SECTION 21 13 39: LOW-LEVEL HIGH EXPANSION FOAM FIRE EXTINGUISHING SYSTEMS FOR AIRCRAFT HANGARS

PART 1  GENERAL

1.01 SECTION INCLUDES
A. High expansion foam System.
B. System design, installation, and certification.

1.02 REFERENCES
E. NFPA 11 – (2010; TIA 10-1) Standard for Low-, Medium- and High- Expansion Foam
J. NFPA 70 - (2014; AMD 1 2013; Errata 1 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014)National Electrical Code
N. SSPC Paint 25 - (1997; E 2004) Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type I and Type II
N. SSPC SP 11 – (2012) Power Tool Cleaning to Bare Metal
O. UFC 3-520-01 - (2015) Interior Electrical Systems
P. UFC 3-600-01 - (2006; with Change 3) Fire Protection Engineering for Facilities
Q. UFC 4-211-01 – (29 Feb 2016; Pre-Decisional: Not for Public Release) Aircraft Maintenance Hangars
R. CID A-A-2962 - (Rev A; Notice 2) Enamel, Alkyd, Gloss, Low VOC Content
S. CID A-A-58092 -(Basic; Notice 1) Tape, Antiseize, Polytetrafluoroethylene

1.03 SYSTEM DESCRIPTION
A. Design Requirements: Modify the existing automatic low-level high expansion foam (Hi-Ex) fire suppression system including electronic detection, control, and release systems. The low-level fire suppression system must provide uniform distribution of aerated high expansion solution to provide complete coverage throughout the areas indicated. The electronic detection, control, and release system must include wiring, raceways and other accessories and miscellaneous items required for a complete
operating system even though each item is not specifically mentioned or described. The design, equipment, materials, installation, and workmanship must be in strict accordance with the required and advisory provisions of NFPA 11, NFPA 13, NFPA 15, NFPA 16, NFPA 24, NFPA 70, NFPA 72, NFPA 409, UFC 3-600-01, UFC 4-211-01 and criteria changes (Appendix B) except as modified herein. All the existing foam generators and all the piping in the hangar shall remain and be reused. The existing bladder type foam solution tank shall be relocated and reused. The foam solution piping shall be replaced. The deluge valve on the two foam risers shall be replaced with new flow control valves. The IR detection system, releasing foam control panel, beacons, conduit, wiring, and START/STOP switches shall be new. Each system must include all materials, accessories and equipment necessary to provide each system complete and ready for use. Design and install each system to ensure the timing parameters are achieved while maintaining the complete coverage in accordance with the drawings to be submitted for approval. Devices and equipment for fire protection service must be of a make and type listed by the Underwriter's Laboratories Inc. in the UL Fire Protection Equipment Directory, approved by the Factory Mutual System in FM APP GUIDE, or other Nationally Reorganized Testing Laboratory listing unless otherwise specified. In the publications referred to herein, the advisory provisions must be considered to be mandatory, as though the word "must" had been substituted for "should" wherever it appears; reference to the "authority having jurisdiction" must be interpreted to mean Air Force Civil Engineer Center Operations Directorate (AFCEC/CO). Begin work at the point indicated.

B. The existing overhead foam system was designed in accordance with ETL 02-15.

C. System Operation: Flow of water must be controlled by new flow control valves. Existing foam proportioning equipment must activate automatically upon tripping of the flow control valve for the corresponding foam system. The flow control valve must be tripped by independent detection systems. No valve will be operated by the building fire evacuation alarm system. Use of motor-operated valves is prohibited. Once activated, the system must remain activated until reset manually, however, foam flow may be interrupted/stopped momentarily by depressing and holding the "foam stop" button strategically placed on the hangar bay walls.

1. Overhead System: Overhead wet pipe sprinkler systems are existing to remain.
2. Hose System: Hose systems including hose reels must not be provided.

1.04 SUBMITTALS
A. Submittals shall be made under provisions of Section 01 33 00.

B. The AFCEC/CO fire protection engineer will review and approve all submittals in this section requiring Government approval.

C. Preconstruction Submittals
1. Environmental protection: Submit high expansion foam solution containment and disposal plan as required under paragraph entitled "Environmental Protection."

D. Shop Drawings
1. Sprinkler System Shop Drawings

E. Product Data: Submit data on proposed equipment, including, but not limited to the items listed below. Include UL or FM listing cards for equipment provided. Data which describe more than one type of item must be clearly marked to indicate which type the Contractor intends to provide. Submit only originals. Photocopies will not be accepted. Partial submittals will not be accepted.

1. Pipe, fittings, and mechanical couplings
2. Flow control valves
3. Valves
4. Pipe hangers and supports
5. Foam System Control Panel (FSCP)
6. Optical flame detectors
7. Terminal cabinets/assemblies
8. Storage batteries
9. Annunciator panel
10. High expansion foam visual notification devices
11. Visual alarms
12. High expansion foam concentrate
14. Stop station
15. Battery charger

F. Design Data
1. Hydraulic calculations
2. Foam delivery calculations: Submit foam delivery calculations demonstrating foam solution is delivered to the most remote High Expansion Foam generator within 30 seconds of system activation.
3. Pressure discharge graphs or tables: Submit pressure discharge graphs or tables showing pressure discharge relationship for discharge nozzles.
4. Battery standby power requirements calculations:
   a. Substantiate battery standby power requirements with calculations showing battery capacity, supervisory and alarm power requirements.
   b. Provide complete battery calculations for both the alarm and supervisory power requirements. Ampere hour requirements for each system component must be submitted with the calculations.
5. System hydraulic surge analysis: System hydraulic transit (surge) analysis showing hydraulic transit pressure occurring throughout the system at both design flow and non-flow conditions.

G. Test Reports
1. Preliminary Test Report: Four copies of the completed Preliminary Test Report, no later than 7 days after the completion of the Preliminary Tests. The Preliminary Tests Report must include both the Contractor's Material and Test Certificate for Underground Piping and the Contractor's Material and Test Certificate for Aboveground Piping. All items in the Preliminary Tests Report must be signed by the Fire Protection Engineer specified in this Section.
2. Final Acceptance Test Report
   a. Submit for all inspections and tests specified under paragraph entitled "Field Quality Control."
   b. Concurrent with the Final Acceptance Test Report, certification by the Fire Protection Engineer specified in this Section that the low-level high expansion foam fire extinguishing system is installed in accordance with the contract requirements, including signed approval of the Preliminary and Final Acceptance Test Reports.

H. Certificates
1. Qualifications of installer
2. Qualifications of System Technician
3. Submit installer and systems technician qualifications as required under paragraphs entitled "Qualifications of Installer" and "Qualifications of System Technician."
4. Fire Protection Engineer: The name and documentation of certification of the proposed Fire Protection Engineer, no later than 14 days after the Notice to Proceed and prior to the submittal of the sprinkler system drawings and hydraulic calculations.
5. Inspection by Fire Protection Engineer: Concurrent with the Final Acceptance Test Report, certification by the Fire Protection Engineer specified in this Section that the sprinkler system is installed in accordance with the contract requirements, including signed approval of the Preliminary and Final Acceptance Test Reports.

I. Operation and Maintenance Data: Furnish one complete set of data prior to the time that final acceptance tests are performed, and furnish the remaining sets before the contract is completed.
1. Flow control valves, Data Package 3
2. Foam System Control panel, Data Package 3
3. Instructions for operating the fire extinguishing system, Data Package 4

J. Closeout Submittals
1. As-built Drawings for the fire extinguishing system: Upon completion, and before final acceptance of the work, submit a complete set of as-built drawings for the fire extinguishing system, including complete as-built circuit diagrams. Provide electronic drawings in dwg and pdf format. Submit as-built drawings in addition to the record drawings required by Division 1.

1.05 QUALIFICATIONS
A. Fire Protection Engineer: A Fire Protection Engineer is a registered professional engineer (P.E.) who has passed the fire protection engineering written examination administered by the National Council of Examiners for Engineering and Surveys (NCEES).

B. Qualifications of Installer: Prior to commencing work, submit data showing that the Contractor has successfully installed automatic high expansion foam fire extinguishing systems of the same type and design as specified herein, or that he has a firm contractual agreement with a subcontractor having the
required experience. Include the names and locations of at least two installations where the Contractor, or
the subcontractor referred to above, has installed such systems. Indicate the type and design of each
system, and certify that the system has performed satisfactorily for a period of at least 18 months.

C. Qualifications of System Technician: Installation drawings, shop drawing and as-built drawings must be
prepared, by or under the supervision of, an individual who is experienced with the types of works
specified herein, and is currently certified by the National Institute for Certification in Engineering
Technologies (NICET) as an engineering technician with minimum Level-IV certification in Special Hazard
System program. Contractor must submit data for approval showing the name and certification of all
involved individuals with such qualifications at or prior to submittal of drawings.

1.06 QUALITY ASSURANCE

A. Sprinkler System Shop Drawings: Prepare shop drawings in accordance with the requirements for "Plans"
as specified in NFPA 11, "Working Plans" as specified in NFPA 13, and "Shop Drawings" as specified in
NFPA 72. Each drawing must be 24 by 36 inches. Unless otherwise noted, floor plans must be drawn to
a scale not less than 1/8" = 1'-0". Show data essential for proper installation of each system. Show
details, plan view, elevations and sections of the systems supply and piping. Show piping schematic of
systems supply, devices, valves, pipe and fittings. Show point to point electrical wiring diagrams. Submit
drawings signed by a registered fire protection engineer.

B. Provide four copies of the Sprinkler System Shop Drawings, no later than 21 days prior to the start of
sprinkler system installation.

C. Do not commence work until the design of each system and the various components have been
approved. Show:

1. A descriptive index with drawings listed in sequence by number. A legend sheet identifying device
symbols, nomenclature, and conventions used in the package.

2. Room, space or area layout and include data essential to the proper installation of each system.
   Floor plans must be drawn to a scale not less than 1/8 inch equals 1 foot clearly showing locations of
devices, equipment, risers, electrical power connections, areas covered by each generator, and other
details required to clearly describe the proposed arrangement.

3. Existing generators and associated piping must be shown.

4. Piping plan and isometric drawing of the high expansion concentrate system and details of all
   associated valves, fittings, and other components. Shop drawings must show the existing
   proportioner. Drawing must indicate all operational features.

5. Equipment room layout drawings drawn to a scale of not less than 1/2 inch equals 1 foot to show
details of each system component, clearances between each other and from other equipment and
construction in the rooms. This includes the Electrical Room 113 and the Fire Riser Room.

6. Details of each high expansion foam system control valve and related components, both existing and
   new components of the two foam risers.

7. Details of all components required for support of the sprinkler piping from the building structural
   system, including hangers and bracing, and details of all connections to the components of the metal
   building system. Provide plans, elevation drawings, and details as required to fully convey the
   clearances required for the floor and wall penetrations.

8. Connection drawings and control diagrams indicating overall mechanical operation of the high
   expansion system. This must include identification and operation of each major component of the
   system. Diagrams must be supplemented with a narrative description of the system. Indicate foam
   system control panel, make and model of devices and equipment to which the system is connected.

9. Point-to-point wiring diagrams showing the points of connection and terminals used for electrical field
   connections in the system, including interconnections between the equipment or systems which are
   supervised or controlled by the system. Diagrams must show connections from field devices to the
   Foam System Control Panel (FSCP) and remote foam system control units, initiating circuits,
   switches, relays and terminals.

10. Field wiring diagrams showing locations of devices and points of connection and terminals used for all
    electrical field connections in the system, with wiring color code scheme.

11. Interfacing with fire suppression control components must be clearly indicated on drawings. Solenoids
    must be FM approved for release by the releasing panel.

12. Optical flame detector manufacturer's recommended detector layout (plan view) including horizontal
    and vertical angles for correct aiming.

D. Fire Protection Engineer: The Fire Protection Engineer specified in this Section, must perform the
inspection services specified in Part 3 of this section.
E. Material and Equipment Qualifications: Provide materials and equipment that are standard products of manufacturers regularly engaged in the manufacture of such products, which are of a similar material, design and workmanship. Standard products must have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use must include applications of equipment and materials under similar circumstances and of similar size. The product must have been for sale on the commercial market through advertisements, manufacturers’ catalogs, or brochures during the 2 year period.

F. Alternative Qualifications: Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer’s factory or laboratory tests, can be shown.

G. Manufacturer’s Nameplate: Each item of equipment must have a nameplate bearing the manufacturer’s name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

H. Field Fabricated Nameplates: ASTM D709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription must identify the function and, when applicable, the position. Nameplates must be melamine plastic, 0.125 inch thick, white with black center core. Surface must be matte finish. Corners must be square. Accurately align lettering and engrave into the core. Minimum size of nameplates must be one by 2.5 inches. Lettering must be a minimum of 0.25 inch high normal block style.

1.07 SPARE PARTS
A. Furnish the following spare parts:
    1. 2 of each type of detector installed.
    2. 1 of each type notification appliance installed.
    3. 4 of each type of fuse required by the system.
    4. 1 each foam system manual release station and stop station.
    5. 6 complete sets of system keys.

1.08 DESIGN OF LOW-LEVEL HIGH EXPANSION FOAM SYSTEM
A. Design and provide modifications to the existing automatic low-level high expansion fire extinguishing system as indicated on drawings. Systems must provide distribution of high expansion foam solution within the timing parameters required by the UFC and this specification. System must be balanced to operate both independently and with simultaneous operation of the overhead wet-pipe sprinkler system.

B. System Activation: System activation must be controlled by an addressable foam system control panel (FSCP) listed for releasing service. High expansion foam discharge must occur upon activation of either of the following:
    1. Any single manual foam release station.
    2. The activation of an alarm condition in any two or more optical flame detectors.

C. Flow Control Valves: Water flow thru the foam concentrate proportioning system and to the foam generator system must be controlled by flow control valves. Flow control valves must be listed and include control of the opening and closing speed of the valve, provide pressure regulation to the discharge devices, and provide for remote resetting of the valve.

D. Foam Solution Distribution: Foam application must be from foam generators providing not less than a 700:1 expansion ratio by aeration specified herein and as indicated on the drawings. Design must be such that foam solution must begin discharging at the most remote foam nozzle within 30 seconds from system activation. Submit foam delivery calculations demonstrating compliance.
    1. Low-level high-expansion foam systems shall cover 90 percent of the aircraft silhouette area projected on the floor in one minute or less.
    2. Within 240 seconds from activation not less than 3.28 feet of aerated foam solution throughout the hangar servicing area.

E. Foam Concentrate Proportioning System: Foam proportioning must be by the existing proportioner taking suction from an existing relocated bladder type high expansion foam concentrate storage tank located in Electrical Room 113.
F. Hydraulic Design: Contractor shall provide calculations and manufacturer’s data sheets on both the removed deluge valve and the new flow control valve to demonstrate that any modifications to the foam riser will result in a completely compliant system. The modified system shall meet all the coverage and timing requirements in the UFC and this specification. Contractor shall provide hydraulic calculations to document that the modified system shall meet the performance requirements of the existing system. Hydraulic calculations must assume a minimum 20 psi pressure loss for the flow control valve or the minimum pressure loss necessary for flow/pressure regulation as published by the manufacturer's literature, whichever is greater. Include "Demand Calculations" and "Supply Calculations".  
1. Overhead Systems: Hydraulic design must consider simultaneous operation of the existing overhead sprinkler systems.  
2. Water Supply: Base hydraulic calculations on the flow to supply the high-expansion generators and the sprinkler design area. 
   a. Base hydraulic calculations on the operation of the minimum number of pumps running necessary to supply the high-expansion generators and the sprinkler design area. There are four (4) 1,000 gpm at 100 psi fire pumps serving Hangar 90032.  

G. Duration of Discharge: System must apply foam solution over the protected area for a minimum of 15 minutes while simultaneously discharging water through the existing overhead wet pipe sprinkler system. Reduction of the discharge duration based on a discharge rate higher than the specified minimum is not permitted.  

PART 2  PRODUCTS  

2.01 FOAM GENERATION PRODUCTS AND EQUIPMENT  
A. Low-Level High Expansion Foam Generators are existing to be reused. 
B. Proportioning Equipment: The existing riser mounted proportioner shall remain and be reused.  
   1. Foam Concentrate Piping and Fittings: Foam concentrate piping and fittings shall be stainless steel. Each proportioner must be provided with a separate individual pipe from the tank to the proportioner. Fittings must be of the same material as the pipe. Acceptable pipe joining methods are TIG welded, or gasketed welded flanges. Provide quarter turn ball valves at each proportioner on the concentrate line to permit low-level nozzle system flushing without proportioning foam. Valve must be lockable in the open position or equipped with an integral tamper switch for electric supervision. Valve must be brass, bronze or stainless steel. Foam concentrate pipe must also be fitted with capped tee-fitting as surrogate foam concentrate test connection. Pre-priming of any foam solution piping is NOT acceptable. All solution piping must be slopped to be self-draining back to the riser. During commissioning, the responsible FPE must seal or otherwise install tamper proof guards on the pressure regulator adjusting stem and the two small globe valves on the speed control assembly. It is crucial these settings not be changed after commission; least the system may be impaired. Safety-wire these devices in those positions and label them "DO NOT ADJUST". Any other trim valves which must be open or closed for the FCV to function also must be safety wired in position.  
C. Flow Control Valves: Provide flow control valve as shown on the drawings with trim package for electric releasing, remote re-setting, and opening/closing speed control. Use of any other flow control valve requires approval from the service criteria office. If flow control valve of a size greater than or less than the risers, provide smoothly tapered inlet and outlet connections. In addition to automatic operation, arrange each valve for manual release at the valve. Provide pressure gages and other appurtenances at the flow control valves as required by NFPA 13. All trim piping must be brass with compatible fittings. Trim piping must be factory configured and installed. The manual release for the flow control valve will be installed no higher than 5 feet above finished floor. Hydraulic calculations must include a minimum pressure drop across flow control valves of 20 psi, or the listed pressure drop, whichever is greater. Valves must be operated by a control system listed for releasing service and independent of the building fire alarm system. Valves located in electrical classified locations must be listed for the classification of the area where located.  
   1. Pressure Regulation: Pressure regulation maintaining a constant pressure at the discharge device (foam generator). Pressure deviation must not exceed ± 10 psig.  
   2. Electrical Actuation and Remote Resetting: Electrical solenoid valve used to actuate the water control valve must be an integral component of the valve releasing control panel manufacturer. Solenoid valve must be of the normally closed, de-energized type, which opens when energized upon receipt of an electrical signal from the foam system control panel to which it is connected. Solenoid valves used with diaphragm-type valves must be rated for a maximum pressure differential of 175 psi.
Electronic solenoids used for high expansion foam release must be listed for fire service applications and approved by the flow control valve manufacturer for use with the specific valve. Water control valve must be capable of recycling to the closed position at an adjustable speed. Assembly must be complete with the gauges and other appurtenances at the flow control valve as required by the NFPA.

3. Opening/Closing Speed Control: Provide manufacturer’s optional valve opening/closing speed control. Flow control valves must open within 5 seconds. Speed control setting must be adjusted such that the time to fully close the control valve will not exceed 15 seconds.
   a. Primary water control valve OS&Y or butterfly is electrically supervised.
   b. All trim valves and drain valves must be locked/sealed in the normal operating position.
   c. All valves must have an attached metal tag or engraved plastic tag identifying purpose and normal operating position.

D. Foam Concentrate Storage Tanks: Foam Concentrate Storage is existing and must be relocated.

2.02 ELECTRONIC CONTROL AND DETECTION COMPONENTS

A. Provide a foam system alarm and control consisting of an addressable foam system control panel (FSCP), multi-spectrum infrared (IR) flame detectors, manual releasing stations, manual stop stations, signage panels, visual notification appliances, and miscellaneous appurtenances and circuit wiring in conduit, as required for a complete, operational, and fully functioning system. All components comprising the foam system alarm and control must be sourced through Det-Tronics, the manufacturer of the required FSCP and optical flame detectors, to ensure compatibility. For the purposes of this Contract, all Det-Tronics installation recommendations must be considered as mandatory requirements. All devices must be grounded in strict accordance with the Det-Tronics installation instructions. All circuit wiring must be installed as part of shielded cable assemblies, in rigid galvanized steel conduit, and grounded in strict conformance with the Det-Tronics installation instructions. The new FSCP will also control the existing clam shell riser deluge valve with START/STOP functions.

B. Foam System Control Panel (FSCP): FSCP must be Det-Tronics Eagle Quantum Premier Fire Detection/Releasing System, must be furnished complete with minimum 60-node Safety Systems Software (S3) configuration/logic programming/diagnostic tools software package including USB dongle key and RS232 cable. FSCP alarm, supervisory, and trouble signal reporting to the Fire Alarm Control Panel must be via discrete dry contact output points. Modular type panel installed in a surface mounted NEMA Type 4 painted steel cabinet with hinged door and cylinder lock. All detectors must be listed for use with that panel. IR detectors must be networked with the panel so that during commission IR detectors can be calibrated from the releasing panel. The FSCP must provide a real time display of current IR levels at any detector, have the ability to set the detector sensitivity for each detector from the panel, be able to download detector level log history, have remote test and diagnostics capability (manual self-test, lens dirty, sensor failure, power out of tolerance, device non-responsive), and remote setup and programming of detector options (lens heater power level, detector alarm LED function, alarm latching or non-latching, device address, sensitivity level, timing and gate count for alarm). FSCP must be electro-magnetic interference/radio frequency interference (EMI)/(RFI) tolerant and rated to SIL level 2 capability (IEC 61508), a safety assessment evaluation which evaluates critical fault paths, redundancies, and statistical measurement/prediction to ensure a specific level of long term reliable performance and stability to co-exist with aircraft radar systems. In certain situations a redundant foam suppression control panel may be needed, verify redundancy requirements with agency and mission. FSCP shall be furnished with an external in-line surge protection device for the input voltage (120 VAC). The surge protector shall be equal to EDCO# HSP-121A.

C. Auxiliary Power Supply

1. Storage Batteries: Provide sealed lead acid, or gel cell batteries and charger. Drycell batteries are not acceptable. House batteries in a well-constructed vented steel rack-style cabinet with cylinder lock, non-corrosive base, and louvered vents. Floor mounted racks are permitted provided all battery components and conductors are no less than 12 inches above finished floor. Rack must be secured to the wall or floor slab. Locate wall-mounted cabinet such that the top of the cabinet not more than 4 feet above floor level. Provide batteries of adequate ampere-hour rating to operate the system under supervisory conditions for 90 hours, at the end of which time batteries must be capable of operating the entire system in a full alarm condition for not less than 30 minutes. Provide battery standby power requirements calculations substantiating the battery capacity. Provide reliable separation between cells to prevent contact between terminals of adjacent cells and between battery terminals and other metal parts.
2. Provide batteries with post-and-nut, "L"-blade, or similar terminals. Slip-on tab type terminals are not acceptable. When a separate battery cabinet is used, provide a fuse block for battery leads within the cabinets. Finish the cabinet on the inside and outside with enamel paint.

3. Battery Charger: Provide completely automatic high/low charging rate type charger capable of recovery of the batteries from full discharge to full charge in 24 hours or less. Provide an ammeter for recording rate of charge and a voltmeter to indicate the state of battery charge under load. Meters must be factory installed, or factory-supplied plug-in modules. Field installation of meters other than the panel manufacturer's plug-in modules is prohibited. Provide a trouble light to indicate when batteries are manually placed on a high rate of charge as part of the unit assembly if a high-rate switch is provided. House charger in the control panel or battery cabinet.

D. Foam System Release Circuit Devices

1. Optical Flame Detectors: Optical flame detection will be the X3301 Multispectrum IR Flame Detector manufactured by Det-Tronics. Optical flame detection system will use triple infrared (IR) flame detectors listed/approved for the expected fuel hazards in the hangar bay. The triple IR flame detectors must be in hangar mode. The detectors will be immune to radar and radio frequency emissions. Provide shielding for the detectors and their circuits from radio frequency interference. All circuiting from the FACP or FSCP to the detector will be shielded, and shielding will be grounded at one end. Optical flame detector alarm signals to the FACP or FSCP will be latching. Detectors must be mounted in accordance with their listing at approximately 8 feet (2.4 m) above the finished floor of the hangar. The specifics for each design must take into account facility construction, type of aircraft, aircraft configuration and positioning, fixed and mobile equipment within the aircraft servicing area, and all other relevant factors. Do not mount optical detectors in inaccessible locations. The detectors will be angled and blinds will be provided such that the cone-of-vision does not extend more than 5 feet (1.5 m) outside the hangar bay. The horizontal and vertical axis of the detector determined during commissioning will be permanently marked on each detector. The optical flame detectors will be installed with 5 feet (1.5 m) of flexible conduit to allow for any minor adjustments during testing or changes in mission of the hangar. Provide a sufficient number of optical flame detectors such that a fire at any position within the hangar bay will be within the range and cone-of vision of at least three detectors. With the exception of a manual foam release station, the cross-zoning of two optical flame detectors in the hangar bay is required to release the foam suppression system.

2. Manual Foam Release Stations: Provide low-level high expansion manual foam release stations where shown. Stations must be of a type not subject to operation by jarring or vibration. Stations must be of all metal construction and have a dual action release configuration to prevent accidental system discharge. Break-glass-front stations are not permitted. Station must provide positive visible indication of operation. Restoration must require use of a key. Place warning signs at each station indicating that operation of the station will cause immediate high expansion foam discharge. Where a building fire alarm manual pull station is also mounted in the vicinity of a manual foam release station, separate the stations by at least 5 feet horizontally. Place fire alarm manual pull stations and manual release stations on opposite sides of exit doors. Mount station on signage panel as specified herein and detailed on drawings. Manual foam releasing stations must be locking type that, when activated, require a key to be reset. Manual releasing stations must be surface mount. Manual foam releasing stations must be yellow in color, distinctly different from manual fire alarm stations, and must be mounted on a signage panel. Manual foam releasing stations must have the word "FOAM" on the front exterior of the enclosure. Manual foam releasing stations must be equipped with clear plastic tamper covers. The tamper covers must have the word "FOAM" on the front. No other words must appear anywhere on the exterior of tamper covers. Stations including associated surface mount back boxes must be weatherproof type (NEMA 4 or 6 as indicated on the drawings) with bottom conduit entry only. Stations with top conduit entry hubs are not acceptable.

3. Stop Station: Provide foam stop stations of the "dead-man" type. The stop stations must be used in conjunction with valves and equipment that will prohibit or stop the discharge of foam/water from the foam suppression system. The stations must have distinctive signage at each device. Provide a red mushroom type push button and include the word "PUSH". Colored portions of tamper cover must be blue and lettering on the cover must be "STOP"; the words "FIRE", "ALARM", or "AGENT" must not appear on the cover. A manual foam stop station will be provided at each manual foam releasing station. Once depressed, and so long as the button is held down, the stop station will prevent/stop discharge from the foam system regardless of whether or not the foam system was activated automatically or manually and whether or not the activation occurs prior to or after the stop station is pressed and held. Unless the FSCP has been reset and all activation alarms (manual and automatic) have been cleared; when the foam stop station button is released, the FSCP will instantaneously restore system operation and foam discharge. When the foam stop station button is depressed under full flow, the time to fully close the flow control valve will not exceed 15 seconds. The time for the flow
control valve to fully open upon release of the foam stop station button will not exceed 5 seconds. Manual foam stop stations will be protected from mechanical damage and water infiltration (minimum NEMA 4). Manual foam stop stations will be provided with a clear plastic tamper cover that must be lifted prior to actuating the station. Conduits will enter the station back box from the bottom. Back box and conduits will not be placed in front of signage, and a breather and drain (at the low point in the conduit) will be provided. Where manual stop stations and foam releasing stations are provided at an exit door, they will be located on opposite sides of doorway from fire alarm manual pull station. Where not located at an exit door opening, the manual stop stations and foam releasing stations will be located at least 5 feet apart.

a. Provide two separate but adjacent 24 inch (610 mm) high by 18 inch (457 mm) wide metal signs. There will be no more than 12 inches of separation between the two signs. The words "FIRE", "ALARM", or "AGENT" will not appear on these signs. The sign for the manual releasing station will have a yellow or lime-yellow background with "START FOAM SYSTEM" in red lettering not less than 3 inches (76 mm) high. The manual release station with tamper cover will be located on the lower center portion of the sign. The word "START" will be written in minimum 1 inch (25.4 mm) high green lettering placed directly above the activation station. The sign for the manual stop station will have a white background with a minimum 1/2 inch wide blue boarder with "STOP FOAM SYSTEM" in blue lettering not less than 3 inches (76 mm) high. The manual stop station with tamper cover will be located on the lower center portion of the sign. The word "STOP" will be written in minimum 1 inch (25.4 mm) high red lettering placed directly above the manual stop station.

2.03 FOAM CONCENTRATE

A. Foam concentrate will be a synthetic based foaming agent designed for use with high expansion foam generating equipment provided. The Contractor's final shop drawings and calculations shall not exceed 1,000 to 1. The shelf life shall be a minimum of 20 years. Foam type shall match existing.

2.04 ELECTRICAL WORK

A. Electrical work is specified in Division 26 except for control and fire alarm wiring. Fire alarm system is specified in Section 28 31 00 FIRE DETECTION AND ALARM SYSTEMS.

B. System Field Wiring: Provide control wiring and connections to foam and fire alarm systems, under this section and conforming to NFPA 70 and NFPA 72. All wiring must be color coded. Wiring, conduit and devices exposed to water or foam discharge must be NEMA 4X (IP65). Wiring, conduit and devices located in hazardous atmospheres, as defined by NFPA 70 and as shown, must be NEMA 7 (explosion proof). Conduits shall enter all boxes and devices in the hangar from the bottom. All conduit must be minimum 3/4 inch size.

1. Wiring Within Cabinets, Enclosures, Boxes, Junction Boxes, and Fittings: Provide wiring installed in a neat and workmanlike manner and installed parallel with or at right angles to the sides and back of any box, enclosure, or cabinet. Conductors which are terminated, spliced, or otherwise interrupted in any enclosure, cabinet, mounting, or junction box must be connected to terminal blocks. Mark each terminal in accordance with the wiring diagrams of the system. Make connections with approved pressure type terminal blocks, which are securely mounted. The use of wire nuts or similar devices must be prohibited.

C. The Det-Tronics wiring shall be run in galvanized rigid conduit.

2.05 ALARMS

A. Fire Alarm: Provide equipment and interconnections for the automatic transmittal of an alarm over the building fire alarm system as specified in Section 28 31 00 FIRE DETECTION AND ALARM SYSTEMS. Arrange so that actuation of any alarm initiating device (OFD or manual release station), trouble and supervisory conditions must cause activation of the fire alarm and reporting systems.

1. Flow Switch: The existing flow switch shall be wired to automatically transmit alarm condition to the building fire alarm system upon flow of water or high expansion foam. Alarm actuating device must instantly recycle.

2.06 ALARM SIGNALING DEVICES

A. Provide the aircraft hangar area with visual alarms located where shown. All alarm circuits must be electrically supervised. Each signal device must be provided with a rigid plastic or metal identification sign with lettering a minimum of 1.5 inches high. The signaling devices must be labeled "FOAM SYSTEM FLAME DETECTOR ACTIVATION."

B. High Expansion Foam Visual Notification Devices: Provide blue beacons not less than 400 cd (208/120VAC) powered from the foam system control panel (FSCP). This requirement does not justify an
emergency generator for the facility. The FSCP will control beacon initiation. A backup power supply or supervision of the power supply feeding the beacons is not required when fed from the dedicated emergency panel. Beacons will be mounted 20 - 30 feet (3 - 9.1 m) above the floor of the hangar bay. For single door hangars, provide one beacon centered on each of the three walls. Provide additional beacons where at least one beacon is not viewable from normally occupied areas of the hangar bay. Design will take into account facility construction, type of aircraft, aircraft configuration and positioning, fixed and mobile equipment within the aircraft servicing area.

2.07 ABOVEGROUND PIPING SYSTEMS

A. Pipe, Fittings, and Mechanical Couplings: NFPA 13, except steel piping must be Schedule 40. Rubber gaskets used with grooved-end fittings must be UL listed for use in dry-pipe sprinkler systems. Use of restriction orifices, reducing flanges, and plain-end fittings with mechanical couplings (which utilize steel gripping devices to bite into the pipe when pressure is applied) are not permitted. Pipe and fittings in contact with high expansion foam concentrate must be material resistant to the corrosive effects of high expansion foam concentrate as approved by the manufacturer of the proportioning system.

1. Foam Solution Piping: All pipe, fittings, fasteners, hangars, and stands downstream of the flow control valve must be hot dip galvanized and a minimum schedule 40 wall thickness. Do not roll groove galvanized pipe. Any cut groves, threaded ends and areas where the zinc coating has been damaged must be cleaned of cutting oils and debris, dried, and painted with two full coats of a cold galvanizing primer containing a minimum of 95% zinc.


C. Pipe Hangers and Supports: Provide galvanized or stainless steel pipe hangars and supports as required by NFPA 13.

D. Valves: Provide valves as required by NFPA 13 and of types approved for fire service. Gate valves must open by counterclockwise rotation. Check valves must be flanged clear opening swing check type with flanged inspection and access cover plate for sizes 4 inches and larger. Provide an OS&Y or butterfly valve beneath each flow control valve in each riser, when more than one valve is supplied from the same water supply pipe.

E. Identification Signs: Attach properly lettered approved metal signs conforming to NFPA 13 to each valve and alarm device. Permanently affix design data nameplates to the riser of each system.

F. Pipe Sleeves: Provide where piping passes through walls, floors, roofs, and partitions. Secure sleeves in proper position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, floors, roofs, and partitions. Provide not less than 1/4 inch space between exterior of piping and interior of sleeve. Firmly pack space with insulation and calk at both ends of the sleeve with plastic waterproof cement.

1. Sleeves in Masonry and Concrete Walls, Floors, Roofs: ASTM A53/A53M, schedule 40 or standard weight, zinc-coated steel pipe sleeves. Extend sleeves in floor slabs 3 inches above the finished floor.

2. Sleeves in Partitions: Provide zinc-coated steel sheet having a nominal weight of not less than 0.90 pounds per square foot.

G. Escutcheon Plates: Provide one piece or split hinge type plates for piping passing through floors, walls and ceilings, in both exposed and concealed areas. Provide chromium plated metal plates where pipe passes through finished ceilings. Provide other plates of steel or cast iron with aluminum paint finish. Securely anchor plates in place.

PART 3 EXECUTION

3.01 INSPECTION BY FIRE PROTECTION ENGINEER

A. The Fire Protection Engineer specified in this Section must inspect the sprinkler system periodically during the installation to assure the sprinkler system is being provided and installed in accordance with the contract requirements and the approved sprinkler system submittal(s). This Fire Protection Engineer must attend both the preliminary and final tests, and must sign the test results. After the preliminary testing has been completed, the Fire Protection Engineer must certify in writing the system is ready for the final inspections and tests. This report must document any discrepancies found and what actions will be taken to correct. Any discrepancy noted during the periodic site visits or the preliminary testing must
be brought to the attention of the Contracting Officer in writing, no later than three working days after the discrepancy is discovered. Pre-priming of any foam solution piping is NOT acceptable. All solution piping must be slopped to be self-draining back to the riser. During commissioning, the responsible FPE must seal or otherwise install tamper proof guards on the pressure regulator adjusting stem and the two small globe valves on the speed control assembly. It is crucial these settings not be changed after commissioning; so that the system will operate correctly. Safety-wire these devices in those positions and label them "DO NOT ADJUST". Any other trim valves which must be open or closed for the FCV to function also must be safety wired in position.

3.02 HIGH EXPANSION FOAM SYSTEM INSTALLATION
A. Equipment, materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing must be in accordance with the NFPA standards referenced herein. Install piping straight and true to bear evenly on hangers and supports. Conceal piping to the maximum extent possible. Piping must be inspected, tested and approved before being concealed. Provide fittings for changes in direction of piping and for all connections. Make changes in piping sizes through standard reducing pipe fittings; do not use bushings. Cut pipe accurately and work into place without springing or forcing. Ream pipe ends and free pipe and fittings from burrs. Clean with solvent to remove all varnish and cutting oil prior to assembly. Make screw joints with PTFE tape applied to male thread only.

3.03 FIELD PAINTING
A. Clean, prime, and paint new foam systems including valves, piping, conduit, hangers, miscellaneous metal work, and accessories. Apply coatings to clean dry surfaces using clean brushes. Clean the surfaces in accordance with SSPC SP 11. Immediately after cleaning, prime the metal surfaces with one coat of SSPC Paint 25 or SSPC Paint 25 primer applied to a minimum dry film thickness of 1.5 mils. Exercise care to avoid the painting of sprinkler heads and operating devices. Upon completion of painting, remove materials which were used to protect sprinkler heads and operating devices while painting is in process. Remove sprinkler heads and operating devices which have been inadvertently painted and provide new clean sprinkler heads and operating devices of the proper type. Finish primed surfaces as follows:

B. Foam Systems in Unfinished Areas: Unfinished areas are defined as attic spaces, spaces above suspended ceilings, crawl spaces, foam rooms, pump rooms, pipe chases, and other spaces where ceilings are not painted or not constructed of a prefinished material. Paint primed surfaces with two coats of CID A-A-2962 red enamel applied to a minimum dry film thickness of 1.5 mils.

C. Foam Systems in All Other Areas: Paint primed surfaces with two coats of paint to match adjacent surfaces, except paint valves and operating accessories with two coats of CID A-A-2962 red enamel applied to a minimum dry film thickness of 1.5 mils. Provide piping with 2 inch wide red bands spaced at maximum 20 foot intervals throughout the piping systems. Bands must be red enamel or self adhering red plastic tape.

D. Piping Labels: Provide permanent labels in foam rooms, spaced at 20 foot maximum intervals along pipe, indicating "WATER" and "FOAM SOLUTION" on corresponding piping.
1. Fire Protection Water
2. Foam Concentrate
3. Foam Solution
4. Sprinkler
5. Test

E. Field Touch-Up: Clean damaged areas of shop coated tanks in accordance with SSPC SP 11 and coat cleaned areas with the same materials used for the shop applied coating system.

3.04 ELECTRICAL WORK
A. Electrical work is specified in Division 26, except for control and fire alarm wiring. The fire alarm system is specified in Section 28 31 00 FIRE DETECTION AND ALARM SYSTEMS.

B. Wiring: Provide control wiring, and connections to foam and fire alarm systems, under this section in accordance with NFPA 70 and NFPA 72. Provide wiring in rigid metal conduit or intermediate metal conduit, except electrical metallic tubing may be used in dry locations not enclosed in concrete or where not subject to mechanical damage. Do not run low voltage DC circuits in the same conduit with AC circuits. Run wiring to optical flame detectors alone in separate conduit if required by the detector
manufacturer. Optical flame detectors, manual release stations, and abort stations must be provided with watertight connections with conduit runs entering the station backbox from the bottom.

3.05 FLUSHING

A. Flush the piping system in accordance with NFPA 13. Continue flushing operation until water is clear, but for not less than 10 minutes. Flushing of low-level system must be accomplished with low-level nozzle covers removed. System isolation valve must be secured prior to the start of flow control valve operation, then slowly opened to assure flushing is conducted in a controlled and safe manner. Once flushing has been completed, low-level nozzle diffusers must be reinstalled in accordance with manufacturer's specifications.

3.06 FIELD QUALITY CONTROL

A. Prior to initial operation, inspect equipment and piping systems for compliance with drawings, specifications, and manufacturer's submittals. Perform tests in the presence of the Contracting Officer to determine conformance with the specified requirements. Contact the AFCEC Hangar Fire Protection Engineer, Ms. Judy Biddle (j.biddle.1@us.af.mil), for the current testing checklist at the time of testing. See Appendix A of this section for a preliminary checklist.

B. Preliminary Tests: Each piping system must be hydrostatically tested at 200 psig in accordance with NFPA 13 and must show no leakage or reduction in gage pressure after 2 hours. The Contractor must conduct complete preliminary tests of the entire system, both modified and existing components, which must encompass all aspects of system operation. Individually test all detectors, manual actuation stations, alarms, control panels, and all other components and accessories to demonstrate proper functioning. Test water flow alarms by flowing water through the inspector's test connection. When tests have been completed and all necessary corrections made, submit to the Contracting Officer a Preliminary Test Report signed and dated by the Fire Protection Engineer, similar to that specified in NFPA 13, attesting to the satisfactory completion of all testing and stating that the system is in operating condition. Also include a written request for a formal inspection and test.

C. Formal Inspection and Tests: The Fire Protection Engineer will witness formal tests and approve all systems before they are accepted. The system must be considered ready for such testing only after all necessary preliminary tests have been made and all deficiencies found have been corrected to the satisfaction of the equipment manufacturer's technical representative and written certification to this effect is received by the Fire Protection Engineer.

1. Formal Inspection and Testing Requests: Submit the request for formal inspection at least 30 working days prior to the date the inspection is to take place.
   a. All Certification that preliminary testing has been completed and a copy of the preliminary test report must accompany the request for formal inspection.
   b. The control panel(s) and detection system(s) must be in continuous service for a "break-in" period of at least 15 consecutive days prior to the formal inspection.
   c. Experienced technicians regularly employed by the Contractor in the installation of both the mechanical and electrical portions of such systems must be present during the inspection and must conduct the testing.
   d. All high expansion foam concentrate, instruments, including optical flame detector test lamp and function test kit, personnel, appliances and equipment for testing must be furnished by the Contractor. All necessary tests encompassing all aspects of system operation must be made including the following, and any deficiency found must be corrected and the system retested at no cost to the Government.
   e. The Contractor must submit the Final Acceptance Test of the entire foam system, both modified and existing components.
   f. Provide protection for all electrical fixtures and equipment exposed to possible damage during tests and protect doors and other openings leading from the protected area(s), to prevent migration of foam solution into other areas or spaces. Install plastic sheeting over all wall and door surfaces from the finish floor to not less than 20 feet above the finish floor.
   g. Report as specified in the Submittals paragraph.

2. Systems Functional and Device Testing: Every feature and function of the foam system control panel, including initiating, alarm, and actuation systems must be operated. As a minimum, operation and supervision of the following functions and devices must be demonstrated:
   a. All operational and supervisory functions of the control and annunciator panels.
   b. Each foam system manual release and abort stations and associated circuit(s).
   c. All optical flame detectors and associated circuits. The Contractor must engage the services of the optical flame detector manufacturer to conduct actual pan fire tests in the presence of the
Contractor, Contracting Officer, AFCEC FPE and the base fire department. The Contractor must provide a liquid tight 3.28 foot square by 4 inch high welded steel fire pan with detachable removable steel cover, and steel sub-frame with rollers/casters to allow for convenient relocation of the fire pan. The Contractor must obtain JP-8/JET-A/JET/A1 fuel from the Government for use in the fire pan, and must conduct pan fire tests to demonstrate the performance of the optical flame detectors. Detector pass/fail status must be determined by comparison of detector performance during pan fire tests relative to the detector manufacturer's published performance data for the specific type detector being tested. Pan fire tests must be conducted in up to 12 separate locations to be determined by the Government. No foam must be discharged during pan fire tests. Coordinate with the AFCEC FPE and the base fire department prior to conducting any pan fire tests.

d. Each general alarm initiating device (manual pull stations, flow switches, pressure switches, and associated circuit(s).

e. Each supervisory initiating device or function (valve tamper switch, tank level supervisory panels, fire pump controllers, etc) and associated circuit(s).

f. All alarms and associated circuits.

g. All actuator circuits and system control valve(s) (without foam discharge).

h. Activation of the building fire evacuation alarm system.

i. Activation of the Base fire alarm system (receipt of fire alarm at alarm office).

j. All of the above tests must then be repeated with the system on battery power only.

k. Flow control valve (FCV) functional testing. Operate flow control valves and adjust valve open/closure speed and discharge pressure settings as specified. Demonstrate proper pressure settings and valve peration speed by utilizing the nozzle test/drain assembly at the most remote nozzle to record system pressure and by using the system abort station to stop and restart flow. Seal the pressure regulator, opening speed, and closure speed valves in their final "set" position with safety wire. Wire seals must prohibit casual movement of valves. Permanently record the final FCV discharge pressure setting on each valve.

3. High Expansion Foam Discharge Testing: When all of the initiating, alarm, actuation, and supervisory functions of the system operate to the satisfaction of the system manufacturer's technical representative and the Fire Protection Engineer, and the AFCEC Fire Protection Engineer; the contractor must conduct a full discharge test of the system servicing each separated fire area. The test must be performed to demonstrate satisfactory performance, proper HIGH EXPANSION FOAM concentration, mechanical operation and operation of valves, release devices, alarms, and interlocks which control the protected areas. These tests must be conducted by experienced personnel according to the equipment and high expansion foam manufacturers' recommendations.

a. Contractor must prepare a plan for conducting the test and the duties of the test team. Contractor must remove any mobile / portable equipment from the hangar servicing area. Contractor must cover the hangar walls and surface mounted equipment with plastic sheeting from the finished floor to 20 feet above the finished floor. Doors into adjacent areas must be protected to prevent foam-water solution leaking into the adjacent areas during the test and subsequent clean-up. The test and any re-test will begin with the system in normal configuration; no recharging of the system piping is allowed. Hangar doors will be closed and will remain closed until the hangar is released to the contractor's clean-up team.

b. Test must be initiated by activating one of the manual foam start stations located throughout the hangar bay.

c. Test low-level fire extinguishing system by full flow of foam-water solution through the foam generators to demonstrate the following:

- 90% Coverage of the aircraft silhouette projected on the floor (marked with painter's tape) within 60 seconds of the opening of the water control valve.
- No foam falls from the foam generators within the projected aircraft silhouette.
- Foam fills the hangar servicing area to a level of not less than 1 meter in not less than 4 minutes or less.

- Once the test director indicates the 1 meter depth has been achieved, depress a "Stop Foam System" button on a station remote to the activation station used to initiate the discharge. The water control valve must close not faster than 5 seconds and not more than 15 seconds.

d. The Contractor shall prepare a written report that documents the results of the tests, in addition to the videos.

e. During the test (c above) the foam concentrate manufacturer's representative must collect samples from not less than two remotely located generators of the discharged expanded foam-water solution and using the conductivity method determine the foam concentrate proportioning rate (percentage).
f. Since the foam generator sizing and placement are existing, the Contractor will not be responsible for the 90% coverage of the aircraft silhouette within 60 seconds of system activation. The Contractor shall be responsible for the proper operation of the control/releasing system, the flow control valve opening/closing and the foam concentrate system. In particular the Contractor is responsible for the timing requirements including ensuring the foam level reaches 1 meter in less than 4 minutes.

4. Flushing and Rinsing: After completion of tests flush all piping carrying HIGH EXPANSION FOAM solution with fresh water. Rinse with fresh water all equipment and building surfaces exposed to high expansion foam discharge.

D. Environmental Protection: The concentrate shall be biodegradable, low in toxicity, and treatable in sewage plants.

E. Additional Tests: When deficiencies, defects or malfunctions develop during the tests required, all further testing of the system must be suspended until proper adjustments, corrections or revisions have been made to assure proper performance of the system. If these revisions require more than a nominal delay, the Contracting Officer must be notified when the additional work has been completed, to arrange a new inspection and test of the system. All tests required must be repeated prior to final acceptance, unless directed otherwise.

F. High Expansion Foam Concentrate: High expansion foam concentrate must be approved by the generator manufacturer as appropriate for use with the specific generators installed. Contractor must provide high expansion foam concentrate for all testing (initial and acceptance) and any required retesting. Concentrate tanks must be full (not less than the minimum quantity intended to provide the 15 minute operating time) for all tests. Foam concentrate removed from the tank for repairs or adjustments must not be reused unless the concentrate manufacturer certifies the removed concentrate is of the same quality as original new concentrate. Following approval of all testing by the Contracting Officer and completion of all "punch list items" the contractor must replenish the concentrate storage tank with not less than the minimum design quantity to provide 15 minutes of operating time.

G. Manufacturer's Representative: Provide the services of representatives or technicians from the manufacturers of the low-level high expansion foam concentrate, foam system control panel, and optical flame detectors experienced in the installation and operation of the type of system being provided, to supervise installation, adjustment, preliminary testing, and final testing of the system and to provide instruction to Government personnel. The foam system control panel manufacturer must provide a minimum of 4-days startup assistance.

3.07 OPERATING INSTRUCTIONS
   A. Provide instructions for operating the fire extinguishing system at control equipment and at each remote control station. Instructions must clearly indicate all necessary steps for the operation of the system. Submit the proposed legend for operating instructions for approval prior to installation. Instructions must be in engraved white letters on red rigid plastic or red enameled steel backgrounds and must be of adequate size to permit them to be easily read.

3.08 TRAINING REQUIREMENTS
   A. Prior to final acceptance, the Contractor must provide two sessions of 4 hours each of operation and maintenance training to the installation Civil Engineering; Installation Fire Emergency Service; and Installation Ground Safety Activity personnel on two different days to accommodate both shifts of the Installation Fire Emergency Services. Each training session must include emergency procedures, and unique maintenance and safety requirements. Training areas will be provided by the Government in the same building as the protected areas. The training conducted must use operation and maintenance manuals specified in paragraph entitled "Operations and Maintenance Manuals". Dates and times of the training period must be coordinated through the Contracting Officer not less than two weeks prior to the sessions.

3.09 APPENDICES
   A. The following are included at the end of this section.
      1. Appendix A - Preliminary and Final Hangar Fire Suppression/Detection Acceptance Testing Requirements
      2. Appendix B – Criteria changes.

END OF SECTION