3.0 UAS MAINTENANCE HANGAR (UAS HGR) *<VER>*(REV 1.10 – 31 JUL 2011)*</VER>*

3.1. GENERAL REQUIREMENTS:

Each hangar shall include administrative areas, aviation operations, maintenance areas, parts storage and maintenance shops co-located within one facility. The ideal site development maintains a comfortable and useful environment for both administrative and maintenance functions. Each site shall be designed in accordance with Antiterrorism Force Protection requirements. Each UAS Hangar consists of the following functional areas.

Administrative Support Area (Paragraph 3.3.1)

Hangar Aircraft Maintenance; Hangar floor and shop space (Paragraphs 3.3.2, 3.3.3 & 3.3.4)

Support Space (Paragraph 3.3.5)

Aviation Unit Operations (Paragraph 3.3.6)

3.2. UAS MAINTENANCE HANGAR (UAS HGR) REQUIREMENTS

UAS repair parking module sizes for hangar floor space should be sized based on Table 3.2 Table 3.2 summarizes parking module requirements for each UAS. Safety lanes are in addition to the module sizes indicated.

Table 3.2

Hangar Modules and Sizes

AIRCRAFT GROUP	MODULE LENGTH	MODULE WIDTH	NO. OF AIRCRAFT PER MODULE
TYPE	LENGTH	WIDTH	(Fully Assembled)
ER/MP (MQ-1c Sky Warrior)	45’	66’	1

3.2.1. ACCESSIBILITY REQUIREMENTS

The Hangar facility shall be handicap accessible for civilian employees and visitors, and Warriors-in-Transition that may be assigned in accordance with the Architectural Barriers Act (ABA) Standard for Department of Defense Facilities.

3.2.2. GROSS BUILDING AREA:

Maximum gross area limits indicated in Paragraph 2.0, SCOPE, may not be exceeded. A smaller overall gross area is permissible if the established net area program requirements are met. Building gross area cannot exceed the authorized Programmed Amount for the project.

See Appendix Q for Area Computations for Enclosed Spaces, Half-Scope Spaces Excluded Spaces and Net Floor Area.

3.2.3. UTILITY AND SUPPORT SPACE:

Mechanical, electrical and communications rooms shall be provided. Mechanical rooms shall accommodate space for equipment maintenance/repair access without having to remove other equipment. Mechanical, electrical and communications rooms shall be keyed separately for access by Installation maintenance personnel. Exterior access is required for mechanical and electrical rooms located on the first floor. All communications rooms shall be conditioned space equivalent to office space and with access into the facility from the interior of the building; unless otherwise noted, exterior access on the ground level is desired. Provide ventilation, heating and cooling for these spaces.

SAMPLE

3.2.4. OFFICE AND ADMINISTRATIVE AREAS:

Administrative workstations shall include appropriate work surface area, upper cabinets or shelves, file cabinet(s), pencil drawer, space for computer and monitor, telephone, ergonomic administrative chair and task lights. Provide centralized areas for photocopier, laser printer and fax machine with waste and paper recycling receptacles and paper storage cabinet storage in each office area. Operations are normal business day except where indicated otherwise.

3.2.5. CONFERENCE ROOMS AND CLASSROOMS:

Provide, as a minimum, a dry-erase whiteboard a motor operated projector screen, a ceiling mounted projector bracket ceiling mounted 110 VAC receptacle and data receptacle in each conference/training and classroom. Verify size requirements of equipment with the user groups during Design After Award to ensure that functionality is met.

3.2.6. RESTROOMS AND SHOWERS:

Except where indicated otherwise, provide restrooms on each floor with fixture counts per IPC with fixture distribution calculated for 80% male and 20% female.

3.2.7. JANITOR CLOSET:

Provide, as a minimum, a janitor closet on each floor of each facility. Each janitor closet shall have a mop sink, mop rack and space for buckets, vacuum and storage for janitorial supplies.

3.2.8. OIL-WATER SEPARATOR SYSTEM:

The design of the separator system will account for the normal peak demand from the trench drains and designed in accordance with ETL 1110-3-466. Operational effects of the fire protection system per ETL 1110-3-481 shall be bypassed from oil-water separator system in accordance with ETL 1110-3-481 and ETL 02-15.

3.3. FUNCTIONAL AND AREA REQUIREMENTS

3.3.1. UAS HANGAR COMPANY ADMINISTRATION AND READINESS AREA:

The company administration readiness area consists of offices, storage, ~~etc~~allied shops., to accommodate personnel within the battalions. See ~~Table 3.3 for specific hangar functions/space requirements and~~ Table 3.4.1 for net square footages and special requirements for each type of administration/readiness space for the companies in each battalion. Where specified for a workstation, provide 110 VAC receptacles, voice and data receptacle in addition to what may be specified in table above.

3.3.2. UAS AIRCRAFT MAINTENANCE AREA:

A consolidated multipurpose space for the maintenance, repair, and major overhaul of military aircraft and includes maintenance bays, tech supply, shop space, production control, and quality control areas directly related to the maintenance and supervision of aircraft, component and assembly rebuilding, and quality control of aviation maintenance The area can be broken down into two primary functions, aircraft maintenance bay and shop space. See ~~Table 3.3 for specific hangar function/space requirements and~~ Table 3.4.1 for net square footages and special requirements for each type of maintenance area space. Where a workstation is specified, provide 110 VAC receptacles, voice and data receptacle in addition to what may be specified in table above.

3.3.3. UAS AIRCRAFT MAINTENANCE BAY:

Hangar floor space should be sized based on UFC 3-260-01 and ETL 110-3-506 except as modified herein. Table 3.2 summarizes parking module requirements for the hangar. Safety lanes are in addition to the module sizes indicated. See paragraph 3.2.2 regarding standard maintenance module to be used for UAS aircraft. Paragraph 01 10 00 – 5.5.2 regarding airtightness of envelop does not apply to the maintenance by (hangar bay).

SAMPLE

3.3.4. UAS AIRCRAFT MAINTENANCE SHOP SPACE:

UAS aircraft maintenance shop space shall be sized based on the sizes indicated in Table 3.4.

3.3.5. UAS AIRCRAFT MAINTENANCE SUPPORT SPACE:

Maintenance support spaces generally include storage rooms for maintenance tools, parts and POL materials. Maintenance support spaces shall be sized based on the sizes indicated in Table 3.4.

3.3.6. UAS AVIATION UNIT OPERATIONS AREA:

Aviation Unit areas for officers, pilots operators and maintainers to prepare flight planning, mission planning,briefing, debriefing, and perform maintenance. Aviation Unit spaces shall be based on the sizes indicated in Table 3.4.1 and shall accommodate a total of «PERSONNEL_PEAK» personnel at peak times for a «HANGAR_DENSITY» hangar. Of the 128 personnel allocated in the total unit, there will be 46 in the company headquarters, 51 in operations, and 31 in maintenance occupying this hangar facility in two shifts per day

3.4. ROOM SUMMARY MATRIX

3.4.1. FUNCTIONAL SPACES:

Net area requirements for functional spaces are included in Table 3.4.1. The gross area space shall be sized to accommodate the required function, comply with code requirements and other requirements of the Facility.

SAMPLE

Table 3.4.1

UAS HANGAR NET AREA SUMMARY FOR A «HANGAR_DENSITY» HANGAR

ROOM NAME	AUTH (SF)	SPECIAL REQUIREMENTS
AIRCRAFT MAINTENANCE BAY (HANGAR FLOOR)		**TOTAL = 91,160**
ER/MP Bay	35,640	Provide the following consolidated multipurpose space for the maintenance, repair, and major overhaul of military aircraft and includes maintenance bays, tech supply, shop space, production control, and quality control areas directly related to the maintenance and supervision of aircraft, component and assembly rebuilding, and quality control of aviation maintenance. ~~The area can be broken down into two primary functions, aircraft maintenance bay and shop space.~~ • Provide space for 12 ER/MP Modules. One (1) ER/MP Module houses one (1) fully assembled MQ-1C Sky Warrior. See Table 3.2 for module size. Modules shall include safety lanes at perimeter of modules. 100% of all aircraft assigned to the Companies shall be located in the hangar bay. • Provide workbench and workstations as per Table 3.4.2 with and utility connections per section 3.10.4. • Provide access lanes where required by design. • Space for GFGI parts cleaning units/stations (110VAC power). • Provide appropriate floor drainage system connected to Oil Water Separator(s). • Fixed tool storage/TOE, 625SF per company -preference for caged tool-room for individual tool boxes, ~~and~~ shop tools, ~~and~~ test sets and maintenance stands. The cage must be No. 8 gauge high carbon manganese steel mesh with a 2-inch diamond grid or No. 6 gauge steel with a 2-inch diamond grid, conforming to Headquarters, U.S. Army Corps of Engineers (HQUSACE) drawing 40–21–01, dated 20 Jun 72, and be attached to the floor. There will be no space between the floor and the bottom of the cage or between the original walls of the room and the cage. Screws and bolts used to construct the cage will be spot welded to preclude disassembly. • Ceiling clearance to be a minimum of 28'-0" AFF.
VTOL UAS and Maintenance Space	21,120	
Perimeter 5'W Safety Lane (1336 LF x 5')	6,680	
Interior Tow Lane	27,720	
ALLIED SHOPS & STORAGE (1st Floor)		**TOTAL = «ALLIED_SHOPS_TOTAL»**

SAMPLE

ROOM NAME	AUTH (SF)	SPECIAL REQUIREMENTS
Allied Shop Area	8,250	Provide three (3) separate shops of equal size. In each shop space provide the following: • Work surfaces, fixed storage bins for miscellaneous parts, supplies, and maintenance tool kits, See FF&E List Table 3.4.2. • Space for GFGI engine repair stand(s). • Space for one desk or modular work stations per Table 3.4.2. with internet and Logistics STAMIS drops. • Space for workbench height workstations as noted in the FF&E, Table 3.4.2. Provide utility connections per section 3.10.4. These workbenches shall be placed along the perimeter walls in each shop. • Equipment grounding bar around room. • Provide for electrostatic discharge with either grounded wrist straps at work benches or grounded discharge plates at doors. Fully coordinate location with user. • Local exhaust ventilation for soldering will be part of the equipment noted in the FF&E list, Table 3.4.2. This will not be a requirement from the HVAC system. • Utility connections – Compressed air, electrical, telephone/data lines, and water. • Route compress air piping around the perimeter of the shops spaces provide a drop every 50 feet. • Provide two ½" water drops with a ½" ball valve capped on perimeter wall opposite each other. • Space for GFCI: 48" box and pan break machine(s), 48" foot shear, shrinker/stretcher machine, one drill press. • Deep sink with foot operated faucet connected to an oil water separator. • Space for GFGI refrigerator for adhesive storage. • Double doors or overhead roll-up door on the exterior wall and hangar wall. • The ceiling clearance to be a minimum of 14'-0" AFF.
Secure Storage	«SECURE_STORAGE_BENCH_STOCK_TOTAL»	Provide easy access to a 300 SF consolidated storage room for non-sensitive secure Aircraft Mounting Systems. The estimated size of each system is 4' x 4' x 4' and is one per aircraft. The actual size of each system is to be verified with the user. The ceiling clearance to be a minimum of 14'-0" AFF. AR 190-51 and AR 190-13 shall govern construction standards for this space.

SAMPLE

ROOM NAME	AUTH (SF)	SPECIAL REQUIREMENTS
		The minimum acceptable wall construction permissible is impact resistant gypsum board with metal lath backing on metal studs. Provide 100 SF secure room for classified parts/items. Provide space for metal cabinets with shelves and industrial shelving units for high value accountable items that are not maintained in each shop see Table 3.4.2 .
Tech. Supply (Class IX Air)	«TOE_TOTAL»	Secured open floor space area for large equipment (e.g. jacks, torque adapters). The equipment storage shall be located for easy access to the Aircraft Maintenance Bay Floor. Provide connection to small tools room for control (caged area inside the hangar is acceptable). Locate adjacent to Production. Provide high-bay storage area with issue and turn-in counters restricting access to admin and storage. Provide workstation at issue and turn-in counters (Logistics STAMIS). Provide storage space (Automated storage systems preferred.) Provide bins for small parts distribution adjacent to counter. Provide an overhead roll-up door for easy forklift access.
<UAS_HIGH_DENSITY>Flight Simulator Room	500	The floor is to support three (3) GFGI ER/MP IMS at 1500 lbs each. The operational footprint of each ER/MP IMS approximately 13' x 8' x 6' High The required temperature is a min 45F and max 68F***</UAS_HIGH_DENSITY>***
AIRCRAFT MAINTENANCE SHOP SPACE (1st Floor)		**TOTAL = «AIRCRAFT_MAINTENANCE_TOTAL»**
Production Control (PC)	«PRODUCTION_CONTROL_TOTAL»	Space for admin workstations (Logistics STAMIS) in a common work area see FF&E Table 3.4.2. Space for fax machine, copier(s). See the FF&E list Table 3.4.2 for file storage, progress/scheduling marker board and/or flat screen monitor. Customer service counter restricting access to admin area. Open meeting space for 10 persons at conference type table integrated in the common work area. Two private/semi-private offices with admin workstations separated from common work area. Locate adjacent to Tech Supply and Logistics STAMIS comm. hub/server room.
Quality Control/ Quality Assurance (QC/QA)	«QC_QA_TOTAL»	Semi-private/private office for OIC/NCOIC with space for admin workstations and Logistics STAMIS. Customer service counter restricting access to common admin area.

SAMPLE

ROOM NAME	AUTH (SF)	SPECIAL REQUIREMENTS
		The counter shall have three Logistics STAMIS connections. Admin workstation space for two personnel. Space for file storage, fax machine and copier(s). Progress/scheduling marker board(s) or space for flat screen monitor(s). Locate adjacent to Production Control and Tech Supply.
Contractor Logistics Support (CLS/LARS)	480	Space for admin workstation for five persons. Space for file cabinets, fax machine(s), copier(s). Locate adjacent to QC and PC.
Break Room	424	Countertop with double compartment stainless sink and garbage disposal, base and overhead cabinets. Space and utility for a GFGI refrigerator and two vending machines Provide space for table and chairs
Small Tools Room	«SMALL_TOOLS_TOTAL».	Provide centrally located secure room adjacent to hangar bay floor with customer service counter. Provide space for one administrative work station, parts storage cabinets, and shelving. Locate adjacent to Aircraft Maintenance Bay, Shops, and Maintenance Repair Sections. Provide doors large enough to move parts storage cabinets. Provide small consolidated storage room for easy access to common (non-accountable) parts (bench stocks not maintained in each shop).
Maintenance Platoon (1ST or 2nd FLOOR)		**TOTAL = «MAINTENANCE_PLATOON_TOTAL»**
Maintenance Platoon	«MAINTENANCE_PLATOON_OFFICE_TOTAL»	Provide two private offices, open admin space for two workstations, waiting area and file storage area file cabinet as per the FF&E List.
UAV Standardization Officer	«UAV_STANDARDIZATION_OFFICER_TOTAL»	Space for one workstation, printer and file cabinet as per the FF&E List. Provide power, data and telephone.
Safety Officer	«SAFETY_OFFICER_TOTAL	Space for one workstation, printer and file cabinet. Provide power, data and telephone.

SAMPLE

ROOM NAME	AUTH (SF)	SPECIAL REQUIREMENTS
	»	
SUPPORT SPACE (1ST FLOOR)		**TOTAL = 1,670**
Personnel Restrooms / Showers and Lockers	«PERSONNEL_RESTROOMS»	Showers to accommodate administrative, maintenance, and off-post personnel. The purpose of these showers will be for personal hygiene from daily PT and for the maintenance personnel during normal work hours. Quantities to be based on the maximum occupancy load of «PERSONNEL_PEAK» personnel of which 80% are male and 20% are female. At a minimum provide: • 1 female and 3 male lavatory, • «WATER_CLOSETS», • «URINALS», • 2 female and 6 male showers, Space for 28 double tier 12" x 72" personnel lockers and dressing benches as noted in the FF&E Table 3.4.2 . Access from the exterior and interior are preferred. Screens and walls should be installed for privacy as required.
Janitor Closet		Centrally Located
Facility Maintenance & Storage	500	Provide lockable storage and work areas for facility equipment, parts and supplies.
FLIGHT PLATOON AREA (INCLUDING SUPPORT, 2ND FLOOR)		**TOTAL = «FLIGHT_PLATOON_AREA_TOTAL»**
Flight Platoon	«FLIGHT_PLATOON_OFFICE_TOTAL»	In each Flight Platoon, provide (3) three private office spaces. In each of the 3 private offices, provide (2) two semi private admin workstations for ~~-~~one Platoon Leader two Operations Techs and three Sargents~~.:~~ . Provide one Logistics STAMIS connection. Locate in proximity to maintenance platoon shops. Provide open admin work space for ~~Platoon~~ UAS Operator personnel. ~~Platoon Leader and Sergeant: Provide two private/semi-private offices with admin workstations separated from common work area.~~ ~~Locate in proximity to System Repair Shops.~~
Small Conference Room	200	
General Purpose Storage	96	Provide space for general purpose admin supplies.
Printer/Copier Station	96	
Distributed/Computer-Based Training (Classroom XXI (DT/CBT Room))	572	Dedicated computer enabled digital training room similar to a small Resource Center. Reference paragraph 2-4.9 of the GIB and ACES Standard Design Criteria:

SAMPLE

ROOM NAME	AUTH (SF)	SPECIAL REQUIREMENTS
		https://eportal.usace.army.mil/sites/COS/GIB/Shared%20Documents/GIB%20Design%20Criteria-Update-Sep08.pdf Provide space for 4' x 8' marker boards, recessed ceiling mounted projection screens, and ceiling mounted projector supports. Provide space for lectern. Provide dimmable light fixtures. Dedicated, computer enabled digital training room providing a maximum of two 6-person stations equipped with Classroom XXI technology for Soldier skills or small group training using computer terminal linkage with training and knowledge centers across the Global Information Grid (GIG). DT/CBT.
Break / Assembly Area	108	Counter with sink and space for GFGI refrigerator.
Restroom & Janitor Closet	460	Separate Men's and Women's Restrooms to accommodate a maximum occupancy load of 55 personnel from the training and briefing rooms plus separate Janitor Closet. The restrooms shall be divided 80% for males and 20% for females.
FLIGHT PLANNING & OPERATIONS AREA (2ND FLOOR)		**TOTAL = «FLIGHT_PLANNING_TOTAL»**
Flight Planning	600	Space for five table top planning workstations as per the FF&E List with power and NIPR drops. Space for one admin workstation, wall-mounted sliding panels for display of GFCI planning maps and white boards as per the FF&E List. Shelving for manuals.
SIPRNET	96	A SIPRNET room or closet and SIPRNET safe shall be provided on the requirements of Secret Internet Protocol Router Network Technical Implementation Criteria Version 6 and constructed in accordance with DCID 6/9 and the USAISEC Technical Guide for the Integration of Secret Internet Protocol Router Network.
Flight Ops	«FLIGHT_OPS_TOTAL»	Space for four admin workstations. Customer service counter restricting access to admin workstations (LAN/voice) one class A phone. Conduit(s) for antennas to roof from one of the admin work stations. Provide conduit and access to roof. At roof, provide permanent mounts and tie-downs for relocatable GFGI HF, FM and UHF antennas. Shelving for publications storage. Flight line view is preferable (CCTV could be an option).
Briefing Room	1,100	Provide power, data, telephone and a CATV cable drop power and wall-mounted brackets for GFGI TV.

SAMPLE

ROOM NAME	AUTH (SF)	SPECIAL REQUIREMENTS
		Provide power and a location for GFGI coffee maker.Provide two ceiling-mounted projector supports with power and data connections, two recessed ceiling-mounted electric screens, marker boards, and audio system (wireless microphones and speaker system). Provide dimmable lighting. Provide space to accommodate 55 people utilizing stackable seating and folding tables as listed in the FF&E Table 3.4.2. ~~Provide space for 25 folding tables with seating.~~ Provide separate storage space for chairs and tables. Provide wall mount electrical outlets for three GFGI digital clocks. Provide a fixed lectern station at the front of the briefing area. Provide power and data connections including AMPS laptop and data transfer system, and microphone from the lectern station. Provide ability to control room lighting level, sound levels, and visual/projection sources from the lectern. Size lectern surface for placement of laptop and data transfer system.
Facility Storage	200	Provide lockable storage for facility equipment, parts and supplies.
NET AREA		**TOTAL = «NET_AREA_TOTAL»**
Mechanical	Included in net to gross area calc, see table 2.1.1	Include but not limited to boilers, fan motors, with adequate maneuverability to service equipment. Consider the use of a separate boiler room if the layout of the mechanical room has limited exterior wall space.
Electrical		Space for Service Rated Entrance Equipment, transformers, Distribution Panels, Lighting Panels, Fire Alarm System Control, etc. Provide additional space for any proposed renewable energy electrical equipment.
Communications		Provide space and power for 3 racks with integral wire management systems and 1 TBB. If a SIPRNET Safe meets the requirements for this facility, in lieu of a SIPRNET room, then it may be combined with the main communications room. The room will have to be constructed to meet the requirements of DCID 6/9 and the USAISEC Technical Guide for the Integration of Secret Internet Protocol Router Network.
Fire Suppression Room		Include space for sprinkler system riser, foam tanks, foam pumps, headers and expansion tanks.
Circulation		Corridors to be a minimum 6' width
Exterior Covered Storage		Provide a secured load-bearing pad, base, apron, or platform upon which various types of equipment are positioned including «UAS_CONTAINERS»~~12~~ UAS storage and transportation containers. Provide impact resistant durable protection to the wall that is to receive these containers.

SAMPLE

ROOM NAME	AUTH (SF)	SPECIAL REQUIREMENTS
		~~SPAMs, g~~Generators, MILVANs, shop sets (M109), power generation, ground support equipment, and transformers are equipment frequently placed on such pads. Locate adjacent to the primary facility. Provide an outdoor covered storage for non-accountable parts stored in 14 military supply containers (ISU 90)~~three - 129 vans~~ adjacent to aircraft maintenance bay. The actual quantity is to be verified with the end user. Provide weatherproof GFI convenience receptacles.
HAZARDOUS/ FLAMMABLE/ OIL STORAGE		Provide compliant storage area for six 55-gal drums of hazardous materials within as a prefabricated facility outside of the hangar. Provide compliant space for six metal hazardous material storage cabinets adjacent to hangar maintenance bay and special tool room.
HAZARDOUS WASTE STORAGE		Provide compliant space for temporary storage of used lubricants, flammable solvents, dry sweep, etc. Provide space for six 55-gallon barrels. This space may be combined with 55-gallon drum hazardous material storage.
WASTE OIL STORAGE TANK WASTE FUEL STORAGE TANK		Provide compliant above-ground 300-gallon waste oil storage tank. The tank shall be constructed of non-corrosive material. Provide secondary containment in compliance with applicable state environmental regulations. Tank construction and location shall comply with IBC and NFPA code requirements. Provide 12" diameter x 5'-4" high, concrete-filled, schedule 80 galvanized steel pipe bollards, painted safety yellow, around the perimeter of above-ground tank areas.

SAMPLE

3.4.2. FURNITURE, FIXTURE AND EQUIPMENT (FF&E) LISTING;

Where a conflict exists between Tables 3.4.1 and Table 3.4.2. Table 3.4.1 governs.

Table 3.4.2 UAS Hangar FURNITURE, FIXTURE, AND EQUIPMENT FF&E LIST

AIRCRAFT MAINTENANCE AREA		
AIRCRAFT MAINTENANCE BAY HANGAR FLOOR - per aircraft module	1	2'D x 3'W Technical ~~Workbench~~ Standing Height Mobile Workstation on hard surface casters.~~w/ESD worktop and grounding points, wrist straps, task lighting; provide metal powerstrip w/minimum 6 receptacles~~
	1	Lockable Tool Storage Cabinet w/Drawers 30"Wx57"H
	1	Lockable Tool Storage Shelving 60" W x 57"H

Hangar Bay Floor	4	L-Shaped ~~Bench~~ Standing Height Workstations. Provide: center drawer; Box/Box File & File/File Storage; Overhead Storage & task lighting
	~~8~~4	Stools w/ hard surface casters~~Ergonomic Task Chair~~
ALLIED SHOP AREAS		
Per Each Allied Shop Area	1	L-Shaped Admin Workstations. Provide: center drawer; Box/Box File & File/File Storage; Overhead Storage & task lighting
	2	Ergonomic Task Chairs
	1	4 H Lockable Lateral File
	4	Lockable Tool Storage Cabinet w/Drawers 30"Wx57"H
	4	Lockable Tool Storage Shelving 60" W x 57"H
	12	Technical Workbench Height Workstations w/ESD worktop and grounding points; wrist straps; four (4) drawers below and a shelf above for small parts boxes and repair materials; task lighting; an area to accommodate a laptop and metal powerstrip w/minimum 6 receptacles. Workstations to have a local exhaust system for soldering to be coordinated with the user.
	12	Operable Stools w/hard surface casters
	1	10'W x 4'D x 6'H Industrial Shelving Unit
Secure Storage & Bench Stock	4	4 H Lockable Metal Storage Cabinets with shelves
	3	Within Classified Secured room provide~~10'W x 4'D x 6'H~~ open Industrial Shelving Units on on either side the length of the room.
Tech. Supply (Class IX Air)	1	Mobile Storage System
	1	Provide grounding points, wrist straps, 30"w x 30"d x 37.5" workbench with lockable tool storage cabinet w/ drawers
	1	Small Receiving Desk
	1	Ergonomic Task Chair
AIRCRAFT MAINTENANCE SHOP SPACE		
Production Control (PC)	3	L-Shaped Admin Workstations. Provide: center drawer; Box/Box File & File/File Storage; Overhead Storage & task lighting
	3	Ergonomic Task Chairs
	10	Task chairs
	1	Printer storage cabinet 72" w x 30"d x 30"h
	2	2 High Lateral File Cabinets with Counter Top
	2	Progress/scheduling marker board(s) or flat screen monitor(s).
	1	Conference table to seat 10 comfortable.
Quality Control/ Quality Assurance (QC/QA)	4	L-Shaped Admin Workstations. Provide: center drawer; Box/Box File & File/File Storage; Overhead Storage & task lighting

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	1	Guest Chair
	4	Ergonomic Task Chair
	1	Printer storage cabinet 72" w x 30"d x 30"h
	2	Progress/Scheduling Marker Board
	1	Small Receiving Desk
	2	Five (5) Shelve Bookcases
	2	Storage shelves for Technical References. CD storage
Contractor Logistics Support (CLS/LARS)	5	L-Shaped Admin Workstations. Provide: center drawer; Box/Box File & File/File Storage; Overhead Storage & task lighting
	5	Ergonomic Task Chair
	1	Printer storage cabinet 72" w x 30"d x 30"h
	4	4 High Lateral File Cabinets
	2	Ergonomic Task Chair
Break Room	3	36" round tables.
	8	Stack Chairs
	1	Microwave
	1	Top Mount Freezer/Refrigerator 21.7 Cu. Ft.
	1	4' x 8' Dry Erase Board
Small Tools Room	1	20 LF Counter w/ESD worktop. Provide grounding points, wrist straps, 30"w x 30"d x 37.5" lockable tool storage cabinet w/ drawers
	1	Check-out countertop running the width of the room, include lift up section or half-height door to transfer tools, space for one person to do book work, with lockable drawers and 1 person working on small tools with lockable tool storage. Provide grounding points,~~U-Shaped workstation. Provide: Overhead storage w/ task lighting; center drawer; Box/Box File, & File/File Storage.~~
	3	Lockable Tool Storage Cabinet w/Drawers 30"Wx57"H
	3	Lockable Tool Storage Shelving 60" W x 57"H
	2	Ergonomic Task Chair
	6	48"W x 36"D x 88" H Shelving Units
	~~4~~2	Technical Workbench w/ESD worktop and grounding points, wrist straps, 2 overhead shelves and task lighting; provide metal powerstrip w/minimum 6 receptacles
	~~4~~2	Operable Stools w/hard surface casters
MAINTENANCE PLATOON AREA 1ST OR 2ND FLOOR		
Maintenance Platoon	2	Private office Workstations with Overhead storage w/ task lighting; center drawer; Box/Box File, & File/File Storage; Wardrobe Tower
	2	L Shaped Workstations
	4	Ergonomic Task Chair

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	4	4 H Lateral Files
	4	Guest Chairs
UAV Standardization Officer	1	Private office with U-Shaped workstation. Overhead storage w/ task lighting; center drawer; Box/Box File, & File/File Storage; Wardrobe Tower
	1	Ergonomic Task Chair
	2	Guest Chairs
	1	Printer storage cabinet 72" w x 30"d x 30"h
Safety Officer	1	Private office with U-Shaped workstation. Provide: Overhead storage w/ task lighting; center drawer; Box/Box File, & File/File Storage; Wardrobe Tower
	1	Ergonomic Task Chair
	2	Guest Chairs
	1	Printer storage cabinet 72" w x 30"d x 30"h
SUPPORT SPACE 1ST FLOOR		
Male Locker/Shower/Latrine	4	4' Locker Bench
	22	12"x72" Double tier; Metal lockers with raised base and sloped top
Female Locker/Shower/Latrine	1	4' Locker Bench
	6	12"x72" Double tier; Metal lockers with raised base and sloped top
Facility Maintenance & Storage	1	Workbench
	1	Operable Stool w/hard surface casters
	1	Small Receiving Desk
	1	Ergonomic Task Chair
FLIGHT PLATOON AREA (INCLUDING SUPPORT) 2ND FLOOR		
Flight Platoon	2	Private office with U-Shaped workstation. Provide: Overhead storage w/ task lighting; center drawer; Box/Box File, & File/File Storage; Wardrobe Tower
	2	3-Seater Sofa
	2	End Tables
	2	U-Shaped Admin Workstations. Provide: center drawer; Box/Box File & File/File Storage; Overhead Storage & task lighting
	4	Guest Chair
	4	Ergonomic Task Chair
	1	Printer storage cabinet 72" w x 30"d x 30"h
	2	Semi-private~~/Private office with~~ U-Shaped workstations in each of the three private offices. Provide: Overhead storage w/ task lighting; center drawer; Box/Box File, & File/File Storage. For the System Repair Platoon.

SAMPLE

Small Conference Room	1	Conference Table
	6	Ergonomic Conference Chairs
Distributed/Comp Based Training / Breakroom		See Section 01 10 00, Para 3.4.1, Table 3.4.1
Facility Storage	4	5 H Storage Cabinets
FLIGHT PLANNING & OPERATIONS AREA 2ND FLOOR		
Flight Planning	5	Table top planning workstations. Box/Box File, & File/File Storage.
	6	Ergonomic Task Chair
	1	Amin Workstation
	1	U-Shaped Admin Workstations. Provide: center drawer; Box/Box File & File/File Storage; Overhead Storage & task lighting
	1	Wall-mounted sliding panels for display of GFCI planning maps
	1	White Board
	1	Printer storage cabinet 72" w x 30"d x 30"h
Flight Operations	4	U-Shaped workstation. Provide: Overhead storage w/ task lighting; center drawer; Box/Box File, & File/File Storage.
	4	Ergonomic Task Chair
	4	4 H Bookcases
	2	Printer storage cabinet 72" w x 30"d x 30"h
	4	4 High Lateral File Cabinets
	4	4'x8' Marker Board
Briefing Room	55	Stackable chairs~~See Section 01 10 00, Para 3.4.1, Table 3.4.1~~
	25	Folding Tables
	1	Markerboard the length of the room
OTHER SPACES		
Hazardous/Flammable/Oil Storage	6	Hazmat Storage Cabinets

3.5. FUNCTIONAL ADJACENCIES

See Table 3.5 https://eportal.usace.army.mil/sites/COS/HGRC/Shared%20Documents/Adjacency-Matrix-UAS-Hangar.pdf.

3.6. SITE FUNCTIONAL AREAS:

Site selection and real property master planning for all Active Component HGR Complexes (and Reserve Component complexes when applicable) shall comply with all safety, obstruction, and airspace boundaries as

SAMPLE

stipulated by AR 95-2 and implemented by the Transportation Systems Center (TS MCX) for DCS G-3, HQDA. The major components of a HGR Complex and minimum sitting requirement for any hangar project (inside the five-foot line) include the primary facility FCC 211 xx, Hangar Access Apron FCC 113 40. The outer boundary of the hangar (outside the five-foot line) abuts the Access Apron FCC 113 40. This assures safe and efficient transition from the power-on components of an AAF/AHP (primary landing surface (i.e., runway or helipad) and aircraft parking) to non-power ingress/egress into the hangar.

3.7. ARCHITECTURE:

3.7.1. FLOORS:

(a) Hangar floors: Non-skid, light reflective, non-oxidizing dry shake surface hardened or light reflective epoxy or polyurethane coating.

(b) Shop floors: Sealed concrete, non-skid, light reflective, non-oxidizing dry shake surface hardener or light reflective epoxy or polyurethane coating.

(c) Restroom floors: ceramic tile / porcelain tile.

(d) Shower floors: ceramic tile

(e) Office floors: carpet or vinyl composition tile.

(f) Corridors / Vestibules: Vinyl composition tile, concrete sealer.

(g) Other auxiliary spaces: Concrete sealer.

3.7.2. BASES:

(a) Hangar: Painted CMU/Rubber Base

(b) Restrooms: Ceramic tile, porcelain tile

(c) Showers: Ceramic tile

(d) Offices / corridors, Vestibules: Rubber base

(e) Other auxiliary spaces: Rubber base

3.7.3. WALLS: (STC and fire rated where required)

Hangar and shop Spaces: Up to 8'-0" Above Finished Floor: Durable, impact resistant, corrosive resistant, and easily cleaned material. The lower portion of the walls is to be protected against incidental damage caused by movement of aircraft parts, fixtures, and equipment. Protect exterior surface against incidental damage. Painted. Above 8'-0": Moisture resistant gypsum board, exposed vinyl faced insulation, metal liner panels solid or perforated. Painted.

The recommended material at the exterior hangar wall to receive the aircraft shipping containers is CMU fully grouted from the finished floor to the bearing height of the protective overhang by the full width of the storage area. This durable and impact resistant construction is to minimize damage from fork lift operations in moving these containers.

(a) Restrooms: ceramic tile / porcelain tile (Utilize water resistant/ mold resistant cement backer board).

(b) Showers: Ceramic tile / porcelain tile (Utilize cement backer board or moisture resistant gypsum board).

(c) Offices: Painted gypsum board.

(d) Corridors, Vestibules: Painted gypsum board.

(e) Other Auxiliary spaces: Painted gypsum board, or CMU.

3.7.4. CEILINGS:

(a) Hangar and Shop Spaces unless otherwise noted: Paint exposed structure. Note: Do not paint exposed vinyl faced insulation, if used.

(b) Offices & Technical Shops: Acoustical Ceiling Tile.

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(c) Restrooms & Lockers and showers: Moisture-resistant Acoustical Tile or moisture-resistant gypsum board-painted. Where acoustical tile is used, extend perimeter walls to ceiling/roof above.

(d) Corridors: Acoustical Ceiling Tile.

(e) Vestibules: Acoustical Ceiling Tile with hold-down clips, Painted Gypsum Board.

(f) Auxiliary Spaces: Acoustical Ceiling Tile, Painted Gyp Bd.

3.7.5. DOORS AND FRAMES: (STC and fire rated where required)

(a) Painted Insulated Galvanized Hollow Metal (corrosive resistant at Hangar and Shop Areas).

(b) Aluminum Entrance System – color PVF finish.

(c) Plastic Laminate, hollow core metal, insulated metal, or solid core wood doors (Administrative spaces).

(d) Hangar Doors: Motorized Fabric; Motorized Insulated Metal Horizontal Sliding– color to compliment other exterior finishes. Metal Hangar doors to be capable of being moved by a tug in case of power failure. Door tracks to have drains or be designed to drain to the building exterior for easy maintenance. ***<UAS_FREEZE>***Door tracks heated at locations that freeze. ***</UAS_FREEZE>***Hangar doors to have a clear opening height of 28'-0" AFF.

(e) Service Doors: Insulated metal motorized overhead coiling doors. Coiling doors to have a clear opening height of 10'-0 AFF by 10'-0" wide in the Allied Shops.

3.7.6. WINDOWS / GLAZING: (Fire rated where required)

(a) Hangar Floor or Shop Space: Fixed High-Bay windows, clerestory windows, or insulated translucent wall system where required. Aluminum is required for exterior windows, and interior glass that may occur in non-rated conditions such as vestibule sidelites. Hollow metal is required at interior windows required to be fire-rated.

(b) Offices, exterior and Vestibule interior: Aluminum, insulated windows, fixed, color PVF finish.

(c) Interior Windows: Hollow core metal with fire or safety glazing as required. Install stops on secure side of the window.

3.7.7. SPECIALITIES:

(a) Marker boards: Liquid writing marker boards.

(b) Bulletin boards: Bulletin boards shall consist of a natural cork tack board, and aluminum tubular frame.

(c) Signage: Comply with requirements of ADA and ABA. Accessibility Guidelines. Fully integrate interior signage as a design element with the architecture and interior design.

(d) Fire Extinguishers, Cabinets or Supports.

(e) Millwork: Built-in accessories/worktops/counters.

3.8. NOT USED.

3.9. PLUMBING

3.9.1. EXTERIOR WALL HYDRANTS:

Provide wall hydrants around perimeter of building as well as one inside of the Mechanical Room(s).

3.9.2. DOMESTIC HOT WATER SYSTEM:

Locate the main water heating equipment within a mechanical room, on the ground floor level only. Instantaneous water heaters are permissible. Size system storage and recovery for delivery of hot water at every shower head over a continuous operation of all heads for a duration of 90 minutes. Usage diversity factor for the showers shall be one. Size water heater(s) based upon usage anticipated and accounting for this diversity factor. Determine the energy source for the domestic water heating system by Life Cycle Cost Analysis.

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3.9.3. TRENCH DRAINS:

Design trench drain for easy cleaning. Provide basket strainers to facilitate trash removal where trench drains discharge to piping systems. Convey waste to exterior oil/water separator prior to discharge to the sanitary sewer system. Prevent fire suppression disposal into oil/water separator system. When a dedicated, walled welding area is provided, provide a solid cover to the trench drain where it runs through the welding area.

3.9.4. EMERGENCY SHOWERS AND EYEWASHES:

Provide eye wash, hand wash and emergency shower requirements within the hangar and shop areas. Locate emergency wash stations in accordance with OSHA standard 1910.151(c) and ANSI Z358.1.

3.9.5. COMPRESSED AIR:

Provide the compressed air outlets with quick disconnect couplings in all bays. Each drop shall include an isolation valve, filter and pressure regulator, condensate trap with drain cock. Provide air compressor with receiver, refrigerated air dryer, filtration and pressure regulation. The air compressor shall be installed building equipment. Size air compressor for 30 SCFM per outlet, with a 60 percent diversity. Unless otherwise indicated by the user requirements, provide compressed air at 120 psi.

3.10. ELECTRICAL AND TELECOMMUNICATIONS

3.10.1. FACILITY POWER

Design facility power in accordance with NFPA 70. At a minimum provide with the following: 3-phase wye-connected, underground secondary service rated at 480VAC with sufficient capacity for future growth. Provide surge suppression on all service entrance equipment. Use 480VAC for mechanical equipment and larger building specific loads. Generally, use 277VAC for lighting. Use dry type step down transformers to provide 208Y/120VAC service for miscellaneous loads. Consider exterior loads, which may vary by site, for each project. Consider some of the following, as applicable: any airfield lighting or taxiway requirements, exterior facility lighting, power connections for exterior ground support equipment, or portable trailers. As many as six trailers, each utilizing 208Y/120VAC, 100A, 3-phase service, may require power from the facility distribution system or a separate primary feed depending on the location. Coordinate project specific requirements for the trailers and their load and connection requirements with the installation or user group to determine number of trailers required. Specific load requirements for the hangar and shop areas will vary by airframe type and specific shop equipment and will vary by specific hangar type design. Careful coordination by the installation, users, COS, and DORs will be required to size incoming service appropriately based upon the type and number of aircraft.

UAS systems and support equipment operate the majority of equipment on 208/110VAC/60Hz systems.. Careful coordination with the specific project and site will be required to ensure proper tailoring of requirements.

3.10.2. STANDBY POWER SYSTEMS:

Standby Generator and UPS Back-Up Power Systems generally are not required for these facilities. Government Furnished – Government Installed (GFGI), UPS systems may be for communications and data systems but will generally not be large in nature and will not be provided by the standard design.

3.10.3. GROUNDING:

Use a ground counterpoise around the building perimeter for grounding incoming service, building steel, telephone service, piping, lightning protection, aircraft static ground points, and facility internal grounding requirements (e.g. shop areas). Provide an equipment grounding bar around the perimeter of shops. Install ground straps where required by function, connected to the building grounding system. Provide a grounding point under each raised access floor. Provide additional grounding based on project-specific requirements and the US Army I3A Technical Criteria.

3.10.4. POWER DISTRIBUTION:

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Provide power receptacles per NFPA 70 and in conjunction with all equipment and proposed furniture layouts. Provide additional power specific power requirements as specified in the following sections.

3.10.4.1. Aircraft Maintenance Hangar: Provide one GFI 120V/20A quad receptacle for every 25 feet of wall minimum. See Aircraft Maintenance Bay and work bench requirements below. Provide power receptacles for addition equipment per table 3.4.2.

3.10.4.2. Allied Shops: Provide one GFI 120V/20A quad receptacle for every for each 15 feet of wall minimum. Provide a 400Hz/115V converter in the shops to supply 400Hz outlets at the benches in accordance with UFC 3-555-01N 400 Hertz Medium Voltage Conversion/Distribution and Low Voltage Utilization Systems.. See additional work bench requirements below. Provide power receptacles for addition equipment per table 3.4.2.

3.10.4.3. Exterior Ground Equipment Connections: Provide one 208V/3Φ/50A receptacle, one GFI 120V/20A quad receptacle, and a quad data/phone for six equipment parking/staging spaces along the exterior of the building.

3.10.4.4. Telecommunications Room (TR): Provide one 120V/20A double duplex receptacle for each communications rack with each duplex on a dedicated circuit. Additionally, provide one general-purpose 120V/20A quad receptacle for every for each 6 feet of wall space.

Each Aircraft Maintenance Bay and workbench shall have power, data, and compressed air as follow:

Aircraft Utility Stand:

(2) – 480V/3Φ/30A Receptacles
(2) – 208V/3Φ/50A Receptacles
(2) – 120V/1Φ/20A GFI Quad Receptacles
(1) – Quad Data Outlet
(3) – Compressed Air Outlets

Hangar Workbenches:

(1) – 208V/3Φ/50A Receptacle
(2) – 120V/1Φ/20A GFI Quad Receptacles
(1) – Quad Data Outlet
(1) – Compressed Air Outlet

Allied Shop Workbenches:

(1) – 400Hz/115V Receptacle
(1) – 208V/3Φ/50A Receptacle
(2) – 120V/1Φ/20A GFI Quad Receptacles
(1) – Quad Data Outlet
(1) – Compressed Air Outlet

GFGI ER/MP IMS Flight Simulators:

(2) – 120V/1Φ/20A GFI duplex Receptacles (on dedicated circuits)
(1) – Quad Data Outlet

3.10.5. LIGHTING:

The exterior and hangar bay lighting shall be compatible with any future security cameras and security requirements as applicable. Lighting levels shall be in accordance with UFC 3-530-01.Provide interior lighting controls in accordance with ASHRAE 90.1. Utilize day lighting where applicable to conserve energy; hangar, shops, etc. Supplement automatic controls in offices and specialized areas such as conference rooms with local manual controls. Provide occupancy sensor controls in all spaces which are not regularly occupied such as storage rooms, restrooms, etc. Interior ambient illumination shall provide a generally glare free, high quality lighting environment in conference rooms and training rooms.

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3.10.6. TELECOMMUNICATIONS:

3.10.6.1. GENERAL:

(a) Connect the facility to the Installation wide area network system (WAN) and telephone system. The Logistics STAMIS system mentioned in Table 3.4.1 shall ride the NIPRnet distribution system. Allocate communications system resources IAW the I3A Technical Criteria regarding outlet amounts based on the functionality of the facility's various component floor spaces. Design in accordance with UFC 3-580-01 and the I3A- Technical Guide.

(b) An acceptable building telecommunications cabling system encompasses, but is not limited to, copper and fiber optic (FO) entrance cable, termination equipment, copper and fiber backbone cable, copper and/or fiber horizontal distribution cable, workstation outlets, racks, cable management, patch panels, cable tray, cable ladder, grounding, and labeling. Provide telecommunications outlets per the I3A based on functional purpose of the various spaces within the facility as modified by user special operational requirements.

(c) Provide each utility space, such as mechanical, electrical and telecommunications rooms with at least one wall mounted telecommunications outlet, with a wall mounting lug face plate near the entrance door.

(d) Provide 2 empty 4" conduits with pull ropes to the roof from the Flight Ops and each of the shop spaces to support User operational equipment.

3.10.6.2. OUTSIDE PLANT TELECOMMUNICATIONS SYSTEMS:

Connect the project's facilities to the Installation telecommunications (voice and data) system through the outside plant (OSP) underground infrastructure per I3A requirements. Connect to the OSP cabling system from each facility main cross connect located in the main telecommunications room or telecommunications equipment room to the closest OSP access point. Components include the physical cable plant and the supporting structures. Items included under OSP infrastructure encompass, but are not limited to, maintenance hole and duct infrastructure, copper cable, fiber optic cable, cross connects, terminations, splices, cable vaults, and copper and FO entrance facilities.

3.10.6.3. TELECOMMUNICATIONS ROOMS (TR):

Provide telecommunications rooms and telecommunications entrance facilities for unclassified network and voice equipment and cabling infrastructure throughout the facilities. There shall be a minimum of one telecommunications room on each floor, located near the center of the building, and stacked between floors. Provide one telecommunications entrance capability for each facility. The telecommunications entrance may be collocated with the Main TR (MTR) for the facility. Size TR's for the area supported. TIA/EIA-569 compliant Telecommunications Enclosures (TE) may be used in hangar areas where the horizontal cable distance exceeds 90 meters.

3.10.6.4. SIPRNET:

Provide a SIPRNET room or SIPRNET safe in accordance with Secret Internet Protocol Router Network Technical Implementation Criteria Version 6. Refer to the USAISEC Technical Guide for the Integration of Secret Internet Protocol Router Network (SIPRNET) for detailed information and references regarding SIPRNET. Section 6.2.5 of the USAISEC SIPRNET Tech Guide provides guidance on physical security. If required the SIPRNET room will be a minimum of six foot by six foot, constructed in accordance with AR 380-5, Section III, Chapter 7 and have a dedicated HVAC system

If a SIPRNET Safe meets the requirements for this facility, in lieu of a SIPRNET room, then it may be installed in the MTR. The MTR room will have to be constructed to meet the requirements of DCID 6/9 and USAISEC Technical Guide for the Integration of Secret Internet Protocol Router Network

3.10.6.5. CATV:

Provide a completely operational CATV cabling system including, but not limited to, all necessary raceways, cabling, terminations, jacks and faceplates will be provided. The horizontal cable for the CATV system will be RG-6 with "F" type connectors on the terminal end. Terminate the CATV cabling on splitters in the telecommunications room, or in a location indicated by the Network Enterprise Center (NEC – formerly the

SAMPLE

DOIM). CATV riser cable will be RG-11 type. Locate splitters on the CATV backboard in the telecommunications room, or in a location indicated by the NEC. Homerun all CATV horizontal cabling between CATV jacks and the CATV backboard. Coordinate service requirements to the building with the local CATV service provider. At a minimum provide one 4' empty conduit stubbed out of the building to facilitate the CATV service entrance.

3.10.7. MISCELLANEOUS SYSTEMS:

Design Secure Access Systems, Intrusion Detection Systems (IDS), Closed Circuit Television (CCTV) to only provide raceways and back boxes for installation of these systems, unless otherwise specified for Project specific requirements.

3.10.7.1. SECURE ACCESS SYSTEM:

Coordinate with the Installation Physical Security anticipated locations of devices and provide raceways and back boxes for installation of a secure access system per Army Installation Design Standards paragraph 3.5.11, “Locks and Locking Devices”.

3.10.7.2. IDS AND CCTV SYSTEM:

Coordinate with the Installation Physical Securityanticipated locations of devices required for a complete IDS and CCTV system. Design raceways and back boxes for installation of a complete system.

3.10.8. MASS NOTIFICATION SYSTEM:

Provide a Mass Notification System in accordance with UFC 4-021-01 Design and O&M: Mass Notification Systems and integrate with the fire alarm system.

3.11. HEATING, VENTILATING AND AIR CONDITIONING

STANDARDS AND CODES:

The HVAC system shall conform to APPLICABLE DESIGN AND ENERGY CRITERIA.

3.11.1. HANGAR AREAS:

For hangar bay areas, consider heating and ventilating units, radiant heating, or some combination of the two. In colder climates, consider supplemental heating at the floor level or under slab radiant floor heating in the hangar bay aircraft modules. Coordinate system selection with the user. Base the system selection on energy compliance life cycle cost, reliability and operating considerations, and the maintenance capabilities and resources of the user. Consider all viable alternative systems meeting the functional requirements of the hangar bays.

3.11.2. ADMINISTRATIVE AREAS:

See Table 3.11 for heating and cooling of administrative areas. HVAC system design should consider including flexibility in zoning to where it can address future changes in occupant densities. Administrative areas shall be temperature-controlled by the DDC system. Temperature set point adjustment shall be accomplished via DDC System by authorized personnel.

3.11.3. SHOP AREAS:

The shops shall be mechanically ventilated, heated, and air conditioned. Consider packaged equipment, split systems or systems utilizing chilled/heating water from either a central plant or decentralized sources. Independent and dedicated packaged A/C units shall be provided for the Non-Sensitive Secure Storage Areas. Communication rooms will be served by an independent and dedicated air-handling system and shall be conditioned. Air handling unit system(s) shall not be floor-space mounted within the actual spaces served. Administrative-type areas located within the shops shall be conditioned per Paragraph 5.5 requirements.

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3.11.4. BUILDING EXHAUST SYSTEMS:

Provide exhaust systems at heat sources, restrooms, battery rooms, and contamination sources. Battery room systems will be ducted exhaust system with explosion proof fans and operate continuously. Exhaust systems will operate continuously while the building is occupied. Exhaust systems shall be in accordance with NFPA 90A.

3.11.5. DESIGN CONDITIONS:

3.11.5.1. Design shall be based on weather data from recognized and authoritative sources weather data. Indoor design conditions shall conform to Table 3.11. Indoor air quality shall confirm with the current ASHRAE Standard 62.1 and OSHA requirements.

TABLE 3.11 – INDOOR DESIGN DATA

HEATING

Indoor Design Temperature – Admin and Offices 70°F

Indoor Design Temperature – Shop Spaces 65°F

Indoor Design Temperature – Hangar 55°F

Unoccupied Space Design Temperature 55°F

COOLING

Indoor Administration and Offices Design Temperature 75°F

Indoor Design Temperature – Shop Spaces 78°F

Indoor Design Temperature – Hangar Ambient

Unoccupied Space Design Temperature 85°F

3.11.5.2. In geographical areas of high humidity, take appropriate measures to control moisture. In areas of high humidity.

3.11.5.3. To prevent mold formation in buildings, air conditioning systems must be designed to maintain space humidity at reasonable levels. Include the following considerations in the design of the air conditioning systems. Avoid over sizing of cooling equipment. Design single zone systems and multi-zone systems to maintain an indoor design condition of 50% relative humidity. Size cooling coils for the greater of the cooling load calculated at the design dry bulb temperature condition or the design humidity condition. Where fan coil units are used, provide a non-permeable wall covering behind the unit. Provide ventilation air from a separate dedicated air handling unit. Do not condition outside air through fan coil units. Avoid the use of direct expansion cooling coils in air handling units with constant running fans that handle outside air.

3.12. FIRE PROTECTION

Hangars are classified as major projects. Provide fire protection in accordance with the Standards and Codes in paragraph 3.12.1. The Army's first priority after life safety is to minimize collateral damage to aircraft which would affect full "mission ready" status after a fire incident. Follow aggressive application of Standards and Codes to minimize damage, down-time, clean-up, and return of aircraft to "fully mission capable" readiness state is a high priority. Aircraft hangars shall use a fire suppression system that meets all the following requirements in the order of priority shown.

3.12.1. STANDARDS AND CODES:

Fire protection and life safety features shall meet UFC 3-600-01, Attachment A following this Paragraph (Army Hangar Fire Protection), NFPA 409 and additional requirements of this contract. Code references to "authority having jurisdiction" shall be interpreted to mean the Contracting Officer.

3.12.2. FIRE PROTECTION AND LIFE SAFETY ANALYSIS:

A fire protection and life safety design analysis shall be provided for this facility type.

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The analysis shall be submitted with the interim design submittal in accordance with section 01 33 00 Submittal Proceedures.

3.12.3. ALLOWABLE FLOOR AREA

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

(a) 100 percent of the facility has full automatic sprinkler coverage in accordance with this document.

(b) Water supply to the sprinkler systems is in compliance with the criteria in this document.

(c) Internal separation walls between hangar bay areas and non-hangar bay areas comply with NFPA 409.

(d) Separation distances from adjacent structures comply with NFPA 409.

3.12.4. HANGAR BAYS

3.12.4.1. FIRE SUPPRESSION

NFPA 409, applies except as modified herein. Comply with referenced NFPA standards including advisory provisions listed in the appendices of such standards as though the word "shall" had been substituted for the word "should" wherever it appears. The requirements of this contract govern In the event of a conflict between specific provisions of this contract and applicable NFPA standards. Comply with Attachment A and A1 following this Paragraph.

<UAS_FS_OPTION1>Provide a combination of automatic high expansion foam system and automatic sprinkler systems for the hangar bays in accordance with Attachment A1.***</UAS_FS_OPTION1><UAS_FS_OPTION2>***Provide an automatic closed-head foam water sprinkler system for the hangar bays in accordance with Attachment A1.***</UAS_FS_OPTION2>***

3.12.4.2. TYPE OF CONSTRUCTION

Use Type I or Type II construction for hangar bays in accordance with the IBC.

3.12.4.3. EGRESS

The means of egress from the aircraft hangar bays shall be inaccordance with NFPA, IBC, noted herein and as shown on the floor plans in Appendix J of this RFP.

(a) Intervals between exit doors at hangar exit access corridors and hangar bay exterior doors shall not exceed 150 feet. Exit access corridors are defined as the corridors through the office/shop/equipment section of this facility type.

(b) All rooms within the office/shop/equipment section shall have at least one exit into an exit access corridor.~~All rooms within the office/shop/equipment section with a lower hazard classification than the hangar bay shall shall not exit into the hangar bay. These rooms shall have at least one exit into an exit access corridor.~~

3.12.5. HANGAR AREAS OTHER THAN HANGAR BAYS

3.12.5.1. FIRE SUPPRESSION

Provide automatic sprinkler systems IAW UFC 3-600-01, applicable NFPA standards, and other requirements contained in this contract including applicable portions of Attachment A and A1 following this Paragraph.

3.12.5.2. TYPE OF CONSTRUCTION

Meet the requirements of Paragraphs 1.0 PROJECT OBJECTIVES, 3.12 FIRE PROTECTION, and 3.12.1.1 ALLOWABLE FLOOR AREA .

3.13. REFERENCES:

Comment [sdn1]: [NOTE TO SPECIFIER: Select one of the following allowable systems best meeting the equirements of Paragraph 3.10:

Allowable hangar bay fire suppression system options:

1. A combination of automatic low-level high expansion foam system and automatic sprinkler system.

2. A closed-head foam-water sprinkler system.

3. Combination of automatic low-level high expansion foam system and automatic sprinkler systems, or closed-head foam water sprinkler system. This option is provided to allow the Contractor to determine which fire suppression system best meets the requirements of Paragraph 3.10.

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Note: In addition to general references in Paragraph 4, the following publications are applicable to the UAS Hangar Facility type to the extent specifically mentioned in Paragraph 3 and/or the remainder of the Solicitation:

(1) 10 CFR 436, Sub Part A, Methodology and Procedures for Life Cycle Cost Analyses.

(2) ABA. Architectural Barriers Act Standard for Department of Defense Facilities

(3) ANSI/IESNA RP-1-04. American National Standard Practice for Office Lighting.

(4) ANSI/TIA/EIA 569-B, Commercial Building Standards for Telecommunications Pathways and Spaces.

(5) ANSI/TIA/EIA 569-B.1, Commercial Building Standards for Telecommunications Pathways & Spaces, Part 1 General Requirements.

(6) ANSI/TIA/EIA 569-B.2, Commercial Building Standards for Telecommunications Pathways & Spaces, Part 2 Balanced Twisted Pair Cabling Components.

(7) ANSI/TIA/EIA 569-B.3, Commercial Building Standards for Telecommunications Pathways & Spaces, Part 3 Optical Fiber Cabling Components.

(8) ANSI Z358.1, Standard for Emergency Eyewash and Shower Equipment

(9) ASHRAE Underfloor Air Distribution (UFAD) Design Guide, 2003

(10) ASHRAE 55 Thermal Environmental Conditions for Human Occupancy.

(11) ASHRAE Hdbk-IP Handbook, Refrigeration I-P Edition.

(12) ASHRAE Hdbk-IP Handbook, HVAC Applications I-P Edition.

(13) ASHRAE Hdbk-IP Handbook, HVAC Systems and Equipment I-P Edition.

(14) AR 190-51, Security of Unclassified Army Property (Sensitive and Nonsensitive).

(15) AR 380-381 Special Access Programs (SAPS) and Sensitive Activities.

(16) AR 380-40 Policy For Safeguarding And Controlling Communications

(17) AR 95-2, Air Traffic Control, Airspace, Airfields, Flight Activities, and Navigational Aids

(18) ASME B31.1 Power Piping.

(19) Clean Air Act Amendment of 1990

(20) Costing for MILCON Design (March 1996)

(21) DCID 6/9 Manual for Physical Security Standards for Sensitive Compartmented Information Facilities.

(22) Discount Factors for Life-Cycle Cost Analysis, Annual Supplement to NIST Handbook 135.

(23) DoD MIL-STD-188-124B, Grounding, Bonding, and Shielding for Common Long Haul/Tactical Communication Systems Including Ground Based Communications-Electronics Facilities and Equipments, Notice 3, 18 December 2000.

(24) DoD MIL-HDBK-419A, Grounding, Bonding, and Shielding for Electronic Equipments and Facilities, Volume 1, Theory, Volume II, Applications, 29 December 1987.

(25) DOD Unified Facilities Criteria Memorandum, 29 May 2002

(26) DoD 5105.21-M-1 Sensitive Compartmented Information Administrative Security Manual.

(27) DoD Regulation 5200.1-R, Information Security Program, Appendix 7 – Physical Security for Vault and Secure Room Construction Standards.

(28) DOE Guidance on Life Cycle cost Analysis Required by Executive Order 13123.

(29) Energy Star Program

(30) ETL 02-15, Fire Protection Engineering Criteria - New Aircraft Facilities

(31) ETL 1110-3-481, Containment and Disposal of Aqueous Film-Forming Foam Solution

(32) ETL 1110-3-506 Aviation Complex Planning and Design Criteria For Army Unmanned Aircraft Systems (UAS)

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(33) Executive Order 12902: Energy Efficiency and Water Conservation at Federal Facilities.

(34) Executive Order 13123: Greening the Government through Efficient Energy Management.

(35) Federal Energy Management Program (FEMP)

(36) IEEE Standard 519-1992, IEEE Recommended Practice and Requirements for Harmonic Control in Electrical Power Systems

(37) Information Systems Facility Design Criteria (FDC) developed by USAISEC for [Division] [Corps] [Numbered Army] [ACOM]

(38) [JAFAN 6/9 – Physical Security Standards for Special Access Program Facilities, 23 March 2004.]

(39) Memorandum of Agreement (MOA) on Criteria/Standards for Economic Analyses/Life Cycle.

(40) MIL-HDBK-232A, Red/Black Engineering-Installation Guidelines

(41) Military Standard (MIL-STD)-3007B, Standard Practice for Unified Facilities Criteria (UFC) and Unified Facilities Guide Specifications, 1 April 2002

(42) NEMA PE 1 Uninterruptible Power Systems.

(43) NFPA 70E Standard for Electrical Safety in the Workplace

(44) NFPA 110 Emergency and Standby Power Systems

(45) NIST Handbook 135 (with the annual supplement of discount factors)

(46) NSTISSI NO 7003, National Security Telecommunications and Information Systems Security Instruction, Protected Distribution System (PDS).

(47) NSTISSAM/2-95, National Security Telecommunications and Information Systems Security Advisory Memorandum, Red/Black Installation Guidance.

(48) OSHA Standard 1910, Occupational Safety and Health Standards

(49) SECURITY-- (COMSEC) MATERIEL

(50) TB- 380-41 Procedures for Safeguarding, Accounting and Supply Control of COMSEC Material

(51) Technical Manual (TM) 5-690 Grounding and Bonding in Command, Control, Communications, Computer, Intelligence, Surveillance, and Reconnaissance (C4ISR) Facilities, 15 February 2002.

(52) Testing and Balancing Bureau

(53) UFC 3-600-01 Fire Protection Engineering for Facilities Approved for Public Release

(54) UL 1008 Transfer Switch Equipment.

(55) UL 1440 Transient Voltage Surge Suppressors.

(56) UL 1778 Uninterruptible Power Systems.

(57) UFC 3-260-01, Airfield and Heliport Planning and Design

(58) USAISEC Lightning Protection, Power Quality analysis, Grounding, Bonding, and Shielding, V1.0, Nov 2006 or latest version.

(59) ASHRAE Standard 189.1 Standard for the Design of High-Performance Building 2009

3.14. GLOSSARY:

ABA	Architectural Barriers Act
ACOM	Army Command (FORSCOM, etc.)
ACSIM	Assistant Chief of Staff for Installation Management.
ADAAG	Americans with Disabilities Act Accessibility Guidelines
AFF	Above Finished Floor
AMC	U. S. Army Materiel Command
AR	Army Regulation

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The Army Standard	The Army Standard for Echelons Above Brigade (EAB) Current edition is 12 March 2008.
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
AT/FP	Anti-Terrorism/ Force Protection
AVN	Aviation
AVUM	Aviation Unit Maintenance
BN HQ	Battalion Headquarters
CATV	Cable Television
CBT	Computer-Based Training
CCTV	Closed-Circuit Television
Classroom XXI	A fully networked multimedia classroom with interoperable video tele-training, internet access, and full distance learning capability. The classroom is specified in the GIB and ACES GENERAL INSTRUCTION BUILDING (GIB) and ARMY CONTINUING EDUCATION SYSTEM (ACES) Standard Design Criteria authored by the U. S. Corps of Engineers, Norfolk District.
CLS	Contractor Logistics Support
COF	Company Operations Facility
COS	Center of Standardization
DA	Department of the Army
DA PAM	Department of Army Pamphlet
DAA	Designated Approving Authority
DAC	Department of the Army Civilian
DAIM-FDC	Department of the Army, Assistant Chief of Staff for Installation Management, Construction Division.
DDC	Direct Digital Control
DT/CBT	Distributed/Computer-Based Training Program
EMI Bleed	Electromagnetic Interference (causing information to migrate).
ER	Entrance (Communications) Room
ER	Engineer Regulation
ER/MP	Extended Range/Multi-Purpose
ESD	Electrostatic Discharge
FACP	Fire Alarm Control Panel
FB-6 Fence	Fence utilizing green knitted fabric for visual screening.
FE-6 Fence	Fence detailed in U. S. Army Corps of Engineers Protective Design Center web site (https://pdc.usace.army.mil/library/drawings/fencehttps://pdc.usace.army.mil/library/drawings/fence)
FDC	Facility Design Criteria
FDT	Facility Design Team
FFE	Furniture, Fixtures, and Equipment
FM	Frequency Modulation
FY	Fiscal Year
G-2, G-3, etc.	Designation of general staff sections.
GCS	Ground Control Station
GFCI	Government Furnished Contractor Installed
GFGI	Government Furnished, Government Installed.
GFI	Ground Fault Interrupter
GPM	Gallons Per Minute

SAMPLE

HF	High Frequency
IAW	In Accordance With
IT	Information Technology
ICIDS	Integrated Commercial Intrusion Detection System
IESNA	Illumination Engineering Society of North America
IEEE	Institute of Electrical and Electronics Engineers, Inc.
LARS	Logistics Assistance Representative
LCCA	Life-Cycle Cost Analysis
LEED-NC	Leadership in Energy and Environmental Design New Construction.
LMOC	Logistics and Movement Operations Center
MNS	Mass Notification System
MILCON	Military Construction
MTOE	Modified Table of Organization and Equipment
NAC	Notification Appliance Circuits
NFPA	National Fire Protection Agency
NIC	Not In Contract
NIPR	Non-Classified Internet Protocol Router
NMT	Not More Than
NLT	Not Less Than
NSA	National Security Agency
NSF	Net Square Footage
NTE	Not To Exceed
OS&Y	Outside stem & yoke (a type of plumbing gate valve)
OTOE	Objective Table of Organization and Equipment
PC	Production Control
PDS	Protective Distribution System
PIV	Pressure Indicator Valve
POV	Privately-owned vehicle
PT	Physical Training
QC/QA	Quality Control / Quality Assurance
RFP	Request for Proposal
RH	Relative humidity
SIPR	Secret Internet Protocol Router
SM Fiber	Single-Mode Fiber
SLC	Single Line Circuits
SOW	Scope of Work
STAMIS	Standard Army Management Information System
STC	Sound transmission coefficient
STP	Shielded Twisted Pair
TDA	Table of Distribution and Allowance
TEMF	Tactical Equipment Maintenance Facility
TER	Telecommunications Equipment Room
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance
TOE	Tables of Organization and Equipment
TR	Telecommunications Room
UFAD	Underfloor Air Distribution
UFC	Unified Facilities Criteria
UPS	Un-interrupted Power Supply
UTP	Unshielded Twisted Pair
VAV	Variable air volume

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VTC	Video tele-conferencing
VTOL	Vertical Take Off and Landing
VTP	Video tele-training

SAMPLE

ATTACHMENT A – ARMY HANGAR FRIE PROTECTION

See contract for paragraphs 3.12.1 through 3.12.3.

3.12.4. Fire Protection Engineer (FPE): A FPE qualified IAW UFC 3-600-01 with a minimum of five (5) years experience in the design and construction of aircraft hangar fire protection systems of similar complexity shall design and specify these systems.

3.12.4.1. The fire protection design documents including calculations and specifications shall be prepared, signed and stamped by a qualified FPE.

3.12.4.2. Shop drawings shall be prepared by a qualified FPE or a National Institute for Certification in Engineering Technologies (NICET) certified Level IV technician. A qualified FPE shall sign the shop drawings and calculations, and certify that the shop drawings and calculations meet contract requirements.

3.12.5. Fire protection and life safety design analysis: Submit a fire protection and life safety design analysis IAW UFC 3-600-01 for all buildings in the project. Include the following:

(a) Life safety analysis and egress diagrams

(b) Fire separation (fire rated walls) diagram. Show all fire rated walls with fire rating.

(c) Hazard classification plans and sections IAW NEC 70.

(d) Location of draft curtains IAW NFPA 409 Section 5.17.

(e) Location of all manual pull foam discharge stations.

~~(c)~~(f) Location of all dead-man foam abort pull stations.

~~(d)~~(g) Fire water supply plans, include fire hydrants, fire water tanks and fire pumps as applicable.

~~(e)~~(h) Flow test data, Include hydrant flow test data IAW NFPA 291 and/or fire pump flow test data IAW NFPA 20. Use appropriate size gages calibrated within six months from the date of flow test. Include calibration certificates for gages.

~~(f)~~(i) Hydraulic Calculations: Calculations in the absence of a specific design will constitute, at best, rough approximations. While such approximations may suffice for the concept submittal, subsequent submittals shall include calculations based on an actual layout of discharge devices and corresponding piping configuration. Perform hangar fire protection system hydraulic calculations using commercially available recognized fire protection software similar to "HASS" (Hydraulic Analyzer of Sprinkler Systems).

~~(g)~~(j) System Sketch: Include a sketch representative of the overall fire protection system. It should show all pipes and nodes in the sprinkler, foam and underground water distribution systems. Assure that the sketch corresponds to what is indicated on the project drawings as well as in the hydraulic calculations.

~~(h)~~(k) Manufacturer's Catalog Data: Include catalog information for all major items of equipment upon which the design is based. This includes, but is not limited to, fire pumps, jockey pumps, foam concentrate tanks, foam pumps, automated foam concentrate valves, foam proportioners, foam generators, automatic water control, back flow preventers, strainers, FSCP, FACP, horns, strobes, manual pull stations, manual foam discharge stations.etc.

3.12.6. Fire Protection Plans: Include the following separate sheets. Symbols shall be in accordance with NFPA 170.

(a) General notes, symbols and abbreviations.

(b) Sprinkler system in aircraft area.

(c) Sprinkler system in non aircraft area.

(d) Foam system.

(e) Foam system detection and controls (FSCP).

(f) Facility fire detection and alarm system (FACP).

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(g) Mass notification system (MNS).

(h) Longitudinal and transverse sections.

(i) Separate riser diagrams for:

1. Piping/Riser Diagram – Provide a consolidated fire suppression system single line piping/riser diagram showing all major components from PIV to discharge devices, such as foam generators, nozzles, strainers, backflow preventer, fire pumps, jockey pump, flow meter, foam proportioners, foam concentrate tank etc. Show all devices such as tamper switches, flow switches, pressure switches, flow meter, strainers, etc. Indicate pipe sizes, all valving, all appurtenances etc.

2. Devices connected to FSCP.

3. Devices connected to FACP.

4. Devices connected to MNS.

(j) Strobe coverage diagram

(k) Fire pump system plans, sections and schematic diagrams.

(l) Details: Include details of critical system components including valve headers, foam generators, nozzles, concentrate tanks, test headers, etc.

3.12.7. Fire Protection Shop Drawings: Prepare shop drawings IAW NFPA standards including foam liquid travel time and foam spread diagrams, riser/piping diagrams, conduit layout diagrams, complete point to point wiring diagrams (typical point to point wiring diagram in lieu of complete wiring diagrams are not acceptable), hydraulic calculations, foam calculations, seismic calculations, voltage drop calculations and battery calculations. Prepare shop drawings only after completion of fire protection design documents.

3.12.8. Seismic protection: Protect fire suppression systems and equipment against damage from earthquakes. Seismic protection shall include flexible and rigid couplings sway bracing, seismic separation assemblies where piping crosses building seismic separation joints, and other features as required by UFC 3-600-01, IBC 2009, NFPA 409, NFPA 13, and ASCE 7 ~~UFC 3-310-04 and NFPA 13~~ for protection of piping against damage from earthquakes.

3.12.9. Underwriters Laboratory (UL) listed or Factory Mutual (FM) approved. All equipment and material shall be UL Listed or FM Approved for the purpose it is used. Pipes 6”and below shall be schedule 40. Shop fabricated or field fabricated fittings, and fittings which require making a hole in the pipe are not permitted. Air exhausters are not permitted in high expansion foam systems. Valves 65 mm (2.5 inch) and larger shall be flanged outside screw and yoke (OS&Y) type.

3.12.10. Underground Piping: Do not install any piping under hangar/facility floor slabs. Do not install any piping (including the fire protection water service entrance into the building) that allows pressurization of the space below the floor slab. Minimize piping under paved exterior operational surfaces (taxiways and aircraft parking, vehicle pavement, etc.). Do not install piping carrying foam concentrate or foam-water solution underground.

3.12.10.1. Provide ductile iron pipe or other pipe listed for buried fire service application for all underground uses.

3.12.10.2. Install fire water service entrance to the hangar in a pit. Do not install any fire protection piping under the floor slab. Use flanged or welded fittings to transition the fire protection water service entrance from horizontal to vertical as it enters the building. Do not use gasketed compression fittings (including locking type) or flanged fittings with set screws.

3.12.10.3. Size underground mains to ensure the maximum flow velocity does not exceed 3 meters per second.

3.12.11. Interior Piping Systems

3.12.11.1. Provide a UL Listed/FM Approved strainer in the water supply for all foam systems.

SAMPLE

3.12.11.2. Do not use galvanized piping for foam-water system piping.. Threaded, flanged, or grooved fittings shall be used for foam-water systems. Do not use fittings that couple plain-end pipe or welded sprinkler fittings or outlets for foam-water solution.

3.12.12. Foam Concentrate Pipe: Foam concentrate pipe shall be one of the following:

(a) Stainless steel pipe shall be grooved, welded, or flanged; or,

(b) Filament-wound fiberglass shall conform to ASTM D2996, designation code "RTRP-11 FF-3121," installed in accordance with ASME/ANSI B31.4-1996, Process Piping.

3.12.13. Exposed interior piping marking: Mark all exposed interior piping at 8.2 meter (27-foot) intervals with plastic wraparound-type pipe labels conforming to ASME/ANSI A13.1-1996, Scheme for the Identification of Piping Systems, indicating the type of fluid carried and direction of flow. Do not use labels on sprinkler system branch lines and pipes less than 51 millimeters (2 inches) in nominal size. Follow the following labeling scheme:

(a) FOAM CONCENTRATE – Use on lines supplying low-expansion foam concentrate.

(b) FIRE SPRINKLER or SPRINKLER FIRE – Use on lines supplying standard water-only sprinkler systems.

(c) ***<UAS_FS_OPTION2>***NOT USED***</UAS_FS_OPTION2><UAS_FS_OPTION1>***AFFF FOAM WATER– Use on lines supplying combination foam-water sprinkler systems. ***</UAS_FS_OPTION1>***

~~(c)~~(d) ***<UAS_FS_OPTION1>***NOT USED***</UAS_FS_OPTION1><UAS_FS_OPTION2>*** HEF WATER – Used on lines supplying combination high expansion foam (HEF) water systems. ***</UAS_FS_OPTION2>***

3.12.14. Containment and disposal of foam solution: Provide a system for containing the test flow for foam discharge solution. Containment capacity is based upon testing requirements only. Minimum capacity should provide for containment of the test flow of foam solution from the system proportioner with the greatest design flow rate for the duration of flow. Provide calculations to determine volume of foam solution discharge.

3.12.15. Fire Water Supply:

3.12.15.1. The fire water supply shall be IAW UFC 3-600-01, NFPA 409 and NFPA 24 except as modified in this document. Perform a detailed water supply and demand analysis. Determine variations in fire water supply. Acquire fire flow test data for preliminary fire protection system design if fire flow test data is not provided in the request for proposal. Verify the fire flow data by conducting necessary fire flow tests at the project site during project design and base the design of fire protection system on the results of this test. Use calibrated liquid filled gages with 3 ½ inch dial and listed nozzles for flow test. Perform hydrant flow test at a flow greater than the maximum system demand IAW NFPA 291. Perform fire pump test IAW NFPA 20. A representative of the installation fire department shall witness the flow tests.

3.12.15.2. The total water supply shall be sufficient to satisfy the combination of maximum hydraulically calculated system demand of automatic sprinkler protection, low-level foam system and the requirements for exterior hose streams. Water shall be available in sufficient quantity and pressure to supply the maximum number of discharge devices likely to operate simultaneously, for the minimum specified duration.

3.12.15.3. Provide booster fire pumps when the water flow rate and storage capacity is adequate but pressure is inadequate to meet system pressure demands.

3.12.16. Fire Protection Water Storage System

3.12.16.1. If fire water storage tank requirements are not specified, determine the requirement for a fire water storage tank installation based on fire flow test data from the project site and fire protection system design requirements for the project. Provide a complete fire water storage system for the facility if required.

3.12.16.2. A single water storage system may be used, when practical, for multiple aircraft facilities. Water supply distribution mains from a fire pump station to an aircraft hangar shall not exceed 457.2 meters (1500 feet).

3.12.16.3. Provide storage capacity equal to 120 percent of the maximum demand for the required duration. Divide the required storage capacity between two equal-sized water tanks, each storing one-half of the required

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volume. The piping configuration shall allow water to be supplied by both reservoirs, and either of the reservoirs if the other is out of service. The water supply for ***<UAS_FS_OPTION1>***closed-head foam-water sprinkler systems(AFFF)***</UAS_FS_OPTION1><UAS_FS_OPTION2>***the high expansion foam (HEF) system and the wet pipe sprinkler system***</UAS_FS_OPTION2>*** shall have a minimum duration of ~~60~~ 45 minutes~~. The water supply for high expansion foam systems shall have a minimum duration of 30 minutes~~.

3.12.16.4. Provide each tank with a low-water-level alarm and a low-temperature alarm, each transmitting back to the fire department as separate supervisory signals.

3.12.16.5. In areas with a 90% dry bulb temperature of 0.5 °C (33 °F) or less per UFC 3-400-02, Design: Engineering Weather Data, provide appropriate freeze protection IAW NFPA 22.

3.12.16.6. Provide an external visual water-level gauge on each tank.

3.12.16.7. Provide automatic tank refill from the base water distribution system. The maximum duration for the replenishment of fire protection water storage shall not exceed the limits identified in UFC 3-600-01. The heating system shall be reliable and of such capacity that the temperature of the coldest water in the tank or riser, or both, will be maintained at or above 42 degrees F (5.6 degrees C).

3.12.17. Fire Pumps

3.12.17.1. Determine the requirement for a fire pump installation based on fire flow test data from the project site and fire protection system design requirements for the project. Select pumps at a flow not exceeding 120% of fire pump rated flow. At no time shall the system pressure exceed 175 PSI. Do not use pressure regulating valves to control discharge pressure. Do not use pressure relief valves to control discharge pressure of electrical fire pumps without an electric variable speed pressure limiting control driver. If there is a potential of system pressure exceeding 175 PSI, use variable speed fire pumps. Submit fire pump design analysis, calculations and drawings during the design phase.

3.12.17.2. Provide one redundant pump for every fire water pump system. Pumps shall have electric motor drivers conforming to NFPA 20, supplied by a single reliable power source. Use dual power sources when a single reliable power source is not available. Use diesel engine drivers only when the installation electrical service fails to meet the reliable standard and dual power sources are not available. (For pump systems with one primary and one redundant pump, provide one electric and one diesel if the electrical service fails to meet the reliability standard and dual power sources are not available.)

3.12.17.3. The designer shall determine and document the reliability of the existing power sources. A power source is adequate when it meets the reliability requirements of UFC 3-600-01.

3.12.17.4. Provide “soft start” or variable frequency pump controllers when electric-driven pumps are installed.

3.12.17.5. Limit the maximum rated pump size to 9,463 Lpm (2500 gpm) at 862 kPa (8.62 bar) (125 psi).

3.12.17.6. Ensure the pumping system will have capacity to meet the maximum demand when the largest capacity pump is out of service.

3.12.17.7. Provide pressure maintenance pumps (“jockey pumps”) to maintain normal operating pressure on the system and to compensate for normal system leakage IAW NFPA 20.

3.12.17.8. Arrange multiple-pump installations for sequential starting at 10-second Intervals until the operating pumps maintain the required pressure. The starting sequence will begin automatically as follows:

(a) Pump start signal transmitted from the foam system control panel in the protected facility.

(b) Drop in system water pressure IAW NFPA 20.

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3.12.17.9. Required monitoring of fire pumps shall be through the FACP and transmitted to the fire department to notify the fire department of pump running signals, pump system trouble, and tamper and supervisory signals provided by the pump controllers. Jockey pumps shall not transmit an operating signal. The FACP shall monitor Jockey pump power supply.

3.12.17.10. Provide surge arresters to moderate the potentially destructive effects of pressure surges or water hammer due to pump starting and stopping and valve opening and closing. Install surge arresters on the system side of the fire pump discharge check valve, as close to the valve as possible. Provide at least one arrester for each pump and each shall be listed/approved as a surge arrester for fire protection piping, with a volume of not less than 378.4 liters (100 gallons) and a rated working pressure not less than 1,724 kPa (250 psi). Provide each arrester with an indicating valve to isolate it from the system. Supervision of this valve is not required. The manufacturer shall engineer each surge arrester installation due to the complex effects of system variables on satisfactory performance. Provide manufacturer prepared sizing calculations.

3.12.18. Foam Concentrate Pumps

3.12.18.1. Provide foam concentrate pumps IAW NFPA 409~~Listed/Approved foam concentrate pumps of the positive displacement rotary gear or vane type. Provide a pressure rating at least 103.4 kPa (15 psi) greater than the maximum water pressure, but not less than that recommended by the manufacturer, at the point of foam injection~~.

3.12.18.2. The designer shall determine and document the reliability of the existing power sources. A power source is adequate when it meets the reliability requirements of UFC 3-600-01.

3.12.18.3. Provide pressure maintenance pumps ("jockey pumps") to maintain normal operating pressure on the system IAW NFPA 20.

3.12.18.4. Provide connection through the installation fire reporting system to notify the fire department of pump running signals, pump system trouble, and tamper and supervisory signals provided by the pump controllers. Jockey pumps shall not transmit an operating signal. The FACP shall monitor Jockey pump power supply.

3.12.19. Foam Concentrate Tanks

3.12.19.1. Bladder type foam concentrate tanks are not permitted.~~Bladder tanks shall be horizontal. Vertical bladder tanks are not permitted.~~

3.12.19.2. Concentrate Storage. Atmospheric foam storage tanks shall be either plastic or fiberglass construction and listed/approved for the storage of foam concentrate. ~~Pressure tanks for bladder tank systems shall be steel and listed/approved for the storage of foam concentrate.~~ Do not provide back-up supply of foam concentrate in the facility.

~~3.12.19.3. Provide clear space at one end of horizontal bladder tanks, at least equal to the length of the tank, to permit bladder replacement. Doors to the outside or adjacent open space at the end of the tank are an acceptable alternative.~~

~~3.12.19.4.~~3.12.19.3. Provide the foam tank (regardless of type) with a minimum 150-mm (six-inch) curb. This curbing is not intended for containment. Its purpose is to control accidental spillage during filling or for unintended leaking.

~~3.12.19.5.~~3.12.19.4. 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 have direct exterior access.

3.12.20. Special Requirements

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3.12.20.1. Manual Foam-Water/Water Fire Hose Stations: Do not use interior or exterior hose stations or fire hose connections.

3.12.20.2. ***<UAS_FS_OPTION1>***NOT USED***</UAS_FS_OPTION1><UAS_FS_OPTION2>***Fire Department Connections: Do not use fire department connections on high expansion foam (HEF) systems.***</UAS_FS_OPTION2>***~~foam water systems~~

3.12.20.3. Foam System Test Header: Provide a test header for all ***<UAS_FS_OPTION2>***HEF overhead ***</UAS_FS_OPTION2><UAS_FS_OPTION1>***~~and~~ low-level foam- (AFFF) ***</UAS_FS_OPTION1>***water systems. Locate the header inside the aircraft servicing area as near as practicable to an outside door. Configure the test header to permit each proportioner to be individually tested. Each test header shall have at least four valved 2.5-inch (no equal metric standard) hose fittings.

3.12.20.4. Sprinkler System Simulation Test Header: Provide sprinkler system simulation test headers for simulating hangar sprinkler system maximum flow based on supply calculations during the foam system discharge test.

3.12.20.5. Route all sprinkler system drains, including main drains, test drains, and auxiliary drains to a 2-foot by 2-foot splash block at exterior grade.

3.12.21. Detection and Actuation Systems

3.12.21.1. Fire Alarm Control Panels

3.12.21.2. Fire Detection and Alarm Control Panel (FACP): Provide a single FACP for all detection and fire alarm functions in the facility not part of the foam-water fire suppression system. The system shall be fully compatible with and integrated with the local installation central monitoring system. The FACP shall supervise all control valves . Plug type tamper switches are not permitted.

3.12.21.3. Foam System Detection and Control Panel (FSCP)

Provide a dedicated FSCP (not a part of FACP) for monitoring and operation of all hangar sprinkler & foam systems and detection/releasing functions. The FSCP shall supervise all control valves . Plug type tamper switches are not permitted.

3.12.21.3.1. Locate all fire control panels in a clean, condition environment having temperature and humidity control. Maintain a room temperature between 60 degrees F and 80 degrees F and a hudmity level not to exceed 60%. Do not locate fire control panels inside the hangar bay or in an un-conditioned space.

~~3.12.21.3.1.~~3.12.21.3.2. The FSCP shall be fully compatible with the installation fire alarm receiving system without field modifications to any system hardware or software. A separate and distinct fire signal shall be transmitted to the fire department upon activation of any portion of a foam system.

~~3.12.21.3.2.~~3.12.21.3.3. Separate fire alarm transmitters/receivers are permitted when they are fully compatible with the FACP and the installation fire alarm receiving system without field modifications to the FACP.

~~3.12.21.3.3.~~3.12.21.3.4. Define the specific number of alarm signals (e.g., fire, supervisory, tamper) to be annunciated and transmitted in a system matrix See samples in Figures 1 and 2.

~~3.12.21.3.4.~~3.12.21.3.5. FSCP activating deluge, pre-action, or nozzle systems shall be listed/approved as releasing panels. All releasing panels shall be specifically listed/approved for use with the automatic water control valves/solenoid release valves specified for the fire suppression system. Provide a switch within the lockable control panel to disable the releasing functions of the panel while leaving all detection and other functions of the panel operational. Activation of this switch will transmit a trouble signal to the Base Fire Department.

3.12.22. Mass Notification Systems (MNS): Provide a Mass Notification System in accordance with UFC-4-021-01. Hangar Bay areas shall comply with exterior criteria.

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3.12.23. Special Requirements:

3.12.23.1. Locate all fire control panels in a clean environment having temperature and humidity control in accordance with the unit's Listing/Approval.

3.12.23.2. Provide transient Voltage Surge Suppression (TVSS) on all fire alarm FACP, FSCP and MNS circuits entering and leaving the facility IAW manufacturer's instructions.

3.12.24. Manual fire alarm pull stations: Provide pull stations throughout the facility at all exit doors. Manual pull stations located in the hangar bay shall be weatherproof.

3.12.24.1. Manual HEF discharge pull stations: Provide pull stations throughout the hangar bay at all exist doors. HEF discharge pull stations located in the hangar bay shall be weatherproof.

~~3.12.24.1.~~3.12.24.2. Dead-Man Type Abort Switches: Provide dead-man type abort switch for the high expansion system (HEF). Abort switches shall be located at each exit from hangar bay, including exits in the corridors through the administration-shop areas.

3.12.25. Thermal Detectors (for pre-action systems): Provide automatic thermal fire detection systems to activate any pre-action sprinkler systems. Locate detectors at the underside of the roof of the aircraft servicing area. The detection system shall consist of rate-compensated fire detectors having a temperature rating between 71 °C (160 °F) and 76 °C (170 °F). The spacing between detectors shall be 12.2 meters (40 feet). The area covered by the fire detection system shall correspond with its affiliated roof-level sprinkler system and shall be bounded by draft curtains. The activation of any heat detection device in the sprinkler zone shall immediately:

(a) Send a start signal to the fire pumping system (if any).

(b) Activate all low-level fuel spill fire suppression systems in the aircraft servicing area of fire origin.

(c) Activate the ***<UAS_FS_OPTION1>***(AFFF) low-level foam fire suppression systems***</UAS_FS_OPTION1><UAS_FS_OPTION2>***the HEF fire suppression systems***</UAS_FS_OPTION2>***.

(d) Activate the foam system annunciation signal.

(e) Actuate the appropriate suppression system pre-action valves for the floor area covered by the detection system.

(f) Activate the fire evacuation alarm signal throughout the facility.

(g) Activate the visual foam system activation signals.

(h) 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 shall be locally determined based on the current fire alarm receiving equipment and planned upgrades.

3.12.26. Water Flow Devices: Activation of hangar bay water flow will cause the FSCP to:

(a) Send a start signal to the fire pumping system (if any).

(b) Activate the ***<UAS_FS_OPTION1>***(AFFF) low-level foam fire suppression systems***</UAS_FS_OPTION1><UAS_FS_OPTION2>***the HEF fire suppression systems***</UAS_FS_OPTION2>***.

(c) Activate the foam system annunciation signal.

(d) Actuate the appropriate suppression system pre-action valves for the floor area covered by the detection system.

(e) Activate the fire evacuation alarm signal throughout the facility.

(f) Activate the visual foam system activation signals.

(g) Transmit a fire alarm signal to the base fire alarm communications center (fire department).

3.12.27. Wiring: Connect all initiating devices to Class A initiating device circuits, and Class A and signal line circuits IAW NFPA 72. Connect alarm notification appliances to Class A notification appliance circuits IAW NFPA 72. All wiring in unfinished areas such as hangar and shop space shall be in electrical metallic tubing

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(EMT) or metallic conduit. Paint all EMT, conduits and junction boxes connected to FSCP, FACP and MNS red or prefinished red from the factory. Label all conduits “FSCP”, “FACP” or “MNS” every 10’ as appropriate. Make connections and splices using screw terminal blocks. Do not use wire nut type connectors in the system.

3.12.28. Fire System Riser Diagram: Identify and group the various inputs and outputs associated with the fire alarm control panels (FACP and FSCP). This will include alarm initiating and supervisory input circuits as well as alarm notification output circuits.

(a) Alarm Initiating Device Circuits--includes water-flow switch, low level foam fire suppression system manual discharge station, heat detector, triple infrared flame detector, etc.

(b) Supervisory Device Circuits-- includes valve supervisory (tamper) switches, pump controllers, low liquid level, etc.

(c) Release Device Circuits--includes circuits to solenoid valves for actuation of automatic water control/deluge valves controlling foam solution flow to foam generator systems and pre-action sprinkler system.

(d) Alarm Notification Device Circuits-- includes alarm bells, horns, speakers, sirens, strobe lights, rotating beacons, etc.

3.12.29. Fire Alarm System Matrix: Define and indicate the specific alarm signals to be annunciated and transmitted in a system matrix. See sample in Figure 3.

3.12.30. Fire Protection Equipment Room

(a) The fire protection 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. Separate the room equipment room from the aircraft servicing and other areas by a minimum of 1-hour fire resistive construction. Locate water and foam flow control valves and proportioning equipment in the hangar bay to minimize the foam delivery time and to meet design criteria. Provide doors withdirect access to the exterior of the structure. Locate equipment to permit removal of tanks, bladders, valves, pumps, and motors without the removal of other components.

(b) Provide independent concentrate storage and proportioning systems for each aircraft hangar facility. Assure that the equipment is arranged to facilitate maintenance and regular testing. Arrange components to be serviceable from the floor. Provide an open steel grate mezzanine, with a permanent ladder, at that equipment level for any equipment and or valves requiring access for maintenance, periodic testing, or re-servicing are located more than 2.4 meters (8 feet) above the floor. All platforms and ladders shall be in compliance with Occupational Safety & Health Administration (OSHA) requirements. Include an enlarged plan at a scale of 1:50 (1/4": 1'-0") of the fire protection equipment room. Show the water service entrance, strainer, back flow preventer if provided, altitude valve if provided, foam concentrate tank, sprinkler riser/valve manifold, foam system control panel, and piping. Provide sections and details to clearly show the riser manifold and all associated components, piping, valves, fittings, etc.

3.12.31. Fire Pump Building or Room: Fire pumping systems for most hangar fire protection systems often involve multiple, high capacity, diesel or electric engine driven fire pumps. It is preferred to locate and arrange such pumping systems in a separate pump house or building adjacent to the water storage tanks from which the pumps take suction. This pump facility will house the pumps, drivers, controllers, fuel tanks, fire pump test headers, altitude valve if provided and associated equipment. The configuration of the equipment space should consider the need to test, maintain and even replace major components of the system. If the fire pump installation shall be co-located with the foam concentrate tank, proportioning equipment, valve header and control panels, assure that adequate space is allocated to facilitate maintenance of all subsystems.

3.12.32. Fire Protection Equipment Power: Clearly indicate power to fire pumps, fire pump controllers, foam concentrate pumps and controllers, foam system and fire alarm system control panels on the electrical drawings. Assure that power supply arrangements to pumps are in compliance with NFPA 20 including centrifugal fire pumps (water) and pumps used for foam concentrate.

3.12.33. Inspection and Testing: Test the entire fire protection system to ensure that all equipment, components, and subsystems function as intended.

3.12.33.1. Test Plan and Procedure

SAMPLE

Provide an initial test plan with test procedures 60 days prior to final acceptance test. Include the following information:

(a) Schedule of tests for each day, Example: Day 1, Day 2, Day 3 etc.

(b) List of tests.

(c) Blank forms for recording test data for each test.

(d) Test procedure for each test.

(e) List of equipment required for each test.

(f) Calibration certificate for testing equipment

3.12.33.2. Preliminary Acceptance Test

Perform preliminary acceptance tests for the entire fire protection system. Provide written confirmation of all preliminary test results. A a professional videographer shall record digitally or on videotape all preliminary tests to document the methods and equipment employed to conduct the test. This digital record shall be provided by the Contractor. The preliminary test shall include stray voltage test and loop resistance tests. Perform 100% of system testing including foam discharge.

3.12.33.2.1. The High Expansion Foam hangar fire suppression system flow tests shall include the following:

(a) Simultaneous flow of simulated overhead sprinkler system maximum demand and foam generators flowing water only. Take pressure readings at each foam generator and risers with calibrated liquid filled gages.

(b) Simultaneous flow of simulated overhead sprinkler system maximum demand and foam generators flowing foam for one minute. Take foam tank level readings at beginning and at end. Overhead sprinkler system maximum demand shall be simulated by using a simulation test header, UL listed play pipes and liquid filled pressure gages.

(c) Flow foam from foam generators for one minute only. Foam tank level readings shall be recorded at the beginning and at the end.

3.12.33.2.2. ***<UAS_FS_OPTION2>***NOT USED***</UAS_FS_OPTION2><UAS_FS_OPTION1>***The AFFF Proportioning System Tests shall include the following:

(a) Flow test each AFFF proportioner (ratio controller) to determine that proportioning accuracy is within specified limits.

(b) Test each proportioner supplying sprinkler systems with closed heads at two flow rates; the minimum flow rate specified in the manufacturer's published data and a flow rate at least four times the minimum.

(c) Collect AFFF samples from each proportioner in accordance with NFPA 16, and the approved test plan. Determine foam solution concentrations using the methods outlined in NFPA 16.

(d) Proportioning for nominal 3 percent concentrate shall be between 3 percent and 3.9 percent. If test results indicate proportioning below or above this range, make necessary adjustments and retest as directed by the Contracting Officer. ***</UAS_FS_OPTION1>***

3.12.33.2.3. Safety Plan

Provide a safety plan for conducting the test of the High Expansion Foam system. Provide a sketch of safe egress path for persons conducting and witnessing the test to exit the building without entering the foam blanket. Obtain approval from the installation Safety Manager.

3.12.33.2.4. Foam Disposal Plan:

(a) Provide Foam Containment Plan and Procedures.

(b) Provide Foam Disposal Plan and Procedures.

3.12.33.2.5. Protective Measures

SAMPLE

Provide procedures for taking protective measures to avoid damage to property during and after the test protection of property during the Final Acceptance Test .

3.12.33.3. Preliminary Acceptance Test Report

Submit the preliminary acceptance test report to the Contracting Officer and to USACE District Fire Protection Engineer before requesting a Final Acceptance Test. Provide the preliminary acceptance test report, digital recording or videotape of the preliminary test, a “Punch List” (list of deficiencies prepared at the completion of preliminary test), and a Final Acceptance Test plan 15 days prior to final acceptance test

3.12.33.4. Final Acceptance Test

The Final Acceptance Test shall begin only after approval of the preliminary test report. The final test will be a repeat of all preliminary test requirements except do not repeat flushing and hydrostatic tests. The Contractor’s Fire Protection Engineer and manufacturer’s representatives shall conduct the Final Acceptance Test and shall provide a complete demonstration of the operation of the system. The USACE District Fire Protection Engineer and the installation fire department representative will witness tests. A professional videographer will record or videotape final acceptance tests . A failed final acceptance will be treated as a preliminary acceptance test. Correct and retest all system failures or other deficiencies identified during the testing in the presence of the USACE District Fire Protection Engineer.

3.12.33.5. Final Acceptance Test Report

Provide the Final Acceptance Test Report within 15 days after the completion of the Final Acceptance Test. Provide the final acceptance test report in booklet form showing field tests performeded with the digital or videotape of the final test to document compliance with the specified performance criteria. Provide documentation of readings, test results, and indicate the final position of control valves. Include all required Final Acceptance Test NFPA forms. The Final Acceptance Test report shall include the resolution of punch list items developed during preliminary acceptance testing.

3.12.33.6. Training

The Contractor Fire Protection Engineer and manufacturer's representatives shall conduct four 6-hour training courses: two for operators and two for maintenance personnel designated by the Contracting Officer. Lesson plans, operating instructions, maintenance procedures, and training data shall be furnished in manual format for the training courses. The operations training course shall familiarize designated government personnel with proper operation of the fire protection systems. The maintenance training course shall provide designated government personnel adequate knowledge required to diagnose, repair, maintain, and expand functions inherent to the system. The training sessions shall be given for two different work shifts. The schedule of training shall be approved by the Contracting Officer. Training sessions shall start after successful completion of the Final Acceptance Test. The field instruction shall cover all of the items contained in the approved O&M manual. Film or tape all training sessions and provide to the Government.

3.12.33.7. Spare Parts

Submit spare parts data for each different item of material and equipment specified. Include a complete list of parts and supplies, with current unit prices and source of supply (with address and telephone number), and a list of parts recommended by the manufacturer to be replaced after 1, 5 and 10 years of service. Include a list of special tools and test equipment required for maintenance and testing of the products supplied by the Contractor.

SAMPLE

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 Low Level Spill Fire Suppression System Valve	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	Low-Level Optical 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
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 in Adjacent Areas																		
7 Water Flow Switches - Wet-Pipe Sprinkler Systems	X				X		X	X						X	X	X	X	X
8 Water Switches - Low Level System	X						X	X						X	X	X	X	X
9 Manual Foam Discharge Station for Low-Level	X				X		X	X						X	X	X	X	X
10 Low Level Optical Fire Detector				X									X				X	
SUPERVISORY SIGNALS																		
11 Valve Supervisory Switch - Wet or Dry-Pipe Sprinklers in Adjacent Areas																		
12 Valve Supervisory Switches - Sprinklers		X								X								
13 Valve Supervisory Switches - Low-Level High-Expansion System		X								X								
14 Valve Supervisory Switches - Water Supply Entrance		X								X								
15 Hi-Lo Pressure Switches - Dry-Pipe Sprinklers																		
16 Temperature Monitoring System				X						X								
17 Low-Level Optical Fire Detector Trouble		X								X								
18 Control Component Common Trouble Condition		X								X								
19 Low Level Auto Disable Switch		X								X								
TROUBLE CONDITIONS																		
20 Low Battery Voltage			X						X									
21 Circuit Fault		X	X						X									
22 Supervised Component Failure			X						X									
23 AC Power Failure			X						X									

NOTES:

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

SAMPLE

Figure 1. Sample Wet Pipe and Low Level High Expansion Foam System Functional 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 Low Level Spill Fire Suppression System 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	Low-Level Optical Detectors Per General Area	Foam 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
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 in Adjacent Areas																		
7	Water Flow Switches - Pre-Action Sprinkler Systems	X				X		X	X						X	X	X	X	X
8	Water Switches - Low Level System	X						X	X						X	X	X	X	X
9	Manual Foam Discharge Station for Low-Level	X				X	X	X	X						X	X	X	X	X
10	Low Level Optical Fire Detector				X									X				X	
	SUPERVISORY SIGNALS																		
11	Valve Supervisory Switch - Wet or Dry-Pipe Sprinklers in Adjacent Areas																		
12	Valve Supervisory Switches - Sprinklers		X								X								
13	Valve Supervisory Switches - Low-level High Expansion		X								X								
14	Valve Supervisory Switches - Water Supply Entrance		X								X								
15	Hi-Lo Pressure Switches - Dry-Pipe Sprinklers																		
16	Temperature Monitoring System																		
17	Low-Level Optical Fire Detector Trouble		X								X								
18	Control Component Common Trouble Condition		X								X								
19	Low Level System Auto Disable Switch		X								X								
	TROUBLE CONDITIONS																		
20	Low Battery Voltage			X						X									
21	Circuit Fault		X	X						X									
22	Supervised Component Failure			X						X									
23	AC Power Failure			X						X									

NOTES:

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

SAMPLE

Figure 2. Sample Pre-Action and Low level High Expansion Foam System Functional 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 Low-Level High-Expansion	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	Low-Level Optical 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
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 in Adjacent Areas	X											X			X	X	X	
7	Water Flow Switches - Pre-Action Sprinkler Systems																	X	
8	Water Switches - Low-level High-expansion System																	X	
9	Manual Foam Discharge Station for Low-Level																	X	
10	Low Level Optical Fire Detector																	X	
SUPERVISORY SIGNALS																			
11	Valve Supervisory Switch - Wet or Dry-Pipe Sprinklers in Adjacent Areas		X								X								
12	Valve Supervisory Switches - Sprinklers																		
13	Valve Supervisory Switches - Low-Level High-Expansion System																		
14	Valve Supervisory Switches - Water Supply Entrance																		
15	Hi-Lo Pressure Switches - Dry-Pipe Sprinklers		X								X								
16	Temperature Monitoring System				X						X								
17	Low-Level Optical Fire Detector Trouble																		
18	Control Component Common Trouble Condition		X								X								
19	Under-Aircraft Foam-Water System Auto Disable Switch																		
TROUBLE CONDITIONS																			
20	Low Battery Voltage			X						X									
21	Circuit Fault		X	X						X									
22	Supervised Component Failure			X						X									
23	AC Power Failure			X						X									

NOTES:

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

SAMPLE

Figure 3. Sample Facility Fire Detection and Alarm system Functional Matrix

ATTACHMENT A1: Option 1 - Combination of Automatic High Expansion Foam (HEF) System and Automatic Sprinkler Systems for UAS Hangar Bays

3.12.2.2 Provide a combination of automatic high expansion foam (HEF) system and automatic sprinkler systems in hangar bays. Sprinkler systems shall be either wet pipe or pre-action, designed and installed in accordance with the applicable sections of NFPA 13 and the provisions listed below.

a. Provide a wet-pipe automatic sprinkler system in the hangar bays. The design density of water from the wet pipe sprinkler system shall be a minimum of 6.9 L/min/m2 (0.17 gpm/ft2) over any 697 m2 (7,500 ft2) area, including the hydraulically most demanding area as defined in NFPA 13. Provide building temperature supervision when the 99.6% dry bulb temperature is less than 0.5 °C (33 °F).

b. Provide a pre-action automatic sprinkler system activated by a roof- or ceiling-level thermal detection system in hangar bays in lieu of the wet pipe sprinkler system in geographic locations having a 99.6% dry bulb temperature less than -17.7 °C (0 °F). The density shall be the same as the wet-pipe automatic sprinkler system.

3.12.2.2.1 Provide the following features for pre-action sprinkler systems :

a. Provide a surge arrester (expansion tank) not less than 38-liter (10-gallon) capacity for each separate pre-action riser below the riser control valve. Provide a surge arrester of not less than 95-liter (25-gallon) capacity for each set of multiple pre-action risers below the control valves on the header. All tanks shall be Listed/Approved as a surge arrester with a rated working pressure of not less than 1895 kPa (275 psi). Provide sizing calculations prepared by the manufacturer.

b. Provide externally resettable automatic water control (deluge) valves for pre-action systems (without opening the valve assembly and without use of special tools).

c. Supervisory air is not required for pre-action sprinkler systems in aircraft servicing areas.

3.12.2.2.2 Sprinkler piping shall be hydraulically sized in accordance with NFPA 13. The maximum system size shall not exceed 4821 m2 (52,000 ft2).

3.12.2.2.3 In aircraft storage and servicing areas, the maximum protected floor area as projected on the floor shall be limited to 12 m2 (130 ft2). The maximum distance between sprinklers either on branch lines or between branch lines shall be 3.7 m (12 ft).

3.12.2.2.4 Where open hangar doors result in interference with the distribution of water from the hangar sprinkler systems, additional sprinklers shall be provided to ensure effective floor coverage.

3.12.2.2.5 Sprinklers shall be nominal K5.6 or K-8.0 sprinklers.

3.12.2.2.6 Sprinklers shall have a temperature rating of 74.9 °C to 93.3 °C (175 °F to 200 °F).

3.12.2.2.7 Sprinklers systems shall be flushed and tested in accordance with NFPA 13.

SAMPLE

3.12.2.2.2.8 High-Expansion Foam (HEF) Systems:

Locate (HEF) generators so that foam discharge falls close to, but not directly on, the aircraft fuselage or wings. Mount generators in the overhead roof support structure and/or high on the walls just below the roof support structure. Initial discharge of foam shall protect the under-aircraft and under-wing area and then spread to the remaining hangar floor area.

a. HEF generators may be designed to use either outside or inside air.

b. Provide a surge arrester (expansion tank) of not less than 38-liter (10- gallon) capacity for each separate high-expansion riser below the deluge valve. Tanks shall be listed/approved as a surge arrester with a rated working pressure of not less than 1895 kPa (275 psi).

c. HEF systems shall cover 95 percent of the floor in one minute or less from the activation of a manual foam discharge station without required depth. (Wall mounted generators alone in larger rectangular/square shaped hangars cannot normally achieve this performance requirement). HEF systems shall cover the aircraft servicing area and adjacent accessible areas to a depth of one meter (3.2 feet) in four minutes or less. Failure to achieve these requirements during acceptance testing indicates a design failure.

d. Rate of Discharge: Calculate the minimum rate of discharge or total generator capacity in accordance with NFPA 11; however, never less than 0.8 m^3min/ m^2 (2.6 ft^3min/ ft^2). Application rates in the range of 0.8 to 1.2 m^3min/m^2 (2.6 to 4 ft^3 min/ ft^2) are required to meet the performance requirements.

e. Calculate the minimum rate of discharge or total generator capacity from the following formula:

R = ([V/T] + RS) x CN x CL, where:

R = Rate of discharge in m^3/min (ft^3/min)

V = Submergence volume in m^3 (ft^3) determined by the following formula:

V = A x D, where:

A = Area of the aircraft servicing floor and adjacent floor areas not cut off from the aircraft servicing floor m^2 (ft^2)

D = Depth = 1 meter (3.28 feet) (see paragraph A1.3.3.2 of NFPA11) which is greater than the 0.6-meter (2-foot) minimum foam depth over the hazard required in

T = Submergence time in minutes = 4 (see paragraph A1.3.3.2 of NFPA 11)

RS = Rate of foam breakdown by sprinklers in ft^3/min (m^3/min) determined by the following formula:

RS = S x Q, where:

SAMPLE

S = Foam breakdown from sprinkler discharge = 0.0748 cubic meters per minute • L/min (10 cubic feet per minute • gpm)

Q = Estimated total discharge from maximum number of sprinklers expected to operate in L/min (gpm).

CN = Compensation for normal foam shrinkage = 1.15. This is an empirical factor based on average reduction in foam quantity from solution drainage, fire, wetting of surfaces, and absorbency of stock.

CL = Compensation for loss of foam due to leakage around doors and windows and through openings that cannot be closed determined by the design engineer after proper evaluation of the structure. This factor for Army hangars cannot be less than 2.0 for hangars less than 1394 square meters (15,000 square feet), 2.5 for hangars less than 2787 square meters (30,000 square feet), and 3.0 for all other hangars.

f. Concentrate and Water Supply: Concentrate and water supply shall permit continuous operation of the system to generate four times the submergence volume, but for not less than 15 minutes. No additional foam is required for maintenance of the submergence volume beyond 15 minutes. Perform the supply calculation method to determine quantity of foam concentrate and fire water supply. A connected reserve concentrate supply is not required.

g. Power Supply: High-expansion foam generators may be either hydraulically (water) or electrically powered. Electrically powered high-expansion foam generators shall be supplied ahead of the building disconnect and do not require a secondary power source when the power source meets the reliability requirements of UFC 3-600-01.

h. Activation: The high-expansion foam system shall be activated by:

1. Manual foam activation stations located at main exits from aircraft servicing area.

2. Water flow signal in overhead sprinkler systems.

3. Roof or ceiling level heat detection systems associated with pre-action systems (when installed).

i. Foam Proportioning Systems: Specifically list/approve all components and assemblies used in this fire protection subsystem 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.

j. High-Expansion Concentrate. Use only high-expansion foam (Hi-Ex) concentrate listed/approved for use with the foam generators and foam proportioners installed.

k. Proportioning. Limit proportioners to 152 millimeters (6 inches) or less. Use in-line balanced-pressure (ILBP) proportioners on all pumped concentrate systems ILBP proportioners shall be factory assembled and tested by the manufacturer, and the entire ILBP proportioner assembly shall be listed/approved by a recognized laboratory. Disassembly, reassembly, and or modification by the installing contractor is prohibited

SAMPLE

l. Control Valve. Provide water-powered ball valves as foam concentrate control valves. Operate the valve by connection to the alarm line of the automatic water control valve or alarm valve. Provide a retard chamber in the line to the water-powered ball valve on wet pipe foam water systems.

m. Application Time. Provide a connected foam concentrate supply sized for a single 15-minute application (or four times the submergence volume, whichever is greater) of foam. The foam concentrate supply shall be verified at final acceptance test by displacement test method in accordance with NFPA 11.

n. Additional Features: Connect all drains to an appropriately sized sanitary drain. Provide sizing calculations prepared by the manufacturer. Automatic water control (deluge) valves shall be externally resettable (without opening the valve assembly and without use of special tools). The maximum valve size shall be 150 millimeters (6 inches). Provide basket-type strainers upstream of the foam system risers. Provide each foam proportioner with a test connection for the connection of a hose lines in order to test the foam proportioners individually. Locate the header inside the aircraft servicing area as near as practicable to an outside door. Provide a supervised control valve for the test header.

o. Manual Foam Discharge Stations for HEF Fire Suppression Systems.

1. Provide manual foam discharge stations inside the aircraft servicing area at all exits to actuate the HEF fire suppression systems. Manual foam discharge stations shall be the locking type that when activated require a key to be reset.

2. Manual foam discharge and abort stations shall be distinctively different from the manual fire alarm stations, and shall have distinctive signage at each device. Mount the manual foam discharge station directly on the sign.

3. House manual foam discharge stations within a clear plastic tamper cover that shall be lifted prior to actuating the station. Any colored portions of the tamper covers shall be yellow and any lettering on the cover shall be “FOAM”; the words “fire” or “alarm” must not appear on the cover.

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

a. Activate foam discharge through the HEF fire suppression systems.

b. Activate the facility fire evacuation alarm and the foam system annunciation signal.

c. Transmit a fire alarm signal to the fire department. The number and type of signals transmitted to the fire department shall be locally determined based on the current fire alarm receiving equipment.

p. Provide blue visual alarm signals (strobes or rotating beacons) within the aircraft servicing area to indicate foam system activation. Mount signals 10 to 20 feet above the finished floor and located to be visible from all parts of the aircraft maintenance and servicing area.

SAMPLE

q. High Expansion Foam Systems Abort Stations

1. Provide abort stations of the “dead-man type. The abort stations must be used in conjunction with valves and equipment that will prohibit or stop the discharge of foam and water from the HEF suppression systems.

2. Abort foam stations shall be distinctively different from the manual foam discharge and fire alarm stations. Abort stations shall be blue in color and the face of the station shall include the word “STOP”. The mushroom type push button shall be red and include the word “PUSH”. The words “fire” and “alarm” must not appear on the HEF abort stations. The stations must have distinctive signage at each device. Colored portions of the tamper covers must be blue and any lettering on the cover must be “FOAM”; the words “fire” and “alarm” must not appear on the cover.

3. HEF abort stations shall be located next to the HEF release stations installed within the hangar bay so they are unobstructed, readily accessible, and located in the natural exit access path near each required exit from the area. Locate additional HEF abort stations in exit corridors between the hangar bay and the administration-shop area so there are unobstructed, and readily accessible.

4. Maintain a minimum separation distance of 1.5m (5 ft) between building fire alarm system manual pull stations and the HEF systems manual releasing and abort stations.

5. Activation of any HEF abort stations will cause the FSCP to:

   a. De-activate foam discharge through the high expansion foam fire suppression systems as long as the switch is activated.

   b. Activate the facility foam system’s annunciation signal.

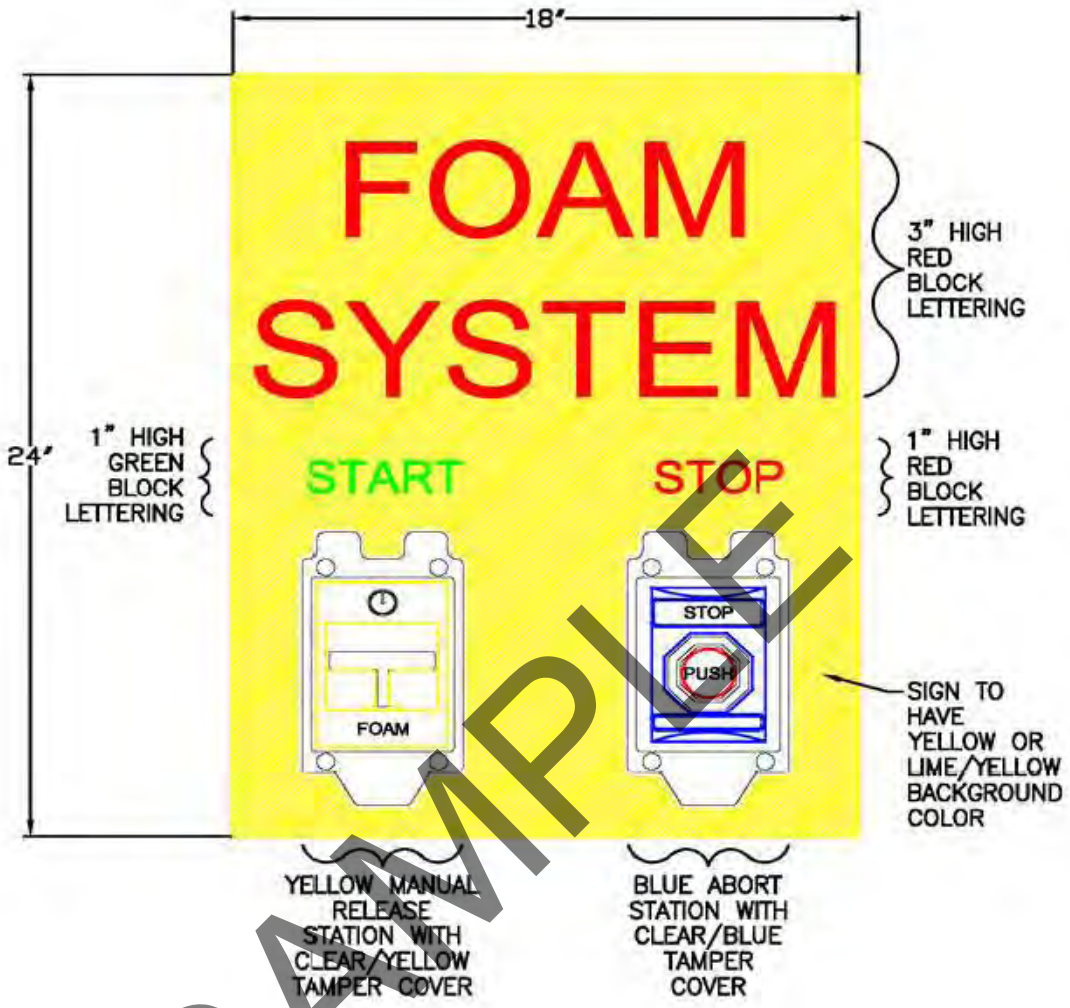
   c. Transmit a foam de-activation alarm signal to the fire department. The number and type of signals transmitted to the fire department shall be locally determined based on the current fire alarm receiving equipment.

r. Signage for HEF Manual Release and Abort Stations

1. Single Sign Option.

   a. Permanently mount both manual activation station and the abort station onto a single 610mm (24 inch) by 457mm (18 inch) wide metal sign with a yellow or lime-yellow background. The upper half of the sign shall have the words “FOAM SYSTEM” in red block lettering not less than 76mm (3 inch) high. The words “fire” and “alarm” must not appear on the sign. The activation and abort stations, along with their tamper covers, shall be located on the lower half of the sign as indicated. Above the activation station the word “Start” shall be stenciled in 25.4mm (1 inch) green block lettering. Above the abort station the word “STOP” shall be stenciled in 25.4mm (1 inch) red lettering.

SAMPLE

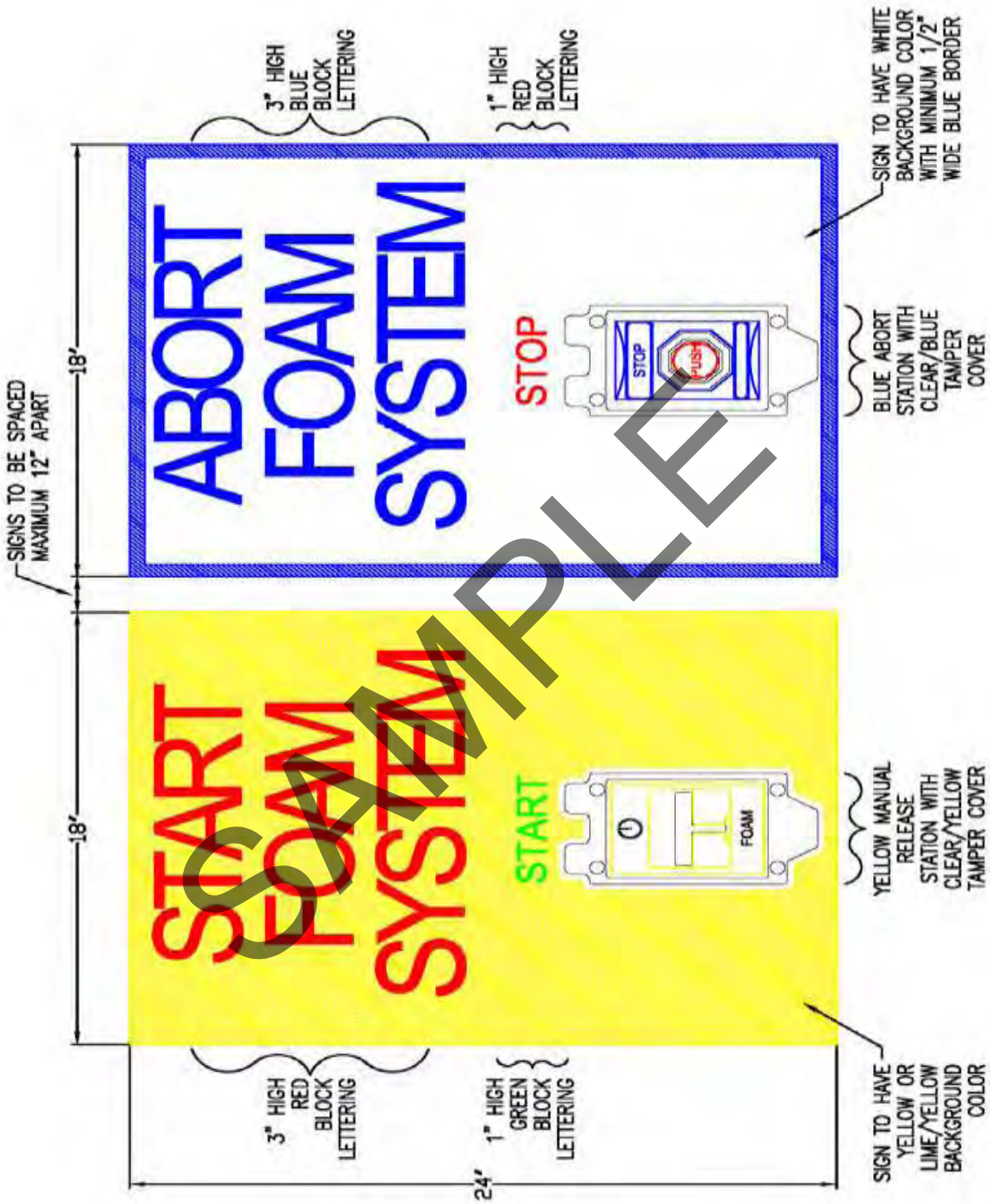


Single Sign Option

SAMPLE

2. Two Sign Mounting Option

Provide two separate but adjacent 610mm (24 inch) high by 457mm (18 inch) wide metal signs. There shall be no more than 12 inches of separation between the two signs. The words “fire” or “alarm” must not appear on these signs. The sign for the manual HEF release station shall have a yellow or lime-yellow background with “START FOAM SYSTEM” in red lettering not less than 76mm (3 inch) high. The release stations with tamper covers shall be located on the lower center portion of the sign. The word “START” shall be written in minimum 24.5mm (1 inch) high green lettering placed directly above the activation station. The sign for the HEF Abort Station shall have a white background with a minimum one-half inch blue border with “ABORT FOAM SYSTEM” in blue lettering not less than 73mm (3 inch) high. The abort station with tamper cover shall be located on the lower center portion of the sign and be protected with a clear plastic tamper cover. The word “STOP” shall be written in a minimum 24.5mm (1 inch) high red lettering placed directly above the abort button.



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Two Sign Mounting Option

ATTACHMENT A1: Option 2 - Closed-Head Foam Water (AFFF) Sprinkler System for UAS Hangar Bays

3.12.2.2 Provide a closed head foam-water (AFFF) sprinkler systems shall be either wet pipe or pre-action, designed and installed in accordance with the applicable sections of NFPA 13 and the provisions listed below. This system shall be allowed in a NFPA 409 classified Group-1 hangar.

a. Provide an automatic closed head wet-pipe foam-water (AFFF) sprinkler system in the hangar bays. The minimum design density shall be 6.5 L/min/m2 (0.16 gpm/ft2) over the most hydraulically remote 2781.7 m2 (30,000 ft2). Provide building temperature supervision when the 99.6% dry bulb temperature is less than 0.5 °C (33 °F).

b. Provide a pre-action automatic closed head foam-water (AFFF) sprinkler system activated by a roof- or ceiling-level thermal detection system in hangar bays in lieu of the wet pipe sprinkler system in geographic locations having a 99.6% dry bulb temperature less than -17.7 °C (0 °F). The density shall be the same as the closed head wet-pipe AFFF sprinkler system.

c. AFFF sprinkler systems shall have risers with check valves and vane-type water flow switches rather than alarm check valves and associated trim. Discharge main drains to an appropriately sized sanitary drain. Do not provide fire department connections on foam-water systems.

d. Provide surge arrester (expansion tank) not less than 38-liter (10-gallon) capacity for each separate pre-action riser below the riser-indicating valve. Provide a surge arrester (expansion tank) not less than 96-liter (26-gallon) capacity for each set of multiple pre-action risers below the riser indicating valves on the header. All tanks shall be listed/approved as a surge arrester with a rated working pressure of not less than 1895 kPa (275 psi). Provide sizing calculations prepared by the manufacturer.

e. Automatic water control (pre-action) valves shall be externally resettable (without opening the valve assembly and without use of special tools). The maximum valve size shall be 150 millimeters (6 inches).

f. Provide basket-type strainers upstream of the foam system risers.

g. Use brass piping on trim piping for all deluge, flow control and alarm check valves.

h. Foam Concentrate. Military Specification MIL-F-24385F, Fire Extinguishing Agent, Aqueous Film Forming Foam (AFFF) Liquid Concentrate, for Fresh and Seawater. The foam concentrated supplied with the system shall be listed for use with the distribution system.

i. Do not provide a reserve supply of foam concentrate.

j. Proportioners : Limit proportioners to 150 millimeters (6 inches) or less. Use in-line balanced-pressure (ILBP) proportioners on all pumped concentrate systems. ILBP proportioners will be factory assembled and tested by the manufacturer, and the entire ILBP proportioner assembly will be Listed/Approved. Disassembly, reassembly, and or modification by the installing contractor is prohibited.

SAMPLE

3.12.2.2.1 Provide the following features for pre-action sprinkler systems :

a. Provide a surge arrester (expansion tank) not less than 38-liter (10-gallon) capacity for each separate pre-action riser below the riser control valve. Provide a surge arrester of not less than 95-liter (25-gallon) capacity for each set of multiple pre-action risers below the control valves on the header. All tanks shall be Listed/Approved as a surge arrester with a rated working pressure of not less than 1895 kPa (275 psi). Provide sizing calculations prepared by the manufacturer.

b. Provide externally resettable automatic water control (deluge) valves for pre-action systems (without opening the valve assembly and without use of special tools).

c. Supervisory air is not required for pre-action sprinkler systems in aircraft servicing areas.

3.12.2.2.2 Sprinkler piping shall be hydraulically sized in accordance with NFPA 13. The maximum system size shall not exceed 4821 m2 (52,000 ft2).

3.12.2.2.3 In aircraft storage and servicing areas, the maximum protected floor area as projected on the floor shall be limited to 12 m2 (130 ft2). The maximum distance between sprinklers either on branch lines or between branch lines shall be 3.7 m (12 ft).

3.12.2.2.4 Where open hangar doors result in interference with the distribution of water from the hangar sprinkler systems, additional sprinklers shall be provided to ensure effective floor coverage.

3.12.2.2.5 Sprinklers shall be nominal K5.6 or K-8.0 sprinklers.

3.12.2.2.6 Sprinklers shall have a temperature rating of 74.9 °C to 93.3 °C (175 °F to 200 °F).

3.12.2.2.7 Sprinklers systems shall be flushed and tested in accordance with NFPA 13.

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