DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR FORCE CIVIL ENGINEER SUPPORT AGENCY

22 JAN 1996

FROM: HQ AFCESA/CES
139 Barnes Drive, Suite 1
Tyndall AFB, FL 32403-5319

SUBJECT: Engineering Technical Letter (ETL) 96-1: Fire Protection Engineering Criteria - New Aircraft Facilities

1. Purpose. This ETL provides fire protection criteria governing all facilities housing Air Force aircraft or other aircraft on Air Force installations. These criteria provide for protection of adjacent aircraft and the facility in the event of a fuel spill fire. Human intervention is required to minimize damage to incident aircraft.

2. Application: All types of aircraft facilities, including but not limited to maintenance, servicing, and storage hangars; corrosion control hangars; fuel cell repair hangars; depot overhaul facilities; R&D/testing facilities housing aircraft; and all types of aircraft shelters (weather, alert, semi-hardened and hardened). Compliance with this ETL is mandatory for:

- ù projects that have not completed the Project Definition (PD) phase,
- ù projects beyond the PD phase but not in active design status.

Compliance with this ETL should be considered for projects in active design beyond PD. Applying these criteria will result in reduced original construction and life-cycle maintenance costs, and increased overall reliability of the fire protection system.

2.1. New Construction: Design and construction of all new aircraft facilities on Air Force installations or housing Air Force aircraft.

2.2. Existing Facilities: Design and construction of fire protection features for all existing aircraft facilities currently without installed fire suppression systems. All renovation, modification, or alteration activities will comply to the extent possible with the criteria contained in this ETL.

2.2.1. Occupancy Changes. Use of this ETL is also mandatory during a major occupancy change, such as a new mission beddown. The MAJCOM Fire Protection Engineer (FPE) may approve continued use of existing facilities with fire suppression systems that have been modernized IAW current guidance.

2.2.2. ICT Facilities. Criteria within this ETL apply to facilities for integrated combat turns (ICT). However, compliance with this ETL is not authorization to conduct ICTS. ICT locations must be specifically evaluated and approved through the System Safety Engineering Program (AFI 91-202).

2.3.Exceptions:

- Aircraft shelters with two or fewer sides (including partial walls). These shelters will be treated as open ramps.
- Semi-hardened and hardened facilities for ICTS. These facilities must be evaluated and approved through the System Safety Engineering Program.
- Existing aircraft facilities with fire suppression systems in the aircraft servicing areas. Fire protection modification/upgrade requirements will be addressed in a separate ETL.

2.4. Authority: AFI 32-2001, Fire Protection Operations and Fire Prevention Program. This ETL supersedes ETL 90-09, Fire Protection Engineering Criteria for Aircraft Maintenance, Servicing, and Storage Facilities.

2.5. Effective Date: Immediately. Expires five years from date of issue.

2.6. Recipients: All Major Commands and other Air Force activities.

NOTE: The criteria in this ETL assume fire department capabilities consistent with AFI 32-2001, and a water supply and fire hydrant configuration at the hangar to support firefighting. Use of these criteria at other locations is not recommended without a complete risk analysis prepared by the base (or the project A-E for new construction) and accepted by the MAJCOM FPE and the MAJCOM Fire Department Operations (FDO) group.

3. Referenced Documents.

3.1. Air Force Publications.

- AFI 32-2001, Fire Protection Operations and Fire Prevention Program, May 1994
- AFR 88-15, Criteria and Standards for Air Force Construction (Draft 15 Dec 1985 - Rescinded)
- AFR 127-6, US Air Force System Safety Engineering Analysis (SSEA) Program, June 1986
- AFM 85-21, Operation and Maintenance of Cross-Connection Control and Backflow Prevention Systems, February 1982
- AFM 88-29, Engineering Weather Data, July 1978

3.2. DoD Publications.

- MIL-HDBK-1 190, Facility Planning and Design Guide, 1 Sep 1987
- MIL-HDBK-1 008B, Fire Protection for Facilities Engineering, Design, and Construction, 15 Jan 1994

3.3. National Fire Protection Association (NFPA) Publications.

- NFPA 11, Foam Systems
- NFPA 13, Installation of Sprinkler Systems

- NFPA 16, Foam- Water Sprinkler and Spray Systems
- NFPA 16A, Closed-Head Foam-Water Sprinkler Systems
- NFPA 20, Fire Pumps
- NFPA 22, Water Tanks for Private Fire Protection
- NFPA 24, Installation of Private Fire Service Mains and their appurtenances
- NFPA 70, National Electrical Code
- NFPA 72, National Fire Alarm Code
- A 410, Aircraft Maintenance

NOTE: The latest edition of an NFPA standard applies.

3.4. Research Reports.

- AFWL-TR-72-135, Requirements for Explosion-Proof Electrical Equipment in Air Force Hangars, August 1973
- AFWL-TR-75-119, Fire Protection of Large Air Force Hangars, October 1975
- FWRC J.1. OC6N3.RG, Closed-Head AFFF Sprinkler Systems for Aircraft Hangars, December 1979
- Engineering Technical Letter (ETL) 86-8, Aqueous Film Forming Foam (AFFF) Waste Discharge Retention and Disposal, 4 Jun 1986
- USACE Engineer Technical Letter 11 10-3-41 1, Design and Construction of Foam Fire Protection Systems to Protect Aircraft in Hangars, 26 Apr 1990

4. Specific Requirements. This ETL, in accordance with paragraph 1.3.4 of MIL-HDBK-1 008B, Fire Protection For Facilities Engineering, Design, and Construction, takes precedence over MIL-HDBK 1008B, section 4.16. This ETL is the Air Force alternative to National Fire Protection Association Standard 409 (Standard on Aircraft Hangars) and will used in lieu of that standard. Attachment 1 provides criteria and technical guidance.

4.1. Responsibilities.

4.1.1. Installation. The Base Fire Marshal is the highest fire protection authority at the base level. Base officials can apply and interpret applicable NFPA standards, but they do not have authority to deviate, waive, or modify the requirements of this ETL or the applicable NFPA standards unless a waiver has been issued IAW MIL-HDBK 1008.

4.1.2. MAJCOM.

4.1.2.1. Fire Protection Engineer. The FPE is the authority having jurisdiction (AHJ) for all issues other than those covered in paragraph 4.1.2.2 and will have the authority to evaluate and resolve such matters elevated from the base-level AHJ. Waiver requests pertaining to all other issues within the scope of this ETL will be resolved by the MAJCOM FPE (GS/GM-804) when the issue is within the FPE purview. Issues considered to be unusually complex, a significant variance to the

NFPA Life Safety Code, or of major significance, may be elevated to HQ AFCESA/CESM. If a MAJCOM does not have an FPE with the qualifications specified in paragraph A6.1.1.1, the FPE authority shall revert to HQ AFCESA/CESM.

4.1.2.2. Fire Department Operations (FDO) Manager. The FDO Manager is the MAJCOM-level authority for firefighting issues contained in paragraph A2. The FDO Manager is the AHJ for the firefighting issues (same paragraph) and has the authority to evaluate and resolve such matters elevated from the base-level AHJ.

4.1.3. HQ AFCESA. HQ AFCESA/CESM is the final AHJ for all issues pertaining to this ETL and is authorized to issue permanent and temporary waivers without restriction except when otherwise required by Public Law.

4.1.4. U.S. Army Corps of Engineers Center of Expertise for Aircraft Hangar Fire Protection.

4.1.4.1. For all hangar MILCON projects on which the CoE is the Design Agent, the CoE Center of Expertise will review all project designs to ensure compliance with this ETL. This review is mandatory at all design review stages, and all formal review comments issued by the Center of Expertise will be implemented to the satisfaction of the Air Force IAW USACE/CEMP 13 July 95 letter, Fire Protection Design Review for Air Force Hangar Facilities.

4.1.4.2. For all hangar MILCON projects on which the CoE is the Construction Agent, the CoE Center of Expertise will review all contractor shop submittals to ensure compliance with this ETL. All review comments issued by the Center of Expertise will be implemented by the CoE's contracting officer to the satisfaction of the Air Force. An FPE in the office of the Center of Expertise will perform the final acceptance testing of all hangar fire protection systems. The MILCON project shall not be accepted by the CoE Contracting Officer until the CoE Center of Expertise has accepted the fire protection systems.

4.1.5. NAVFACENGCOM Division Fire Protection Engineer.

4.1.5.1. For all hangar MILCON projects on which NAVFAC is the design agent, the Division Fire Protection Engineer will review all project designs to ensure compliance with this ETL. This review is mandatory at all design review stages, and all formal review comments issued will be implemented to the satisfaction of the Air Force.

4.1.5.2. For all hangar MILCON projects, the Division Fire Protection Engineer will review all contractor shop submittals to ensure compliance with this ETL. All review comments be implemented by the contracting officer to the satisfaction of the Air Force. A Fire Protection Engineer will perform the final acceptance testing of all hangar fire protection systems.

5. Point of Contact. Fire protection criteria for aircraft facilities must evolve concurrently with technical developments in fire science, data generated in fire testing programs, and the availability of new fire protection equipment or methodologies. Recommendations for improvements to this ETL are encouraged and should be furnished to Mr. Fred Walker, HQ AFCESA/CESM, DSN 523-6315, commercial (904) 283-6315, FAX 523-6219.

William G. Schauz, Colonel,USAF
Director of Technical Support

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1. Technical Criteria
2. Distribution List

TECHNICAL CRITERIA
USAF AIRCRAFT HANGAR FIRE PROTECTION

A1. Construction Requirements.

A1.1. Structural Requirements. All new aircraft hangars will be exclusively noncombustible construction IAW Uniform Building Code (UBC) requirements for any category of Type I or Type 11 construction.

A1.1.1. Fire-Rated Construction. Protection of structural members (columns, beams, trusses, joists) is not required in a facility protected by an approved fire suppression system in compliance with this ETL.

A1.1.2. Internal Fire-Rated Separations. When AF aircraft assets are co-located in a facility with non-DoD operations that are beyond the control of the DoD activity, the AF aircraft assets will be isolated from the non-DoD areas by 4-hour rated fire walls. Penetrations of such fire walls shall be minimized. Any necessary door, window, and other penetration shall be protected IAW Factory Mutual Loss Prevention Data Sheets 1-22, Criteria for Maximum Foreseeable Loss Fire Walls and Space Separation, and 1-23, Protection of Openings.

A1.1.2.1. To allow the greatest operational flexibility in AF hangars covered by this ETL, fire-rated walls and partitions are not required between adjacent aircraft servicing areas when the nature of the occupancy is similar in both bays. Operations such as fuel cell maintenance, ICTS, and indoor refueling must be separated from general maintenance by not less than walls of masonry construction and having a 1-hour fire rating with 45-minute opening protection. Such walls will extend from the floor to the underside of the roof deck.

A1.1.2.2. Except in facilities containing only drained and purged aircraft, all operations outside of the aircraft servicing area shall be isolated from the aircraft servicing area by a masonry wall having a fire resistance rating of at least 1 hour. This wall will extend from the concrete floor to the roof. All openings in this wall will be automatic-closing or self-closing and will be rated for at least 45 minutes. (These areas are required to be fully sprinklered IAW other sections of this ETL.)

A1.1.3. Allowable Floor Area.

A1.1.3.1. The allowable floor area of a facility is unlimited when all of the following conditions are met:

- ù 100 percent of the facility is sprinklered IAW this ETL;
- ù the water supply to the sprinkler systems is in full compliance with the criteria in this ETL;
- ù the separations from adjacent structures is IAW paragraph Al.1 of this ETL;
- ù internal separation walls are IAW paragraph 1.1.2 of this ETL.

A1.1.3.2. Facilities not meeting the above conditions will be limited to the floor areas contained in the latest edition of the Uniform Building Code for Occupancy type B-3; except facilities used for fuel cell maintenance, integrated combat turns, or indoor refueling/defueling, which shall be Occupancy type H-5.

A1.1.4. Siting - Separation Between Adjacent General Maintenance Hangars.

A1.1.4.1. No separation distance is required between any combination of Type I or Type II construction hangars
protected by approved fire suppression systems.

A1.1.4.2. Minimum separation distance between Type I or Type II construction hangars without an approved fire suppression system and between hangars of any other type of construction is 12 meters (40 feet). This may be reduced to 7.5 meters (25 feet) if one of the hangars has an 1 -hour exposing wall and protected 3/4-hour openings (e.g., windows, doors). This may be further reduced to 3 meters (1 0 feet) if both hangars have one-hour exposing walls and protected 3/4-hour openings.

A1.1.5. Siting - Separation Between Hangars and Other Buildings. Minimum separation between hangars and other buildings is 12 meters (40 feet). Reductions in this distance must conform to the Uniform Building Code, Section 504.

A1.1.6. Draft Curtains.

A1.1.6.1. Provide draft curtains for all hangars surrounding each sprinkler system. Extend draft curtains down from the roof or ceiling not less than one-eighth of the height from the floor to roof or ceiling. When the roof structural supports are below the roof or ceiling, extend the draft curtains to the lowest member of the structural supports or one-eighth of the height from the floor to roof or ceiling, whichever is greater.

A1.1.6.2. Install draft curtains to form roof pockets that are rectangular in shape. Install draft stops on the exposed structural roof supports whenever possible.

A1.2. Utility Systems.

A1.2.1. Floor Drainage.

A1.2.1.1. Aprons and the approach into the hangar will be sloped away from the hangar with a grade of not less than 1/2 of 1 percent (0.3:60 meters [1:200 feet]) to preclude a ramp fuel spill from entering the hangar. When the required grade cannot be accomplished, a trench drain of appropriate size will be provided across the entire apron side of the hangar with a discharge to a safe location remote from the hangar.

A1.2.1.2. Floor elevations within the hangar will be arranged such that a liquid spill within the aircraft servicing area will not flow into adjacent areas of the building.

A1.2.1.3. Provide trench drains in the aircraft servicing area for removal of fuel spills. Floors shall be sloped to provide for flow of spilled fuel away from the aircraft and directly to the nearest trench drain; slope floors 1/2 to 1 percent. Slope hangar floors away from the aircraft shadow area and away from hangar walls.

A1.2.1.4. Carefully coordinate the location of trench drains with aircraft parking positions and with foam-water nozzle locations and projected foam discharge patterns. A properly coordinated design of foam-water nozzles, floor slope, and trench drains will allow for a natural flow of a fuel spill away from the aircraft and the facility walls. Ensure the discharge of the nozzles will rapidly cover the aircraft shadow area while pushing the spilled fuel away from the aircraft shadow as directly as possible to a drain.

A1.2.1.5. Discharge from the hangar floor drainage system shall be at a safe location sufficiently remote from the hangar to preclude a fire exposure to the hangar or any other structure. Arrangement of the drainage system and valving will be IAW Air Force ETL 86-8 and will be coordinated with the installation environmental management organization. Ensure foam-water solutions do not flow through oil water separators.

A1.2.2. Heating Systems.

A1.2.2.1. Install heating equipment IAW NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems; NFPA 31, Standard for the installation of Oil Burning Equipment, or NFPA 54, National Fuel Gas Code, except as modified.

A1.2.2.2. Install overhead radiant tube heating systems whenever radiant heating is desired. Do not install any heater with a flame or glowing element open to the atmosphere in the aircraft servicing area.

A1.2.3. Electrical Systems.

A1.2.3.1. Install all electrical equipment in general maintenance aircraft hangars in accordance with NFPA 70, the National Electrical Code NEC Article 513.

A1.2.3.2. Install electrical equipment in hangars for fuel cell maintenance operations involving aircraft serviced with JP-8 (or another combustible fuel at a temperature below its flash point) in accordance with NFPA 70, the National Electric Code NEC Article 513.

A1.2.3.3. Hangars shall comply with the following where:

- refueling or defueling is conducted regardless of fuel type;
- Integrated Combat Turns (ICTS) may be conducted regardless of fuel type, and
- fuel cell maintenance operations with flammable fuels including JP-4 (or combustible fuel at a temperature above its flash point) are conducted.

A1.2.3.3.1. Install electrical equipment above the floor in the aircraft servicing area up to the height of the highest hangar door IAW NEC criteria for Class I Division 2 locations.

Al.2.3.3.2. Install electrical equipment including lights outside the classified area in the facility IAW NEC Article 513.

Al.2.3.4. In hangars where the rate of spray paint application exceeds 1 quart per hour or the cumulative application of more than 1 gallon over an 8-hour period, install electrical equipment IAW NFPA 33, Spray Applications Using Flammable or Combustible Materials.

Al.2.4. Fire Hydrants.

A1.2.4.1. Fire hydrants will be supplied by the domestic (potable) water with curb box control valves around the hangar IAW MIL-HDBK 1008B, section 5.7.3. Do not provide hydrants supplied by the fire protection water system. Hydrants installed for the protection of the apron side of the hangar should be located at the corners of the hangar approximately 30 meters (100 feet) from the hangar out of the way of moving aircraft. Do not use flush-mounted hydrants. Hose threads on hydrants shall match those used by the base fire department. Install wall hydrants in the side of the hangar supplied by the domestic water system when conventional hydrants cannot be used on the apron side of a hangar. Wall hydrants will be properly labeled and will be provided with a wall indicator valve to open the hydrant from outside the hangar.

A1.2.4.2. Install water mains supplying hydrants IAW MIL-HDBK 1008B.

A2. Accessibility for Firefighting.

A2.1. Accessibility for Exterior Firefighting. Provide fire apparatus access on at least two entire sides of every hangar. Suitable access surfaces include ramp, aircraft parking aprons, automotive parking areas, and fire apparatus access roads.

A2.1.1. Automotive parking areas used for fire department access must include at least one aisle 5.4 meters (18 feet) wide with adequate turning radius for fire department apparatus.

A2.1.2. Fire department access. roads shall be at least 5.4 meter (18 feet) wide and shall be designed to support the imposed loads of fire apparatus and shall provide all weather driving capabilities. Fire department access roads covered by mowed lawns will be provided with bollards to mark the limits of the supporting surface. Fire department access roads over 45 meters (150 feet) in length must include provisions to drive through or turn fire apparatus around. Fire department access roads ate not to be used for any other purpose and may be secured with gates, bollards, or other devices to restrict use.

A2.2. Accessibility for Interior Firefighting.

A2.2.1. Design hangar doors to be operable under emergency conditions. The electrical supply for power-operated doors shall be independent of the building power supply such that electrical power to the facility can be isolated during a fire without interrupting the power to any door motors.

A2.2.1.1. Configure hangar doors for manual operation by hand without special tools or disassembly.

A2.2.1.2. Provide door track heaters in all areas subject to freezing to prevent accumulations of snow and ice from impairing the operation of hangar doors.

A2.2.1.3. Provide a key operated switch on the exterior of the facility for control of power.

A2.2.2. Personnel doors installed to meet the requirements of the Life Safety Code will provide sufficient access into the hangar for normal structural firefighting operations

A3. Automatic Fire Suppression Systems.

A3.1. Requirements.

A3.1.1. Provide automatic sprinkler protection in all areas of aircraft facilities (including shop, admin, and all other areas). Sprinkler protection will be designed IAW this ETL, MIL-HDBK 1008B, and NFPA Standards 13, 16A, 30, 33, 34, 231, 231 C for the occupancy hazard present. When there is a conflict between this ETL and any provisions of an NFPA standard or code, this ETL will take precedence.

A3.1.1.1. Protect areas used exclusively for unfueled aircraft (IAW Technical Order 1-1-3) with conventional wet-pipe sprinkler systems designed for Ordinary Hazard Group 2 occupancy (0.76 lpm over 270 square meters[0.2 gpm over 3000 square feet]).

A3.1.1.2. Protect dedicated single-aircraft facilities used exclusively for NDI x-raying of fueled aircraft with no aircraft maintenance or servicing operations by conventional wetpipe sprinkler systems designed for Extra Hazard Group 1 occupancy (1.14 lpm over 270 square meters (0.3 gpm over 3000 square feet]).

A3.1.1.3. Use wet-pipe sprinkler protection only where freeze protection is required.

A3.1.2. Manual Foam-Water Fire Hose Stations. Do not provide interior or exterior foam-water hose stations or fire hose connections.

A3.1.3. Fire Department Connections. Do not provide fire department connections on foam-water systems.

A3.1.4. Strainers. Provide a basket-type strainer in the system header upstream of risers on all foam-water systems.

A3.1.5. Test Header. Provide a test header for all overhead foam -water systems and all foam-water nozzle systems. Locate the header inside the aircraft servicing area as near as practical to a door to the outside. Configure the test header to permit each proportioner to be individually tested. Each test header will have four 2.5-inch (no equal metric standard) hose fittings with independent valving.

A3.1.6. Underground Piping. Install underground piping systems IAW National Fire Protection Association Standard 24 (NFPA 24), Installation of Private Fire Service Mains and their Appurtenances, and the following.

A3.1.6.1. Provide ductile iron pipe or other pipe listed by Underwriters Laboratories or approved by Factory Mutual for buried fire service application for all underground uses.

A3.1.6.2. Do not install any piping under hangar/facility floor slabs. If it is necessary to locate any piping below the floor line, use concrete trenching with open steel grating. Do not install any piping including the fire water service entrance into the building such that it is possible to pressurize the space below the floor slab. Minimize the piping under paved operational surfaces (taxiways and aircraft parking).

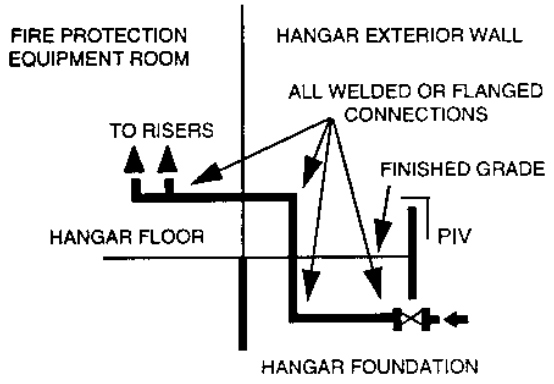

Figure A1. Water Supply Pipe Entry

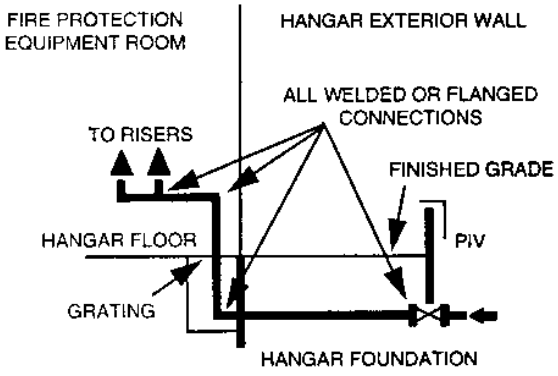

Figure A2. Water Supply Pipe Entry

Pipe Entry]

A3.1.6.3 Size underground mains to ensure the maximum flow velocity does not exceed 0.3 meters per second (10 feet per second).

A3.1.6.4. Use flanged fittings to transition the fire water service entrance from horizontal to vertical as it enters the building. Do not use gasketed compression fittings (including locking type) or flange fittings with set screws.

A3.1.6.5. Provide corrosion protection on underground fire mains in the same manner as is required for the domestic water and other buried piping at the

location.

A3.1.6.6. Do not install piping carrying foam concentrate or foam-water solution underground.

A3.1.7. Backflow Prevention. Install backflow prevention devices at connections to domestic water distribution systems. Valves which are part of a backflow prevention assembly will be of the indicating type and will be supervised. Omit post indicator valves, when backflow preventers are located outside. Locate backflow preventers inside the protected buildings when freeze protection is required. Do not use heat tapes or tracings to provide freeze protection; however, in locations where simple insulation will provide adequate freeze protection, the backflow preventer may be located outside.

A3.1.7.1. Connections between potable water systems and systems containing foam will use reduced-pressure backflow preventers.

A3.1.7.2. Connections between potable water systems and systems which do not contain chemicals (e.g., wet pipe systems) will use double-check valve assemblies unless otherwise required by local health/water authorities.

A3.1.7.3. Install backflow prevention on the discharge side of pumps when supplied directly from domestic water systems.

A3.1.8. Interior Piping Systems.

A3.1.8.1. Limit maximum flow velocity in interior facility piping to 0.6 meters per second (20 feet per second) or less.

A3.1.8.2. Use only standard weight pipe conforming to ASTM A-795 or ASTM A-53. Do not use galvanized pipe for foam-water solution.

A3.1.8.3. Use threaded, flanged, or grooved fittings. Do not use fittings which couple plain end pipe. Do not used welded sprinkler fittings or outlets for foam-water solution.

A3.1.8.4. Paint all exposed interior piping (color to be the same as the walls/ceiling or a complementing color) and mark all exposed interior piping indicating the type of fluid carried and direction of flow. Stainless steel piping may be cleaned and left unpainted. The use of plastic wraparound-type pipe labels conforming to ANSI Al 3.1 1981 is required. Labels are not required on sprinkler system branch lines and pipes less than 2 inches (5.08 centimeters) nominal size. The following legends are required:

- FIRE PROTECTION WATER - used on dedicated potable and non-potable fire protection water lines.
- FOAM CONCENTRATE - used on AFFF/FOAM concentrate lines.
- ROAM-WATER NOZZLE - used on lines supplying supplementary foamwater nozzles.

- ù FOAM-WATER SPRINKLER - used on lines supplying overhead
- ù AFFF/FOAM wet pipe, deluge, and pre-action sprinkler systems.
- ù FIRE SPRINKLER or SPRINKLER FIRE - used on standard wet pipe systems

A3.2. Foam-Water Sprinkler Systems.

A3.2.1. Provide an aqueous film forming foam (foam-water) suppression system for all aircraft servicing areas for fueled aircraft.

A3.2.1.1. Use a wet-pipe foam-water sprinkler system in geographic areas having a 99% dry bulb temperature greater than -17.7[deg]C(O[deg]F) (per AFM 88-29). See paragraph A5.4 pertaining to building temperature supervision when the 99% dry bulb temperature is less than -0.5[deg] C (33[deg] F) (per AFM 88-29).

A3.2.1.2. Use a pre-action foam-water sprinkler system activated by a roof- or ceiling level thermal detection system as described in paragraph A3.5.2 of this ETL in geographic areas having a 99% dry bulb temperature less than -17.7[deg] C (O[deg] F) (per AFM 88-29).

A3.2.1.2.1. Provide externally re-setable (without opening the valve assembly and without the use of special tools) automatic water control (deluge) valves for pre-action systems. Maximum valve size will be 6-inches.

A3.2.1.2.2. Do not provide supervisory air on pre-action sprinkler systems in aircraft servicing areas.

A3.2.1.3. Limit the area protected by an overhead foam-water sprinkler system to a maximum of 1350 square meters (15,000 square feet) per riser. When multiple systems are required in a aircraft servicing area, all overhead systems will cover essentially equal floor areas.

A3.2.1.4. Provide upright quick response sprinklers at the roof or ceiling level with temperature ratings of 79.4[deg] C (175[deg] F).

A3.2.1.5 The minimum design area will be the total floor area under not less than two hydraulically most demanding systems. If two systems total less than 2160 square meters (24,000 square feet) then the minimum design area will be the total floor area under the three hydraulically most demanding systems.

A3.2.1.6. The minimum design density for every sprinkler head in the aircraft servicing area shall be 6.7 lpm/mÀ2Ù (0.16 gpm/ftÀ2Ù) when the system is discharging over the operating areas. The maximum discharge from any sprinkler shall not exceed 20 percent above the design density.

A3.2.1.7. Provide an inspector test valve on each system and provide low point drains for all sections of piping subject to not draining back to the main drain.

A3.2.1.8. Provide a diaphragm expansion tank for each separate wet pipe or precharged system riser of not less than 38 liters (1 0 gallons) capacity (include calculation).

A3.3. Foam-Water Nozzle Systems.

A3.3.1. Provide foam-water nozzle systems for all aircraft except the following: AT-38, C-9, C-12, C-12, C-20, C-21, C-23, C-26, H-1, H-3, H-53, H-60, T-1, T-2, T-3, T-37, T-38, T-43, and UV-18.

A3.3.1.1. Limit individual foam-water nozzle flow rates to less than 1893 lpm (500 gpm). Provide additional nozzles at alternate locations as required.

A3.3.1.2. The foam-water system will be precharged with foam-water solution up to the automatic water control valve (deluge valve), located at each foam-water nozzle location.

A3.3.2. Application Rate and Flow Rate. The foam-water application rate from foamwater nozzle systems is 42 lpm/mÀ2Ù (0.10 gpm/ftÀ2Ù) over the protected area.

A3.3.2.1. In aircraft servicing areas dedicated to a single aircraft having a fixed parking position, cover the entire shadow area of the aircraft. The limited area under engines extending beyond the wing edge and under rear elevators does not have to be considered in the aircraft's shadow area. It is not necessary for the foam-water nozzle discharge pattern (throw) to cover the aircraft shadow area - the foam is more effective in suppressing fuel spill fires when it flows across the floor into the shadow area. Apply the foam-water nozzle discharge 3 meters (1 0 feet) from the edge of the shadow area and push the foam under the aircraft. Foam-water nozzles will effectively cover an area 20 percent greater than the throw range.

A3.3.2.2. In aircraft servicing areas with flexible parking positions or a variety of aircraft, cover the entire floor area up to 6 meters (20 feet) from the walls. Allow for a 20 percent flow beyond the nozzles' throw range when determining coverage.

A3.3.2.3. Use fixed non-aspirating nozzles. Select foam-water nozzle size and locations to provide maximum efficiency in covering the aircraft shadow area(s) without distributing foam onto any aircraft surface.

A3.3.2.3.1. Align foam-water nozzle elevations below horizontal to push the foam across the floor with minimal agitation of the pool fire. It is critical that foam-water nozzles be located and positioned so as not to spray foam-water solution onto any aircraft surface, especially inside aircraft engines, doors, or hatches.

A3.3.2.3.2. Locate foam-water nozzles to avoid obstructions (structural components, aircraft components) interfering with the discharge pattern.

A3.3.2.3.3. Locate foam-water nozzles at least 3 meters (10 feet) away from the wall to permit aerospace ground equipment (AGE), tools, and aircraft components to be stored behind the foam-water nozzles. Install piping to such foam-water nozzles in trenches in the floor covered with steel grating. Do not run piping under concrete floors.

A3.3.2.3.4. Provide bollards to protect foam-water nozzle locations. Locate bollards so that all parts of the foam-water nozzle assembly, including the full sweep of any oscillating nozzle, are within the bollards' protection.

A3.3.2.3.5. Do not provide manual activation devices as part of the listed valve trim installed on each deluge valve.

A3.3.2.3.6. Oscillating monitor non-aspirating foam-water nozzles may only be used when fixed nozzles can not provide the required range.

A3.3.3. Activation: Activate the foam-water nozzle systems as follows:

- ù Manual foam activation stations located at principle exits from aircraft servicing area (if provided).
- ù Waterflow signal in wet-pipe overhead systems.
- ù Roof- or ceiling-level heat detection systems in overhead systems.

A3.4. Foam Proportioning Systems.

A3.4.1. Listing. All components and assemblies used in this fire protection subsystem will be specifically listed/approved for their intended use by a nationally-recognized testing organization whose listing/approval process includes follow-up factory inspections to ensure that products comply with the listing/approval conditions.

A3.4.2. Concentrate. Use only aqueous film forming foam (AFFF) concentrates complying with the current military specification (MIL-F-21385).

A3.4.3. Location. Provide independent concentrate storage and proportioning systems for each aircraft hangar facility. Locate foam concentrate storage, foam proportioning, foam injection and system risers. in a dedicated fire protection equipment room isolated from the aircraft servicing area by construction rated for at least one hour. These rooms shall be accessible by direct exterior access only.

A3.4.3.1. The foam equipment room will be large enough to accommodate all required equipment. All equipment will be fully accessible for inspection, testing, maintenance, and removal/replacement without the removal of any other equipment.

A3.4.3.2. If any equipment and/or valves requiring access for maintenance or periodic testing is located more than 2.4 meters (8 feet) above the floor, provide an open steel grate mezzanine, with a permanent ladder, at that equipment level. All platforms and ladders shall be in compliance with OSHA requirements.

A3.4.4. Proportioning.

A3.4.4.1. Locate the proportioners on overhead foam-water sprinkler systems downstream of the alarm check valve or automatic water control valve. Proportioners shall be limited to 15.24 centimeters (6 inches) or less.

A3.4.4.2. Use ILBPs on all pumped concentrate systems. Do not use ILBPs on bladder tank systems. ILBPs will be factory assembled and tested by the manufacturer, and the entire ILBP assembly will be listed/approved by a recognized laboratory. Disassembly, reassembly, and/or modification by the installing contractor will be prohibited.

A3.4.4.2.1. Concentrate pumping systems will be designed to deliver the required flow with the largest concentrate pump out of service.

A3.4.4.2.2. A pressure maintenance pump will be provided when concentrate piping between the concentrate pump and the point of injection exceeds 4.5 meters (50 feet).

A3.4.5. Control Valve. Provide water-powered ball valves as foam concentrate control valves. The valve shall be operated by connection to the alarm line of the automatic water control valve or alarm valve. Provide a retard chamber in the line to the waterpowered ball valve on wet pipe foam water systems.

A3.4.6. Application Time. Provide a connected foam concentrate supply sized for a single 10-minute application of foam, based on the actual system flow in the hydraulically least demanding area.

A3.4.7. Concentrate Storage. Provide a single foam concentrate tank. Atmospheric foam storage tanks will be either plastic or fiberglass construction and listed/approved for the storage of foam concentrate. Pressure tanks for bladders tank systems will be steel and listed/approved for the storage of foam concentrate.

A3.4.7.1. Do not provide back-up supply of foam concentrate in the facility either as a connected reserve or bulk reserve.

A3.4.7.2. Limit bladder tanks to the horizontal type only. Provide clear space at one end of the tank, at least equal to the length of the tank, to permit bladder replacement. Doors to the outside at the end of the tank are an acceptable alternative.

A3.4.8. Pipe. Use only welded or flanged stainless steel pipe for AFFF concentrate.

A3.5. Foam System Detection and Controls. Design all foam system detection and controls IAW NFPA 72, the National Fire Alarm Code, and the following criteria.

A3.5.1. Foam System Control Panel (FSCPs).

A3.5.1.1. Locate all FSCPs in the fire protection equipment room, in a clean environment having temperature and humidity control IAW the unit's listing/approval.

A3.5.1.2. FSCPs will have electrical surge/spike protection on all fire alarm circuits entering and leaving the facility, including but not limited to the power supply circuits to the FSCP, circuits interfacing with fire pumping stations, and circuits interfacing with the fire alarm receiving station.

A3.5.1.3 Provide an FSCP for all suppression and detection functions in the aircraft area. The FSCP shall be fully compatible with the base fire alarm receiving system without field modifications to any system hardware or software.

A3.5.1.3.1. The FSCP will transmit a separate and distinct fire signal to the fire department upon activation of any portion of the foam-water system. Separate fire alarm transmitters/receivers will be permitted when they are fully compatible with the FSCP and the base fire alarm receiving system without field modifications to the FSCP.

A3.5.1.3.2. The specific number of alarm signals (e.g., fire, supervisory, tamper) to be transmitted will be defined in the system matrix (Figures A3 and A4).

A3.5.1.4. Control panels activating deluge, pre-action, or nozzle systems shall be listed/approved as releasing panels. All releasing panels shall be specifically approved by Factory Mutual for use with the automatic water control valves/solenoid release valves specified for the fire suppression system.

A3.5.2. Thermal Fire Detectors.

A3.5.2.1. Provide automatic fire detection at the underside of the roof of the aircraft servicing area only when a pre-action fire suppression system is used. Provide rate compensated fire detectors having a temperature rating between 71[deg] C (160[deg] F) and 76[deg] C (170[deg] F). Maximum area of coverage per detector will be 56.25 square meters (625 square feet).

A3.5.2.2. The area covered by the fire detection system shall correspond with its affiliated roof-level sprinkler system bound by draft curtains. The activation of any heat detection device in the sprinkler zone will immediately:

- Send a start signal to the fire pumping system (if any).
- Actuate all foam-water nozzles in the aircraft servicing area of fire origin.
- Actuate the appropriate suppression system valves (e.g., pre-action valves, foam concentrate valves) for the floor area covered by the detection system.

SYSTEM INPUTS	ANNUNCIATION AT LOCAL PANELS					FIRE SUPPRESSION SYSTEM FUNCTIONS					TRANSMIT SIGNALS TO FIRE DEPARTMENT							AUXILIARY FUNCTIONS			EVACUATION SIGNALS		
	Audio-Visual Fire Alarm Indication by Zone	Audio-Visual Trouble Indication by Zone	Audio-Visual Common Trouble Indication	Audio-Visual Alarm Indication by Device		Transmit Pump Start Signal to Pumphouse	Open Pre-Action Sprinkler Valves	Open All Foam-Water Nozzle Auto Water Control Valves	Divert Drain Flow from Separators to Containment		Common Trouble Signal Per Building	Common Supervisory Signal Per Building	Common Fire Alarm Per General Area	Sprinkler Water Flow Per General Area	UV/IR Flame Detectors Per General Area	Foam-Water Discharge Per General Area		Shut Down All Supply & Recirculating Fans	Release magnetically Held Smoke Doors		Facility Fire Evacuation Audio-Visual Signal	Foam System Signal Blue Strobe/Beacon	
FIRE ALARMS	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
1 Manual Fire Alarm Stations																							
2 Spot-Type Smoke Detectors																							
3 Fixed Temp & Rate-of-Rise Type Heat Detectors																							
4 In-Duct Smoke Detectors																							
5 Rate-Compensated Type Heat Detectors on Hangar Ceiling																							
6 Water Flow Switches - Wet or Dry-Pipe Sprinkler Systems																							
7 Water Flow Switches - Wet-Pipe Foam-Water Sprinkler Systems	X					X		X	X							X		X	X		X	X	
8 Water Switches - Under-Aircraft Foam-Water Nozzles	X							X	X							X		X	X		X	X	
9 Manual Foam Discharge Station for Nozzles	X					X		X	X							X		X	X		X	X	
10 Low Level Optical Fire Detector				X											X						X		
11																							
SUPERVISORY SIGNALS																							
12 Valve Supervisory Switch - Wet or Dry-Pipe Sprinklers																							
13 Valve Supervisory Switches -Foam-Water Sprinklers		X										X											
14 Valve Supervisory Switches - Underwing Foam-Water Nozzles		X										X											
15 Valve Supervisory Switches - Water Supply Entrance		X										X											
16 Hi-Lo Pressure Switches - Dry-Pipe Sprinklers																							
17 Temperature Monitoring System				X								X											
18 UV/IR Flame Detector Trouble		X										X											
19 Control Component Common Trouble Condition		X										X											
20 Under-Aircraft Foam-Water System Auto Disable Switch		X										X											
21																							
TROUBLE CONDITIONS																							
22 Low Battery Voltage			X								X												
23 Circuit Fault		X	X								X												
24 Supervised Component Failure			X								X												
25 AC Power Failure			X								X												
26																							

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.

Figure A3. Sample Wet-Pipe Foam-Water FSCP Controls Matrix

	SYSTEM INPUTS	ANNUNCIATION AT LOCAL PANELS					FIRE SUPPRESSION SYSTEM FUNCTIONS					TRANSMIT SIGNALS TO FIRE DEPARTMENT							AUXILIARY FUNCTIONS			EVACUATION SIGNALS		
		Audio-Visual Fire Alarm Indication by Zone	Audio-Visual Trouble Indication by Zone/Middle	Audio-Visual Common Trouble Indication	Audio-Visual Alarm Indication by Device		Transmit Pump Start Signal to Pumphouse	Open Pre-Action Sprinkler Valves	Open All Foam-Water Nozzle Auto Water Control Valves	Divert Drain Flow from Separators to Containment		Common Trouble Signal Per Building	Common Supervisory Signal Per Building	Common Fire Alarm Per General Area	Sprinkler Water Flow Per General Area	UV/IR Flame Detectors Per General Area	AFFF Discharge Per General Area		Shut Down All Supply & Recirculating Fans	Release magnetically Held Smoke Doors		Facility Fire Evacuation Audio-Visual Signal	Foam System Signal Blue Strobe/Beacon	
	FIRE ALARMS	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
1	Manual Fire Alarm Stations																							
2	Spot-Type Smoke Detectors																							
3	Fixed Temp & Rate-of-Rise Type Heat Detectors																							
4	In-Duct Smoke Detectors																							
5	Rate-Compensated Type Heat Detectors on Hangar Ceiling	X					X	X	X	X							X		X	X		X	X	
6	Water Flow Switches - Wet or Dry-Pipe Sprinkler Systems																							
7	Water Flow Switches - Pre-Action Foam-Water Sprinkler Systems	X					X		X	X							X		X	X		X	X	
8	Water Switches - Under-Aircraft Foam-Water Nozzles	X							X	X							X		X	X		X	X	
9	Manual Foam Discharge Station for Nozzles	X					X	X	X	X							X		X	X		X	X	
10	Low Level Optical Fire Detector				X											X						X		
11																								
	SUPERVISORY SIGNALS																							
12	Valve Supervisory Switch - Wet or Dry-Pipe Sprinklers																							
13	Valve Supervisory Switches -Foam-Water Sprinklers		X										X											
14	Valve Supervisory Switches - Underwing Foam-Water Nozzles		X										X											
15	Valve Supervisory Switches - Water Supply Entrance		X										X											
16	Hi-Lo Pressure Switches - Dry-Pipe Sprinklers																							
17	Temperature Monitoring System																							
18	UV/IR Flame Detector Trouble		X										X											
19	Control Component Common Trouble Condition		X										X											
20	Under-Aircraft Foam-Water System Auto Disable Switch		X										X											
21																								
	TROUBLE CONDITIONS																							
22	Low Battery Voltage			X								X												
23	Circuit Fault		X	X								X												
24	Supervised Component Failure			X								X												
25	AC Power Failure			X								X												
26																								

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.

Figure A4. Sample Pre-Action Foam-Water FSCP Controls Matrix

- ù Activate the facility fire evacuation alarm system and the foam system annunciation signal.
- ù Transmit a fire alarm signal to the base fire alarm communications center (fire department). The number and type of signals transmitted to the fire department will be locally determined based on the current fire alarm receiving equipment.

A3.5.3. Low-Level Optical Fire Detectors.

A3.5.3.1. Provide low-level optical fire detectors connected to the foam system control panel (FSCP). The MAJCOM Fire Protection Engineer may delete the requirement for low-level optical detection. Arrange for alarm notification only; do not use optical detection systems to activate any fire suppression system.

A3.5.3.2. Use only combination or dual-spectrum ultraviolet/infrared (UWIR) type optical detectors, listed/approved by a nationally recognized laboratory. Additionally, the manufacturer must provide a copy of the test report prepared by a nationally recognized laboratory certifying the listed/approved unit will detect a fully developed 3 meter by 3 meter (10 foot by 10 foot) JP-4, JP-8, or JET-A fuel fire at a minimum distance of 45 meters (150 feet) within 5 seconds.

A3.5.3.3. Provide a sufficient number of optical detectors such that a fire at any position under an aircraft will be within the range and cone-of-vision of at least one optical detector.

A3.5.3.4. Mount optical detectors approximately 3 meters (10 feet) above the hangar floor level, but the specifics of each design will take into account the facility construction, the 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 such as under roofs or on roof trusses.

A3.5.3.5. The optical detectors will be of a latching design. Fire detection by any optical detector will immediately:

- ù Activate the facility fire evacuation alarm system.
- ù Transmit a fire alarm signal to the fire department.

The number and type of signals transmitted to the fire department will be locally determined based on the current fire alarm receiving equipment.

A3.5.4. Waterflow Detecting Devices. Provide waterflow detecting devices on all fire protection risers. Waterflow will be detected by pressure-type switches with a built-in adjustable (not less than 0 - 90 seconds) retard on all sprinkler systems. Waterflow causes the foam system control panel to accomplish the following actions:

- ù activate the foam-water nozzle systems, if installed.
- ù activate the facility fire evacuation alarm system and the foam system annunciation signal.

- ù transmit a fire alarm signal to the fire department. The number and type of signals transmitted to the fire department will be locally determined based on the current fire alarm receiving equipment.

A3.5.5. Manual Foam Discharge Stations for Foam-Water Nozzle Systems.

A3.5.5.1. Provide manual foam discharge stations inside the aircraft servicing area at exits to actuate the foam-water nozzle systems.

A3.5.5.2. Manual foam discharge stations will be distinctly different in shape and color from the fire alarm stations and will have distinct signage at each device stating "Start FOAM Nozzles" in red lettering not less than 3 inches in height on a lime yellow background.

A3.5.5.3. Manual foam discharge stations will be housed within a clear plastic tamper cover that must be lifted prior to activating the station.

A3.6.5.4. Actuation of any manual foam discharge stations will cause the FSCP to:

- ù Activate all nozzles.
- ù Activate the facility fire evacuation alarm and the foam system annunciation signal.
- ù Transmit a fire alarm signal to the fire department. The number and type of signals transmitted to the fire department will be locally determined based on the current fire alarm receiving equipment.

A3.5.6. Foam System Signals. Provide blue visual alarm signals, strobe or rotating beacon(s), within the aircraft servicing area to indicate foam system activation. When the base has adopted a standard audio-visual signal for foam system activation, the signals in this facility will comply fully with that base standard.

A4. Fire Protection System Water Supply.

A4.1. Requirement. Use the base domestic water system for hangar fire protection systems whenever adequate capacity (flow rate and pressure) is available. The A-E is responsible for testing and determining the capability of the existing systems and integrating those systems with the new systems being designed.

A4.1.1. Provide booster fire pumps when the water flow rate is adequate but pressures are inadequate to meet system pressure demands in accordance with paragraph A4.3 below.

A4.1.2. Provide a separate dedicated fire protection system water supply when the available domestic flow rate is not sufficient to meet the system flow rate demands.

A4.2. Fire Protection Water Storage System.

A4.2.1. Provide water storage tanks IAW NFPA 24. Provide corrosion protection when steel water tanks and associated piping is used.

A4.2.2. Use a single water storage system, when practical, for multiple aircraft facilities. Limit water supply distribution mains from a fire pump station to less than 1500 feet. The MAJCOM Fire Protection Engineer may approve a greater length when specific physical situations justify.

A4.2.3. Provide storage capacity equal to 120 percent of the maximum demand for 30 minutes. Divide the required storage capacity between two equal-sized water tanks, each storing one-half of the required volume. The piping configuration will allow water to be supplied by both reservoirs and either of the reservoirs while the other is out of service.

A4.2.4. Provide each tank with a low water level alarm and a low temperature alarm, in areas with a 90% dry bulb temperature less than 0[deg] C (32[deg] F), each transmitting back to the fire department as separate supervisory signals. Provide external visual water-level gauging on each tank.

A4.2.5. Provide automatic refill from the base water distribution system.

A4.3. Fire Protection Water Pump Systems.

A4.3.1. Design and install fire pumping installations IAW NFPA 20, Standard for the Installation of Centrifugal Fire Pumps. Use a single fire pumping station for multiple aircraft facilities when practical. Limit water supply distribution mains from a fire pump station to less than 450 meters (1500 feet). The MAJCOM Fire Protection Engineer may approve a greater length when specific physical situations justify.

A4.3.2. Fire pumps shall have electric motor drivers IAW NFPA 20. Diesel engine drivers may be used only when the installation electrical service fails to meet the reliable standard and dual power sources are not available. The A-E is responsible for determining and documenting the reliability of the existing power sources. A reliable power source must not exceed:

- A forced downtime, excluding scheduled repairs, more than 8 consecutive hours for any one incident over the previous 3 years; and
- More than 24 cumulative hours downtime during the previous year.

A4.3.3. Use "soft start" fire pump controllers when electric-driven fire pumps are installed.

A4.3.4. Limit the maximum rated fire pump size to 9463 lpm (2500 gpm) at 862 kPa (8.5 bar) (125 psi).

A4.3.5. Provide pressure maintenance pumps ("jockey pumps") to maintain normal operating pressure on the system and to compensate for normal system leakage. See NFPA 20, paragraph 19, for jockey pump flow requirements. The jockey pump's rated pressure will be sufficient for the startup and shutdown pressures specified in NFPA 20. Set jockey pump controllers to automatically start and stop IAW paragraph A-11-2.6 of NFPA 20. Provide run timers to ensure that the jockey pump will run for at least the minimum time recommended by the manufacturer of the jockey pump's motor.

A4.3.6. Ensure the fire pumping system will have sufficient capacity to meet the maximum water demand with the largest pump out of service.

A4.3.7. Arrange multiple-pump installations for sequential starting at 10-second intervals until the required pressure is maintained by the operating pumps. The starting sequence will begin automatically as follows:

- ù Drop of water pressure in the system IAW NFPA 20.
- ù A pump start signal transmitted from the foam system control panel in the protected facility.

A4.3.8. Provide connection through the installation fire reporting system to notify the fire department of pump running signals, system trouble, tamper and supervisory signals provided by the fire pump controllers.

A5. Facility Fire Detection and Alarm System. Design all facility fire detection and alarm systems IAW NFPA 72, the National Fire Alarm Code and the following criteria.

A5.1. Fire Alarm Control Panel (FACPs).

A5.1.1. Locate all FACPs in a clean environment having temperature and humidity control IAW the unit's listing/approval.

A5.1.2. FACPs will have electrical surge/spike protection on all fire alarm circuits entering and leaving the facility, including but not limited to the power supply circuits to the FACP, circuits interfacing with fire pumping stations, and circuits interfacing with the fire alarm receiving station.

A5.1.3. Provide a single FACP for all detection alarm functions in the facility not part of the foam-water fire suppression system. The FACP shall be fully compatible with the base fire alarm receiving system without field modifications to any system hardware or software.

A5.1.4. Separate fire alarm transmitters/receivers will be permitted when they are fully compatible with the FACP and the base fire alarm receiving system without field modifications to the FACP.

A5.1.5. The specific number of alarm signals to be transmitted will be defined in the system matrix (Figure A5).

A5.2. Manual Fire Alarm Stations (Pull Stations).

A5.2.1. Provide pull stations throughout the facility at all required exit doors. Additional pull stations will be provided when required by NFPA 101.

A5.2.2. Ensure all manual alarm activation stations are identical throughout the facility. If the base has established a formal base-wide standard for manual pull stations, the pull stations in facilities governed by this ETL will comply fully with that standard.

A5.2.3. Actuation of any pull station will immediately cause the FACP to:

- ù Activate the facility fire evacuation alarm signal through out the facility.
- ù Transmit a fire alarm signal to the base fire department.

A5.3. Fire Alarm Notification. Provide audio-visual alarm notification devices. When the base has a standard for audible sound (e.g., slow whoop, bell) and visual signal (red, white), the devices in this facility will comply fully with the base standard. No other system (hangar doors, alert signal) will be permitted to use these signals. In high noise areas, special provisions will be made to make the alarm distinctive.

A5.4. Temperature Monitoring System.

A5.4.1. Provide a system of temperature sensors for the aircraft servicing area in all geographic areas having a 99% dry bulb temperature less than -1 [deg] C (30[deg] F) where wet-pipe sprinkler systems are present. The temperature sensors will be located at the same level as the sprinkler piping spaced not more than 60 meters (200 feet) apart. Provide this temperature monitoring to ensure a warning when freezing temperatures endanger sprinkler piping.

A5.4.2. This facility temperature monitoring system will be tied into the FACP as a dedicated supervisory zone, and this supervisory signal will be transmitted to the fire department in the same manner as all fire-related supervisory signals in the facility.

A6. Design and Construction Management.

A6.1. Architect-Engineer (A-E) Qualifications.

A6.1.1. It is mandatory that the design organization (whether the design is accomplished by the Design Agent in-house or through an outside A-E firm) use a

SYSTEM INPUTS

		ANNUNCIATION AT LOCAL PANELS					FIRE SUPPRESSION SYSTEM FUNCTIONS					TRANSMIT SIGNALS TO FIRE DEPARTMENT							AUXILIARY FUNCTIONS			EVACUATION SIGNALS		
		Audio-Visual Fire Alarm Indication by Zone	Audio-Visual Trouble Indication by Zone/Middle	Audio-Visual Common Trouble Indication	Audio-Visual Alarm Indication by Device		Transmit Pump Start Signal to Pumphouse	Open Pre-Action Sprinkler Valves	Open All Foam-Water Nozzle Auto Water Control Valves	Divert Drain Flow from Separators to Containment		Common Trouble Signal Per Building	Common Supervisory Signal Per Building	Common Fire Alarm Per General Area	Sprinkler Water Flow Per General Area	UV/IR Flame Detectors Per General Area	Foam-Water Discharge Per General Area		Shut Down All Supply & Recirculating Fans	Release magnetically Held Smoke Doors		Facility Fire Evacuation Audio-Visual Signal	Foam System Signal Blue Strobe/Beacon	
	FIRE ALARMS	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
1	Manual Fire Alarm Stations	X												X						X		X		
2	Spot-Type Smoke Detectors	X												X					X	X		X		
3	Fixed Temp & Rate-of-Rise Type Heat Detectors	X												X						X		X		
4	In-Duct Smoke Detectors	X												X					X	X		X		
5	Rate-Compensated Type Heat Detectors on Hangar Ceiling																					X		
6	Water Flow Switches - Wet or Dry-Pipe Sprinkler Systems	X													X				X	X		X		
7	Water Flow Switches - Pre-Action Foam-Water Sprinkler Systems																					X		
8	Water Switches - Under-Aircraft Foam-Water Nozzles																					X		
9	Manual Foam Discharge Station for Nozzles																					X		
10	Low Level Optical Fire Detector																					X		
11																								
	SUPERVISORY SIGNALS																							
12	Valve Supervisory Switch - Wet or Dry-Pipe Sprinklers		X										X											
13	Valve Supervisory Switches -Foam-Water Sprinklers																							
14	Valve Supervisory Switches - Underwing Foam-Water Nozzles																							
15	Valve Supervisory Switches - Water Supply Entrance																							
16	Hi-Lo Pressure Switches - Dry-Pipe Sprinklers		X										X											
17	Temperature Monitoring System				X								X											
18	UV/IR Flame Detector Trouble																							
19	Control Component Common Trouble Condition		X										X											
20	Under-Aircraft Foam-Water System Auto Disable Switch																							
21																								
	TROUBLE CONDITIONS																							
22	Low Battery Voltage			X								X												
23	Circuit Fault		X	X								X												
24	Supervised Component Failure			X								X												
25	AC Power Failure			X								X												
26																								

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.

Figure A5. Sample FACP Controls Matrix

qualified Fire Protection Engineer, experienced in the design of aircraft hangars, for the design of the fire protection systems in all Air Force projects covered by this ETL.

A6.1.1.1. "Qualified Fire Protection Engineer" does not have a universal definition and is defined differently among various government agencies. For the sake of this ETL, one of the following credentials is required to meet the criteria for "qualified Fire Protection Engineer":

- Bachelor of Science or Master of Science degree in fire protection engineering from an accredited university.
- Professional Engineer (PE) registration by examination as a fire protection engineer.
- Qualification as a GS/GM 804-series fire protection engineer.
- Full time practicing fire protection engineer with 5 years prior experience in projects of similar complexity.

A6.1.1.2. For Air Force aircraft hangars, the Design Agent shall confirm that: (1) the designer complies with the definition of "qualified Fire Protection Engineer" above; and (2) that the Fire Protection Engineer has substantial experience in the design and construction of aircraft hangar fire protection systems.

A6.1.2. The Commerce Business Daily announcement for the project design will specifically include the requirement for a qualified Fire Protection Engineer on the A-E design team.

A6.2. System Testing and Acceptance.

A6.2.1. Preliminary Testing.

A6.2.1.1. Testing of the fire protection system is critical. The entire fire protection system shall be tested in accordance with the specification to assure that all equipment, components, and subsystems function as intended. In addition to establishing written confirmation of all test results, all preliminary tests shall be videotaped to record the methods and equipment employed to conduct the tests.

A6.2.1.2. A copy of the videotape shall be submitted with a copy of the proposed test plan to the CoE Center of Expertise or NAVFACENGCOM FPE before the request for a final acceptance test is made. All preliminary tests must be completed prior to scheduling the final acceptance test.

A6.2.2. Final Acceptance Test. The final test shall be a repeat of all preliminary tests, except that flushing and hydrostatic tests shall not be repeated. Tests shall be witnessed by the CoE Center of Expertise or NAVFACENGCOM FPE. All system failures or other deficiencies identified during the testing shall be corrected and retested in the presence of the CoE Center of Expertise or NAVFACENGCOM FPE.

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