

**ADDENDUM NO. 2
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August 7, 2002

Notice to All Bidders:

The attention of Bidders submitting proposals for the Fire Suppression System project indicated above is called to the following Addendum to the Plans and Specifications. The revisions set forth herein, whether of omission, addition or substitution, are to be included in and form a part of the Proposal submitted.

The number of this Addendum must be entered in the space provided on the Bid Form.

Changes to the Specifications:

Table of Contents

- A. A. Add the following document title at the end of the specification:
Appendix A - Commissioning of Fire Protection Systems, and insert the document provided herewith in the body of the specification.

Section 04810 – Unit Masonry Assemblies

- A. A. Insert attached Section 04810 – Unit Masonry Assemblies in sequence.

Section 13851 - Fire Suppression Control System

- A. A. Replace Section 13851 - Fire Suppression Control System with revised Section 13851 - Fire Suppression Control System, dated August 7, 2002.

Section 16720 - Fire Alarm System

- A. A. Replace Section 16710 - Fire Alarm System with revised Section 16710 - Fire Alarm System, dated August 7, 2002.

Changes to the Drawings:

Drawing C-1 – Site Plan

- A. A. Add the following notes pertaining to the two 6' x 8' x 6' high valve pits shown:

1. 1. The Contractor shall perform exploratory excavations to determine the exact location and depth of existing drain lines prior to ordering the precast concrete structures.
2. 2. The Contractor shall provide layout drawings of the proposed structures showing locations and orientation of all valves, supports, actuators, conduits, junction boxes and related items.
3. 3. Precast structures for valve pits shall conform to the requirements of Connecticut DOT Standard Specifications, latest edition, Section 5.07 and to Section 02630 – Storm Drainage of the specifications.
4. 4. Manhole frames and covers shall be in accordance with Section 02630 – Storm Drainage of the specifications and shall be adjusted to existing grade with concrete grade rings or brick (maximum of three courses).
5. 5. The existing drain lines (believed to be 12-inch reinforced concrete pipe, based upon record drawings provided by the Air National Guard) shall be saw cut clean and true at a sufficient distance from the location of the valve pits to allow excavation and installation of the precast concrete valve pits.
6. 6. Valves shall be resilient-seated, eccentric-plug type with PowerRac operator as manufactured by DeZurik, or approved equal.
7. 7. Valves shall be automatic-closing type, with a NEMA 7 explosion-proof enclosure for the operator. The valve and operator shall be factory-furnished as a packaged unit. The valve shall fail in the closed position. The operator shall be 120 volt, single phase and shall be capable of manual wrench operation for testing and in case of power supply failure.
8. 8. Valves shall be connected to sections of flanged ductile iron pipe, conforming to AWWA C110 and Section 02510 – Water Distribution of the specifications.
9. 9. Openings in the precast concrete valve pits shall be cast-in-place or cored after setting the precast concrete units. Openings shall be circular with true edges and margins for the installation of resilient, water-tight connectors, Kor-N-Seal, Link Seal, or approved equal.

10. 10. Ductile iron pipe shall be connected to the existing reinforced concrete pipe with resilient couplings, Fernco Series 1006, or approved equal.
11. 11. A cast-in-place concrete support shall be provided beneath the valve body to support the weight of the valve and connected ductile iron pipe. The support shall be a minimum of 24 inches by 24 inches square in plan area, shall be cast directly on the floor of the precast structure in one piece and extend up to and surround the bottom quadrant of the valve body, leaving space for removal of bolts, valve fittings and actuator. Provide two galvanized steel straps, 3/16 by 1-1/2 inch, or other size as recommended by the valve manufacturer, to secure the valve to the concrete support. The galvanized steel straps shall be secured to the concrete support with 5/8 inch by 4-3/4 inch stainless steel expansion bolts, Hilti Kwik-Bolt II, KBII 316SS 5/8" x 4 3/4" or approved equal. Bolts shall be installed a minimum of 6 inches from the edge of the concrete support. Increase the size of the support to greater than the 24-inch minimum as necessary to provide the specified edge clearance.

Drawing FP-3 – Fire Protection System Riser

- A. A. Add a pressure gauge to the 12-inch discharge pipe as it exits the Fire Pump House located on the pump side of the isolation valve.
- B. B. Provide a tamper switch for the isolation valves on the supply and discharge piping to the foam concentrate tank located in the Fire Protection Valve Room.
- C. C. Add a pressure gauge to the 12-inch fire protection water entrance to the Fire Protection Valve Room located on the supply side of the isolation valve.
- D. D. Provide a pressure switch with the trim package for each of the one deluge and four preaction valves. The switches shall transmit a flow condition to the Fire Suppression Control Panel.
- E. E. Provide a flow switch for each of the two wet pipe alarm risers located in the Fire Protection Valve Room.

Drawing FP-8 – Fire Protection Valve Room Plan

- A. A. Delete in its entirety the “Fire Suppression System Single Line Diagram.”

Drawing FP-11 – Fire Protection Alarm Risers

- A. A. Insert new drawing provided herewith in the set of drawings.

Drawing E-1 – Fire Pump House Electrical Notes, Legend & Diagrams

- A. Replace original drawing with revised version dated August 7, 2002, attached.

Drawing E-2 – Fire Pump House & Bldg. 01 Elec., Plans & Diagrams

- A. Replace original drawing with revised version dated August 7, 2002, attached.

Drawing E-3 – Electrical Site Plan and Notes

- A. Replace original drawing with revised version dated August 7, 2002, attached.

END OF ADDENDUM NO. 2

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SECTION 04810 - UNIT MASONRY ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes unit masonry assemblies consisting of the following:
 - 1. Concrete masonry units.

1.2 SUBMITTALS

- A. Product Data: For each masonry unit, accessory, and other manufactured product indicated.
- B. Material Test Reports: For each type of masonry unit, mortar, and grout required.
- C. Material Certificates: For each type of masonry unit required.

1.3 QUALITY ASSURANCE

- A. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E 119 by a testing and inspecting agency, by equivalent concrete masonry thickness, or by another means, as acceptable to authorities having jurisdiction.

1.4 PROJECT CONDITIONS

- A. Cold-Weather Requirements: Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements in ACI 530.1/ASCE 6/TMS 602.
- B. Hot-Weather Requirements: When ambient temperature exceeds 100 deg F (38 deg C), or 90 deg F (32 deg C) with a wind velocity greater than 8 mph (13 km/h), do not spread mortar beds more than 48 inches (1200 mm) ahead of masonry. Set masonry units within one minute of spreading mortar.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified.

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2. Products: Subject to compliance with requirements, provide one of the products specified.

2.2 MASONRY UNITS

A. Concrete Masonry Units: ASTM C 90.

1. Unit Compressive Strength: 2800-psi- (19.3-MPa-) minimum, average net-area compressive strength.
2. Weight Classification: Normal weight.
3. Type: I, moisture-controlled units.
4. Special Shapes: Provide for lintels, corners, jambs, sash, control joints, headers, bonding, and other special conditions.

2.3 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction.

B. Hydrated Lime: ASTM C 207, Type S.

C. Mortar Cement: ASTM C 1329.

D. Masonry Cement: ASTM C 91.

E. Aggregate for Mortar: ASTM C 144; except for joints less than 1/4 inch (6.5 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.

F. Aggregate for Grout: ASTM C 404.

G. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494, Type C, and recommended by the manufacturer for use in masonry mortar of composition indicated.

H. Water: Potable.

2.4 MISCELLANEOUS MASONRY ACCESSORIES

A. Offset Anchor – mill galvanized – 3/4" wide x 12 ga. thick x 7" long offset strap giving 4" of vertical adjustability.

B. Metal Web – mill galvanized – 3/16" diameter masonry wire tie.

C. Ladder Mesh Reinforcement – hot dip galvanized 3/16" diameter longitudinal wires welded not more than 16" O.C. to 3/16" diameter cross wire.

2.5 MASONRY CLEANERS

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- A. Job-Mixed Detergent Solution: Solution of 1/2-cup (0.14-L) dry measure tetrasodium polyphosphate and 1/2-cup (0.14-L) dry measure laundry detergent dissolved in 1 gal. (4 L) of water.
- B. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

2.6 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, unless otherwise indicated. Do not use calcium chloride in mortar or grout.
- B. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification.
 - 1. Extended-Life Mortar for Unit Masonry: Mortar complying with ASTM C 1142 may be used instead of mortar specified above, at Contractor's option.
 - 2. Limit cementitious materials in mortar to Portland cement, mortar cement, and lime.
 - 3. For masonry below grade, in contact with earth, and where indicated, use Type S.
 - 4. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
- C. Grout for Unit Masonry: Comply with ASTM C 476.
 - 1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 5 of ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
 - 2. Provide grout with a slump of 8 to 11 inches (200 to 280 mm) as measured according to ASTM C 143.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cut masonry units with motor-driven saws. Allow units cut with water-cooled saws to dry before placing, unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- B. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
- C. Comply with tolerances in ACI 530.1/ASCE 6/TMS 602 and the following:

1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/4 inch in 20 feet (6 mm in 6 m), nor 1/2 inch (12 mm) maximum.
2. For conspicuous horizontal lines, such as exposed lintels, sills, parapets, and reveals, do not vary from level by more than 1/4 inch in 20 feet (6 mm in 6 m), nor 1/2 inch (12 mm) maximum.

3.2 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Lay exposed masonry in running bond pattern; do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.
- C. Fill cores in hollow concrete masonry units with grout 24 inches (600 mm) under lintels, unless otherwise indicated.

3.3 MORTAR BEDDING AND JOINTING

- A. Lay hollow masonry units as follows:
 1. With full mortar coverage on horizontal and vertical face shells.
 2. Bed webs in mortar in starting course on concrete slab and where adjacent to cells or cavities to be filled with grout.
 3. For starting course on concrete slab where cells are not grouted, spread out full mortar bed, including areas under cells.
- B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than the joint thickness, unless otherwise indicated.

3.4 LINTELS

- A. Provide masonry lintels where shown of the type indicated.

3.5 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores to support reinforced masonry elements during construction.
 1. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.

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- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist grout pressure.
 - 1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.

3.6 FIELD QUALITY CONTROL

- A. Owner will engage a qualified independent testing agency to perform field quality-control testing indicated below. Payment for these services will be made by Owner.
 - 1. Testing Frequency: Tests and Evaluations listed in these subparagraphs will be performed during construction for each 5000 sq. ft. (465 sq. m) of wall area or portion thereof.
 - 2. Mortar: Properties will be tested per ASTM C 780.
 - 3. Grout: Sampled and tested for compressive strength per ASTM C 1019.
 - 4. Concrete Masonry Unit Tests: For each type of concrete masonry unit indicated, units will be tested according to ASTM C 140.

3.7 CLEANING

- A. Clean unit masonry by dry brushing to remove mortar fins and smears before tooling joints, as work progresses.
- B. After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
 - 2. Protect adjacent surfaces from contact with cleaner.
 - 3. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing the surfaces thoroughly with clear water.
 - 4. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
 - 5. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2 applicable to type of stain on exposed surfaces.

3.8 MASONRY WASTE DISPOSAL

- 1. Masonry Waste Disposal: Remove masonry waste, and legally dispose of off Owner's property.

END OF SECTION 04810

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SECTION 13851 - FIRE SUPPRESSION CONTROL SYSTEM

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes a Fire Suppression Control System with manual stations, heat detectors, signal equipment, controls, and devices.

1.3 DEFINITIONS

- A. FSCP: Fire Suppression Control System.
- B. LED: Light-emitting diode.
- C. Definitions in NFPA 72 apply to fire alarm terms used in this Section.

1.4 SYSTEM DESCRIPTION

- A. General: Noncoded, non-addressable, zoned system with manual and automatic alarm initiation; and hard-wired for signal transmission, using separate individual circuits for each zone of alarm initiation and notification appliances. System shall utilize supervised, four-wire (class A) zoned wiring with non-proprietary generic type devices.
- B. Audio and visual alarm shall differentiate between high expansion foam activation alarm and a general facility system activation alarm.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
 - 1. Wiring Diagrams: Detail wiring and differentiate between manufacturer-installed and field-installed wiring. Include diagrams for equipment and for system with all terminals and interconnections identified.
 - 2. Battery: Sizing calculations.
 - 3. Floor Plans: Indicate final outlet locations and routings of raceway connections

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4. System Operation Description: Detailed description for this Project, including method of operation and supervision of each type of circuit and sequence of operations for manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are not acceptable.
- C. Operation Instructions: For mounting at the FSCP.
- D. Product Certificates: Signed by manufacturer certifying that installers comply with requirements.
- E. Installer Certificates: Signed by manufacturer certifying that installers comply with requirements.
- F. Field Test Reports: Indicate and interpret test results for compliance with performance requirements. Comply with NFPA 13 and 72.
- G. Maintenance Data: For fire alarm systems to include in maintenance manuals specified in Division 1. Comply with NFPA 72.
- H. Submissions to Authorities Having Jurisdiction: In addition to distribution requirements for Submittals specified in Division 1 Section "Submittals," make an identical submission to authorities having jurisdiction. Include copies of annotated Contract Drawings as needed to depict component locations to facilitate review. Resubmit if required to make clarifications or revisions to obtain approval. On receipt of comments from authorities having jurisdiction, submit them to Architect for review.
- I. Certificate of Completion: Comply with NFPA 72.
- J. All documents shall be submitted a minimum of 30 days prior to the expected scheduling of final ANG acceptance inspection/testing and commissioning.

1.6 QUALITY ASSURANCE

- A. The Contractor (prime or sub) shall have on staff or under contract a qualified and experienced fire protection engineer. This person(s) shall be responsible for performing and overseeing all engineering aspects of the fire protection system construction, including but not limited to calculations, layout, shop drawings, equipment selection and inspections. This person shall also be responsible
- B. Installer Qualifications: An experienced installer who is an authorized representative of the FSCP manufacturer for both installation and maintenance of units required for this Project.
- C. Manufacturer Qualifications: A firm experienced in manufacturing systems similar to those indicated for this Project and with a record of successful in-service performance.

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- D. Source Limitations: Obtain fire alarm system components through one source from a single manufacturer.
- E. Compliance with Local Requirements: Comply with applicable building code, local ordinances and regulations, and requirements of authorities having jurisdiction.
- F. Comply with NFPA 70, 72, 90A, and 101.
- G. All panels and devices shall be UL or FM listed for their intended application.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Rotating Beacon or Horn Strobe Units: Quantity equal to 10 percent of amount installed, but not less than one unit.
 - 2. Heat Detectors: Quantity equal to 10 percent of amount of each type installed, but not less than one unit of each type.
 - 3. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but not less than one unit of each type.
 - 4. Keys and Tools: One extra set for access to locked and tamperproofed components.

1.8 COMPONENTS

- A. All facility fire system components shall be complete and shall be of the same manufacturer.
- B. Systems shall utilize supervised, four wire (Class A) zoned wiring with non-proprietary generic type devices. Devices shall be interchangeable with other brands that are readily available.
- C. Systems shall include full identification. All junction, terminal and pulling boxes and covers shall be painted the color red and shall be identified with engraved labels by the zone and circuit that it contains. All LB's and similar units shall be painted the color red. All detection and terminal devices shall have engraved plastic or metallic alphanumeric identification, which shall be keyed to the posted operations and maintenance instructions.
- D. All panels and devices shall be UL or FM listed for their intended application.

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PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following and shall be compatible with Signal Communications System:
1. Signal Communication.
 2. Edwards Systems Technology; Unit of General Signal.
 3. Faraday, Inc.
 4. Federal Signal Corp.; Commercial Products Group.
 5. Gamewell Co. (The).
 6. Grinnell Fire Protection Systems.
 7. Honeywell, Inc.
 8. Notifier; Div. Of Pittway Corp.
 9. Simplex Time Recorder Co.
 10. Detector Electronics.

2.2 FUNCTIONAL DESCRIPTION OF SYSTEM

- A. Control of System: By the FSCP (Fire Suppression Control Panel).
- B. System Supervision: Shall be Class “A” for wire system.
- C. Priority of Signals: Automatic alarm response functions resulting from an alarm signal from one zone or device are not altered by subsequent alarm, supervisory, or trouble signals. An alarm signal is the highest priority. Supervisory and trouble signals have second- and third-level priority. Higher-priority signals take precedence over signals of lower priority, even when the lower-priority condition occurs first. Annunciate and display all alarm, supervisory, and trouble signals regardless of priority or order received.
- D. Noninterference: A signal on one zone shall not prevent the receipt of signals from other zones.
- E. System Reset: All zones are manually resettable from the FSCP after initiating devices are restored to normal.
- F. System Alarm Capability during Circuit Fault Conditions: System wiring and circuit arrangement prevent alarm capability reduction when an open circuit, ground or wire-to-wire short occurs, or an open circuit and a ground occur at the same time in an initiating device circuit, signal line circuit, or notification-appliance circuit.
- G. Loss of primary power at the FSCP initiates a trouble signal at the FACP and the annunciator. An emergency power light is illuminated at both locations when the system is operating on the secondary power supply.

- H. Basic Alarm Performance Requirements: Unless otherwise indicated, operation of a manual pull station, automatic operation of a heat detector initiates the following:
 - 1. Notification-appliance operation.
 - 2. Identification at the FSCP of the zone originating the alarm.
 - 3. Identification at the FSCP of the device originating the alarm.
 - 4. Transmission of an alarm signal to the FACP.
 - 5. Recording of the event in the system memory and the FACP.

- I. Heat detection for zones or detectors with alarm verification initiates the following:
 - 1. Audible and visible indication of an “alarm verification” signal at the FSCP.
 - 2. Activation of a listed and approved “alarm verification” sequence at the FSCP and the detector.
 - 3. Recording of the event by the system printer.
 - 4. General alarm if the alarm is verified.
 - 5. Cancellation of the FSCP indication and system reset if the alarm is not verified.

- J. Sprinkler valve-tamper switch operation initiates the following:
 - 1. A supervisory, audible, and visible “valve-tamper” signal indication at the FSCP and the annunciator.
 - 2. Flashing of the device location-indicating light for the device that has operated.
 - 3. Recording of the event by the system printer.
 - 4. Transmission of supervisory signal to FACP.

- K. Removal of an alarm-initiating device or a notification appliance initiates the following:
 - 1. A “trouble” signal indication at the FSCP for the device or zone involved.
 - 2. Transmission of trouble signal to FACP.

- L. 120V power input to FSCP shall be provided with TVSS.

- M. Refer to Matrix at the end of this section for additional requirements.

2.3 MANUAL PULLSTATIONS

- A. Description: Fabricated of metal or plastic, and finished in lime-green with molded, raised-letter operating instructions of contrasting color.
 - 1. Single-action mechanism initiates an alarm for building pullstations.
 - 2. Manual pull stations for Hi-Ex foam system shall be double-action mechanism requiring two actions (push and pull) to initiate an alarm. These stations shall be

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clearly identified for foam discharge and shall be different in shape than the building pullstations.

3. Station Reset: Key or wrench operated; double pole, double throw; switch rated for the voltage and current at which it operates.

2.4 HEAT DETECTORS

- A. Heat Detector, Hangar Maintenance Bay Only: Detectors shall be cross-zoned, four-wire, supervised heat detection configuration. They shall be of rate compensated type with temperature range of 160-170 degrees F. Detectors shall be wired with a minimum of two zones with adjacent detectors on opposite zones. Fenwal Catalog No. 12-E27121-000-03 or equal.

2.5 NOTIFICATION APPLIANCES

- A. Description: Equip for mounting as indicated and have screw terminals for system connections.
- B. Horns: Electric-vibrating-polarized type, 24V dc; with provision for housing the operating mechanism behind a grille. Horns product a sound-pressure level of 90 dB, measured 10 feet (3m) from the horn.
- C. Visible Alarm Devices: Blue rotating beacon. (min. 10-inch diameter)

2.6 CENTRAL FSCP

- A. FSCP: Fire alarm panels shall be field expandable. Panels may be field programmable provided that this can be accomplished at the unit level, without the use of proprietary software, keys, the changing of electronic hardware, or use of any proprietary device. Any software, device, password or other element used to program any component of the fire system shall be specified to become property of the Government, along with the installed program. All panel shall include input and output modules and terminations for each four-wire (Class A) supervised zone. All zones to be annunciated to the central systems (two)(redundantly) for fire and trouble, on a zone-by-zone basis. All detection and suppression systems shall be simple and reliable. They shall use proven technology and shall avoid the use of proprietary or copyrighted technology.
- B. Fire alarm and suppression panels shall be complete from the factory and shall not require any field modifications or additions to perform the intended function.
- C. The FSCP components and sub-systems shall be a separate unit from the building system and shall be factory-built, UL-approved "as-built" for releasing agents. No field additions or modifications to the panel or system to make the system operate in the intended manner shall be allowed.

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- D. The FSCP shall have output signaling capability, which emulates the inputs on a zone-by-zone basis. The panel shall have a minimum of 48-hour maintenance-free battery backup for operations.
- E. The high expansion foam system, in conjunction with the pre-action overhead sprinkler system, shall utilize cross-zoned, four wire, supervised heat detection configurations. Detector shall be wired with two zones with adjacent detectors on opposite zones. Detectors shall be of the rate compensated type with a temperature range of 102 – 112 degrees Centigrade (160 – 170 degrees Fahrenheit) (UL or FM listed). All wiring shall be in minimum 1.9 cm (3/4 inch) EMT.

2.7 EMERGENCY POWER SUPPLY

- A. General: Components include sealed gel-cell maintenance free type battery, charger, and an automatic transfer switch. Battery shall be located in FSCP and not in separate panel.
 - 1. Battery Nominal Life Expectancy: 5 years, minimum.
- B. Battery Capacity: Shall be capable of maintaining fire alarm operations for a minimum of 48 hours in the event of a power outage. Must maintain an alarm condition for 1 ½ hours.
- C. Battery Charger: Solid-state, fully automatic, variable-charging-rate type. Provide capacity for 150 percent of the connected system load while maintaining batteries at full charge. If batteries are fully discharged, the charger recharges them completely within four hours. Charger output is supervised as part of system power supply supervision.
- D. Integral Automatic Transfer Switch: Transfers the load to the battery without loss of signals or status indications when normal power fails.

2.8 GUARDS FOR PHYSICAL PROTECTION

- A. Description: Welded wire mesh of size and shape for the manual station, heat detector, or other device requiring protection.
 - 1. Factory fabricated and furnished by the manufacturer of the device.
 - 2. Finish: Paint of color to match the protected device.

2.9 WIRE

- A. All Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.
 - 1. See fire alarm riser diagram.

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- B. All detection and alarm wire shall be installed in separate conduits. Conduit shall be EMT conduit. Alarm and supervisory wiring shall be in separate conduits. Use of FMC or Liquid Lite is not permitted (except in areas subject to extreme vibration). In those rare instances, no more than a six-foot length may be specified. All conduit runs and function boxes shall be identified through color-coding and labeling.
- C. Wiring shall be THHN or TFFN stranded with crimp on terminal ends affixed. All terminal ends shall be clearly marked and numbered as to appropriate terminal and device. All wiring shall be color-coded and fully identified and standard throughout the facility. Use of multi-conductor twisted pair or similar wiring is not permitted. The use of wire nuts in fire protection systems is prohibited.

2.10 DEVICES

- A. Tamper switches shall be equal to Potter-Roemer Model 6220 red, tamperproof cover with J-bolt mounting. Two double pole double-throw microswitches.
- B. Flow switch shall be equal to Potter-Roemer Model 6201-6208 red tamperproof housing with flow paddle. Adjustable retard setting from 0-90 seconds.
- C. Alarm line pressure switch shall be equal to Victaulic Model EPS-10 for use with specified deluge and preaction valves.

PART 3 – EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. Manual Pull Stations: Surface mount at locations indicated on the plans.
- B. Water-Flow Detectors and Valve Supervisory Switches: Connect for each high expansion foam and sprinkler valve station required to be supervised.
- C. Visible Alarm-Indicating Devices: At locations indicated on the plans.

3.2 WIRING INSTALLATION

- A. Wiring Method: Install wiring in EMT according to Division 16 Section "Raceways and Boxes." Conceal raceway except in unfinished spaces and as indicated. Minimum conduit size shall be $\frac{3}{4}$ ". Alarm and supervisory wiring shall be in separate conduits. Use of FMC or LiquidLite is not permitted.
- B. Wiring Within Enclosures: Separate power-limited and non-power-limited conductors as recommended by the manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or

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interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

- C. Cable Taps: Use numbered terminal strips in junction, pull and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.
- D. Color-Coding: Color-code for the fire alarm conductors shall be black and red with red jacket and shall differ from the normal building power wiring. Use one color-code for alarm circuit wiring and a different color-code for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.
- E. Wiring shall be four wire (Class A).

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals according to Division 16 Section "Basic Electrical Materials and Methods."
- B. Install grounding electrodes of type, size, location, and quantity as indicated. Comply with installation requirements in Division 16 Section "Grounding."
- C. Ground equipment and conductor. For audio circuits, minimize, to the greatest extent possible, ground loops, common-mode returns, noise pickup, cross-talk, and other impairments. Provide 5-ohm ground at main equipment location. Measure, record, and report ground resistance.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and connections and to supervise pretesting, testing, and adjustment of the system. Report results in writing.
- B. Pretesting: After installation, align, adjust, and balance the system and perform complete pretesting. Determine, through pretesting, the compliance of the system with requirements of Drawings and Specifications. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new ones, and retest until satisfactory performance and conditions are achieved. Prepare forms for systematic recording of acceptance test results.
- C. Report of Pretesting: After pretesting is complete, provide a letter certifying the installation is complete and fully operable, including the names and titles of witnesses to preliminary tests.

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- D. Final Test Notice: Provide a minimum of 10 days' notice in writing when the system is ready for final acceptance testing.
- E. Minimum System Tests: Test the system according to procedures outlines in NFPA 72. Minimum required tests are as follows:
 - 1. Verify the absence of unwanted voltages between circuit conductors and ground.
 - 2. Test conductors for shot circuits using an insulation-testing device.
 - 3. With each circuit pair, short circuit at the far end of the circuit and measure the circuit resistance with an ohmmeter. Record the circuit resistance of each circuit on record drawings.
 - 4. Verify that the control units is in the normal condition as detailed in the manufacturer's operation and maintenance manual.
 - 5. Test initiating and indicating circuits for proper signal transmission under open circuit conditions. One connection each should be opened at not less than 10 percent of initiating and indicating deices. Observe proper signal transmission according to class of wiring used.
 - 6. Test each initiating and indicating device for alarm operation and proper response at the control unit. Test heat detectors.
 - 7. Test the system for all specified functions according to the approved operation and maintenance manual. Systematically initiate specified functional performance items at each station, including making all possible alarm and monitoring initiations and using all communications options. For each item, observe related performance at all devices required to be affected by the item under all system sequences. Observe indicating lights, displays, signal tones, and annunciator indications. Observe all voice audio for routing, clarity, quality, freedom from noise and distortion, and proper volume level.
 - 8. Test Both Primary and Secondary Power: Verify by test that the secondary power system is capable of operating the system for the periods and in the manner specified.
- F. Retesting: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets Specifications and complies with applicable standards.
- G. Report of Tests and Inspections: Provide a written record of inspections, tests, and detailed test results in the form of a test log. Submit log on the satisfactory completion of tests.
- H. Tag all equipment, stations, and other components at which tests have been satisfactorily completed.

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3.5 CLEANING AND ADJUSTING

- A. Cleaning: Remove paint splatters and other spots, dirt, and debris. Touch up scratches and marred finish to match original finish. Clean unit internally using methods and materials recommended by manufacturer.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Government's maintenance personnel as specified below:
 - 1. Train Government's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, adjusting, and maintaining equipment and schedules. Provide a minimum of 8 hours' training.
 - 2. Training Aid: Use the approved final version of the operation and maintenance manual as a training aid.
 - 3. Schedule training with Government, through Architect, with at least seven days' advance notice.

3.7 ON-SITE ASSISTANCE

- A. Occupancy Adjustments: When requested within one year of date of Substantial Completion, provide on-site assistance in adjusting sound levels, controls, and sensitivities to suit actual occupied conditions. Provide up to three requested visits to Project site for this purpose.

3.8 SEQUENCE OF OPERATIONS

- A. High Expansion Foam System (HEFS):
 - 1. Any HEFS alarm conditions will be transmitted from the FSCP panel to the Fire Alarm Control Panel (FACP), which in turn activate all the building alarm devices.
 - 2. Activation of any HEFS tamper switch will be transmitted from FSCP panel to FACP and will provide a supervisory alarm at FACP.
 - 3. Any trouble at the HEFS panel or system will be transmitted from FSCP panel to FACP and will provide a trouble alarm at FACP.
 - 4. HEFS and overhead preaction sprinkler system release shall be achieved with the following actions:
 - a. Automatic release of the cross-zoned rate compensated ceiling mounted heat detectors. The system will be activated only when two different zones are activated.
 - b. Manual release of the High Expansion Foam manual discharge stations.
 - 5. Upon activation of any of the above two systems, a signal will be sent to the FSCP panel. This signal will provide an alarm at the FSCP panel and activate the High Expansion Foam blue strobe lights. This will also provide a signal (thru the

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releasing module in the FSCP panel) to the master releasing panel, which will open the deluge valve allowing the water flow in the High Expansion Foam and Preaction Sprinkler piping system.

6. FSCP panel shall monitor water flow thru the High Expansion Foam water pipe and the hanger bay preaction sprinkler water pipes.
7. FSCP panel shall also monitor tamper switch in the High Expansion Foam water pipes and the hanger bay preaction sprinkler water pipes.
8. The blue Rotating Beacon will only act as signaling devices upon activation of any of the foam system detection devices and not the building fire alarm detecting system.

END OF SECTION 13851

FIRE SUPPRESSION CONTROL SYSTEM MATRIX

SYSTEM INPUTS		ANNUNCIATION AT LOCAL PANELS				FIRE SUPPRESSION SYSTEM FUNCTIONS				EVACUATION SIGNALS				
		A Audio-Visual Fire Alarm Indication by Zone	B Audio-Visual Trouble Indication by Zone	C Audio-Visual Common Trouble Indication	D Audio-Visual Alarm Indication by Device	E Open Pre-Action Sprinkler Valves	F Open High Expansion Fire Suppression System Valve	G Interrupt Drain Flow from Hangar Bay	H Common Trouble Signal Per Building	I Common Supervisory Signal Per Building	J Sprinkler Water Flow at Hangar Bay	K Foam Discharge per General Area	L Facility Fire Evacuation Audio-Visual Signal	M Foam System Signal Blue Rotating/Beacon/Horn
FIRE ALARMS														
1	Manual Foam Discharge Station for High-X Foam	X				X						X		X
2	Heat Detectors – Crossed Zoned – Hangar Ceiling	X				X						X		X
SUPERVISORY SIGNALS														
3	Valve Supervisory Switch – Preaction System		X							X				
4	Valve Supervisory Switch – High-X Foam Water Supply		X							X				
5	Valve Supervisory Switch Foam Concentrate Supply Water		X							X				
6	Valve Supervisory Switch Foam Concentrate Discharge		X							X				
TROUBLE CONDITIONS														
7	Low Battery Voltage			X										
8	Circuit Fault			X										
9	Supervised Component Failure			X										
10	AC Power Failure			X										

NOTES:

1. Fire alarm signals and supervisory alarm signals shall be clearly differentiated at the fire alarm control panel(s).
2. General area means the specific bay, dock, mezzanine, office area, or mechanical area. System zoning shall be sufficient to direct responding firefighters directly to the fire area.

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SECTION 16720 - FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. This section of the specification includes the furnishing, installation, and connection of a new microprocessor-based addressable or hard-wired fire alarm system required to form a complete coordinated system ready for operation. It shall include, but not be limited to, fire alarm control, alarm initiating devices, alarm notification appliances, auxiliary control devices, integrated radio transceiver, antenna, power supplies, and wiring as shown on the drawings and specified herein. Separate systems shall be provided for both Hanger No. 1 and Fire Pump House. The system design is based on Monaco Enterprises, Inc., Spokane, WA.
- B. The fire alarm system shall comply with requirements of NFPA Standard No. 72 for protected premises signaling systems except as modified and/or supplemented by this specification. The system shall be capable of on-site programming.
- C. The system shall be an active type system where each device causes an LED signal to be transmitted to the Main Fire Alarm Control Panel (FACP) indicating that the zone and its associated circuit wiring is functional. Loss of this signal at the main FACP shall result in an LED and audible trouble indication as specified on the drawings or hereinafter for the particular zone.
- D. The alarm system shall have the capability of recalling "in memory" alarms and trouble conditions in chronological order to recreate an alarm event history.
- E. The operation of any fire detection system or manual alarm shall automatically:
 - 1. Notify the Central Receiving Station.
 - 2. Sound an alert signal to all required locations.
 - 3. Activate the evacuation signal.
- F. The Control Panel shall include alarm verification operation for the smoke detector zones, which incorporates a 1-minute alarm verification. If no second alarm is received, the zone will reset automatically to normal mode. A verification second alarm will activate the alert system.
- G. A manual evacuation (drill) switch shall be provided to operate the alarm indicating appliances without causing other control circuits to be activated. A true alarm will override the test conditions.
- H. The Control Panel shall be served by a dedicated 120 Volt single-phase circuit. The 24 VDC alarm system shall automatically transfer to standby battery upon power failure.

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1.2 RELATED WORK

- A. The work of this Section shall hereby include Section 16010 - Basic Electrical Requirements, Section 16050 - Basic Electrical Materials and Methods, Section 16721 – Fire Alarm Reporting/Receiving System.

1.3 REFERENCES

- A. The fire detection system shall be installed in accordance with the specifications, drawings, and the requirements of NFPA-72, National Electric Code 760 and in accordance with (ADA) American Disabilities Act.
- B. The installing company shall employ NICET (minimum Level II Fire Alarm Technology) technicians on site to guide the final check-out and to ensure the systems integrity.
- C. All conduit wiring and fire alarm equipment shall be wired as follows:
 - 1. Initiation Device Circuits (IDC) shall be wired Class A (NFPA Style D).
 - 2. Notification Appliance Circuits (NAC) shall be wired Class A (NFPA Style Z).
- D. Work of this section shall be coordinated with other contract work.

1.4 SUBMITTALS

- A. General:
 - 1. Submittals shall be submitted for review in accordance with Section 16010, Basic Electrical Requirements.
 - 2. All references to manufacturers and other pertinent information herein is intended to establish minimum standards of performance, function and quality. Equivalent equipment (compatible UL Listed) from other manufacturers may be substituted for approval as the specified equipment as long as the minimum standards are met and equipment is compatible with the design system.
 - 3. All substitute equipment proposed as equal to the equipment specified herein, shall meet or exceed the standards. For equipment other than that specified, the contractor shall supply proof that such substitute equipment equals or exceeds the features, functions, performance, and quality of the specified equipment.
- B. Shop Drawings:
 - 1. Sufficient information on the design system and equipment, clearly presented, shall be included to determine compliance with drawings and specifications.

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2. Include manufacturer's name(s), model numbers, ratings, power requirements, equipment layout, device arrangement, complete wiring point-to-point diagrams, and conduit layouts.
3. Show annunciator layout and main control panel module layout with configurations and terminations.

C. Certifications:

Together with the shop drawing submittal, submit a certification from the successful bid equipment manufacturer indicating that the proposed supervisor of installation and the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include names and addresses in the certification. Performance and operating system test shall be conducted in the presence of the Contracting Officer or his representative.

1.5 WARRANTY

All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one (1) year from the date of acceptance. The full cost of maintenance, labor and materials required to correct any defect during this one year period shall be included in the submittal bid. Manufacturer's material and service shall be available within a 50-mile radius.

1.6 POST CONTRACT MAINTENANCE

- A. Complete maintenance and repair service for the fire alarm system shall be available from a factory trained authorized representative for a period of five (5) years after expiration of the guaranty. The manufacturer shall be prepared to offer a warranty contract beyond the one-year period.
- B. After system acceptance, provide the Government with a quote for a maintenance contract to provide all maintenance, test, and repair described below. Include also a quote for unscheduled maintenance/repair, including hourly rates for technicians trained on this equipment, and response travel costs. Submittals that do not identify all post contract maintenance costs will not be accepted. Rates and costs shall be valid for a five (5) year period after the expiration of the guaranty.
- C. Maintenance and testing shall be on a semiannual basis or as required by the local agent. A preventive maintenance schedule shall be provided which describes the procedures for preventive maintenance. The schedule shall include:

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1. Systematic examination, adjustment and cleaning of all detectors, manual fire alarm stations, control panel, power supplies, relays and all accessories of the fire alarm system.
2. Each circuit in the fire alarm system shall be tested semiannually.
3. Each smoke detector shall be tested in accordance with the requirements of NFPA 72.

1.7 APPLICABLE PUBLICATIONS

The publications listed below form a part of this specification. The publications are referenced in text by the basic designation only.

A. National Fire Protection Association (NFPA):

No. 70	National Electric Code (NEC)
No. 72-1996	National Fire Alarm Code
No. 101	Life Safety Code

B. Underwriters Laboratories Inc. (UL):

No. 50	Cabinets and Boxes
No. 268	Smoke Detectors for Fire Protective Signaling Systems
No. 864	Control Units for Fire Protective Signaling Systems
No. 521	Heat Detectors for Fire Protective
No. 228	Door Closers-Holders for Fire Protective Signaling Systems.
No. 464	Audible Signaling Appliances.
No. 38	Manually Actuated Signaling Boxes.
No. 1481	Power supplies for Fire Protective Signaling Systems.
No. 1076	Control Units for Burglar Alarm Proprietary Protective Signaling Systems.
No. 1971	Visual Notification Appliances.

C. Local and State Building Codes - Authority Having Jurisdiction (AHJ).

D. Requirements of the American Disabilities Act (ADA).

1.8 APPROVALS

A. The fire alarm system must have proper listing and/or approval from the following nationally recognized agencies:

NFPA National Fire Protection Agency

UL Underwriters Laboratories Inc

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FM Factory Mutual

B. Modular Labeling

The fire alarm control panel shall meet the modular listing requirements of Underwriters Laboratories Inc. To facilitate system changes and expansions, and to ensure that all subassemblies have the proper listing, each subassembly of the FACP shall carry the appropriate UL modular label. This includes, but is not limited to, all printed circuit board assemblies, power supplies, and enclosure parts.

1.9 QUALITY ASSURANCE

- A. All fire alarm system products shall be those of a single manufacturer and bear the "UL" label. All control equipment shall be listed under UL Category "UOJZ" as a single control unit. Partial listing shall not be acceptable.
- B. All control equipment shall have transient protection to comply with UL 864.
- C. The manufacturer of the fire alarm system shall have a minimum of 10 years of successful installation experience.

1.10 SYSTEMS IDENTIFICATION

- A. Identification systems shall include complete labeling, graphics, painting, color selection of components, tags, signs, placards and other forms of necessary identification.
- B. All equipment identification and operations signage shall be engraved on metal or plastic material and mechanically attached to the facility.
- C. All identification and operations identifications shall be coordinated with and keyed to the posted operations instructions and the O&M manuals.

1.11 OPERATIONS AND MAINTENANCE MANUALS

- A. Manuals shall be required to include original data on all materials, systems, components, equipment and warranties provided. Manuals shall include approved shop drawings and other as-built information. Manuals shall be professionally prepared, including printed spine and cover with full table of contents and tabbed indexing. Full-size sheets, as required, shall be folded into special holding pockets. All manual data shall be required to be original copy. Faxed, hand-written or illegible material is not acceptable. Manuals should be prepared in three-ring binders for ease of document addition or removal.
- B. O&M manuals shall be required to be completed, submitted and approved by no later than at the 75% construction complete stage. Three copies of final manuals are required. One copy

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is for file, one copy is for fire department training, and the other copy will be located in the O&M manual lock box, located in each mechanical room.

- C. Manuals will be required to include, but not be limited to:
- Include full instructions on servicing and maintenance requirements.
 - Include operating instructions including start-up, emergency shutdown and start-up, seasonal servicing and start-up, etc.
 - Include owner's manuals for each item of equipment.
 - Include all equipment wiring diagrams.
 - Include all piping and wiring systems diagrams and operational diagrams.
 - Include full parts lists and exploded schematic diagrams.
 - Include full warranty information.
 - Include all available manufacturer installation and O&M manuals.
 - Include full names, addresses, phone number, suppliers, service companies, contract numbers and other points of contact/information relative to the job.
- D. Three copies of original manufacturer operations, service and training manuals shall be provided for each fire alarm system provided. Examples of these types of manuals would include factory manuals for fire pumps, HE equipment and fire alarm control panels.

1.12 POSTED OPERATIONS INSTRUCTIONS

- A. Posted instructions shall be completed with professionally prepared graphics, printed on full-size sheets and shall be in color. Instructions shall be prepared for all fire protection systems and shall include all components.
- B. Posted instructions will include (but not be limited to) the following:
- Facility floor plans showing location of all fire alarm devices with coordinated identification. Show items such as fire walls, fire dampers, etc.
 - System diagrams, including isometrics of special equipment and systems (fire alarm riser, fire pumps, HE system, etc.)
 - Wiring diagrams and schematics.
- C. Posted Operations Instructions shall be framed in heavy gauge extruded metal frames, mounted under glass and shall be water/weatherproof. Instructions will be permanently mounted in the reserved clear wall area in each fire protection room.

1.13 FIRE DETECTION AND SUPPRESSION COMMISSIONING AND ACCEPTANCE

- A. Commissioning requirements, checklists, tool and parts requirements, manufacturer involvement, etc., shall be comprehensive and based on NFPA, standard of the industry, or manufacturer practice. Commissioning and acceptance procedures and checklists shall be part of the acceptance procedure for any facility and shall be required as a submission by the

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Contractor. Commissioning and checklist documentation shall be completed by the Contractor as part of the pre-final acceptance of the facility. Checklists shall be submitted prior to substantial completion inspections.

1.14 TRAINING

- A. A complete mix of on-site, classroom and/or off-site training shall be provided for all equipment and systems. Level and quantity of training shall depend on complexity of the system. Training shall be specified to be complete with all materials, fees and tuition covered by the contract. (Only employee travel costs shall not be covered by the contract.) Training shall be provided by factory instructors or factory-trained and authorized instructors.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIAL, GENERAL

- A. All equipment and components for the system shall be new. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protected premises protective signaling (fire alarm) system. The authorized representative of the manufacturer of the major equipment, such as control panels, shall be responsible for the satisfactory installation of the complete system.
- B. All equipment and components shall be installed in strict compliance with manufacturers' recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation.
- C. All equipment shall be attached to walls and ceiling/ floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load with a minimum safety factor of 3.
- D. The Control Panel shall be expandable with solid-state microprocessor-based electronics. Keyboard or keypads shall not be required to operate the system during fire alarm conditions.
- E. A local audible device shall sound during alarm conditions. This audible device shall also sound upon any key press to confirm the key press is correct.
- F. The Control Panel shall use backlighted liquid crystal display for readable clarity. During AC outage, the display under battery power shall only be lighted for alarm or keyboard activity.
- G. The Control Panel shall be capable of operating all connected devices with 10% spare capacity.

- H. An "alarm silence" button shall silence all activated alarms, but retain an LED display until the system is reset.
- I. Alarm system reset shall require all alarm clearances and a procedure through manufacturer's reset process per the operations manual.
- J. The alarm system shall be capable of being tested by one person.
- K. All LED's shall be monitored for burnout or failure. Any LED problem shall be identified on the module to facilitate location and repair.
- L. The following primary controls shall be visible through the front access panel:
 - 1. Liquid crystal display
 - 2. Red system alarm - LED
 - 3. Yellow supervisory service - LED
 - 4. Yellow trouble - LED
 - 5. Green "Power On" - LED
 - 6. Alarm Acknowledge key
 - 7. Supervisory Acknowledge key
 - 8. Trouble Acknowledge key
 - 9. Alarm silence key
 - 10. System reset key
- M. Fire alarm panels shall be field-expandable. Panels may be field-programmable, provided that this can be accomplished at the unit level, without the use of proprietary software, keys, the changing of electronic hardware, or use of any proprietary device. Any software, device, password or other element used to program any component of the fire system shall be specified to become property of the Government, along with the installed program. All panels shall include input and output modules and terminations for each four-wire (Class A) supervised zone. All zones to be annunciated to the central systems, two redundantly, for fire and trouble, on a zone-by-zone basis. All detection and suppression system shall be simple and reliable. They shall use proven technology and shall avoid the use of proprietary or copyrighted technology.
- N. Fire alarm panels shall be complete from the factory and shall not require any field modifications or additions to perform the intended function.
- O. Fire system battery systems shall be of the sealed gel-cell maintenance-free type. Batteries shall be located upright, in the fire alarm panel and not in separate panels.

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Battery capability shall be capable of maintaining fire alarm operations for a minimum of 48 hours in the event of a power outage.

- P. All facility fire system components shall be complete and shall be of the same manufacturer. Fire alarm systems shall be of the same as, and compatible with, the manufacturer of the central receiving station.
- Q. Systems shall utilize supervised, four wire (Class A) zoned wiring with non-proprietary generic type devices. Devices shall be interchangeable with other brands that are readily available.
- R. Systems shall include full identification. All junction, terminal and pulling boxes and covers shall be painted the color red and shall be identified with engraved labels by the zone and circuit that it contains. All LB's and similar units shall be painted the color red. All detection and terminal devices shall have engraved plastic or metallic alphanumeric identification, which shall be keyed to the posted operations and maintenance instructions.
- S. All panels and devices shall be UL or FM listed for their intended application.

2.2 CONDUIT AND WIRE

- A. Conduit:
 - 1. Conduit shall be installed in accordance with Section 16050, the National Electrical Code (NEC), local and state requirements.
 - 2. All wiring shall be installed in conduit or raceway. Conduit fill shall not exceed 40 percent of interior cross sectional area per NEC where three or more cables are contained within a single conduit.
 - 3. Cable must be separated from any open conductors of Power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors, as per NEC Article 760-29.
 - 4. Wiring for 24 volt control, alarm notification, emergency communication and similar power-limited auxiliary functions may be run in the same conduit as initiating and signaling line circuits. All circuits shall be provided with transient suppression devices and the system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals.
 - 5. Conduit shall not enter the fire alarm control panel, or any other remotely mounted control panel equipment or backboxes, except where conduit entry is specified by the FACP manufacturer.

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6. Conduit shall be 3/4 inch (19.1 mm) RGS minimum.

B. Wire:

1. All conductor and cable for the fire alarm system wiring must be new.
2. Wiring shall be in accordance with local, state and national codes (e.g., NEC Article 760) and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG (1.02 mm) for initiating device circuits and signaling line circuits, and 14 AWG (1.63 mm) for notification appliance circuits.
3. All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signaling system.
4. Wire and cable not installed in conduit shall have a fire resistance rating suitable for the installation as indicated in NFPA 70 (e.g., FPLR). No splices shall be allowed in conduit runs.
5. The system shall permit the use of IDC and NAC wiring in the same conduit with the multiplex communication loop.
6. All field wiring shall be completely supervised. In the event of a primary power failure, disconnected standby battery, removal of any internal modules, or any open circuits in the field wiring; a trouble signal will be activated until the system and its associated field wiring are restored to normal condition.

C. Terminal Boxes, Junction Boxes and Cabinets:

1. All boxes and cabinets shall be UL listed for their use and purpose.

D. Initiating circuits shall be arranged to serve like categories (manual, smoke, waterflow). Mixed category circuitry shall not be permitted except on signaling line circuits connected to intelligent reporting devices.

E. Door Holders and Electric Locks:

1. Door holders and electric locks shall be UL listed and shall interface with the alarm to release upon alarm activation.

2.3 SYSTEM COMPONENTS

A. Strobe lights shall meet the requirements of the ADA, UL Standard 1971 and shall meet the following criteria:

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1. The maximum pulse duration shall be 2/10 of one second.
2. Strobe intensity shall meet the requirements of UL 1971.
3. The flash rate shall meet the requirements of UL 1971.
4. Strobe lights shall be synchronized with all other strobe lights and all audio/visual combination devices.
5. Strobe lights shall be flush wall-mounted in new construction and wherever possible and surface mounted using manufacturer provided type "FS" backboxes in existing building where flush mounting is not possible.

B. Audible/Visual Combination Devices:

1. Shall meet the applicable requirements of Section A listed above for audibility.
2. Shall meet the requirements of Section B listed above for visibility.
3. Audio/visual combination devices shall be synchronized with all other audio/visual combination devices and all strobe lights.
4. Audio/visual combination devices shall be flush wall mounted in new construction and wherever possible and surface-mounted using manufacturer provided type "FS" backboxes in existing building where flush mounting is not possible.

C. Duct Smoke Detectors: Duct smoke detectors shall be a 24 VDC type and shall be furnished and installed under Division 15 and fire alarm wired under this Section. Associated remote test indicating stations shall be furnished under Division 15, but installed and fire alarm wired under this section.

D. Waterflow Indicator:

1. Waterflow Switches shall be an integral, mechanical, non-coded, non-accumulative retard type.
2. Waterflow switches shall be fire alarm wired and connected under this section but furnished and installed under Division 15 by the fire protection contractor.
3. Where possible, waterflow switches shall be located a minimum of one (1) foot from a fitting which changes the direction of the flow and a minimum of three (3) feet from a valve.

E. Sprinkler and Standpipe Valve Supervisory Switches:

1. Each sprinkler system water supply control valve riser, zone control valve, and standpipe system riser control valve shall be equipped with a supervisory switch. Standpipe hose valves, and test and drain valves shall not be equipped with supervisory switches.
2. PIV (post indicator valve) or main gate valves shall be equipped with a supervisory switch.
3. The switch shall be mounted so as not to interfere with the normal operation of the valve and adjusted to operate within two revolutions toward the closed position of the valve control, or when the stem has moved no more than one-fifth of the distance from its normal position.
4. The supervisory switch shall be contained in a weatherproof aluminum housing, which shall provide a 3/4-inch (19 mm) conduit entrance and incorporate the necessary facilities for attachment to the valves.
5. The switch housing shall be finished in red baked enamel.
6. The entire installed assembly shall be tamper proof and arranged to cause a switch operation if the housing cover is removed, or if the unit is removed from its mounting.
7. Valve supervisory switches shall be fire alarm wired and connected under this section and furnished and installed under Division 15 by the fire protection contractor.

F. Pull Box (manual station)

1. All operated stations shall have a positive, visual indication of latch operation and utilize a key type reset. Pull stations shall be single-action-type and shall be UL listed.
2. Manual stations shall be constructed of high impact red Lexan with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters, 1.75 inches (44 mm) or larger. Key operation shall be common with the Control Panel. No Allen key or special tools will be allowed.
3. Manual stations shall be flush wall mounted in new construction and wherever possible, and surface mounted using manufacturer provided type "FS" backboxes in existing building where flush mounting is not possible.

G. Photoelectric Smoke Detector

1. The detectors shall be solid state photoelectric (light- scattering) principal in measuring smoke density and use a refracted infrared LED light source with seals against rear air entry.
2. The detector shall fit into a base common to both heat and smoke-type detectors. Spare heads and bases shall be provided.
3. There shall be no limit to number of detectors which may be activated, "in alarm" simultaneously.

H. Thermal Detectors

1. Thermal detectors shall be devices rated at 135 degrees Fahrenheit (58 degrees Celsius) and have a rate-of-rise element rated at 15 degrees F (9.4 degrees C) per minute.

I. Annunciators

1. Annunciator shall be microprocessor solid-state design.

J. Audible/Visual Units (Xenon Strobes)

1. Audible/visible units shall include separate horn and Xenon flash tube units entirely solid state.
2. Visual units shall be solid state with Xenon flash tube construction in single gang, surface mount box. Minimum light output shall conform to ADA at 75 cd.
3. Visual units shall be installed according to drawings, specifications, NEC and manufacturer's recommendations.

K. Emergency Batteries and Cabinet

1. The emergency battery system shall be capable of maintaining the fire alarm operation in excess of 60 hours.
2. Batteries, charger system and cabinet shall be the product of a single manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with the NEC, NFPA 72, local and state codes, as shown on the drawings, and as recommended by the equipment manufacturer.
- B. All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage. Fire alarm wiring shall not be installed with any power or lighting system conductors. Enroute splices or wire nuts are not allowed.
- C. All fire detection and alarm system devices shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.
- D. Wiring details shown on the drawings is approximate only and final wiring shall be based upon manufacturer's wiring diagrams, at no increased cost to the Government.
- E. The manufacturer shall provide complete one-line schematic wiring diagrams for all specified fire alarm systems.
- F. All equipment connected to alternating current circuits shall be protected by surge arresters for IEEE C62.41 and NFPA 70.
- G. The fire alarm system shall be connected to building ground per the manufacturer's instructions. Maximum readings to ground shall meet NEC requirements. A final reading of 5 ohms or less is recommended.
- H. All fire alarm system wiring shall be installed in conduit, $\frac{3}{4}$ " min.
- I. Wiring shall be THHN or TFFN with crimp terminal ends. Use of wire nuts is prohibited.

3.2 TYPICAL OPERATION

- A. Actuation of any manual station, smoke detector, heat detector or water flow switch shall cause the following operations to occur unless otherwise specified:
 - 1. Activate all notification circuits until silenced.
 - 2. Actuate all strobe units until the panel is reset.

3. Annunciate the active initiating devices and zones.
4. Release all magnetic door holders to doors to adjacent zones on the floor from that the alarm was initiated.
5. Return all elevators to the primary or alternate floor of egress.
6. A smoke detector in any elevator lobby shall, in addition to the above functions, return all elevators to the primary or alternate floor of egress.
7. Smoke detectors in the elevator machine room or top of hoistway shall return all elevators in to the primary or alternate floor.
8. Activation of any sprinkler system low-pressure switch, or valve tamper switch shall cause a system supervisory alarm indication.

B. The table matrix at the end of this section constitutes the minimum level of detection required.

3.3 TEST

- A. Provide the service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system. The Contracting Officer and/or the Government shall be notified of the planned test date to complete their attendance.
1. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
 2. Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.
 3. Verify activation of all flow switches.
 4. Open initiating device circuits and verify that the trouble signal actuates.
 5. Open signaling line circuits and verify that the trouble signal actuates.
 6. Open and short notification appliance circuits and verify that trouble signal actuates.
 7. Ground initiating device circuits and verify response of trouble signals.
 8. Ground signaling line circuits and verify response of trouble signals.
 9. Ground notification appliance circuits and verify response of trouble signals.

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10. Check presence and audibility of tone at all alarm notification devices.
11. Check installation, supervision, and operation of all intelligent smoke detectors during a walk test.
12. Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the existing FACP and the correct activation of the control points.
13. When the system is equipped with optional features, the manufacturer's manual should be consulted to determine the proper testing procedures. This is intended to confirm verifying controls performance on individually addressed or grouped devices, including sensitivity monitoring, location, verification and other alarm functions.

3.4 FINAL INSPECTION

- A. At the final inspection a factory-trained representative of the manufacturer of the major equipment shall demonstrate to the Contracting Officer and/or the Government that the systems function properly in every respect. The Government shall reserve the right of final approval.

3.5 INSTRUCTION

- A. Provide 8 hours instruction for two government employees on operating the fire alarm system. Hands-on demonstrations of the operation and maintenance of all system components and the entire system including program changes and functions shall be provided.
- B. Coordinate all training sessions with the Government and/or the Contracting Officer.
- C. Training shall be conducted by technical personnel in the direct employ of the fire alarm manufacturer. A third party instructor shall not be acceptable.

END OF SECTION

SYSTEM INPUTS		ANNUNCIATION AT LOCAL PANELS				TRANSIT SIGNALS TO FIRE DEPARTMENT						AUXILIARY FUNCTIONS			EVACUATION SIGNALS			
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	Facility Fire Evacuation	Audio-Visual Signal	
FIRE ALARMS																		
1	Manual Fire Alarm Stations	X																
2	Fixed Temp & Rate-of-Rise Type Heat Detectors	X																
3	Rate-Compensated Type Heat Detectors on Hangar Ceiling																	
4	Water Flow Switches – Wet or Dry-Pipe Sprinkler Systems in Adjacent Areas	X																
SUPERVISORY SIGNALS																		
5	Valve Supervisory Switch – Wet, Dry-Pipe Foam Sprinklers in Adjacent Areas		X															
6	Valve Supervisory Switches – Sprinklers, Foam																	
7	Valve Supervisory Switches – Low-Level High-Expansion System																	
8	Valve Supervisory Switches – Water Supply Entrance																	
9	Hi-Lo Pressure Switches – Dry-Pipe Sprinklers		X															
10	Temperature Monitoring System																	
11	Control Component Common Trouble Condition		X															
12	Fire Water Storage Level		X															
13	Fire Pump Control		X															
14	Jockey Pump Control		X															
15	Low Temp. Alarm, Storage Tank		X															
TROUBLE CONDITIONS																		
16	Low Battery Voltage			X														
17	Circuit Fault		X															
18	Supervised Component Failure			X														
19	AC Power Failure			X														

NOTES:

1. Fire alarm signals and supervisory alarm signals shall be clearly differentiated at the fire alarm control panel(s).
2. General area means the specific bay, dock, mezzanine, office area, or mechanical area. System zoning shall be sufficient to direct responding firefighters directly to the fire area.
3. This sample matrix shows the basic requirements and is expected to be tailored to each individual project.

APPENDIX A

COMMISSIONING OF FIRE PROTECTION SYSTEMS

TABLE OF CONTENTS

- 1.0 PURPOSE**
- 2.0 SCOPE**
- 3.0 TERMS AND DEFINITIONS**
- 4.0 REFERENCES**
- 5.0 PREREQUISITES**
- 6.0 LIMITATIONS**
- 7.0 MATERIALS AND/OR TEST EQUIPMENT**
- 8.0 FIRE PUMP HOUSE AND WATER STORAGE TANK CHECKLIST AND TEST PROCEDURE**
 - 8.1 Water Storage Tank
 - 8.2 Electric Fire Pump and Controller
 - 8.3 Diesel Fire Pump and Controller
 - 8.4 Jockey Pump and Controller
 - 8.5 Tank Heater
 - 8.6 Fire Pump House Protection
- 9.0 HANGAR BUILDING SUPPRESSION SYSTEMS CHECKLIST AND TEST PROCEDURE**
 - 9.1 High Expansion Foam System
 - 9.2 Preaction System
 - 9.3 Fire Suppression Control Panel
 - 9.4 Heat Detectors
 - 9.5 Foam Sample
- 1.0 PURPOSE**

The purpose of this procedure is to confirm the operability of the high expansion foam and preaction systems in Hangar Building No. 1 (including interfaces with the manual

pull stations, crossed zoned heat detectors and the fire suppression control panel) and operation of the new electric and diesel single-stage centrifugal fire and jockey pumps.

2.0 SCOPE

This procedure includes a full flow test in accordance with NFPA 20 for the 3,000 gpm electric and diesel fire pump and the 20 gpm electric jockey pump. This procedure will verify proper operation of the fire pump controllers and fire pumps.

The Contractor shall complete all NFPA Test Forms (i.e., Fig. A-11-2.6.3(f) Pump Acceptance Test Data) for record in conjunction with this test procedure document.

This procedure does not include flushing or hydrostatic testing of system piping, or testing of post indicator valves on the underground supply piping.

3.0 TERMS AND DEFINITIONS

AHJ – Authority having jurisdiction (Contract Officer)

FACP – Fire Alarm Control Panel

FSCP – Fire Suppression Control Panel

NFPA – National Fire Protection Association

EOL – End of Line Device

LED – Light Emitting Diode

4.0 REFERENCES

- 4.1 ANG Engineering Technical Letter 01-1
- 4.2 Engineering Technical Letter 01-2
- 4.3 NFPA Standard 11A High Expansion Foam (Latest Edition)
- 4.4 NFPA Standard 13 Installation of Sprinkler Systems (Latest Edition)
- 4.5 NFPA Standard 20 Centrifugal Fire Pumps (Latest Edition)
- 4.6 NFPA 70 National Electrical Code (Latest Edition)
- 4.7 NFPA 72 National Fire Alarm Code (Latest Edition)
- 4.8 NFPA Standard 409 Aircraft Hangars (Latest Edition)
- 4.9 Maguire Group Inc. FP Drawings

5.0 PREREQUISITES

- 5.1 Prior to testing, notify Base Fire Department of test.
- 5.2 Verify materials and test equipment listed in Section 7.0 is on site and available for use.

5.3 Representatives of all subcontractors are on site and available to support testing.

6.0 LIMITATIONS

None

7.0 MATERIALS AND/OR TEST EQUIPMENT

- 7.1 Multimeter
- 7.2 Three, inline pressure gauges
- 7.3 Test graphs for water flow
- 7.4 Two, 0-300 test pressure gauges
- 7.5 Screwdrivers
- 7.6 Phillips
- 7.7 Six radios
- 7.8 One compound to 300 test pressure gauge
- 7.9 Pitot tube
- 7.10 Decibel meter
- 7.11 Twelve 50' lengths of 2 ½" hose
- 7.12 Twelve play pipe nozzles
- 7.13 Hand-held tachometer
- 7.14 Test data sheet for fire pump
- 7.15 Six 100 ml graduated cylinders
- 7.16 Two Fenco heat detector test cups
- 7.17 Two 10 ml pipettes
- 7.18 One, hand Refractometer Reichert Catalog No. 10419
- 7.19 No "or equal" substitute acceptable
- 7.20 Test graphs for foam readings
- 7.21 Jumper wire

8.0 FIRE PUMP HOUSE AND WATER STORAGE TANK CHECKLIST AND TEST PROCEDURES

8.1 Water Storage Tank

8.1.1.a Water Storage Tank Pre-Commissioning Checklist

- Water supply piping to tank tested
- Water supply piping to fire pumps tested
- Water level controls tested
- Tank heating, piping tested
- Manufacturer's required maintenance/operational clearance provided

Electrical

- Power available to unit control panel

Controls

- Unit safety/protection devices tested
- Control and alarm installed
- Control and alarm operational

8.1.2.b Water Storage Tank Functional Performance Test Checklist

- Functional performance test: Contractor shall demonstrate operation of water storage tank
- Verify tank filling controls are installed and operational
- Verify liquid level alarms are operational
- Remarks: _____

8.2 Electric Fire Pump And Controller

8.2.1.a Installation

- Pumps grouted in place
- Pump surge suppression devices functional
- Pump/motor coupling alignment verified
- Piping system installed
- Piping system pressure tested
- Pump not leaking
- Field assembled couplings aligned to meet manufacturer's prescribed tolerances

8.2.1.b Electrical

- Power available to pump disconnect
- Pump rotation verified
- Control system interlocks functional
- Verify that power disconnect is located within sight of the unit it controls

8.2.1.c Confirm Circuit Breaker Location Is Identified and Locked On

- Confirm locked

8.2.1.d Pump Operation

- Verify pump is completely primed
- Close isolating switch and then close circuit breaker
- Automatic controller will start pump if system demand is not satisfied (e.g., Pressure low, deluge tripped, etc.)
- For manual operation, activate switch or pushbutton, or manual start handle
- Verify motor start _____ psi

Fire pump start point should be 5 psi less than jockey pump stop point.

8.2.1.e Cycle 1-12" OS&Y valve and 1-12" indicating type butterfly valve
Verify supervisory trip within 2 rotations off normal on suction and discharge valves

- 1. Supply
- 2. Discharge
- Verify address to FACP
- Secure valves to normal position
- Verify supervisory trip within two rotations off normal

8.2.1.f Verify Supervisory Circuits in FACP (jump out electrically)

- Electric fire pump running
- Electric fire pump power failure
- Fire pump failure to start

8.2.2 Fire Pump Field Acceptance Test

8.2.2.a Pressure Starting Test

- Place control switch in auto position
- Open bleeder valve in sensing line until mercoid switch closes
- Verify motor start ____ psi
- Close bleeder valve in sensing line while motor is running
- Pump discharge pressure
- Operate stop pushbutton

8.2.2.b Fire Pump Flow Test

- Secure 12-50' lengths of 2 ½" hose to hose test header
- Secure play pipe nozzles
- Verify 1 ¾" nozzles
- Verify 1 1/8" nozzles
- Verify test header valves closed
- Open test header OS&Y
- Start pump
- Slowly open one or two hose valves
- Verify
- Volts _____ amps _____
- Check pump packings for approximate leakage of 10 drips per minute

8.2.2.c Test Points to be Recorded at 150% Rated Capacity

- Record suction pressure _____
- Record discharge pressure _____
- Net psi _____
- Record pitot tube reading for each nozzle

Nozzle-1 ____ gpm ____ Nozzle-2 ____ gpm
Nozzle-3 ____ gpm ____ Nozzle-4 ____ gpm
Nozzle-5 ____ gpm ____ Nozzle-6 ____ gpm
Nozzle-7 ____ gpm ____ Nozzle-8 ____ gpm
Nozzle-9 ____ gpm ____ Nozzle-10 ____ gpm
Nozzle-11 ____ gpm ____ Nozzle-12 ____ gpm

- Record amperes _____
- Record volts _____
- Record total gallons per minute _____

8.2.2.d Test Points to Be Recorded for Rated Capacity

- Record suction pressure _____
- Record discharge pressure _____
- Record pitot tube reading for each nozzle
Nozzle-1 ____ gpm ____ Nozzle-2 ____ gpm
Nozzle-3 ____ gpm ____ Nozzle-4 ____ gpm
Nozzle-5 ____ gpm ____ Nozzle-6 ____ gpm
Nozzle-7 ____ gpm ____ Nozzle-8 ____ gpm
Nozzle-9 ____ gpm ____ Nozzle-10 ____ gpm
Nozzle-11 ____ gpm ____ Nozzle-12 ____ gpm
- Record amperes _____
- Record volts _____
- Record total gallons per minute _____

8.2.2.e Test Points to Be Recorded for Shutoff

- Record suction pressure _____
- Record discharge pressure _____
- Net psi _____
- Record amperage _____
- Record volts _____

8.2.2.f Calculate Total Head _____

- Discharge pressure _____ +
- Velocity head difference _____ +
- Gauge elevation corrections _____ +
- Suction gauge _____

8.2.2.g Secure from Test Procedure

- Disconnect hoses from header
- Remove all trapped water that would freeze from valves
- Close valves and secure caps
- Close test header OS&Y
- Confirm all valves in normal position
- Confirm controller selector in AUTO
- Verify FACP all clear
- Verify pump controller all clear

- Confirm jockey pump controller in AUTO
- Verify caps secured on wall hydrant
- Verify swivel action and caps secure on Fire Department connection
- Top off water tank

8.3 Diesel Fire Pump and Controller

8.3.1.a Confirm Circuit Breaker Location is Identified and Locked On

- Confirmed locked

8.3.1.b Verify Battery Connections Are Tight

- Batt #1 _____
- Batt #2 _____

8.3.1.c Check Specific Gravity and Electrolyte Height

- Batt #1 _____
- Batt #2 _____

8.3.1.d Diesel Engine/Valves

- Verify dual battery charger operation
- Check crank case oil level
- Check water level in heat exchanger
- Operate relay for motorized louver vent

8.3.1.e Cycle 1-12" OS&Y valve and 1-12" indicating type butterfly valve

Verify supervisory trip within 2 rotations off normal on suction and discharge valves

- 1. Supply
- 2. Discharge
- Verify address to FACP
- Secure valves to normal position
- Cycle post indicator valve
- Verify supervisory trip within two rotations off normal

8.3.1.f Verify Supervisory Circuits in FACP (jump out electrically)

- Low water level
- Low water level engine shut down
- Low temperature pump house
- Low temperature water tank
- Verify heater operation
- Low fuel zone ___ document zone
- Diesel fire pump running
- Diesel fire pump power failure
- Fire pump failure to start
- Engine overspeed cutout

8.3.1.g Fuel Supply Topped Off

- Verify guard protecting exposed lines NFPA-20
- Verify absence off shut-off valve in return line to tank

8.3.1.h Controller/Engine Instrument Panel

- Three position switch
- Manual starting switch
- Water temperature gauge
- Ammeter-charging circuit
- Tachometer
- Oil pressure gauge
- Running time meter
- Merciod switch shipping guards removed
- Sensing line pressure gauge/valve assembly ½" minimum

8.3.2 Fire Pump Field Acceptance Test

8.3.2.a Manual Starting

- Verify battery voltage at controller
- Battery #1 _____
- Battery #2 _____
- Place main control switch in Manual 1
- Depress manual start and release when engine starts
- Turn control switch to "OFF" to stop engine
- Place control switch in Manual 2
- Depress start pushbutton to start engine
- Turn control switch to "OFF" to stop engine

NOTE: Observe battery voltage while cranking. Verify voltage drop not below 75% of nominal.

8.3.2.b Cranking Cycle Test

- Disable engine run circuit (remove relay)
- Place control switch in TEST
- Depress test button
- Verify drain valve solenoid operation
- Visualize pressure drop and operation of mercoid switch
- Verify engine crank
- Verify local alarm bell
- Verify failure to start signal
- Verify engine failure alarm
- Return switch to OFF position
- Reconnect engine run circuit

8.3.2.c Starting Motor Release

- Place control switch in TEST
- Depress test button

- Verify engine start promptly and starting motor
- Release at 1/3 engine speed

8.3.2.d Oil Pressure Failure Test

- Place control switch in TEST
- Depress test button
- Connect jumper between terminal of oil pressure
- Switch and ground
- Verify oil pressure signal
- Verify local alarm bell
- Verify engine failure alarm
- Return control switch to OFF position
- Remove jumper

NOTE: Oil pressure light should momentarily go on and off when engine builds up pressure. This indicates oil switch proper operation.

8.3.2.e High Water Temperature Test

- Place control switch in TEST position
- Depress test button
- Connect jumper between terminal of water temperature switch and ground
- Verify water temperature signal light
- Verify local alarm bell
- Verify engine failure alarm
- Turn control switch to OFF position
- Remove jumper

8.3.2.f Overspeed Test

- Place control switch in TEST position
- Depress test button
- Momentarily jump engine overspeed terminal
- Verify engine shutdown
- Verify local alarm
- Verify overspeed signal light
- Verify engine failure alarm
- Turn control switch to OFF position to reset signals

8.3.2.g Pressure Starting Test

- Place control switch in AUTO position
- Open bleeder valve in sensing line until mercoid switch closes
- Verify engine start _____ psi
- Close bleeder valve in sensing line
- While engine is running
- Observe oil pressure _____
- Observe water temperature _____

- Observe ammeter charging
- Batt #1 _____
- Batt #2 _____
- Engine rated speed _____
- Pump discharge pressure _____
- Operate STOP pushbutton

NOTE: Manual STOP differential setting should be at a minimum. Top setting must be set below lowest churn pressure of the pump.

8.3.2.h Fire Pump Flow Test

- Secure 12-50' lengths of 2 ½" hose to hose test header
- Secure play pipe nozzles
- Verify 1 ¾" nozzles
- Verify 1 1/8" nozzles
- Verify test header valves closed
- Open test header OS&Y
- Start pump
- Slowly open one or two hose valves
- Verify
- Engine oil pressure _____
- Engine water temperature _____
- Tachometer readings
- Engine mounted _____
- Hand held _____
- Check pump packings for approximate leakage of 10 drips per minute.

8.3.2.i Test Points to be Recorded at 150% Rated Capacity

- RPM with external tachometer _____
- Record suction pressure _____
- Record discharge pressure _____
- Net psi _____
- Record pitot tube reading for each nozzle
 - Nozzle-1 ___ gpm ___ Nozzle-2 ___ gpm
 - Nozzle-3 ___ gpm ___ Nozzle-4 ___ gpm
 - Nozzle-5 ___ gpm ___ Nozzle-6 ___ gpm
 - Nozzle-7 ___ gpm ___ Nozzle-8 ___ gpm
 - Nozzle-9 ___ gpm ___ Nozzle-10 ___ gpm
 - Nozzle-11 ___ gpm ___ Nozzle-12 ___ gpm
- Record amperes
- Record volts _____
- Record entire temperature _____
- Record engine oil pressure _____
- Record total gallons per minute _____

8.3.2.j Test Points to be Recorded for Rated Capacity

- RPM with external tachometer _____
- Record suction pressure _____
- Record discharge pressure _____
- Record pitot tube reading for each nozzle
Nozzle-1 ____ gpm ____ Nozzle-2 ____ gpm
Nozzle-3 ____ gpm ____ Nozzle-4 ____ gpm
Nozzle-5 ____ gpm ____ Nozzle-6 ____ gpm
Nozzle-7 ____ gpm ____ Nozzle-8 ____ gpm
Nozzle-9 ____ gpm ____ Nozzle-10 ____ gpm
Nozzle-11 ____ gpm ____ Nozzle-12 ____ gpm
- Record amperes
- Record volts _____
- Record entire temperature _____
- Record engine oil pressure _____
- Record total gallons per minute _____

8.3.2.k Test Points to be Recorded at Shutoff

- RPM with external tachometer _____
- Record suction pressure _____
- Record discharge pressure _____
- Net psi _____
- Record amperage _____
- Record volts _____
- Record entire temperature _____
- Record engine oil pressure _____

8.3.2.l Calculate Total Head _____

- Discharge pressure _____ +
- Velocity head difference _____ +
- Gauge elevation corrections _____ +
- Suction gauge _____

8.3.2.m Secure from Test Procedure

- Disconnect hoses from header
- Remove all trapped water that would freeze from valves
- Close valves and secure caps
- Close test header OS&Y
- Confirm all valves in normal position
- Confirm controller selector in AUTO
- Verify FACP all clear
- Verify pump controller all clear
- Confirm jockey pump controller in AUTO
- Verify caps secured on wall hydrant
- Verify swivel action and caps secure on fire department connection
- Top off water tank

- Top oil fuel tank

8.4 JOCKEY PUMP AND CONTROLLER

8.4.1.a Confirm circuit breaker location and lock on feature

- Confirmed locked

8.4.2 Cycle 2" OS&Y Valve Supply Side

- Cycle 2" OS&Y valve on discharge side
- Place selector switch on controller to hand
- Verify jockey pump operation
- Place selector switch on controller to AUTO
- Open bleeder valve on sensing line to fire pump controller
- Verify pressure switch operation and note start pressure _____
- Allow pump to run until automatic shut-off
- Verify pressure switch stop operation and note pressure _____

NOTE

- ◆ Jockey pump stop point should equal fire pump churn pressure plus static head pressure
- ◆ Jockey pump start pressure should be 10 psi less than stop point

8.5 TANK HEATER

8.5.1. Hot Water Boiler Pre-Commissioning Checklist

8.5.1.a Installation

- Boiler flue installed
- Boiler hot water piping installed
- Boiler hot water piping tested
- Boiler makeup water piping installed
- Boiler gas piping tested
- Manufacturer's required maintenance clearance provided

8.5.1.b Startup

- Boiler system cleaned and filled with water
- Boiler safety/protection devices, including high temperature burner shut-off, low-water cutoff, flame failure, pre and post purge, have been tested
- Verify that PRV rating conforms to boiler rating
- Boiler startup and checkout complete

8.5.1.c Electrical

- Verify that power disconnect is located within sight of the unit served

8.5.2. Hot Water Boiler Functional Performance Test Checklist

8.5.2.a Functional Performance Test: Contractor shall demonstrate operation of hot water system as per specifications including the following: Start building heating

equipment to provide load for boiler. Activate controls system boiler start sequence as follows:

- Start hot water pump and establish hot water flow
- Verify control system energizes boiler start sequence.
- Verify boiler senses hot water temperature below set point and control system activates boiler start.
- Shut off building and tank heating equipment to remove load on hot water system. Verify boiler shutdown sequence is initiated and accomplished after load is removed.

8.6 FIRE PUMP HOUSE PROTECTION

8.6.1.a Fire Alarm Control Panel

- Verify electrical supervision of alarm initiating circuits
- Verify electrical supervision of alarm indicating circuits
- Verify circuit breaker location and lock on feature
- Confirmed locked
- Verify "Fire Alarm Fuse Cut-Out" label
- Interrupt primary power supply by removing one lead – Verify that a trouble indication is present (both audio and visual).
- Verify battery back-up
- Trip manual pull station
- Verify alarm transmittal
- Reset pull station
- Restore AC power
- Verify panel clear

NOTE: On receipt of all alarm and trouble signals, press acknowledge. Verify indicating zone blinking light to steady light. Then press signal silence. Verify horn/strobe secure. Then press reset. Verify all clear on all circuits, only power lamp lit.

8.6.2.b Activate Pull Station West Exit

- Verify alarm transmittal/address to FACP
- Verify alarm transmittal via radio box to fire station
- Verify indicating circuit address matches initiating circuits
- Audible appliances emit 87dBA at 10 ft. from appliance
- One visual appliance operational
- Reset pull station

8.6.2.c Activate Pull Station East Exit

- Verify alarm transmittal/address to FACP
- Verify alarm transmittal via radio box to fire station
- Verify indicating circuit address matches initiating circuits
- Audible appliances emit 87dBA at 10 ft. from appliance
- One visual appliance operational
- Reset pull station

8.6.2.c Remove End of Line Resistor from Initiating Circuit (Pull Station West)

- Verify trouble signal to FACP
- Verify trouble signal to fire station
- Activate pull station
- Verify alarm transmittal
- Restore EOL resistor
- Reset pull station
- Ensure no trouble condition is indicated at the FACP and the only LED that is on is the AC power LED

8.6.2.d Remove End of Line Resistor from Indicating Circuit (Pull Station East)

- Verify trouble signal to FACP
- Verify trouble signal to fire station
- Activate pull station
- Verify indicating appliances operational
- Restore EOL resistor
- Reset pull station
- Ensure no trouble condition is indicated at the FACP and the only LED that is on is the AC power LED.

9.0 HANGAR BUILDING SUPPRESSION SYSTEM CHECKLIST AND TEST PROCEDURES

9.1 Water Storage Tank Pre-Commissioning Checklist

9.1.1.a For High Expansion Foam Piping Systems

- Piping complete
- As-built shop drawings submitted
- Piping flushed and cleaned
- Strainers cleaned
- Valves installed as required
- Gauges installed as required
- Verify operation of valves
- Verify that piping has been labeled and valves identified as specified

9.1.1.b High Expansion Foam Storage Tank

- Tank properly piped
- Water supply pipe leak tested
- High Expansion foam supply pipe leak tested
- Bladder
- Ratio controller properly piped
- Manufacturer's required maintenance clearance provided

Electrical

- Power available to unit control panel

Controls

- Factory startup and checkout complete
- Control devices tested
- Water deluge valve installed
- Foam deluge valve installed
- Water deluge valve tested
- Foam deluge valve tested

9.1.1.c High Expansion Foam System Controls

- As-built shop drawings submitted
- Layout of control panel matches drawings
- Framed instructions mounted in or near control panel
- Components properly labeled (on inside and outside of panel)
- Components piped and/or wired to each labeled terminal strip
- Connection made to each labeled terminal strip as shown
- Control wiring and tubing labeled at all terminations, splices, and junctions
- Proper wiring used on electronic sensors

9.1.1.d Main Power

- 110 volt AC power available to panel

9.1.1.e Testing Commissioning and Balancing Checklist Items

- Testing and commissioning report submitted

9.1.2.a High Expansion Foam Storage Tank

Functional Performance Test: Contractor shall demonstrate operation of High Expansion Foam system as per Base fire chief including the following:

- Close 3" base valve controlling foam supply before these tests
- Trip deluge valves controlling water and foam by tripping heat detector
- Trip deluge valves controlling water and foam by tripping manual pull alarms
- Water should flow through foam generators in each case and fire pumps should start

Full Function Foam Test

- Open 3" ball valve controlling foam supply to system
- Trip overhead system with test fire on hangar floor as required by NFPA standard.

Remarks _____

Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Contractor's Chief Quality Control Representative: _____

Contractor's Mechanical Representative: _____

Contractor's Electrical Representative: _____

Contractor's Testing, Adjusting and Balancing Representative: _____

Contractor's Fire Protection Representative: _____

Contractor's Fire Alarm Representative: _____

Contracting Officer's Representative: _____

Using Agency's Representative: _____

9.1.2.b High Expansion Foam Controls

The Contracting Officer will select High Expansion Foam control systems to undergo functional performance testing

Functional Performance Test: In accordance with combined criteria set forth by equipment manufacturer and Base Fire Department requirements.

Certification: We, the undersigned, have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative: _____

Contractor's Mechanical Representative: _____

Contractor's Electrical Representative: _____

Contractor's Testing, Adjusting and Balancing Representative: _____

Contractor's Controls Representative: _____

Contracting Officer's Representative: _____

Using Agency's Representative: _____

9.2 Preaction System

9.2.1.a Preaction Piping and Valving Pre-Commissioning Checklist

- Piping complete
- As-built shop drawings submitted
- Piping flushed and cleaned
- Valves installed as required
- Gages installed as required
- Verify operation of valves
- Verify piping has been labeled and valves identified as specified
- Piping leak tested
- Control device tested
- Water deluge valve tested

9.2.2.a Preaction System Functional Performance Test Checklist

- Trip deluge valve controlling water by tripping heat detector
- Trip deluge valve controlling water by tripping manual pull station
- Water should flow through piping in each case and fire pumps should start

9.3 Fire Suppression Control System

9.3.1.a Fire Suppression Control Panel

- Verify electrical supervision of alarm initiating circuits
- Verify electrical supervision of alarm indicating circuits
- Verify circuit breaker location and lock on feature

- Confirmed locked
- Verify "Fire Alarm Fuse Cut-Out" label
- Interrupt primary power supply by removing one lead – verify that a trouble indication is present (both audio and visual)
- Verify battery back-up
- Trip manual pull station
- Verify alarm transmittal
- Reset pull station
- Restore AC power
- Verify panel clear

NOTE:

On receipt of all alarm and trouble signals, press acknowledge. Verify indicating zone blinking light to steady light. Then press signal silence. Verify horn/strobe secure. Then press reset. Verify all clear on all circuits, only power lamp lit.

9.3.2.a Activate Pull Station (Test each pull station in Hangar Bay)

- Verify alarm transmittal/address to FACP
- Verify alarm transmittal via radio box fire station
- Verify indicating circuits address matches initiating circuits
- Audible appliances emit 87dBA at 10 ft from appliance
- One visual appliance operational
- Reset pull station
- Verify operation of deluge and preaction valves

9.3.2.b Remove End of Line Resistor from Initiating Circuit (Test each pull station in Hangar Bay)

- Verify trouble signal to FACP
- Verify trouble signal to fire station
- Activate pull station
- Verify alarm transmittal
- Restore EOL resistor
- Reset pull station
- Ensure no trouble condition is indicated at the FACP and the only LED that is on is the AC power LED

9.3.2.c Cycle all OS&Y valve and all indicating type butterfly valve. Verify supervisory trip within 2 rotations off normal on suction and discharge valves

- 1. Supply
- 2. Discharge
- Verify address to FSCP
- Secure valves to normal position
- Verify supervisory trip within two rotations off normal

9.3.2.d Verify Supervisory Circuits in FSCP (jump out electrically)

- Electric fire pump running
- Electric fire pump power failure
- Fire pump failure to start

9.4 Detector Testing

9.4.1.a Activate all Thermal Detectors on Group 1 Individually

For each detector

- Verify alarm transmittal/address to FSCP
- Verify alarm transmittal via radio alarm box
- Audible appliances elicit wailing tone
- Buzzer at control panel
- Visual appliances
- Flashing red light at panel
- Depress acknowledge button
- Verify buzzer silence
- Verify flashing light to steady
- Verify audio/visuals remain active
- Allow thermal detector to reset automatically
- Verify zone pre-alarm light off
- Verify audio/visuals silence

9.4.1.b Activate all Thermal Detectors on Group 2 Individually

For each detector

- Verify alarm transmittal/address to FSCP
- Verify alarm transmittal via radio alarm box
- Verify indicating circuit address matches initiating circuit
- Audible appliances elicit wailing tone
- Buzzer at control panel
- Visual appliances
- Flashing red light at panel
- Depress acknowledge button
- Verify buzzer silence
- Verify flashing light to steady
- Verify audio/visuals remain active
- Allow thermal detector to reset automatically
- Verify zone pre-alarm light off
- Verify audio/visuals silence
- Verify release of deluge and preaction valves with operation of crossed-zone detectors

9.5 Foam Sample

9.5.1.a

- Close isolation valve to generators
- Open test header for foam discharge
- Flow a minimum of 300 gpm from test header into holding tank
- Draw off sample from holding tank
- Test sample for proper ratio in accordance with manufacturer's recommendations