ESL-TR-86-13
VOL III OF III

FIRE PROTECTION SYSTEM FOR HARDENED AIRCRAFT SHELTERS VOL III OF III: APPENDIX H

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OCTOBER 1987

FINAL REPORT
OCTOBER 1984 - AUGUST 1987

APPROVED FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED

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SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION Unclassified	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release. Distribution unlimited.
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) NMERI WA3-9 (3.06)	5. MONITORING ORGANIZATION REPORT NUMBER(S) ESL-TR-86-13 (Vol. III of III)
6a. NAME OF PERFORMING ORGANIZATION New Mexico Engineering Research Institute 6b. OFFICE SYMBOL (If applicable) NMERI	7a. NAME OF MONITORING ORGANIZATION Engineering and Services Laboratory
6c. ADDRESS (City, State and ZIP Code) Box 25, University of New Mexico Albuquerque, New Mexico 87131	7b. ADDRESS (City, State and ZIP Code) Air Force Engineering and Services Center Tyndall Air Force Base, Florida 32403
8a. NAME OF FUNDING/SPONSORING ORGANIZATION HQ AFESC 8b. OFFICE SYMBOL (If applicable) RDCF	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER Contract No. F29601-84-C-0080
8c. ADDRESS (City, State and ZIP Code) Tyndall AFB FL 32403-6001	10. SOURCE OF FUNDING NOS. PROGRAM ELEMENT NO.: 64708F PROJECT NO.: 2673 TASK NO.: 0103 WORK UNIT NO.:

11. TITLE (Include Security Classification)
FIRE PROTECTION SYSTEM FOR HARDENED AIRCRAFT SHELTERS

12. PERSONAL AUTHOR(S)
Dennis M. Zallen, Edward T. Morehouse, Billy R. Dees, Joseph L. Walker and Phyllis Campbell

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Yr., Mo., Day)	15. PAGE COUNT
Final Report	FROM 10/84 TO 08/87	October 1987	35

16. SUPPLEMENTARY NOTATION
This report is divided into three volumes. Volume I contains the discussion and Appendixes A-C; Volume II contains Appendixes D-G; Volume III contains Appendix H.

17. COSATI CODES

FIELD	GROUP	SUB. GR.
02	06	
09	01	

18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
Hardened Aircraft Shelter (HAS) Fire Detection Halon
Fire Protection System Fire Suppression
Fire Extinguishing Agents JP-4 fuel

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

To keep personnel, aircraft, and munitions safe and ready, a fire protection system for hardened aircraft sheler (HAS) is needed. This report describes the effort to design, integrate, and test a fire protection system to combat fires in HAS, aircraft and associated equipment during hot fueling, defueling and other operations in semihardened aircraft shelters.

The smart and fast detection/suppression system used was required to possess the capability to distinguish between normal operations/events, false stimuli and an actual fire. Halon agents were used for partial flooding tests. Agent toxicity and cleanliness were evaluated and considered in the selection of agents and systems.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS ☐	21. ABSTRACT SECURITY CLASSIFICATION Unclassified
22a. NAME OF RESPONSIBLE INDIVIDUAL Joseph L. Walker	22b. TELEPHONE NUMBER (Include Area Code) (904) 283-6194 22c. OFFICE SYMBOL HQ AFESC/RDCF

DD FORM 1473, 83 APR EDITION OF 1 JAN 73 IS OBSOLETE.

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE

11. TITLE (CONCLUDED)

Volume III of III: Appendix H

18. SUBJECT TERMS (CONCLUDED)
Optical Fire detector (OFD)

19. ABSTRACT (CONCLUDED)

This report describes the five-part approach used to develop a fire protection system for HAS:

1. Define the HAS environment,
2. Analyze the HAS environment to determine the most likely fire scenarios,
3. Conduct thorough tests and evaluations of commerically available fire detectors,
4. Design, implement and evaluate HAS fire protection system tests, and
5. From the system analyses and tests, develop a purchase description.

This report consists of three volumes. Volume I contains the body of the report and Appendix A, HAS/FPS Test Plan; Appendix B, HAS/FPS Test Results; and Appendix C, Halon Concentration Data. Volume II contains HAS/FPS test reports and specifications from three companies (Appendixes D, E, and F), and the Optical Fire Detector Description (Appendix G). Volume III consists of the HAS/FPS Purchase Description, Appendix H.

PREFACE

This final report was prepared by the New Mexico Engineering Research Institute, University of New Mexico, under Contract F29601-84-C-0080 with the Headquarters Air Force Engineering and Services Center, Engineering and Services Laboratory, Tyndall Air Force Base, Florida.

The performance period for this effort was from 1 October 1984 through 30 August 1987. The HQ/AFESC/RDCF Project Offciers were Capt Edward T. Morehouse Jr. and Joseph L. Walker.

This report is published in three volumes, of which this is Volume III. Volume I contains a discussion and Appendixes A-C. Volume II contains Appendixes D-G, and Volume III is comprised of Appendix H.

The authors would like to acknowledge the support and assistance provided by the following individuals: Col Ed Maduli, Mr John Crowell, and SMSgt Keith Moser, of USAFE; Chief John C. Stokes and his personnel from Tyndall Air Force Base Fire Department; and Mr Loran M. Womack and his personnel assigned to the Headquarters Air Force Engineering and Services Support Branch (RDCO).

This report has been reviewed by the Public Affairs (PA) Office and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.

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APPENDIX H

HAS FPS PURCHASE DESCRIPTION

This is a self-contained document with its own internal style, which varies from our format.

1.0 SCOPE

1.1 General

This purchase description covers the details of a Fire Protection System (FPS) for Hardened Aircraft Shelters (HAS).

1.2 Summary of Requirements

The following is a summary of the Hardened Aircraft Shelter Fire Protection System (HAS FPS) "system" requirements. Details of the HAS FPS requirements are discussed herein.

1. The FPS shall be provided as an entire system for which the system contractor is fully responsible for all hardware, installation, maintenance, and spares over the time period of the contract.

2. The system contractor shall provide all hardware, install all FPSs, provide all maintenance, provide all spare parts, provide USAF personnel training, and maintain the FPS' MTBF status/reliability at a high level.

3. The contractor shall ensure the availability of necessary resources, capital, and continued service, and continue to make available a variety of spare parts that are necessary to complete the system requirements successfully.

4. The FPS shall consist of a modular design that only needs to be qualified once. This design provides the capability to add or reduce the number of various components without affecting performance and reliability, and is immediately adaptable to any size of HAS. Back-up power shall be provided for at least 72 hours.

5. Automatic self-diagnostics shall be included and defined to check the overall health of the entire system.

6. Manual dump activation and automatic dump overrides shall be provided.

7. A zonal detection and suppression approach shall be used to reduce personnel trauma, save cost, reduce down time, reduce service time, and increase reliability of the overall system.

8. The FPS shall not signal fire in response to any of the false fire stimuli described later in this Purchase Description. The FPS shall also not dump the suppressors in response to possible false alarm stimuli from engine power setting at 100 percent and with afterburner, wet starts, black powder start backfires, IR jammers, navigation radar, wet APU starts, and other stimuli occurring in actual HAS. Supportive data shall be provided.

9. The suppression system shall be comprised of individual halon bottles either suspended from the ceiling or externally located in a separate semihardened structure.

10. The FPS shall be capable of extinguishing running fuel fires according to requirements stated herein, (a) even in winds of up to 20 mi/h gusting through the front/side/rear doors of a HAS, (b) with mechanical ventilation of 21,000 SCFM, and (c) with jet engines running at 75 percent power.

11. The FPS system shall be designed according to Military Standards and shall function at high reliability in electromagnetic interference (EMI) environments (MIL-STD-461/462) and all MIL-STD-810 environments.

12. The FPS shall be designed to provide 132,000 hours (15 years) mean time between failures (MTBF) to detect and suppress any fire greater than or equal to 16 ft^2 in any location in the HAS. Moreover, the FPS shall have a mean time to false dump due to internal electrical component failures at over 100,000 years. The system must be configured based upon reliability models according to MIL-HDBK-217D and MIL-STD-756B. The MTBF and reliability shall be defined and stated.

13. The FPS shall identify and extinguish any 16 ft^2 or larger fire within 15 seconds, and typically less than 10 seconds, but shall not respond to small fires (about 1 ft^2) as defined herein.

14. The FPS shall alarm inside a HAS and to the fire station upon detecting any fire of 16 ft^2 or larger.

15. The FPS shall be designed to provide for safe egress of all personnel in a HAS. Halon 1211 concentrations in the HAS shall not be at levels significantly higher than those needed for extinguishment.

16. The FPS shall also provide the capability to extinguish aircraft nacelle fires.

1.3 Types of Shelters

The following four types of Hardened Aircraft Shelters shall be considered:

1. First Generation or TAB VEE: There are two manually operated, vertically hinged, prow-shaped, recessed, metal aircraft entry doors. The floor space is about 48 ft by 100.8 feet.

2. Modified First Generation or Modified TAB VEE: One electrically operated, laterally opening, roller supported, prow-shaped, externally mounted, metal aircraft entry door. The usable space is about 48 feet by 100.8 feet.

3. Second Generation: Two electrically operated, laterally opening, roller supported, externally mounted, reinforced concrete panel aircraft entry doors. The usable area is 81.9 feet by 124 feet.

4. Third Generation: This is similar to the Second Generation type except the floor space is 70.8 feet by 120 feet.

The shelter can contain at any one time one or more of the following aircraft: F-111, F-4, F-5, F-106, A-7, A-10, F-15, F-16, and A-037. Therefore, the aircraft-associated fire threat, false alarm threat, fueling operations, acoustic vibrations, etc., can all differ within any HAS over a wide range of environments associated with or induced by aircraft.

The HAS types vary primarily in dimensions and openings as far as the FPS is concerned. The basic operations within any HAS, as well as the basic fire threats posed by these operations, are the same for any HAS type. Individual base regulations (unclassified) for operations in and around a HAS shall apply to all aspects of the HAS FPS.

1.4 HAS Operations Environment

The activities that are common in all HAS types include the following:

1. Aircraft standby/alert; engine start.
2. Refueling/defueling.
3. Maintenance of on- and off-aircraft equipment.
4. Weapons loading and unloading.
5. Cold Integrated Combat Turnaround (ICT).
6. Hot Integrated Combat Turnaround (ICT). Personnel required at any particular time can vary from 0 to 10.

In addition to personnel and aircraft, a HAS can contain various types of test and maintenance equipment, start carts, fuel recovery carts, containers of flammable liquids, missiles, bombs, ammunition, racks, fork lifts, welding gear, wing tanks, and fuel trucks.

The basic air environment should be considered "dirty" because of the hydrocarbons emitted from the engine exhaust and because the doors may often be open. The hydrocarbons typically attach themselves to the walls around the aircraft and build up in density at a rate proportional to the time of running the aircraft engines and other vehicle engines in the shelter.

The floor of a typical HAS can contain "puddles" of fuel (approximately 1 gallon of JP-4) around the aircraft, or some flammable residues.

The physical environment of the HAS FPS varies, depending on location of the HAS and type of aircraft housed in the HAS.

1.5 Fire Threats

There are three basic classes of fuel spills in a HAS that pose fire threats.

Class I spills are typically confined to a very small area of up to 2 feet in dimension in any direction. These standing pools of fuel need monitoring, but usually pose no major threat to aircraft and life; they can be easily extinguished with a hand held extinguisher.

Class II spills are not greater than 10 feet in any plane dimension and are not over 50 ft^2 in area. They are not of a "continuing flow" nature, and need monitoring and neutralizing as soon as possible. They pose a threat to aircraft, weapons, and life, and the HAS FPS must extinguish any resulting fire.

Class III spills are greater than 10 feet in any plane dimension or over 50 ft^2 in area or of a "continuing flow" nature. These are considered major mishaps and require fast fire suppression measures such as those provided by an automatic HAS FPS.

The FPS must be highly reliable in detecting real Class II and Class III hydrocarbon fires and extinguishing them before any damage occurs. It must also discriminate between real and false fire stimuli and must not be inhibited to respond to any real fire in the presence of any or many false fire type stimuli.

1.5.1 Real Fire Scenarios

A major fire threat is associated with refueling during which a large "dump" of aviation fuel (600 gallons of JP-4 or JP-8) may occur as a result of a ruptured fuel pump connection, a ruptured belly tank, etc. This running pool of fuel may then be ignited by a hot surface, for example, resulting in a running fire that could cover most of the HAS floor area within a few seconds. This type of fire would immediately jeopardize the aircraft and any weapons, and would seriously threaten the lives of personnel. Rapid detection and suppression, as well as assurance that the fire will not restart after initially being extinguished are, therefore, basic HAS FPS requirements. Reignition is a very real threat in a high wind situation, which can prevail when the HAS doors are open, and the FPS must be designed to eliminate this threat.

Real fires can occur at any time of day in any location in the HAS, although the probability of such events occurring may be much greater during fueling operations and after sortie missions. The design of the HAS FPS must take into account the ability to "see" and "suppress" fires reliably at any time as a function of fire size and location within the HAS.

1.5.2 False Alarm Stimuli

The HAS FPS shall not false dump the halon suppressors as a consequence of any of the potentially confusing radiations from sources such as sunlight, acetylene welding, x-ray devices, cameras flash bulbs, incandescent lamps, fluorescent lamps, electric arc, radio frequencies, electric motors, maintenance equipment vehicle headlights and IR lamps, movie lights, chopped light, radiation heaters with fans, rifle flash, cigarette lighters, lit cigars/cigarettes and matches. The false alarm stimuli are specified in Table H-1.

In addition, the HAS FPS system shall not be triggered to false dump or its operation hindered to react to real fires from EMI sources such as IR jammer and ECM devices per MIL-STD-461/462. The FPS must also be designed to be immune to aircraft engine operations.

2.0 APPLICABLE DOCUMENTS

2.1 Specification and Standards

The following documents, of the issue in effect on date of invitation for bids or request for proposal (RFP), unless otherwise specified, form a part of this Specification to the extent specified herein (see Attachment 1 for summary list):

2.2 Military Standards

MIL-STD-810C	MIL-STD-199
MIL-STD-202	MIL-STD-198
MIL-STD-461	MIL-STD-833
MIL-STD-462	MIL-HDBK-217D
MIL-STD-454	MIL-STD-756B
DOD-STD-1986	MIL-STD-108E

2.3 Military Specifications

MIL-C-26482	MIL-C-39006
MIL-R-8573	MIL-S-19500
MIL-T-27	

2.4 European Standards/British Standards (BS)

BS 5501 (detector only): Part 1:1977. EN 50014 for Group IIC gases and temperature classification T6 (-40 °C to +70 °C) electrical apparatus for potentially explosive atmospheres; Part 1, General Requirements.

BS 5501 (all components): Part 5, Flameproof Enclosure "I" (EN50018)

BS 2011 Part I (environmental section), 1983

BS 800 (1983) radio interference

BS 5420 IP 67, 1977

BS 5045 transportable gas containers

BS 6436

BS 5445 Part 5, paragraph 5, vibration

EN 5001B

3.0 REQUIREMENTS

3.1 Scope of Program and Schedule

The contractor shall be required to develop, certify, deliver, install, and maintain all portions of the complete FPS. All components and subsystems of the FPS, along with other functional and hardware interfaces in a HAS and on the air bases, must be designed and qualified from a systems approach to reliability and performance and must be documented to meet all the applicable documents.

The contractor shall design, develop, manufacture, and install 20 full shipsets within 12 months after award of contract. The contractor shall also deliver a full test plan and shall participate in the system qualification test. Deliverables include configuration and general layout drawings, first article acceptance and procedure test plan, specification compliance test plan and installation of 20 full shipsets. The schedule of deliverables and preliminary and final design review shall be set forth in the RFP.

The first article system shall be installed by the contractor into HAS units located at air bases as specified in the RFP. The contractor shall deliver a full system test plan and perform the system tests in conjunction with USAFE/PACAF. The full-scale system qualification tests shall be completed three months after installation.

After full-scale system tests and upon receiving approval of the first articles, the contractor will then be directed to begin manufacturing at an anticipated rate of 25 HAS FPS units per month. Each HAS FPS shall be crated individually and every component labeled and assigned a serial number. The contractor shall begin installing these systems within three months after First Article approval and shall complete installing at least 175 systems within 12 months after First Article approval. These units shall be installed at bases to be named later.

After completing the first 175-unit installation, the contractor will begin installing the remainder of HAS FPS units. Installation at a rate of 40 systems per month is anticipated during this phase. Approximately 1,500 HAS units shall be equipped with fire protection systems within 60 months after the contract award.

In addition to the FPS deliverables, the contractor shall also deliver the following: FPS system description and parts list; halon filing procedure/valve refurbishment; system checkout/test procedure; data log/serialized parts for each FPS; and maintenance/repair tool sets.

Immediately after installing a HAS FPS, the contractor shall assume responsibility for maintaining the system to assure required reliability and availability. The contractor shall provide the capability the repair and service the FPS at all HAS locations. In addition, the contractor shall perform a 100 percent system test inspection and service, if necessary, each HAS FPS quarterly for the first year to assure performance to specifications and to maintain a high level of system reliability. The second-year and succeeding inspections may be reduced.

The contractor shall require that all employees having any reason for access to any USAFE/PACAF base or information related to HAS shall hold a security clearance at a level and from a sponsor approved by the USAF.

The contractor shall be responsible for performing the entire contract.

All equipment, tools, and supplies necessary to install and maintain each FPS shall be the responsibility of the contractor, except for the following:

a. Cranes and other heavy lifting devices that may be available on base.

b. Halon 1211 (GFE).

All spare parts for system maintenance shall be stored at the contractor facilities, unless otherwise specified where all materials/equipment and spare parts shall be stored on the base.

The contractor shall be able to provide the functions stated above for USAFE and PACAF locations.

3.2 System Contractor Requirements

The selection of a system contractor for the HAS FPS program will eliminate the need for USAFE/PACAF to integrate the FPS, oversee routine installations, maintain and service the FPS, prepare integrated logistics documentation, and administer a number of contracts (rather than one).

Another major reason for USAFE/PACAF to acquire the HAS FPS as a system is because the contractor has an inherent performance responsibility in assuring that the FPS reliability to suppress fires, as well as not to false dump, remains at a high level. In order to maintain this reliability to perform, service and maintenance is required from a source that knows the system and provides continuity of components and spare parts worldwide over the lifetime of the system. Only a system contractor can do this.

The contractor, therefore, must qualify the FPS as a system and perform all associated program functions including integration, delivery, installation, and certification of hardware; all programs administrative interfaces; and continuous total maintenance.

The system contractor must demonstrate technical expertise, manufacturing expertise, and product experience in all aspects of the HAS FPS including optical sensors, electronics, Halon 1211, fire suppression in and around aircraft, high pressure halon containers/bottles, nozzles, and valves. The contractor must also have demonstrated experience in providing high reliability military products to military standards such as MIL-STD-810C, -461/462, -454H, and -202H, Reliability HDBK-217D, and quality assurance. The contractor must also demonstrate experience with manufacturing military products which satisfy European codes and standards such as BS5501 (EN50014), EN50018, BS5445, BS5420, (IP67), BS800, and any applicable USAFE/PACAF, USAF, NFPA, DOT, ASTM, ANSI, UL and DOD codes.

In addition to the above requirements, the system contractor shall also have in-depth system management expertise and experience within the Far East and European countries where HAS units are located. The contractor shall also demonstrate the degree of foreign content it can place in the FPS program.

The system contractor must provide continuing maintenance of all HAS FPS including repairs, replacements, refilling, and logistics, and be able to respond to any major HAS FPS fault and to restore the FPS to full performance specification within a 12-hour period after notification of the fault.

The contractor shall have sufficient resources and financial depth to assure the successful completion of the program. A commitment in writing from an executive officer of the contractor's company regarding the level of commitment of personnel and management attention, as well as the willingness to accept the obligations of the program, is required. This would also include commitment of any capital equipment and administrative office/storage facilities that are deemed necessary.

The system contractor shall designate key personnel who will manage and conduct the program, as well as personnel who will be available to provide support where necessary for technical matters related to the FPS and other applications.

3.3 General Design Goal and Performance Requirements

The overall general design goals are as follows:

1. Maximum reliability,
2. Minimum maintenance,
3. Simplicity in servicing,
4. Ease of installation without impeding HAS operations,
5. Ability to refurbish rapidly after an activation or fault,
6. Adherence to full environment Military Standards specified,
7. Protection against false dumps from specified stimuli,
8. Protection against false dumps from internal fault,
9. Maximum effective inertion,
10. Cost effectiveness,
11. Flexibility with no design changes for all HAS sizes and configurations,
12. Minimization of trauma to personnel,
13. Ability to function as a system,
14. Continuity of system management and spare parts, and
15. Maximum safety for personnel and all internal equipment.

The system shall perform according to the following requirements:

1. The FPS shall detect and extinguish any growing external hydrocarbon fire within the confines of the HAS volume represented by the total floor area and an arbitrary height of 15 feet, provided that the size of the fire is at least equivalent to or greater than that represented by a 16 ft^2 panfire. (A 16 ft^2 panfire is defined as a 4 foot by 4 foot pan filled with water within 2 inches of the top of the pan. The pan is assumed to be 6 to 12 inches deep. The fuel is 5 gallons of JP-4 that has burned for 20 seconds. The HAS environment for the panfire is assumed to be between 0 and 40 °C with no wind.) The total duration of the event from ignition of JP-4 to fire out shall be typically less than 10 seconds, and in no circumstance greater than 15 seconds.

2. Two- and three-dimensional fires involving both aircraft and surface fires and/or equipment/surface fires and running fuel fires on the floor of a HAS shall be effectively detected and extinguished by the FPS.

3. The FPS shall not cause an executive dump of extinguishant to single small (approximately 1 ft^2) fires anywhere in the HAS. A 1-ft^2 panfire is defined the same as a 16-ft^2 panfire except the pan is 1 foot by 1 foot with a half gallon of JP-4.

4. The detector subsystem shall be configured in zones.

5. In the presence of potential false fire scenarios as described in Table H-1, and in the presence of integrated optical and RF emissions expected from all USAFE/PACAF aircraft types or ancillary equipment associated with these aircraft, the fire protection system shall not false dump nor be inhibited, but shall detect and extinguish all hydrocarbon fuel fires of size equal to or greater than 16 ft^2.

3.4 HAS FPS Configuration

3.4.1 Subsystems

The HAS FPS shall be directly adaptable to all HAS types and sizes without any change in overall design. The system configuration shall be modular and zonal and consist of the following major subsystems: (1) fire detectors, (2) extinguishers, (3) control electronics, (4) back-up power, and (5) various alarms, safety devices, and sensors. The overall system shall only vary between different HAS types and sizes in the number of subsystem components.

3.4.2 Fire Alarms

The HAS FPS shall discriminate against small fires (1 ft^2) and shall detect all fires equal to and greater than a standard 16 ft^2 area pan fire and initiate alarm within the HAS. An alarm shall also be simultaneously initiated in the fire station.

The alarms in the HAS and fire station shall be "latched" upon initiation and manually turned off.

3.4.3 Fire Detection Geometry

The fire detection subsystem shall consist of multiple sensors, divided into zones and voted.

3.4.4 Fire Suppressors

The suppressors shall be located in positions that do not impede HAS operations; FPS subsystems must be readily accessible for maintenance. NATO requirements for semihardened systems must be met for all FPS components/communications located external to the HAS. A sufficient halon concentration for fire extinguishment must be obtained within 10 seconds and sustained for 1 minute at the floor level against any prevailing turbulences and/or wind conditions of up to 20 mi/h. The halon suppressors may be suspended from the walls along both sides of the HAS at a height to maintain a clearance of no less than 10 feet. The suppressant containers may be located external to the shelter, provided they are protected by semihardened construction. The contractor may select either option as long as the choice meets the NATO requirements for semihardened facilities. No component shall be considered as an explosive.

3.4.5 Control Box

The control box shall be mounted inside a flameproof, metal enclosure in a location that allows for ease of access, safety, and minimum HAS interference.

3.4.6 Back-Up Power

The FPS shall have back-up power for a minimum of 72 hours in case of HAS main power failure. The back-up power source shall be located in a flameproof container in the HAS away from HAS activities.

3.4.7 Fault Warning

An FPS fault warning shall be provided inside the HAS. The fault warning device shall be flameproof and easily identified from any location in the HAS. Also, a fault warning of the same type shall be located in the fire station.

3.4.8 Electrical Wiring

All electrical cables shall be mounted in conduit inside the HAS at a location that minimizes the extent of the cabling, yet maximizes safety and simplicity.

3.4.9 Egress Safety System

A means shall be provided for safe egress after halon release initiation. The contractor shall specify the techniques proposed and provide an explanation of why the approach was selected.

3.4.10 System Reliability

The detailed design of the FPS shall be based upon trade-off studies centered on optimizing the overall system reliability to detect and suppress fires and not to false dump due to false signal stimuli or internal component failure. The contractor shall specify what electrical component quality levels will be used to determine reliability predictions in accordance with MIL-STD-833, MIL-S-19500, MIL-C-39006, MIL-STD-198, MIL-STD-199, MIL-T-27, MIL-C-26482, and other applicable standards and codes.

The contractor shall demonstrate according to MIL-STD-756B (Reliability Prediction and Modeling) how the final system design approach was selected by means of trade-off studies. These studies shall be based upon reliability models and calculations that take into account the expected operations environment, the physical environment, false alarm stimuli, overall system performance requirements, and possible fire scenarios. The model shall include but not be limited to the performance requirements of each subsystem.

3.4.11 Mission Success Criteria

Mission success criteria for the HAS-FPS shall include:

1. Detecting and suppressing all "real" hydrocarbon fires as defined below under "Successful Operation Against Fires."

2. Preventing false triggering (dumping suppressant) under the conditions defined below under "False Triggering Criteria, False Fire Stimuli" and "False Triggering Criteria, Internal Component Malfunction."

3.4.12 Successful Operation Against Fires

The HAS FPS shall have a minimum overall MTBF of 132,000 hours (15 years) and a minimum reliability level of 0.96 in its operation to detect and suppress all fires of 16 ft^2 or larger pan size within 15 seconds (assuming a mean time between fires of 5000 hours). These reliability levels are to be maintained for the following conditions:

1. Combat mode or peacetime mode,
2. Open or closed doors, including hangar doors,
3. Aircraft engine on or off,
4. Presence of weapons,
5. Up to 6-foot space outward from wall along walls occupied with racks, equipment, and so forth,
6. Vehicles and equipment anywhere in open spaces,
7. Winds of up to 20 mi/h,
8. Fire at any location in HAS,
9. Fire at any time of day or night,
10. Presence of false stimuli listed under "False Triggering Criteria, Fake Fire Stimuli," including Table H-1,
11. Fires internal to aircraft engine or nacelle,
12. Presence of environmental extremes due to temperature, humidity, vibration, EMI, fungus, flames, insects, water, and other environments expected in HAS locations,
13. Hot Integrated Combat Turns (ICTs) and other integrated operations, and
14. Loss of main power.

3.4.13 False Triggering Criteria, False Fire Stimuli

The FPS shall be tested and be exempt against the possible false fire stimuli listed in Table H-1. Satisfactory compliance with this requirement shall be demonstrated.

3.4.14 False Triggering Criteria, Internal Component Malfunction

The mean time to false dump of the FPS due to internal component failure shall be greater than 100,000 years.

TABLE H-1. FPS FALSE ALARM SUSCEPTIBILITY CRITERIA.

Stimuli to Which FPS Shall Not False Alarm[a]

1. Headlamp, MS50323-1
2. Flashlamp, MX-991-U
3. Incandescent lamp, 100 W, standard
4. Incandescent lamp, 100 W, rough service
5. Fluorescent lamp, 40 W
6. Vehicle IR lamp, MS-52024
7. Red dome lamp, MS-51073-1
8. Blue-green dome lamp, MS-51073-1
9. Electric arc, 1.2 cm gap at 4000 V
10. Electronic flash, Graflite 250
11. Movie lamp, 650 W quartz, DWY
12. Sunlight
13. Brightly colored clothing
14. Radiation heater, 1500 W
15. Arc welding, 4 mm rod, 300 amp
16. Acetylene welding, 00 tip, 16 by 50 mm flame
17. Rifle flash, M16
18. Lit cigar
19. Lit cigarette
20. Match, wood, stick, including flareup
21. Match, paper, including flareup
22. Aircraft engine afterburner/reheat
23. Auxiliary power unit, wet starts
24. Engine startup, normal
25. Engine running, maximum dry
26. Engine at maximum, temperature after sortie
27. Engine cartridge starts (including malfunction)
28. EMI, MIL-STD-461B, Class A1c

29. IR jammers
30. X-rays from radiographic equipment
31. 1 kW heating element, 10 Hz chopped
32. Avionics package (e.g., C-10 vehicle)
33. Hydraulic mule
34. Air starter unit
35. Emergency power unit
36. Jet fuel starter
37. Weapon jammer (e.g., M-4 Jammer, gasoline or diesel)
38. R-5 and R-9 fuel truck operations
39. Electric winch
40. Electric motors for ventilation fans
41. Gun carts
42. Avionics checking units
43. Radio: tactical, maintenance, all vehicles
44. Generators: USAF model using JP-4 Fuel
45. Lox and nitrogen carts
46. Optical reflections (e.g., sun/welding from truck windows)
47. Engine wet starts
48. Navigation radar

[a]For F-4, F-5, F-106, F-15, F-16, A-7, A-10, A-037, and F-111 aircraft.

3.4.15 Fault Detection

The contractor shall demonstrate via system analysis which functions shall be monitored and checked.

3.4.16 Maintenance and Service

The contractor shall maintain the FPS at a high level of MTBF. The Contractor must provide facilities that are close enough to any air base to assure any FPS is not down for more than 12 hours. The contractor shall also be responsible for storage of FPS spare components that may be required as replacements. This requirements holds for all base locations except for those to be specified later by USAF.

The contractor shall demonstrate how he proposes to maintain the FPS.

A data log (service record) shall be kept for each HAS FPS. It shall contain lifted component renewal scheduling, detailed records of tests, replacements, and status. The data log shall also reference each FPS by code number along with component serial numbers to trace reliability and service. The contractor's maintenance person shall certify that the FPS meets performance requirements after each test and this certification shall be noted in the log. The data log record shall be approved by the contractor's program management. Copies of this data log shall be provided to the Fire Chief and Base Civil Engineer of each base.

The FPS must be designed to be a stand-alone, hands-off system that is highly reliable and long lived. Although the Base Civil Engineer (BCE) must have maintenance capability, the contractor should assume that no Air Force personnel will be available to install or maintain the system. As such, the contractor is expected to provide all equipment, vehicles, and tools necessary to install and service all the HAS FPSs, except for cranes and other heavy-lifting devices.

3.5 FPS Electrical Design

3.5.1 Power Supplies

The FPS shall be capable of operating on any of the following supplies:

1. 220-250 V AC, 50-60 Hz
2. 110-120 V AC, 50-60 Hz
3. 22-30 V DC

3.5.2 Power Interruptions

Momentary interruptions or loss of the supply power for any duration shall not cause a false fire alarm.

The FPS shall not produce a fire alarm when the power supply is first connected.

3.5.3 Back-Up Power

The FPS shall provide the following:

1. Back-up supply in good state of charge,
2. Operation from the back-up supply in the event the normal supply is disconnected or discontinued (must operate the FPS for 72 hours).

3.5.4 Alarm Circuitry

The fire alarm circuit shall be designed to give the option of having a latched or nonlatched fire alarm output.

The fire alarm output will consist of a set of volt-free changeover contacts.

3.5.5 Fault Signals

The FPS shall have various fault signals which it will provide during system fault conditions.

3.5.6 Interface Connections

All interface connections will be made using connectors conforming to MIL-C-26482. Open test connectors will be terminated/protected with caps conforming to the same specification. Open connectors, even though protected as described above, will have 0 volts on all pins when unmated, for protection in flammable/explosive atmospheres.

3.5.7 Internal Construction

Insulation resistance between any point in the circuit and the chassis of the FPS shall be 10 MΩ minimum when tested at 500 V DC in accordance with MIL-STD-202, Section 302, Test Condition B.

Individual circuit cards, if used, shall be separable at field level.

Short circuit protection shall be provided at subsystems to ensure no damage to subsystems or false dumps of FPS.

3.6 Mechanical Design

3.6.1 Housing

The housing of all subsystems shall be flameproof and weatherproof in accordance with the appropriate standards listed in section 2.0. Special attention shall be paid to reducing moisture and dust traps to a minimum. Construction materials will be selected to provide maximum rigidity, EMI/RFI immunity, and corrosion resistance. Stainless steel or similar material will be used to meet requirements for flameproofing.

3.6.2 Mounting

The mounting materials shall be compatible with the subsystem housing and with the structure to which it is most likely to be attached. The mounting shall be compatible with vibration isolation mountings. The detector shall accept without modification a mounting capable of adjusting the orientation of the detector.

3.6.3 Cable Entry

All cable entry and exit interfaces on FPS components and subassemblies shall be flameproof.

3.6.4 Conduit

All interconnections of subsystems shall be run in conduit such that environment requirements and (section 3.7) and electromagnetic interference requirements (section 3.8) are met and maintained.

3.6.5 Materials/Performance/Operating Characteristics

Suppressor and characteristics of suppressor are:

Suppressant	Halon 1211
Propelling Agent	Dry Nitrogen
Container	B.S. 5045, Part 2
DOT-4B	

Suppressor Valve

Characteristics of the suppressor valve are:

Mechanism	Repairable, nonexplosive and nonhazardous per DOT
Residual Pressure	None after discharge
Safety	Anti-recoil plug or other safety device (fitted for transport, during installation and nozzle repair/replacement, etc.)

Leakage.

Agent leakage shall be limited to the following:

The leakage of halon shall be less than 50 g/yr at 20 °C.

The leakage of nitrogen pressurizing agent shall be less than 5 $lb/in^2/yr$ (at 20 °C).

Suppressor Status. A method for indicating halon charge condition and container pressure shall be provided.

3.6.6 Agent Containers and Discharge Valves and Nozzles

The container for storage of the suppressing agent and the nitrogen propellent must meet the requirements of the pressure container regulations and the relevant government specifications. The approval documents for the container assemblies (tank; valves, including tripping and safety valves; rupture disc, etc.) must accompany each FPS system delivery. The containers shall not fragment in response to small arms penetration. The containers must be provided with an overpressure safety relief device from which the extinguishing agent will be discharged without any hazard to personnel. The contractor shall demonstrate overall general handling safety and mounting safety including structural design analysis.

The suppressor discharge valves and nozzles must be protected from corrosion and manufactured from halon-resistant material and have to be contructed to meet the maximum possible operating pressure. To assure personnel safety, the nozzles and outlets must be arranged so that fast distribution and adequate suppressant concentration are assured without the generation of unacceptably high pressure, which would be injurious to personnel upon discharge.

3.7 Environmental Requirements

3.7.1 Temperature

Storage. FPS and its subsystems shall be capable of withstanding storage over the temperature range -40 °C to 70 °C.

Operation. The FPS and its subsystems shall be required to operate over the temperature range of -40 °C to 70 °C.

3.7.2 Environmental Test Requirements

The FPS and all subsystems shall satisfy the requirements of MIL-STD-810C test method:

501:1 High Temperature
502:2 Low Temperature
506:2 Rain
509:2 Salt
520:0 Altitude
510:1 Sand and Dust
511.1 Explosive Atmospheres
516.1 Shock
514.1 Vibration
(MIL-STD-810D)
507.7 Humidity
508.1 Fungus

The following British Standard requirements shall also apply:

B.S. 5445 (Part 5, Paragraph 5)
B.S. 5001 (Parts 1 and 5)

3.7.3 Environmental Test Levels

Shock. The FPS sub-systems must be able to withstand the following shock without being mechanically damaged. With this test the subsystem and/or component must be mounted in accordance with this test in the HAS.

After 3 shocks in each of 3 planes of 500 ± 50g of 0.5 ms duration (or shock with the same energy content) the subsystem must operate in accordance with the operating data.

After 10 shocks of 10g ± 1g of 60 ms duration in each plane the sub-system must operate in accordance with the operating data.

Vibration. The equipment must be able to withstand the vibration conditions specified in MIL-STD-810C, Paragraph 514.3, in all three planes, one after the other without damage. The test must be carried out with each subsystem mounted as in the HAS.

During the specified vibration test, the sub-system must demonstrate the specified performance.

Altitude. The FPS sub-systems must function correctly over the pressure altitude range from sea level to 3300 meters and survive an altitude of 15,000 meters in accordance with MIL-STD-810C, Paragraph 520.0.

3.8 Electromagnetic Interference Requirements

The FPS and all subsystems shall conform to MIL-STD-461 and 462. The contractor shall provide a test plan. Any exceptions to these standards shall be submitted at the time of the RFP.

4.0 QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own facilities or any commercial laboratory acceptable to the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed requirements.

4.2. Classification of Inspection

Required inspections are designated as preproduction inspection (see section 4.3) and acceptance inspection (see section 4.4).

4.3 Preproduction Inspection

The subsystems of the FPS shall be examined and tested as specified in sections 3.7 and 3.8.

4.4. Acceptance Inspection

Each FPS subsystem shall be examined as specified below and the presence of one or more defects shall be cause for rejection.

4.4.1 Defects inspected for each subsystem shall be examined for the following or similar defects including:

Missing parts
Nonconformance to approved drawings
Nonspecified materials of construction
Damaged components or parts
Noncompliance with purchase description
Void areas of primer, paint and plating
Appropriate fire and false alarm stimuli

5.0 PREPARATION FOR DELIVERY

The contractor is required to install all systems. Therefore, packaging and packing are left to his discretion. However, the marking shall be in accordance with MIL-STD-130.

ATTACHMENT 1

MIL-STD-108E: DEFINITION OF BASIC REQUIREMENTS FOR ENCLOSURES FOR ELECTRIC AND ELECTRON EQUIPMENT.

1. MIL-STD-810C: Environmental Test Methods and Enginering Guidelines, Rev. C, 10 Mar 75

2. MIL-STD-202H: Test Methods for Electronic and Electrical Component Parts

3. MIL-STD-461E: Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference

4. MIL-STD-462: Electromagnetic Interference Characteristics, Measurement of

5. MIL-STD-454: Standard General Requirements for Electronic Equipment

6. MIL-C-26482: General Specification for Connectors, Electrical, (Circular, Miniature, Quick-Disconnect, Environment-Resisting), Receptacles, and Plugs

7. MIL-R-8573: Nonshatterable Steel Air Reservoirs

8. MIL-STD-130: Identification Marking of U.S. Military Property

9. MIL-STD-833: Minimization of Hazards of Electromagnetic Radiation to Electroexplosive Devices (Superseded by MIL-STD-1512: Electroexplosive Subsystems, Electrically Initiated, Design Requirements and Test Methods)

10. MIL-S-19500: General Specifications for Semiconductor Devices

11. MIL-C-39006C: Capacitors, Fixed, Electrolytic (Nonsolid Electrolyte), Tantulum, Established Reliability, General Specification for

12. MIL-STD-198: Capacitors, Selection and Use of

13. MIL-STD-199: Resistors, Selection and Use of

14. MIL-T-27: General Specifications for Transformers and Inductors

15. DOD-STD-1986:

16. MIL-HNDBK-217: Reliability Prediction of Electronic Equipment

17. BS 5501: Flameproof Enclosure, D (Part 5)
- Electrical Apparatus of Potentially Explosive Atmosphere

18. BS 2011, Part 1: General and Guidance
- Basic Environmental Test Procedures

19. BS 800: Radio Interference Limits and Measurements for Household Appliances; Portable tools and other Electrical Equipment Causing Similar Types of Interference

20. BS 5420 IP67: Degrees of Protection of Enclosures of Switch Gear and Controlled Gears for Voltages Up To and Including 1000 V AC and 1200 V DC

21. BS 5445: Components of Automatic Fire Protection Systems Parts I, V, VII, VIII, IX

22. German EN 50014: 0785: Climates and Their Technical Applications: Standard Atmosphere
1275: Atmospheres and Their Technical Application

23. EN 50018: Testing of Metallic Materials; Creep Test Depending on Time

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