establish the elements used to evaluate performance, including conflict between systems, out-of-sequence operation of systems components, and energy and water usage profiles.
F. Develop an action plan for identifying and correcting operational errors and deficiencies.
G. Provide training on how to prevent and address errors.
H. Develop plan for preventative maintenance needed to maintain performance.
I. Set the frequency of analyses in the first year of occupancy (at least quarterly).

802.4 RENEWABLE ENERGY
The LEED Project Administrator shall confer with SFIA on renewable energy opportunities for municipal construction projects, including photovoltaics, solar hot water and wind power. Space allocation and infrastructure for future renewable energy installations shall be included in municipal construction projects, as advised by SFIA, including but not limited to structural capacity, wiring conduits, supply and return piping, and control wiring. The LEED Project Administrator shall submit documentation verifying that either:

A. At least 1 percent of the building’s energy costs are offset by on-site renewable energy generation, achieving LEED credit EA 2, including any combination of: photovoltaic, solar thermal, wind, biofuel-based electrical systems, geothermal heating, geothermal electric, wave, tidal, or low impact hydroelectric systems, or as specified in Section 25741 of the California Public Resources Code; or,
B. In addition to meeting LEED prerequisite EA 1 Energy Performance requirement, achieve an additional 10 percent compliance margin over Title 24, Part 6, California Energy Standards, for a total compliance margin of at least 25 percent.

SECTION 803 – INDOOR AIR QUALITY

803.1 MINIMUM INDOOR AIR QUALITY (IAQ) PERFORMANCE
Contribute to the comfort and well-being of building occupants by establishing minimum standards for indoor air quality (IAQ). For mechanically ventilated spaces, meet the minimum outdoor air intake flow for mechanical ventilation systems using the ventilation rate procedure from ASHRAE 62.1 or a local equivalent, whichever is more stringent.

For variable air volume systems, provide a direct outdoor airflow measurement device capable of measuring the minimum outdoor air intake flow. This device must measure the minimum outdoor air intake flow with an accuracy of +/-10% of the design minimum outdoor airflow rate, as defined by the ventilation requirements above. An alarm must indicate when the outdoor airflow value varies by 15% or more from the outdoor airflow set point.

803.2 THERMAL COMFORT (DESIGN)
Provide occupants with quality thermal comfort to increase productivity, comfort, and well-being. Meet the requirements for both thermal comfort design and thermal comfort control.

Design the heating, ventilating, and air-conditioning (HVAC) systems and the building envelope to meet the requirements of ASHRAE Standard 55 – Thermal Comfort Conditions for Human Occupancy.

Provide individual thermal comfort controls for at least 50% of individual occupant spaces. Provide group thermal comfort controls for all shared multi-occupant spaces, and for any individual occupant spaces without individual controls. Thermal comfort controls allow occupants, whether in individual spaces or shared multi-occupant spaces, to adjust at least one of the following in their local environment: air temperature, radiant temperature, air speed, and humidity.

803.3 CONTROLLABILITY OF SYSTEMS (THERMAL COMFORT)
Provide individual thermal comfort controls for at least 50% of individual occupant spaces. Provide group thermal comfort controls for all shared multi-occupant spaces, and for any individual occupant spaces without individual controls. Thermal comfort controls allow occupants, whether in individual spaces or shared multi-occupant spaces, to adjust at least one of the following in their local environment: air temperature, radiant temperature, air speed, and humidity.

SECTION 804 – WATER EFFICIENCY

804.1 INDOOR WATER USE REDUCTION
For the fixtures and fittings listed in Table 804.1, as applicable to the project scope, reduce aggregate water consumption by a minimum of 30% from the baseline. The baseline water consumption for fixtures and fittings are shown in Table 804.1.

<table>
<thead>
<tr>
<th>Commercial Fixtures, Fittings &amp; Appliances</th>
<th>Current Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Closets (Toilets)</td>
<td>1.6 gallons per flush (gpf)</td>
</tr>
<tr>
<td>Urinals</td>
<td>1.0 gallons per flush (gpf)</td>
</tr>
<tr>
<td>Public Lavatory Faucets</td>
<td>0.5 gallons per minute (gpm)</td>
</tr>
<tr>
<td>Private Lavatory Faucets</td>
<td>2.2 gallons per minute (gpm)</td>
</tr>
<tr>
<td>Kitchen Faucets</td>
<td>2.2 gallons per minute (gpm)</td>
</tr>
<tr>
<td>Showerhead</td>
<td>2.5 gallons per minute (gpm)</td>
</tr>
</tbody>
</table>

All newly installed toilets, urinals, private lavatory faucets, and showerheads that are eligible for labeling must be WaterSense labeled (or a local equivalent for projects outside the U.S.).

804.2 WATER METERING
Track water consumption in an effort to manage water usage and identify opportunities for additional water savings.

Install permanent water meters for the following water subsystems, as applicable to the project:
A. Meter domestic water systems serving at least 80% of the indoor fixtures and fitting included in the indoor water use reduction, either directly or by deducting all other measured water use from the measured total water consumption of the building and grounds.

B. Meter domestic hot water use of at least 80% of the installed domestic hot water heating capacity, including both tanks and on-demand heaters.

C. Meter reclaimed water, regardless of rate. A reclaimed water system with a makeup water connection must also be metered so that the true reclaimed water component can be determined.

D. Tie into EMCS (Energy Management & Control System).
APPENDIX B – MASTER LIST OF MANUFACTURERS

This section provides the Master List of Manufacturers approved by SFO for the use of Mechanical Systems, organized by section and subsection. All final decisions regarding products shall be made at the Owner’s discretion. If Contractor presents hardware items that are not specified or named equals, there may be a charge to the Contractor for evaluation of those products.

21 10 00 – FIRE PROTECTION / SPRINKLER SYSTEMS

PIPE AND FITTINGS

1. Allied.
4. Wheatland.
5. Stockham.
7. Warwick.
8. Anvil.
10. Tyco.
11. Smith-Cooper.
12. Or approved equal.

MECHANICAL COUPLINES

1. Victaulic.
2. Tyco.
5. Or approved equal.

DIP COUPLING AND SLEEVES

1. U.S. Pipe.
2. Tyler.
3. Union.
4. Or approved equal.

MECHANICAL JOINT RESTRAINTS

1. EBBA Iron Sales.
2. MJ Field-Lok by U.S. Pipe.
3. Or approved equal.

DIELECTRIC UNIONS

1. EPCO.
2. Or approved equal.

DIELECTRIC WATERWAY FITTINGS

1. Victaulic.
2. Or approved equal.
DIELECTRIC FLANGE KITS
1. Calpico.
2. Or approved equal.

FLANGE ADAPTERS FOR FLANGED COMPONENTS TO GROOVED SYSTEM
1. Victaulic.
2. Or approved equal.

GROOVED END FITTINGS
1. Victaulic.
2. Or approved equal.

CORROSION PROTECTION FOR UNDERGROUND PIPE AND FITTINGS
1. Christy’s.
3. Trumbull Manufacturing.
5. Or approved equal.

VALVES
1. AGF.
2. Grinnell.
5. Mueller.
6. Reliable.
7. Elkhart.
8. Victaulic.
11. Viking.
12. FPPI.
14. Or approved equal.

INTEGRAL INSPECTOR ALARM TEST AND SYSTEM DRAIN
1. Victaulic.
2. Star Sprinkler.
3. Ashcroft.
4. United.
5. Or approved equal.

TAMPER SWITCHES
1. Potter-Roemer.
2. Notifier.
3. Simplex.
4. Or approved equal.
STANDPIPE FIRE DEPARTMENT HOSE VALVE OUTLETS
   1. Potter-Roemer Model.
   2. Or approved equal.

ROOF FIRE DEPARTMENT OUTLET CONNECTIONS
   1. Potter-Roemer.
   2. Or approved equal.

EXPANSION SETTLEMENT JOINTS
   1. Ebba Iron.
   2. Hyspan.
   4. Or approved equal.

ACCESS DOORS AND PANELS
   1. Elmdor.
   2. Mifab.
   3. Or approved equal.

WATER FLOW SWITCHES
   1. Potter Electrical Signal Co.
   2. VSR.
   4. Or approved equal.

SUPERVISORY (TAMPER) SWITCHES
   1. Potter Electric Signal Co.
   2. System Sensor.
   3. Notifer.
   4. Simplex.
   5. Or approved equal.

BURIED UTILITY WARNING AND IDENTIFICATION TAPE
   2. MSI Marking Services Inc.
   3. Or approved equal.

VALVE TAGS
   2. MSI Marking Services Inc.
   3. Or approved equal.

SPRINKLER HEADS
   1. Manufacturer per SFO Tenant Improvement Guide.
   2. Tyco.
   3. Victaulic.
   4. Viking.
5. Or approved equal.

FIRE HOSE VALVE CABINETS
1. Potter Roemer.
2. Or approved equal.

DETECTORS
1. FIKE.
2. Or approved equal.

HANGERS AND SUPPORTS
1. Tolco.
2. Or approved equal.

COMPRESSED AIR SUPPLY – QUICK OPENING DEVICE
1. Viking.
2. Or approved equal.

21 22 00 – CLEAN AGENT FIRE SUPPRESSION

MANUFACTURERS
1. FIKE Corporation
2. ECARO.
3. Rhino Control System.
4. Or approved equal.

21 13 29 – WATER SPRAY FIXED SYSTEM

DELUGE VALVE ASSEMBLY CABINET
1. Fire Flex Systems Inc.
2. Or approved equal.

DETECTION AND CONTROL SYSTEM
1. Fike Cheetah.
2. Or approved equal.

DELUGE VALVE
1. Viking.
2. Or approved equal.

DELUGE SYSTEM CONTROL PANEL
1. Cheetah XI.
2. Or approved equal.

DETECTORS
1. Detector Electronics Corporation.
2. Or approved equal.
ADDRESSABLE MODULES
1. Fike.
2. Or approved equal.

AUXILIARY PANELS
1. Fike.
2. Or approved equal.

AUTOMATIC SPRINKLERS (SPRAY NOZZLE)
1. Viking.
2. Or approved equal.

15 30 20 – FIRE PROTECTION SYSTEM (PRE-ACTION SYSTEM)

SPRINKLER PIPING AND FITTINGS
1. Viking.
2. Or approved equal.

DOUBLE CHECK DETECTOR ASSEMBLY
1. Ames.
2. Wilkins.
3. Febco.
4. Or approved equal.

FIRE DEPARTMENT CONNECTION
1. Potter Roemer.
2. Or approved equal.

FIRE ALARM BELL
1. Potter PB.
2. Gamewell.
3. Or approved equal.

PIPE HANGERS AND SUPPORTS
1. Tolco.
2. Grinnell.
3. Or approved equal.

SEISMIC BRACING
1. Tolco.
2. Grinnell.
3. Or approved equal.

FIRE EXTINGUISHER
1. Potter Roemer.
2. Wilkin.
3. Or approved equal.
15 36 50 – TOTAL FLOODING EXTINGUISHING SYSTEM

MANUFACTURERS
1. Fike Corporation.
2. Or approved equal.

23 11 12 – FUEL OIL PIPING SYSTEM

PIPING AND PIPE FITTING
1. Pisces by OPW.
2. Or approved equal.

VENT PIPING
1. Titeflex.
2. Model Fail Safe APC.
3. Or approved equal.

PIPE COATING AND PAINTING
1. Fuller.
2. Or approved equal.

PIPE HANGERS AND SUPPORTS
1. Unistrut
2. Or approved equal.

23 13 13 – FACILITY UNDERGROUND FUEL-OIL STORAGE TANKS

DOUBLE WALL STEEL TANK (UNDERGROUND TANK)
1. Modern Welding Co., Inc.
2. Or approved equal.

TANK BOTTOM PROTECTOR
1. Pomeco.
2. Or approved equal.

BALL VALVE
1. Crane.
2. Or approved equal.

OVERFILL PREVENTION VALVES
1. Emco.
2. Or approved equal.

GROUND LEVEL SPILL CONTAINMENT
1. Baker Industries Northwest, Inc.
2. Or approved equal.
SPILL CONTAINMENT – MANHOLE

1. Pomeco.
2. Or approved equal.
APPENDIX C – ELECTRICAL CONTROL PANELS

A. The control panel shall be a Rhino Control System, P/N 10-2161, manufactured by Fike Protection Systems, Blue Springs, MO.

B. The Rhino Control System, and its components, shall be UL listed and FM approved for use as a local fire alarm system with releasing device service and be suitable for Deluge/Pre-action sprinkler service.

C. The Rhino Control System shall perform all functions necessary to operate the system detection, actuation and auxiliary functions, as outlined.

D. The Rhino Control System shall be capable of providing 33AH battery standby power.

E. The Rhino Control System shall consist of a combination of the following modules:
   1. Detection and Control module (DCM), Fike P/N 10-2141.
   2. Interactive Display Module (IDM), Fike P/N 10-2142.

F. The Rhino Control System shall be capable of providing detection and control for up to 39 hazards.

G. The Rhino Control System shall be microprocessor based utilizing a distributed processing concept. A single microprocessor failure shall not impact operation of additional modules on the system.

H. The Rhino Control System shall be capable of supporting Cross Zoned and/or Sequential detection schemes, per zone.

I. The DCM shall supply an integrated 2.0 amp power supply circuitry. Systems requiring multiple DCMs shall use a bus power concept to allow power sharing between modules for redundancy.

J. Each DCM shall provide 3 initiating circuits.
   1. Each circuit shall be capable of Class B (Style A).
   2. Each circuit shall be capable of operating up to 50 approved detectors with a maximum of 35 ohms line resistance.
   3. Each circuit shall be capable of monitoring contact devices configured for manual release, manual alarm, system abort, trouble input or auxiliary (non-fire) input.
   4. Each circuit shall have a user defined, custom message.

K. Each DCM shall contain 3 indicating/release circuits for annunciation and activation of an extinguishing/suppression system(s).
   1. Each circuit shall be capable of Class B (Style Y).
   2. Each output circuit shall be jumper selectable as an indicating circuit, solenoid activation or an agent release circuit.
   3. Each circuit shall be rated for 2.0 amp @ 24vdc and shall be protected from false actuation by an intelligent transistor.
   4. Each circuit shall support a user defined, custom message.
L. Each DCM shall provide an auxiliary power supply rated at 0.5 amps @ 24vdc.

M. Each DCM shall provide a SPST relay for common alarm and common trouble. Four (4) additional programmable relays can be added to each DCM by adding a RM4 Relay Module, Fike P/N 10-2143.

N. Each Rhino Control System shall require at least one (1) Interactive Display Module. The IDM shall provide an 80-character LCD display for system annunciation and configuration.
   1. The IDM shall have dedicated LEDs for Normal AC power, Alarm, Supervisory, Trouble and Silence.
   2. The IDM shall maintain a 600 event history buffer. Each history record contains a time/date stamp, a brief event description, and identification of the module and circuit involved.
   3. All programming shall be done from the IDM without requiring custom software or a computer.
Standards Adoption

The "Building Systems – Fire Protection and Fuel Piping/Storage" Version 3.1, March 2018 standards were adopted by the Standards Committee on April 5th, 2018, and are effective immediately.

Confirmed:

[Signature]

Geoffrey W. Neumayr, Standards Committee Chair