METRIC/INCH-POUND

KSC-STD-F-0004G
DECEMBER 1, 2016

Supersedes
KSC-STD-F-0004F
March 9, 2010

FIRE PROTECTION DESIGN, STANDARD FOR

ENGINEERING DIRECTORATE

National Aeronautics and
Space Administration

John F. Kennedy Space Center

Export Determination Request
KSC Export Control Office (ECO)

Record # 1633354

I. To be Filled by Submitter

Name of Submitter / Organization

Neal W. Colvin/NE-F2

a. Technical Document	☒	b. FOIA	☐
c. Pictures / Videos / Websites / Tours	☐	d. Shipping Requests	☐
e. Procurement	☐	f. Space Act Agreements	☐
g. Property Disposal	☐	h. TOPs / Technical Briefs (ESC only)	☐
i. Other _____	☐		

j. Click to Attach Document

k. Sensitive But Unclassified (SBU)

SBU must be handled and protected as instructed in **NID 1600-55**, NASA Security Program Procedural Requirements, Sensitive But Unclassified (SBU) Controlled Information, Section 5.24.

This document contains SBU? ☐ Yes ☒ No

SBU Designated Official Signature	Date	Company / Organization
WALLACE SCHROEDER Digitally signed by WALLACE SCHROEDER DN: c=US, o=U.S. Government, ou=NASA, ou=People, 0.9.2342.19200300.100.1.1=unclassed, cn=WALLACE SCHROEDER Date: 2016.12.05 10:51:45 -05'00'	12/05/2016	NASA/NE-F2

l. Submitter Comments

Please review KSC-STD-F-0004 Revision G, the KSC Standard for Fire Protection Design, to supersede Revision F. After a KATS review cycle, this will be released as the current revision and made available on the NASA Center Technical Standards site (https://standards.nasa.gov/center-specific-standards?field_organization_tid=5), a public website where KSC-STD-F-0004 Revision F is currently available.

II. Export Control Determination

a. Not Export Controlled	☒	Item / transaction / event is not controlled under EAR or ITAR.
b. EAR 99	☐	The information contained in the document is technical in content, but not technical data as defined by the International Traffic in Arms Regulations (ITAR) or the Export Administration Regulations (EAR), and therefore is EAR 99 NLR, no export license required. [General Prohibition Six (Embargo) applies to all items subject to the EAR, (i.e., items on the CCL and within EAR 99 NLR). You may not make an export or re-export contrary to the provisions of part 746 (Embargos and Other Special Controls) of the EAR and 22 CFR part 126.1 of the ITAR].
c. EAR	☐ ECCN	This document contains information within the purview of the Export Administration Regulations (EAR), 15 CFR 730-774, and is export controlled. It may not be transferred to foreign nationals in the U.S. or abroad without specific approval of a knowledgeable export control official, and/or unless an export license or license exception is obtained/available from the Bureau of Industry and Security, United States Department of Commerce. Violations of these regulations are punishable by fine, imprisonment, or both.
d. ITAR	☐ Category	This document contains information which falls under the purview of the U.S. Munitions List (USML) as defined in the International Traffic in Arms Regulations (ITAR), 22 CFR 120-130, and is export controlled. It shall not be transferred to foreign nationals in the U.S. or abroad without specific approval of a knowledgeable NASA export control official, and/or unless an export license or license exemption is obtained/available from the United States Department of State. Violations of these regulations are punishable by fine, imprisonment, or both.

e. Rationale or Comments (Optional)

Signatures

f. Contractor / Export Control Representative (ECR)	Organization or Contract
g. NASA / KSC Center Export Counsel (when applicable)	h. NASA / KSC ECO DOUGLAS LESHO Digitally signed by DOUGLAS LESHO DN: c=US, o=U.S. Government, ou=NASA, ou=People, cn=DOUGLAS LESHO, 0.9.2342.19200300.100.1.1=dlesho Date: 2016.12.06 10:37:51 -05'00'

III. Save and Upload EDR

Save Form | Upload EDR

Export Determination Request
KSC Export Control Office (ECO)

Instructions

Section I: To be Filled by Submitter *Per KDP-KSC-P-2190*

Enter the submitter / user name and Organization (NASA organization, company, or name of contract).

I.a. Technical document in the form of a document, drawing, report, Word, Excel, pdf, hyperlink, etc.
I.b. FOIA requests.
I.c. Pictures / Videos / Websites / Tours. Photos, videos, websites in the form of jpg, gif, png, pdf, multiple hyperlinks on Word document, etc. Tours / Visitor requests (in the form of Excel spread sheets, hyperlinks on Word document).
I.d. Shipping requests in the form of NASA or KSC forms (e.g. 7-248) , pdf, Word document, etc. Multiple documents for shipping package.
I.e. Procurement packages from single document to multiple required for solicitations, bids or purchases.
I.f. Space Act Agreements.
I.g. Property Disposal items list in the form of Word, Excel, KSC Form, etc.
I.h. TOPS/Technical Briefs for ESC only. This area is for items intended for publishing that do not meet the requirements for an STI review. Note: KSC Export Control Counsel authorization is required in Section II.g. prior to submittal to the KSC ECO.
I.i. Other. To be used when item is not listed in I.a. – I.h. Add a brief description.
I.j. Attach document. Click in this area to attach item(s) to be reviewed. Attachment is not required when copying a hyperlink into the Submitter Comments Section. e.g. LFT, Windchill, etc.
I.k. Sensitive But Unclassified (SBU) Section: SBU determinations shall be conducted upon creation (as required per NID 1600.55 section 5.24) prior to sending this form to the ECO for an export control review. Questions regarding this requirement shall be directed to the appropriate SBU Designating Official in your area or Henry Yu in the NASA KSC IT Security Office.
I.l. Submitter Comments. This area is optional and can be used for title, description, hyperlinks or any comments.

Section II: Export Control Determination *To be completed by authorized EC representative per KTI-2190, KSC Export Control Instruction. Note: This area will not typically have boxes checked for NASA generated items prior to the ECO determination. Contractors are required to obtain KSC ECO concurrence for determinations with an ECCN or ITAR classification, in which case this area will be completed by the contractor prior to submitting to the KSC ECO.*

II.a. Item / transaction / event is not controlled under EAR or ITAR. Examples of such items include (but are not limited to) generic photos, general statements of work, items currently in the public domain such as pamphlets, general mathematical formulas, etc. This check box may also be used for items that only require an ECO approval (e.g. tour list).
II.b. EAR99 definition on page 1. Typical EAR99 items are dual use items widely available to the general public and not limited to the USA.
II.c. EAR definition on page 1. Dual use items controlled on the Commerce Control List (CCL) under an ECCN.
II.d. ITAR definition on page 1. Items which are on the United States Munitions List (USML) controlled under an ITAR category.
II.e. Rationale or comments is an optional area to be completed as deemed appropriate.

Signature Section
II.f. Contractor generated documents shall have an EC representative's approval signature. For NASA generated documents (etc.) this area will be blank.
II.g. NASA KSC Export Control Counsel signature is only required when TOPS, Technical Briefs are submitted in section I.h. (see above).
II.h. NASA KSC Export Control Office representative signature is required for all NASA generated documents, products, etc., and on all contractor submittals with an ECCN or ITAR determination. This area will be blank if a contractor determines their item to be either Section II.a. "Not Export Controlled" or II.b. EAR99.

Section III: Save and Upload EDR
Once EDR is completed (and required SBU applied), click the "Save Form" button and name your file to your desktop using the naming convention, EDR XXXXXXX, DOC Name or Number.

Click "Upload EDR" button and "Add a document" to initiate the EC Workflow.

Note: The submitter will receive an auto generated email after the upload and another when the ECO review is complete/approved. The submitter will then go back into the ECO SharePoint site and download their signed / approved document **within 24 hours**.

FIRE PROTECTION DESIGN, STANDARD FOR

Approved by:

Scott T. Ulbrich for:

Patrick A. Simpkins, D.B.A.
Director, Engineering

KSC-STD-F-0004 Revision G Statement of Revisions

Primary revisions to KSC-STD-F-0004 from Revision F to Revision G made by consensus of the KSC Authority Having Jurisdiction (AHJ), NASA Engineering (NE), NASA Spaceport Integration and Services (SI), and applicable contractor personnel in a series of meetings in 2015 and 2016 are as follows:

- General: Revisions that did not alter technical content are not specifically referenced below, as they are considered general editorial revisions.
- General: Instances of Central Fire Monitoring System (CFMS) were revised to Central Radio Monitoring System (CRMS), as all fire alarm systems now report on the CRMS.
- General: Minimal references to construction documentation were removed throughout, as this standard applies to design only, not construction contractors.
- Section 1.1: Revised to identify that scope of KSC-STD-F-0004 focuses on fire alarm and fire suppression requirements only, relying on other applicable documentation for other aspects of fire protection design (fire stopping, etc.).
- Section 2.1: Added references for standard backflow prevention assembly and nitrogen inerting drawings and deleted ETL 01-18, as it is no longer applicable.
- Section 2.2: Addition of the International Building Code as a reference.
- Section 3.1: Complete rewording and reduction of specific criteria for applying fire alarm and fire suppression to KSC facilities.
- Section 3.2.5.2: This section on fire stopping was deleted because it only restated application of the National Fire Protection Association (NFPA) Code.
- Section 3.2.6.3: This section was removed because spot type smoke detectors are no longer used for new construction and renovation at KSC since the application of much more sensitive air sampling detection systems are used in sensitive electronic equipment and processing areas.
- Section 3.2.6.4 (3.2.6.3 in Rev G): The maximum port spacing requirement was removed, as it changes whenever the air sampling detection system technology advances and depends upon the configuration of spaces.
- Section 3.2.7: Requirements that only restated code for specific scenarios and were not KSC specific to elevator recall and shutdown were removed.
- Section 3.2.12.1: Completely revised to reflect that reporting is only by CRMS and the associated reporting capabilities and requirements.
- Section 3.2.12.2: CFMS reporting methods are removed from the document, as the section is no longer applicable.
- Section 3.2.12.2.1: The section on zoned radio transceivers was revised to reflect that Zone 5 is not used for summary silent alarms and it also became 3.2.12.1.1.
- Section 3.2.12.2.2: This section is removed, as there is no further intent to use or add to radio transceivers currently on center that utilize the serial data interface.
- Section 3.2.12.2.4: This section is removed, as there is no intent to utilize summary reporting panels for the primary reporting method of new fire alarm systems.
- Section 3.2.12.3: This section is removed, as the CRMS does not utilize color graphics screens in the way that the CFMS did at the fire alarm reporting head-end equipment.

- Section 3.2.13: This section is removed as not required. This section restated an outdated, generic version of what is in the Construction of Facilities (CoF) Statement of Work (SOW) for architecture and engineering firm fire alarm design drawings that is regularly updated in the boilerplate version of the CoF SOW.
- Section 3.2.15: This section is removed, as fire alarm system shop drawings are performed by construction contractors under the requirements of NASAKSC SpecsIntact for the specific project, which this section generically restated. The standard is not intended to apply to construction contractors.
- Section 3.2.16: This is removed, as battery calculations are performed by the construction contractor for fire alarm systems as part of the requirements for shop drawings and installation driven by NASAKSC SpecsIntact for the specific project. The standard is not intended to apply to construction contractors.
- Section 3.3.1.1: Significant revisions were made to remove requirements in this section that were verbatim to NASAKSC SpecsIntact Master Specification Sections that are updated more regularly than this standard. Additionally, references to the backflow prevention assembly and nitrogen inerting drawings are added.
- Section 3.3.1.3: This section was modified to require consultation with the LDE and KSC AHJ for modification of drain systems in existing facilities.
- Section 3.3.1.7: This section on fire stopping was deleted because it only restated application of NFPA Code.
- Section 3.3.1.8 (3.3.1.7 in Rev G): Revised the title of this section from Painting to Coating, since powder-coated piping is an allowable option.
- Section 3.3.1.10 (3.3.1.9 in Rev G): Removed restatement of testing and acceptance criteria already in NASAKSC SpecsIntact Master Specification Sections. Added the general requirement about air testing prior to application of water in launch critical or mission essential facilities.
- Section 3.3.3.2: This section is removed, as power for compressed air systems related to dry pipe system is covered in NASAKSC SpecsIntact Master Specification Sections.
- Section 3.3.4.1: This section on pre-action systems is significantly reduced and revised to reflect that these systems are not permitted at KSC except where specifically approved for use by the KSC AHJ.
- Section 3.3.5.1: This section was reduced to remove recommendations and restrictions for types of deluge systems stated in other section and requirements that were considered outdated or not applicable to all types of deluge systems.
- Section 3.3.5.3: This section was revised to better clarify application of Type I and Type II deluge systems.
- Figure 7 (Now Figure 6): Figure was originally mislabeled as Figure 6, but is now actual Figure 6. Separately, the figure was modified to include vent lines for each solenoid valve. That is the preferred operational configuration of this solenoid cabinet, as opposed to a joined vent line.
- Section 3.3.5.4: This section of deluge system electrical controls was significantly pared down, as it is not reflective of the current control schemes, which vary based upon

location and configuration of fire alarm systems. A general statement about the current primary control intent replaced specific detail.

- Section 3.3.5.5: This section is removed, as deluge water manual shutoff/control valves are typically now outside stem and yoke (OS&Y) control valves, regardless of the riser pipe size. Information on control valves is covered earlier in the standard.
- Section 3.4.1: This section is revised to state that carbon dioxide systems are not permitted at KSC, except as determined by the KSC AHJ.

CONTENTS

FIGURES

FIRE PROTECTION DESIGN, STANDARD FOR

1. SCOPE

1.1 Purpose

This document provides additional fire protection design requirements to be applied in conjunction with NASA-STD-8719.11, Safety Standard for Fire Protection, for the design or modification of facilities and systems under the jurisdiction of KSC, NASA. This document focuses on KSC-specific design requirements related to fire alarm and fire suppression systems that are a direct result of best practices and lessons learned, primarily relying on applicable codes and standards referenced in NASA-STD-8719.11 for other aspects of fire protection design. Where this design extends beyond facilities at KSC (Cape Canaveral Air Force Station, Vandenberg Air Force Base, etc.), local requirements (e.g. local fire alarm reporting methods) and the requirements of local Authorities Having Jurisdiction (AHJ) shall apply.

1.2 General

The minimum basic requirements for the design of a fire protection system shall be in accordance with the applicable provisions of the latest revision of the National Fire Codes, Standards, and Guides published by the National Fire Protection Association (NFPA). If there are inconsistencies or conflicts between these requirements and other NASA documents, then the more stringent requirements shall be followed.

Throughout this Standard, reference is made to "Designer shall consult" with the KSC AHJ or another party on specific fire protection requirements. For purposes of this Standard, "consult" is the exchange of ideas between the Designer and the applicable party, typically the KSC AHJ. The KSC AHJ shall be either the NASA official or his designee. The agreements that take place during these consulting sessions between Designer and the applicable party shall be documented as meeting minutes, e-mails, correspondence, or engineering review comments.

Monitoring systems installed for monitoring a particular hazard, such as systems using hydrogen and hypergolic fuel leak detectors, are of a specialized nature and are not within the scope of this standard.

General facility fire protection system design shall consist of the following elements:

a. Full coverage sprinkler protection serving as the primary automatic fire detection means using flow switches.

b. Modular fire alarm control panel (FACP) with initiation and auxiliary control devices being individually addressable.

c. Manual pull station placement in accordance with the Americans with Disabilities Act (ADA) and NFPA requirements.

d. Audible and visual evacuation appliance placement in accordance with ADA and NFPA requirements.

e. Additional automatic fire detection and auxiliary control devices as required by NFPA standards, NASA-STD-8719.11, or the KSC AHJ. Common examples include duct smoke detection and elevator system smoke/heat detection.

f. Looped "Class A" wiring systems in diverse routed raceways for all circuit types where such equipment is available for the purpose, unless otherwise approved by the KSC AHJ.

g. Standardized operating requirements and sequences including evacuation alarm operation, maintenance bypasses, auxiliary control operation, and Central Radio Monitoring System (CRMS) reporting.

Specialized systems that may be incorporated into or integrated with the basic protection strategy include, but are not limited to, the following:

a. Computer room or essential electronic equipment area smoke detection.

b. Additional fire suppression systems and their related Underwriters Laboratory (UL)-listed or Factory Mutual (FM)-approved releasing system controls, including deluge, wet/dry chemical, etc.

c. High bay, clean room, or hazardous area fire detection.

d. Emergency power disconnecting systems.

e. Fire pump systems.

1.3 Questions and Conflict Resolution

The coordination and the resolution of questions and conflicts concerning the application of this Standard to a design shall be the responsibility of the NASA Lead Design Engineer (LDE), with support from the NASA Fire Protection System Engineer and the KSC AHJ. Any clarifications to the design requirements in the statement of work (SOW) shall be documented and followed up with a contract modification, if applicable.

Significant issues, including existing system deficiencies, any issue that affects SOW design requirements, or any issue that delays turnover of a system for normal operations and maintenance, shall be brought to the attention of the applicable NASA management required to facilitate resolution. In general, the following issues shall be discussed with concurring or dissenting opinions summarized in writing for disposition by the KSC AHJ and/or NASA management:

a. Statement of the issue.

b. Primary stakeholders and their positions on the issue.

c. Synopsis of NFPA code, NASA standard, law or consensus standard, or listing agency (UL or FM) requirements regarding the issue.

d. Assessment of life-safety risk caused by the issue.

e. Other impacts caused by the issue (e.g. maintenance).

f. Construction document and contract requirements regarding the issue.

g. Project impact relative to available budget and schedule.

h. Methods to fund and correct the issue, both short and long term.

i. Proposed alternatives for mitigating the issues.

2. APPLICABLE DOCUMENTS

The following documents form a part of this document to the extent specified herein. When this document is used for procurement, including solicitations, or is added to an existing contract, the specific revision levels, amendments, and approval dates of said documents shall be specified in an attachment to the SOW.

2.1 Governmental

Federal (FED)

29 CFR, Subtitle B, Chapter XVII, Part 1910	Occupational Safety and Health Standards
FED-STD-595	Colors Used in Government Procurement

John F. Kennedy Space Center (KSC), NASA

KSC-STD-E-0002	Hazard Proofing of Electrically Energized Equipment, Standard for
SPECSINTACT	NASA KSC Shelf Masters
79K32573	Water Deluge Activation Station Standard Assembly
98K01375	Design Backflow Preventer Device For Fire Protection
81K07129	Nitrogen Inerting of Fire Protection Systems

Military (MIL)

MIL-STD-101	Color Code for Pipelines and for Compressed Gas Cylinders
UFC 3-600-01	Unified Facilities Criteria (UFC) Design: Fire Protection Engineering for Facilities

NASA

NASA-STD-8719.11	Safety Standard for Fire Protection
NPR 8715.3	NASA Safety Manual
NASA-STD-5008	Protective Coating of Carbon Steel, Stainless Steel, and Aluminum on Launch Structures, Facilities, and Ground Support Equipment

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specified procurement functions should be obtained from the procuring activity or as directed by the Contracting Officer.)

2.2 Non-Governmental

International Building Code (IBC)

The IBC is applied where it contains fire protection and life safety requirements more stringent than, or not contained in, other codes, standards, and guides.

National Fire Protection Association (NFPA)

All volumes of NFPA fire codes, standards, and guides including appendices and recommended practices.

(Application for copies should be addressed to the National Fire Protection Association, One Batterymarch Park, Quincy, MA 02169-7471.)

National Institute of Standards and Technology (NIST)

NIST TN 1423	Analysis of High Bay Hangar Facilities for Fire Detector Sensitivity and Placement

(Applications for copies should be addressed to the Building and Fire Research Laboratory, National Institute of Standards and Technology, Gaithersburg, MD 20899.)

Underwriters Laboratories Inc. (UL)

UL FPED	UL Fire Protection Equipment Directory

(Application for copies should be addressed to Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2069.)

American Society of Mechanical Engineers (ASME)

ASME A17.1 Safety Code for Elevators and Escalators

(Application for copies should be addressed to The American Society of Mechanical Engineers, Three Park Avenue, New York, NY 10016-5990.)

3. GENERAL REQUIREMENTS

3.1 Criteria

Fire alarm and fire suppression systems shall be required in new and existing KSC facilities and areas as indicated in the latest revision of NASA-STD-8719.11 and/or the assessment of the KSC AHJ. Fire alarm and fire suppression systems shall be designed in compliance with this standard and all applicable documentation referenced herein. Conflicting requirements shall be at the discretion of the KSC AHJ to resolve, but the order of precedence for requirements is typically the Code of Federal Regulations (CFR), NASA documentation, KSC documentation, and then all other applicable codes, standards, and guides referenced therein.

3.2 Fire Alarm and Detection Systems

3.2.1 General

The KSC fire alarm detection and reporting system is composed of local systems and a Center-wide proprietary protective signaling system as described in NFPA 72. Alarm, supervisory and trouble signals report to KSC's CRMS for fire or maintenance dispatch. All system components shall be listed or approved for use with each other by a recognized independent testing laboratory such as UL or FM; modification of existing facility fire alarm systems require sole-sourcing of components only as required to meet these listing requirements. New facility installations do not require the sole-sourcing of equipment unless the new system is required to connect to existing fire alarm control panel networks.

Fire alarm system components and system integration shall meet the material and installation requirements of the KSC Master SPECSINTACT section titled FIRE DETECTION AND ALARM. Air sampling smoke detection systems and components shall meet the requirements of the KSC Master SPECSINTACT section titled FIRE DETECTION AND ALARM INTERFACES.

3.2.2 Facility Fire Alarm Systems

Generally, only one fire alarm control panel shall be installed per facility. The Designer shall consult with the KSC AHJ on requirements of large facilities or if other specialized control

panels for elevator or suppression systems are considered. Facility FACPs should not control suppression systems unless the suppression system covers most or all of the facility area.

a. The facility fire alarm system shall be a fully addressable, microprocessor-based, expandable modular type unless approved otherwise by the KSC AHJ.

b. Fire alarm systems shall be stand-alone systems and shall not be combined with a security system, paging and area warning system (PAWS), energy management and control system, or any other control system. Fire alarm systems may be connected to other control systems for monitoring and control purposes after consultation with the KSC AHJ on a case-by-case basis.

c. Drawings shall include a programming matrix that fully defines system operation by cross-referencing all fire alarm panel inputs (rows) to all fire alarm panel outputs (columns).

d. FACP shall be custom-programmable. Software operating sequences shall adhere to the KSC standard operating practice as follows:

(1) See 3.2.12 for detailed CRMS reporting requirements.

(2) Activation of any alarm initiating device, automatic or manual, shall annunciate an alarm signal at the FACP and report an alarm signal to the CRMS.

(3) Activation of any supervisory device (valve tamper switch, maintenance bypass switch, etc.) shall annunciate a supervisory signal at the FACP and report a supervisory signal to the CRMS.

(4) Activation of alternating current (AC) power shunt trip systems for essential electronic equipment rooms shall annunciate a supervisory signal at the FACP and report a supervisory signal to the CRMS. When provisions to bypass the shunt trip system are approved by the KSC AHJ, then this supervisory condition shall also be separately reported.

(5) Elevator control shall be designed in accordance with NFPA 72 and American National Standards Institute (ANSI) A17.1.

(6) Any AC power circuit that is not monitored by the FACP, but is performing a required life safety function, shall be monitored for trouble by the fire alarm control panel using a power fail relay. The FACP shall be programmed to delay the trouble report at the CRMS for at least 30 minutes, with a specific time delay included in the specifications.

(7) Activation of a CRMS-reporting radio-trouble contact (antenna cut or loss of communications) shall annunciate supervisory at the FACP and shall be self-clearing.

(8) Any NFPA 72 defined trouble condition (wiring problem, loss of power, flame detector trouble, etc.) shall annunciate a trouble signal at the FACP and report a trouble signal to the CRMS. Loss of AC power shall report a trouble signal to CRMS with a time delay of at least 30 minutes; the specific time delay shall be

included in the specification (maximum time delay varies by panel type and manufacturer).

(9) Activation of any manual pull station, heat detector, flame detector, or suppression system flow (or discharge) switch shall cause operation of notification appliances to evacuate the facility.

(10) Activation of any ceiling or under-floor mounted spot type smoke detector shall cause operation of notification appliances to evacuate the facility only if it is the primary protection (i.e. the area is not covered by other automatic detection devices such as sprinkler system flow switches, heat detectors, or flame detectors).

(11) Activation of air sampling smoke detection system Alarm Level 1 (Alert) and Alarm Level 2 (Action) shall annunciate a supervisory signal at the FACP and report a supervisory signal to the CRMS.

(12) Activation of air sampling smoke detection system Alarm Level 3 (Fire 1) shall annunciate an alarm signal at the FACP and report a silent alarm signal to the CRMS, unless otherwise approved by the KSC AHJ.

(13) Activation of air sampling smoke detection system Alarm Level 4 (Fire 2) shall annunciate an alarm signal at the FACP, and shall report as a silent alarm if the area is protected with a suppression system (air sampling system shall sound the evacuation if it is the primary protection). An Alarm Level 4 signal shall report an alarm signal to the CRMS.

(14) For FACPs serving multiple buildings, notification appliances to evacuate a facility shall be activated for alarm devices in the same building only, unless otherwise approved by the KSC AHJ.

(15) An audible evacuation alarm shall be programmed for or have hardware provided for temporal three-bell tone. More than two strobes visible from the same location shall be synchronized, unless otherwise approved by the KSC AHJ.

(16) Activation of any alarm initiation device, automatic or manual, shall release all door holders in the same building as the initiation device.

(17) Activation of any duct smoke detector shall shut down the respective air handling unit only, or as required by NFPA 90A, multiple air handling units for integrated or common area systems, but shall not sound the facility evacuation alarm, causing only a silent alarm signal at the FACP and CRMS to initiate a fire department response.

(18) Designer shall consult with the KSC AHJ on the operation of all electrically controlled suppression systems.

e. To facilitate testing, software-programmed maintenance bypass functions shall be provided for the following capabilities, as applicable. Activation of any bypass

function shall annunciate supervisory at the fire alarm control panel and report supervisory to the CRMS.

(1) Evacuation Signal Bypass (audible and visual) – Bypasses all audible and visual evacuation appliances. Provide a separate bypass for each facility (building number) controlled by the fire alarm control panel.

(2) Air Handling Unit (AHU) Shutdown Bypass Control – Bypasses AHU shutdown relay(s). Generally, provide a separate bypass function switch for each individual AHU. For large facilities, facilities with many AHUs, or multiple AHUs serving a common area, the designer shall consult with the KSC AHJ regarding the grouping of multiple AHUs on a single bypass switch.

(3) CRMS Bypass – Bypasses remote reporting signals (except the supervisory signal for bypass switch operation).

(4) Elevator Interface Bypass Control – Bypasses elevator recall and shutdown relay(s). Generally, provide a separate bypass function switch for each individual elevator. For multiple elevators in a common area, the designer shall consult with the KSC AHJ regarding the grouping of multiple elevators on a single bypass switch.

(5) Suppression System Discharge Bypass – Bypasses an electrically controlled suppression system discharge output, typically to a solenoid valve. Provide a supervised, hard-wired key switch bypass at the releasing device and a separate software function switch bypass for each suppression system releasing device (solenoid valve). Specify that these bypasses must generate a supervisory signal at the FACP and CRMS in addition to any trouble signals generated.

(6) Flame detector test function – Activates a software addressable relay wired to the test input function on one or more flame detectors. Activation of this test function initiates an alarm on the flame detector(s).

3.2.2.1 Retrofitting/Expansion of Existing Fire Alarm Systems

During field investigations for planning, studies, preliminary engineering reports, and designs that require existing fire alarm systems to be modified (i.e. replacing fire alarm control panels, adding fire alarm initiation/signaling/control devices, modifying or adding space to a facility, adding or modifying sprinkler systems), designers shall fully review the existing hardware documentation, software documentation, and CRMS reporting information for the system to be modified. The designer shall consult with the KSC Fire Alarm Operations and Maintenance Organization to obtain existing system data and arrange any equipment inspections required. Designers shall ensure the existing FACP meets the following guidelines or documents any deficiencies in writing to the NASA LDE.

a. Ensure the fire alarm system meets current code and standards requirements.

b. Ensure the fire alarm system communicates the required alarm, supervisory, and trouble reporting information to the CRMS.

c. Ensure the fire alarm control panel sequence of operations meets current standards.

d. Ensure the existing FACP has adequate expansion capability and expansion hardware is available from the original equipment manufacturer.

e. Ensure new fire alarm equipment specified is compatible with, and UL-listed or FM-approved for use with, existing fire alarm equipment.

f. Ensure there is adequate space to install additional fire alarm terminal cabinets at the designated locations.

g. Verify the existing secondary power supply and conductors are adequate to handle the additional load associated with the modifications.

h. Determine location and size for any new AC circuits required for new systems (e.g. air sampling system, pre-action air compressor, audio amplifiers, etc.).

i. If the new criteria for the retrofitting/expansion of the existing fire alarm system exceed the expansion capabilities of the FACP, a new fire alarm system or new FACP shall be provided. In addition, the designer shall obtain approval of the KSC AHJ for continued use of the fire alarm system with any known deficiencies related to the above.

3.2.2.2 Fire Alarm Control Panel (FACP) Location

The FACP shall be installed in an air-conditioned cabinet or room, such as a communications room, located on the floor of exit discharge. Location shall take into account CRMS connection. Location of the FACP near an outside wall simplifies antenna installation for radio transceivers. In multistory or large buildings, remote cabinets containing electronic components need to be installed in air-conditioned rooms.

A wiring terminal cabinet shall be installed immediately adjacent to the FACP. This terminal cabinet shall be the interface point for all field wiring connections to the FACP modules. Where site or system arrangement conditions necessitate the installation of additional wiring cabinets, they shall be specifically indicated by location on the design drawings.

3.2.3 Annunciators

The designer shall consult with the KSC AHJ on the requirement for, type, and location(s) of fire alarm system annunciators. The minimum functions of the lobby annunciator shall include reporting alarms, silent alarms, and supervisory signals; trouble signals shall not annunciate at the annunciator(s). Capability to silence, acknowledge, or reset the facility fire alarm system from the annunciator panel shall be determined by the designer following consultation with the KSC AHJ.

3.2.4 FACP Wiring

Wiring shall be provided in accordance with NFPA 70 and NFPA 72. Fire alarm system circuits shall be installed in dedicated raceway (conduit) systems. The 60 hertz power circuits shall not enter enclosures containing fire alarm circuits, except where required to connect to a FACP.

Generally, all initiating device, signaling line, notification appliance, and control circuits shall be "Class A type" using separate and diverse routed raceways in accordance with NFPA 72. The following "Class B type" wiring is acceptable:

a. Between a Class B addressable module and the connected initiation device when installed in the same box.

b. Between Class B CRMSCRMS Radio Transceiver monitor zones and corresponding fire alarm control panel relays.

c. Where Class A hardware such as suppression release circuit modules are not available from the equipment manufacturer.

d. Other instances where approved by the KSC AHJ.

3.2.4.1 Circuit Color Coding

Circuit color coding and labeling shall meet the requirements of the KSC Master SPECSINTACT section titled FIRE DETECTION AND ALARM.

3.2.4.2 Surge Suppression

Design to provide line voltage and low-voltage surge suppression devices to suppress all voltage transients that may damage fire alarm system components. Line voltage surge suppressors shall be installed on the load side of a lockable fused disconnect switch that supplies fire alarm control equipment. Low voltage surge suppressors shall be installed on any circuit entering or leaving a facility.

Where a radio transceiver with an externally mounted antenna is installed, a surge suppressor shall be installed between the antenna and electronic equipment. Also, external antennas shall be located to minimize the probability of a direct lightning strike.

Provisions for connecting all surge suppressors to an earth ground must be specifically indicated on the design drawings. For new facilities, connection locations shall be coordinated with plans showing earth grounding. For existing facilities, existing and accessible earth ground connection points shall be indicated or new connection points bonded to existing grounding shall be installed.

3.2.5 Wet and Corrosive Location Requirements

Conduit in exterior (outdoor) unfinished areas shall be designed in a manner that will minimize water intrusion into exterior-mounted devices and enclosures. Drawings shall provide necessary details showing conduit entering device junction boxes from the bottom and leaving the device junction boxes from the sides. Indicate conduit shall be sloped away from the device junction boxes and towards an automatic or manual drain.

Equipment mounted in exterior, corrosive, or wet locations shall be NEMA 4X, protected from corrosion, and gasketed. Where severe corrosion conditions exist, such as at launch pads or near the ocean, special paint coatings shall be used in accordance with NASA-STD-5008.

3.2.5.1 Installation in Hazardous Locations

Local fire alarm systems installed in hazardous areas shall comply with NFPA 70, including Chapter 5, NFPA 497, and KSC-STD-E-0002.

Drawings shall indicate all hazardous areas by geographic area and hazardous class-division-group type. Conduit, enclosures, and devices installed in hazardous locations shall conform to the requirements of UL or FM for the hazardous location classification indicated. When the device is not factory-sealed, conduit seal-off fittings suitable for the hazardous classification shall be indicated at each conduit connection to the explosion-proof enclosure in accordance with NFPA 70.

The operating current of explosion-proof devices (bells, strobes, speakers) may be significantly higher than that for standard devices. The design shall specify the basis of component selections and incorporate the necessary special provisions, including but not limited to additional power supplies, additional circuits, fewer devices on a circuit, larger conductor sizes, etc.

3.2.6 Initiating Devices

This shall include all devices that initiate an alarm by either manual or automatic means. The automatic devices are designed to respond to measurable quantities of heat, smoke, energy radiation, or other detectable byproducts of fire.

Unless otherwise prohibited by existing system limitations or specified in the design SOW, initiating devices shall be made individually addressable by using addressable devices or by connecting the device to addressable modules. Initiating device circuits and power supplies shall have sufficient capacity to operate all devices connected, plus 25 percent minimum spare capacity per circuit.

3.2.6.1 Manual Pull Stations

Place and install manual pull stations in accordance with NFPA and ADA requirements. Locate additional manual pull stations at the exits of kitchens, electronic equipment areas, or other locations as required by the KSC AHJ.

Manual pull stations using spring-loaded contacts are not permitted at KSC. Non-addressable pull stations are generally made addressable by installing an addressable module with the pull station in an extended depth back-box.

3.2.6.2 Heat Detectors

Heat detectors shall not be installed in areas protected by sprinkler systems unless specifically required by code (e.g. elevator shafts and machine rooms).

Locate and space heat detectors in accordance with NFPA 72 requirements. Design documents shall indicate spacing reductions due to ceiling heights or the use of fixed temperature detectors.

Electronic and addressable heat detectors shall only be used in air conditioned spaces. Design documents shall indicate restrictions in locating these detectors near fluorescent lighting fixtures or other equipment that may interfere with the operation of the detectors. Non-addressable type heat detectors are generally made addressable by installing an addressable module in an extended depth back-box with the detector.

3.2.6.2.1 Line-Type Fixed Temperature Heat Detector

The designer shall consult with the KSC AHJ for the requirement of line-type heat detection cable for the protection of interior cable trays. Cable specified shall operate on a fixed temperature principle only.

3.2.6.2.2 Rate Compensation Heat Detectors

Rate compensation heat detectors shall be of a hermetically sealed and automatically resetting type that will operate when the ambient air temperature reaches the detector setting regardless of the rate-of-temperature rise. This type of detector is used to protect certain types of hazardous locations in accordance with NFPA 72.

3.2.6.2.3 Duct Smoke Detectors and Shutdown Relays

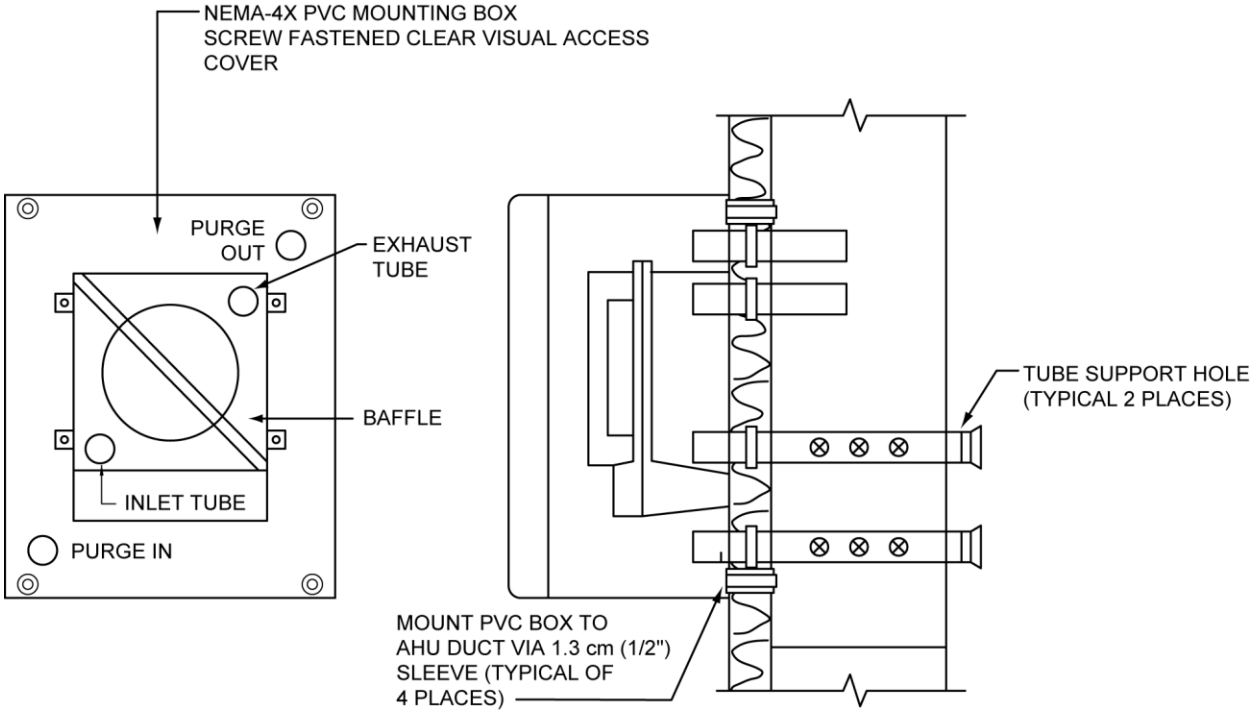
Duct smoke detectors shall be a photoelectric type listed by UL Fire Protection Equipment Directory (FPED) or FM Approval Guide and installed in accordance with NFPA 90A. Duct smoke detectors shall be an addressable type connected to an addressable FACP with the ability to perform sensitivity testing in accordance with NFPA 72.

Where duct smoke detectors are installed outdoors, in unconditioned mechanical or electrical rooms, or in areas with high ambient temperatures and humidity, the detector housing shall be installed in an additional polyvinylchloride enclosure with an additional set of supply and exhaust sampling tubes to prevent condensation from forming within the detector housing (see Figure 1).

AHU shutdown relays shall be mounted within 0.92 m (3 ft) of the AHU's starter (or motor control center), but shall not be grouped with other fire alarm system electronic modules, in order to maintain isolation from the AHU's control power source. In general, normally closed, held-open relay contacts shall be wired in series to the starter control coil. Drawings shall depict necessary detail to ensure correct connections. Fire system designers shall coordinate with

electrical power designers to ensure such connection provisions are incorporated into motor control centers, combination starters, etc.

A separate remote test/light assembly shall be installed for each duct smoke detector. Where multiple duct smoke detectors are installed, the remote test switches shall be grouped together at a common location.



ELEVATION
NO SCALE

SECTION
NO SCALE

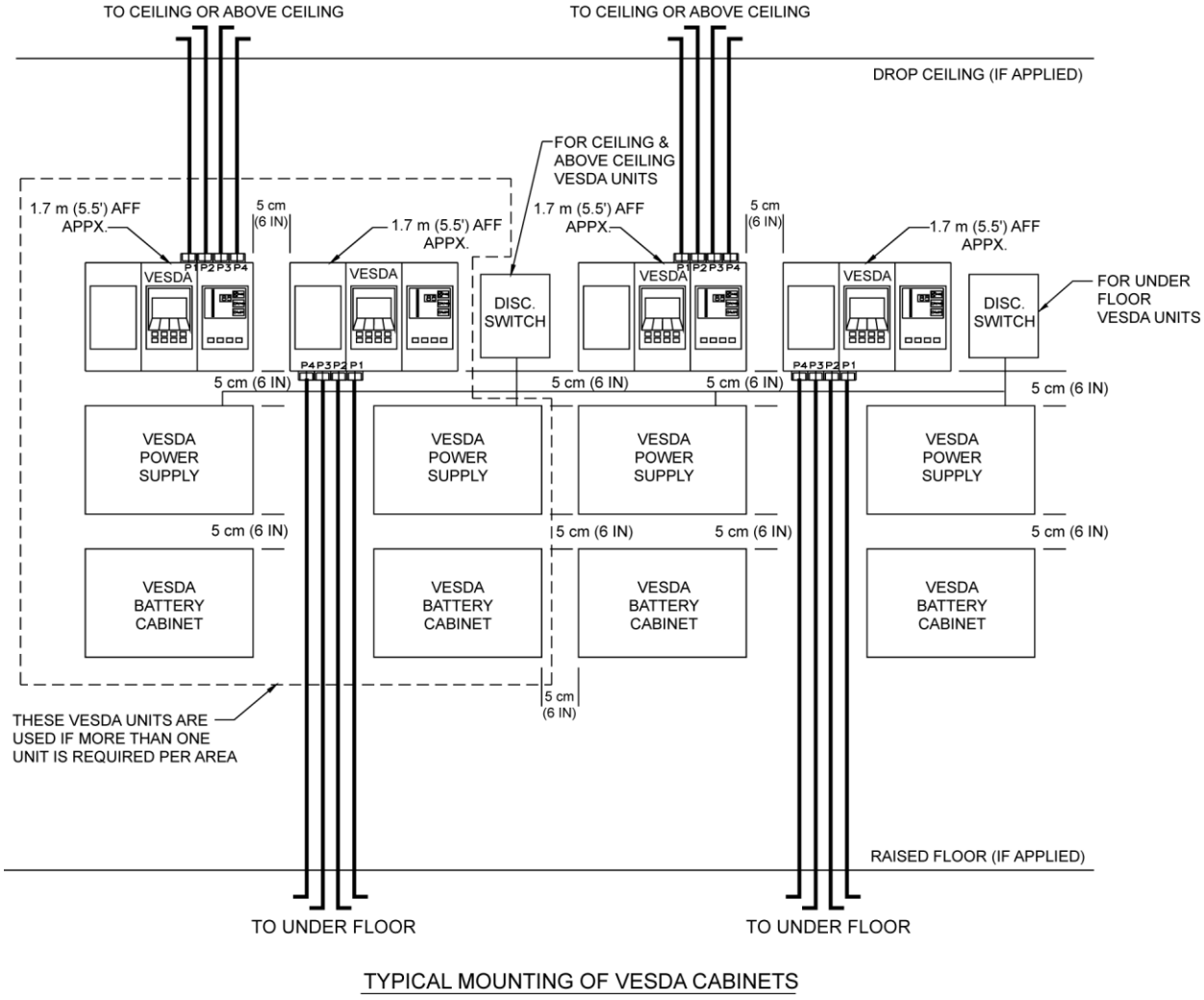
NOTES:

1. ALL MANUFACTURERS INSTALLATION RECOMMENDATION PROCEDURES AND TEST METHODS SHALL BE OBSERVED UNLESS OTHERWISE STATED. REFERENCE MANUFACTURERS INSTALLATION INSTRUCTIONS
2. ALL DUCT WORK PENETRATIONS SHALL BE AIR TIGHT AND WATER TIGHT.
3. A DIFFERENTIAL PRESSURE GAUGE SHALL BE USED TO ADJUST THE SAMPLING AND REFERENCE TUBES IN ORDER TO OBTAIN MAXIMUM PRESSURE DIFFERENTIAL.
4. DUCT WORK HOLE PENETRATIONS SHALL BE PER MFG SPECIFICATIONS.
5. 41 cm x 41 cm (16"x16") WATERTIGHT, AIRTIGHT ACCESS DOOR, MATERIAL TO MATCH DUCT MATERIAL, SHALL BE PROVIDED TO BE USED FOR CHECKING AND ADJUSTING AIR SAMPLING TUBES. IT SHALL NOT WEAKEN DUCTWORK.
6. PVC MOUNTING BOX SHALL NOT BE ATTACHED DIRECTLY TO DUCTWORK.

Figure 1. Outdoor AHU Duct Detector Housing

3.2.6.3 Air Sampling Detection Systems

An approved, high-sensitivity Air Sampling Detection System, such as VESDA or equivalent, shall be installed to provide early detection of smoke in areas where mission-critical and essential electronic equipment is used, where flight hardware is processed, or as designated by the KSC AHJ. This type of smoke detection system shall be installed under raised floors and at the ceiling level. Unique applications, such as clean rooms, may require protection directly above the return air intakes of the computer room air conditioning units and above the false ceiling in locations where combustible materials are present. The air sampling detection systems can be used in conjunction with pre-action sprinkler systems, wet pipe sprinkler systems, special suppression systems, or as a stand-alone alarm and detection system. See Figure 2 for typical mounting of VESDA cabinets.



TYPICAL MOUNTING OF VESDA CABINETS

Figure 2. VESDA Cabinet Mounting Example

Air sampling detection system components and system integration shall meet the material and installation requirements of the KSC Master SPECSINTACT section titled FIRE DETECTION AND ALARM INTERFACES.

The following alarm conditions for each air sampling detection system shall be separately connected to the facility FACP as applicable and annunciate as follows (VESDA signal names in parentheses):

a. "Alarm Level 1 (Alert)" – Supervisory Alarm

b. "Alarm Level 2 (Action)" – Supervisory Alarm

c. "Alarm Level 3 (Fire 1)" – Silent Alarm

d. "Alarm Level 4 (Fire 2)" – Alarm. Level 4 (Fire 2) will report as a silent alarm if the area is protected with a suppression system

e. Summary trouble alarms indicating any trouble conditions such as low airflow, high airflow, and malfunctioning circuit board

f. Air sampling detection system has been bypassed for maintenance

3.2.6.4 Flame Detectors

Flame detectors shall be installed in high-bay areas where the ceiling height is more than 9 m (30 ft) and where flight vehicles or payloads are processed. Detector type(s) (ultraviolet [UV], infrared [IR], UV/IR, Triple-IR) specified shall be based on optimizing detector capabilities with probable fire and false alarm source spectrums. The type of flame detector required will be identified in the first phase of design. Generally, Triple-IR detectors are preferred. Detectors shall be tested by UL, FM or other acceptable testing laboratory for the fuel detected (i.e. hydrazine, hydrogen, and hydrocarbon fuels).

Flame detectors shall be individually addressable for both alarm and trouble conditions. Detectors shall have their own self-test capability and the ability to remotely test the optical integrity of the detector from the FACP using addressable relay(s). Remote test detector groups shall generally be grouped by common fire area (platform levels, different rooms, etc.).

The design shall provide the necessary details associated with flame detector installation including but not limited to the following:

a. Mounting and other installation details, such as sealing for explosion-proof installations.

b. Aiming and detector field of views in both plan and elevation views to ensure full fire detection coverage. Obstructions, range of the detector for the fire fuel source, and sensitivity settings shall be considered in detector placement.

c. Wiring details showing typical connections for alarm, trouble, and remote test functions; location and installation of addressable modules required for flame detector installations; and details showing the grouping of detectors for remote test purposes.

d. Direct current (DC) power circuit wiring design and additional power supplies, including remote power supplies, to power the detectors.

3.2.6.5 Suppression System Devices

Suppression system activation alarm and supervisory switches shall be connected to the FACP and shall be individually addressable, as applicable. Such switches are generally made addressable by installing a Class A wired zone addressable module nearby in a separate back-box or grouped together in a cabinet.

The fire alarm designer shall coordinate with the fire suppression designer regarding the locations and types of alarm, supervisory, and tamper switches.

Where FACPs are used for suppression system release, they shall be UL-listed or FM-approved for the purpose. Each releasing appliance circuit shall include a supervised key switch that shall disconnect the circuit conductors from the solenoid releasing valve. When operated, in addition to any trouble signal, the point associated with any key switch shall be programmed to generate a supervisory signal at the FACP and CRMS. These disconnect switches shall be located on building walls or structures adjacent to the solenoid valve. Solenoid valves used for releasing service shall be UL-listed or FM-approved for use both with the releasing circuit hardware and the suppression system mechanical release valve.

3.2.7 Elevator Recall/ Shutdown

Elevator recall systems shall be designed and installed in accordance with ANSI A17.1 and NFPA 72. The smoke detectors and heat detectors located in elevator lobbies, elevator hoist-ways, and elevator machine rooms used to initiate a firefighters' service recall or shunt trip power shall be connected to the building FACP or to a dedicated FACP, which shall be designated as "Elevator Recall Control and Supervisory Panel." Unless otherwise required by the KSC AHJ, only elevator lobby, elevator hoist-way, and elevator machine room smoke detectors shall be used to recall elevators for firefighters' service. All smoke detectors for elevator recall shall be the photoelectric type. Heat and smoke detectors will not be installed in the elevator pit unless required by the KSC AHJ.

Elevator interface relays shall be mounted within 0.92 m (3 ft) of the elevator controller or power disconnection point as applicable. Relays or addressable relays shall not be grouped with other fire alarm system electronic modules in order to maintain isolation from the elevator's control power source. Generally, normally open, held-closed relay contacts shall be wired to the elevator control points. Drawings shall depict necessary detail to ensure correct connections. Fire alarm system designers shall coordinate with electrical power designers to ensure such connection provisions are incorporated into elevator power and control components.

3.2.7.1 Emergency Disconnect Means

A manually activated emergency disconnect means shall be provided in accordance with NFPA 75 and NFPA 70, Article 645, to disconnect power to all essential electronic equipment. There

shall also be a similar means to disconnect the power to all dedicated HVAC systems serving the room and cause all required fire/smoke dampers to close. The control for these disconnecting means shall be grouped and identified and shall be readily accessible at the principal exit doors. A single means to control both the electronic equipment and HVAC systems shall be permitted unless otherwise directed by the LDE. Where a push button is used as a means to disconnect power, pushing the button inwards shall disconnect the power. Manually activated mushroom push-button stations shall be installed within 457 mm (18 in) of the latch side of the exit doors and approximately 1219 mm (48 in) above the finished floor measured from the finished floor to the top of the plastic protective enclosure. Where both a manual pull station and mushroom push-button station are required, mounting locations shall be approved by the KSC AHJ. The protective enclosure shall prevent accidental activation and be capable of accepting a metal wire with lead seal or a plastic integrity seal.

Requirements for automatically activated shunt-trip circuits in areas other than computer and essential electronic equipment rooms shall be specified by the KSC AHJ. Automatically activated shunt-trip circuits shall only be installed in locations approved by the essential electronic equipment owner and the KSC AHJ. Automatically activated shunt-trip circuits shall not be installed where the KSC AHJ agrees that activation of a shunt-trip system during hazardous operations would introduce greater hazards. In this case, a means for bypassing the shunt-trip system shall be provided.

Activation of AC power shunt trip systems for essential electronic equipment rooms shall annunciate a supervisory signal at the FACP and report supervisory to the CRMS. When provisions to bypass the shunt-trip system are approved by the KSC AHJ, this supervisory condition shall also be separately reported. Relays used to generate these signals shall be dedicated for connection to fire alarm equipment and segregated from other shunt-trip wiring components.

3.2.8 Notification Appliances

The standard evacuation signal at KSC is a temporal three-bell tone. Bells or speakers shall produce at least 87 decibels at 3 m (10 ft); placement shall conform to NFPA 72 and ensure required audibility performance is achieved during testing. Audible notification appliance circuits and power supplies shall have sufficient capacity to operate all devices connected, plus 25 percent minimum spare capacity per circuit.

3.2.8.1 Voice Evacuation Systems

Voice evacuation systems shall be installed in all facilities required by NFPA 101, NASA-STD-8719.11, Uniform Federal Accessibility Standards, ADA, or as required by the KSC AHJ. Speaker placement shall conform to NFPA 72 and ensure required audibility and intelligibility performance is achieved during testing. Wattage tap for all speakers installed shall be indicated on the drawings. Audible notification appliance circuits, power supplies, and amplifiers shall have sufficient capacity to operate all devices connected, plus 25 percent minimum spare capacity per circuit.

Provide voice announcement evacuation message system if required by the KSC AHJ. Generally, multilingual voice announcements shall be provided in public visitor areas. Intelligibility of voice announcements shall have a common intelligibility score (CIS) of 0.70 for all areas. The tone preceding and following the voice evacuation message shall meet the "Public Mode Audible Requirements" of NFPA 72. Multilingual messages shall be in the English, Spanish, French, and Japanese languages or as specified by the KSC AHJ. For non-public facilities, English voice messages shall include the facility number, facility name, and reference to evacuation to marshalling areas.

3.2.9 Visual Evacuation Appliances

Strobe brightness (15, 30, 75, or 110 candela) shall be indicated for each unit shown on the drawings. Strobe placement shall be in accordance with NFPA 72 and ADA requirements. Strobes shall also be installed in high-noise areas and equipment rooms. All strobes shall be synchronized and shall remain flashing until the FACP is silenced. Visual notification appliance circuits and power supplies shall have sufficient capacity to operate all devices connected, plus 25-percent minimum spare capacity per circuit.

3.2.10 Signaling Line Circuits

This shall include all circuits where simultaneous or sequential transmissions, or both, are transmitted between circuit interfaces, control devices, addressable modules, and FACPs. Design shall specify Style 6, or if available, Style 7, circuit performance and include DC power circuits for addressable modules as required.

3.2.11 Networked Fire Alarm Control Panels

Network interface modules shall individually communicate with other FACPs using multiplexed communication techniques. Communication circuit wiring connections shall be suitable for supervised Style 7 operation. Module power shall be derived from the communication circuit or 24 VDC supervised power supply. Invalid configuration or loss of communication, component failure, or power failure shall initiate a trouble signal at the CRMS.FACP that reports to the CRMS. Designs shall specify necessary hardware requirements including communications media, fiber, or copper cabling.

3.2.12 CRMS Reporting

3.2.12.1 CRMS Reporting Signals

The CRMS is the primary means of fire alarm reporting at KSC. This includes the CRMS head-end reporting equipment used for fire department dispatch located at the Launch Control Center (LCC) and Kennedy Data Center (KDC), facilities with their own radio transceivers reporting to the head-end equipment, and facilities reporting to the head-end equipment through summary panels that have redundant radio transceivers and data taps. Summary panels with redundant radio transceivers and data taps are located at the Communications Distribution and Switching Center (CD&SC), Vehicle Assembly Building (VAB) Repeater Facility, and the VAB. New or

significantly modified facilities shall have their own radio transceiver(s) located at the facility for reporting the minimum required signals to the CRMS. Multiple radio transceivers may be required for a single facility to report all of the minimum required signals. The designer shall consult with the KSC AHJ in regard to the requirement for facilities to also report signals through a summary panel that has redundant radio transceivers and data tap where more detailed reporting of signals may be required utilizing the data taps. The following devices and conditions shall be transmitted to the CRMS:

a. Summary fire alarm signal by facility number. Summary fire alarm signal should not be sent to the CRMS if other more specific alarm data is being concurrently sent (e.g. suppression system discharge signals listed below). An exception occurs where local facility FACPs are connected to Summary Reporting Panels located in the CD&SC (M6-0138) and VABR (K6-1193) to report through the radio transceivers at those Summary Reporting Panels for redundancy to data reported to CRMS through the local facility FACP radio transceiver. The data reporting through the Summary Reporting Panels shall be filtered as appropriate at the CRMS head-end to not duplicate summary alarm signals by facility number.

b. Automatic sprinkler systems pressure or flow switches. Each flow or pressure switch shall be individually reported to the facility FACP and then generally grouped into a single summary CRMS water flow alarm signal by facility number. Consult with the KSC AHJ on additional requirements for multi-story or large facilities.

c. Special suppression systems pressure or flow switches (deluge, pre-action sprinkler, wet/dry chemical, etc.). Each flow or pressure switch shall be individually reported to the facility FACP and then generally grouped into a single summary CRMS alarm signal by facility number and suppression system type. Consult with the KSC AHJ on additional requirements for facilities with multiple special suppression systems of the same type.

d. Summary supervisory and trouble conditions for the facility FACP. Subsequent unacknowledged supervisory and trouble signals shall resend a signal to the CRMS.

e. Supervisory alarm conditions for the maintenance bypass and the operation of emergency disconnect means (shunt-trip).

f. Additional supervisory alarm conditions for the suppression system isolation valves, low air pressure switches, tamper switches, or other supervisory devices as specified by the KSC AHJ.

g. CRMS reporting signals for fire pumps shall be in accordance with NFPA 20.

h. The following alarm conditions shall be transmitted to the CRMS for air sampling detection systems. For each air sampling detection system, the following signals shall be individually addressable at the local FACP. Consult with the KSC AHJ to determine if consolidated CRMS reporting requirements are acceptable:

   (1) “Alarm Level 1 (Alert)” – Supervisory Alarm. Signals for multiple systems may be consolidated if in the same facility.

(2) "Alarm Level 2 (Action)" – Supervisory Alarm. Signals may be consolidated with Alarm Level 1 signals to provide a common supervisory signal when system is in Alarm 1 or Alarm 2 condition.

(3) "Alarm Level 3 (Fire 1)" – Silent Alarm. Signals for multiple systems may be consolidated if in the same facility.

(4) "Alarm Level 4 (Fire 2)" – Alarm Signals may be consolidated with summary alarm signal for the facility.

(5) Summary trouble alarms indicating any trouble conditions such as low air flow, high air flow, and malfunctioning circuit board. Signals may be grouped with summary trouble signal for the facility.

(6) Air sampling detection system has been bypassed for maintenance. Signals may be grouped with summary supervisory signal for the facility.

i. Any addressable devices identified by the KSC AHJ during design consultation.

Reporting requirements shall be included in the sequences of operations matrix which fully defines system reporting requirements operation by cross-referencing how each FACP alarm input (row) activates the required CRMS signal (column).

3.2.12.1.1 Zoned Radio Transceiver

Design shall specify the AES or Keltron radio transceiver currently in use at KSC. Each radio transceiver has eight zones that are to be wired to the FACP relay contacts generally programmed for the following functions.

a. Transceiver Zone 1: Fire Alarm – FACP controlled relay contacts programmed to close on any fire alarm signal except special alarm conditions on any other relays, typically relays connected to transceivers zones 4 through 8 (transmit only 1 fire alarm signal to the CRMS).

b. Transceiver Zone 2: Summary Supervisory Signal – FACP controlled relay contacts are to close on any NFPA defined supervisory signal, and are to be programmed to resend a supervisory signal to the CRMS (open, delay, and then re-close relay contacts) for each subsequent unacknowledged FACP supervisory condition.

c. Transceiver Zone 3: Summary Trouble Signal – FACP controlled relay contacts are to be closed on any NFPA defined supervisory signal, and are to be programmed to resend a trouble signal to the CRMS (open, delay, and then re-close relay contacts) for each subsequent unacknowledged FACP trouble condition.

d. Transceiver Zone 4: Summary Water Flow Signal – Activated by sprinkler system flow switches. The FACP relay to Transceiver Zone 1 is not activated if this relay is activated.

e. Transceiver Zones 5 through 8 and/or use of additional radio transceivers: Designer to consult with the KSC AHJ for function assignments and need for additional radios to provide more than 8 CRMS reporting signals. The FACP relay to Transceiver Zone 1

is not activated if any of these relays are activated for fire alarm reporting purposes. Possible assigned functions can include:

(1) Fire pump running.

(2) Fire pump trouble or AC phase reversal.

(3) Fire pump not in auto or loss of AC voltage.

(4) Wet/Dry/Clean agent suppression system release.

(5) Deluge system discharge pending and water discharge.

(6) VESDA alarm, supervisory, and trouble signals.

(7) Low supervisory air pressure signal.

Design documents shall consider the following radio system installation issues:

a. Method of installation of FACP relays that connect to the radio transceiver shall be specified, either relay card within the FACP wired via the FACP wiring terminal cabinet (if installed) or a separate zone addressable module cabinet. The design shall indicate or specify the use of shielded cable and Class B wiring with end-of-line resistors to connect the FACP relay to each radio transceiver zone.

b. Connection of the radio transceivers trouble relay contact to a FACP zone for local supervisory annunciation (UL listing requirement). When connection of this contact to the FACP is not practical, then a separate audible and visual annunciation shall be provided at the radio location.

c. Radio transceiver location: installation on exterior wall or use of external antenna may be required.

d. Separate power provisions such that the radio transceiver does not power-down when the FACP is turned off or vice versa. Typical installation includes a safety-switch and equipment enclosures as follows:

(1) Fused disconnect switch with the line-side source tapped to the FACP's AC power ahead of the radio transceiver's disconnect switch.

(2) Enclosure with an in-line surge suppressor, NEMA 5-20R receptacle, and plug-in power transformer:

(3) Enclosure with radio equipment with backup battery and supplied by low voltage AC power.

e. Surge suppression protection for radio transceivers shall be the same as for FACPs. Exterior-mounted antenna placement shall minimize potential for direct lightning strike and shall include a surge suppressor with direct earth ground connection.

3.2.12.2 Connecting to an Existing Fire Alarm Control Panel Network

The designer shall consult with KSC AHJ regarding the connection of a new FACP to an existing network system. The design shall incorporate the following elements:

a. Specify the network communications media (fiber or copper cabling), hardware modifications at the new and existing panels, new cable routing, and connection points.

b. Method of providing hardwired zone inputs in addition to serial data input in order to meet UL requirements.

c. Programming requirements at the existing NDU on the network. Each new or revised CRMS reporting signal sent using zone and serial data communications methods (via the NDU) shall be included in the programming matrix for the fire alarm control panel.

d. Reacceptance testing of other fire alarm systems using reporting software modified by the installation.

3.2.13 Fire Alarm System Specifications

Fire alarm system components and system integration shall meet the material and installation requirements of the KSC Master SPECSINTACT sections titled FIRE DETECTION AND ALARM (FACPs and components) and FIRE DETECTION AND ALARM INTERFACES (air sampling smoke detection systems). Any editing of the specification, other than deleting non-applicable selections, paragraphs, and sections, that changes these requirements shall be approved by the KSC AHJ.

3.2.14 Fire Alarm System Acceptance Testing

Fire alarm system testing shall meet the requirements of the KSC SPECSINTACT Master Section entitled FIRE DETECTION AND ALARM and NFPA 72. Air sampling smoke detection system testing shall meet the requirements of the KSC SPECSINTACT Master Section titled FIRE DETECTION AND ALARM INTERFACES. Where fire suppression systems are installed, fire alarm system testing shall be coordinated with the testing of the fire suppression systems to ensure a proper interface between these systems.

The designer shall ensure that the scope of fire alarm system acceptance testing requirements is incorporated in the construction contract documents. Special consideration shall be given to the modification of existing systems to ensure that the extent of reacceptance testing required on portions of the system not modified is adequately incorporated in the construction documents. Include portions of existing system drawings as necessary to indicate the scope of the existing system requiring reacceptance testing.

3.3 Water-Based Suppression Systems

3.3.1 General Requirements

All water-based suppression systems shall be designed and installed in accordance with NFPA codes, except as specified by this document. The designer shall consult with the KSC AHJ on the specific types of systems applicable for the design. Suppression system electrical control and detection design shall be in accordance with the applicable subsections of this standard.

3.3.1.1 Requirements for Automatic Sprinkler Systems

Automatic sprinkler protection shall be provided for all new building/facility construction. Sprinkler protection shall be provided in renovation projects exceeding 232 m^2 (2500 ft^2) or involving over 50 percent of the building. Small building construction housing only noncombustible materials may not require automatic sprinkler protection if approved by the KSC AHJ.

Where NFPA, other codes, or the KSC AHJ, require installation of additional flow switches for a wet pipe system fed from a single riser (e.g., a paint booth in a hangar, an elevator hoist-way, etc.), a separate inspector's test connection will be required at the hydraulically most remote location for each of these system sections or a location approved by the KSC AHJ to verify water flow alarms for these specific areas. Provide a GN2 inerting port and connection assembly in accordance with 81K07129. Provide backflow prevention assemblies for fire suppression water supply in accordance with 98K01375.

3.3.1.2 Water Supply Demands

The water supply demand requirements in NFPA 13 are minimum design requirements. For all KSC facilities, the occupancy classification for the design density of a sprinkler system shall be increased by one occupancy classification for light and ordinary hazard group 1 systems, as defined by NFPA 13 (e.g. light hazard becomes ordinary hazard group 1). The KSC AHJ shall determine the need for increased water supply requirements to provide for occupancy flexibility.

3.3.1.3 Drain Systems

In areas with essential electronics and other areas protected by automatic sprinkler systems that are subject to excessive water damage, floor drain systems with sufficient capacity shall be provided to handle anticipated accumulation of sprinkler system and hose stream discharge. For existing facilities, consult with the LDE and KSC AHJ in regard to modifications of floor drain systems.

3.3.1.4 Fire Department Connections

At least one Fire Department Connection (FDC) shall be provided for each facility with an automatic sprinkler system and/or standpipe system. The FDC shall serve the sprinkler system and interior standpipe system in buildings equipped with both. All standpipes and sprinkler systems shall be interconnected so that each FDC serves all fire protection systems simultaneously, unless otherwise approved by the KSC AHJ.

3.3.1.5 Control Valves

All control valves installed in these systems shall be the type with a visually indicating outside stem and yoke (OS&Y) and shall meet NFPA codes. Valve tamper switches shall be installed on all system isolation valves, unless otherwise directed by the LDE after consultation with the KSC

AHJ. Each valve tamper switch shall be monitored directly from the facility FACP as a separate supervisory signal.

A system control valve is required at the base of each riser for wet pipe, dry pipe, pre-action, and deluge/water spray fire suppression systems.

Other valves capable of isolating all, or portions of, a system, such as post indicator valves, backflow preventers, fire pump test header, and isolation valves, shall be locked with non-frangible locks and/or provided with tamper switches as directed by the LDE after consultation with the KSC AHJ. Locks shall be provided by the Government. All systems subject to freezing shall have the capability of being isolated and drained for freeze protection or be designed to mitigate problems associated with freezing.

3.3.1.6 Hydraulic Calculations, Schematics, and Fabrication Drawings

The design agency shall ensure that automatic sprinkler and standpipe system fabrication and assembly drawings be submitted for approval by the KSC AHJ or designated representative. Fabrication drawings shall meet all requirements in NFPA 13 stipulated for "working plans," to include a building cross section. The automatic sprinkler system shall be hydraulically designed to meet density and area of coverage requirements using a UL-listed or FM-approved hydraulic design program. Systems shall be designed in accordance with NFPA 13.

3.3.1.7 Coating

All automatic sprinkler and standpipe system piping, valves, and appurtenances shall be coated red or other color as dictated by the KSC AHJ.

3.3.1.8 Test Procedures

The design agency shall ensure that a test procedure and test record forms for conducting and recording complete tests be used to perform the final acceptance tests on automatic sprinkler and standpipe systems installed in accordance with the hydraulic calculations. The design agency shall ensure final inspection and testing forms that meet the requirements of NFPA 13 are provided upon completion of the final acceptance testing.

3.3.1.9 Testing and Acceptance Criteria

The design agency shall ensure aboveground and underground systems be tested in accordance with NFPA 13 and 24. The design agency shall ensure preapproved automatic sprinkler system test procedures are used to perform the acceptance testing. Final inspection and testing forms that meet the requirements of NFPA 13 shall be provided upon completion of the final acceptance testing. Systems in launch critical or mission essential facilities shall be tested with compressed air prior to testing with water, except where identified otherwise in consultation with the KSC AHJ.

3.3.2 Wet Pipe Sprinkler Systems

Wet pipe sprinkler systems shall have a riser comprised of a swing check valve with all associated trim, including a 51 mm (2 in) main drain connection port and gauges indicating supply and system side pressures at the swing check valve above the OS&Y supply control valve. A vane-type water flow switch shall be installed on the riser piping above the swing check valve.

When wet pipe sprinkler systems are used in conjunction with air sampling detection systems for the protection of essential electronic equipment, the air sampling systems shall be monitored by the facility FACP instead of an auxiliary control panel.

3.3.3 Dry Pipe Sprinkler Systems

Dry pipe sprinkler systems are permitted only where climate control is not adequate to prevent freezing of water in all or part of a system. Dry pipe valves shall be UL-listed or FM-approved with standard trim and alarm devices necessary to provide water flow alarm and low or high air pressure supervisory signals. A 51 mm (2 in) main drain connection port shall be provided on the dry pipe valve. A water flow alarm line with an alarm test valve and a supervised (via lock or built-in tamper) alarm bypass valve shall be provided. Low air pressure supervisory signal is tested via the inspector's test valve. Pressure gauges on the supply side of the dry pipe valve, system side of the dry pipe valve (indicating air pressure), and the air compressor shall be provided. Optional trim includes a low air pressure supervisory test valve assembly at riser and a quick opening device (air accelerator) at riser, which expels the compressed air from the system faster after a sufficiently rapid drop in air pressure occurs downstream.

Modern, externally resettable dry pipe valves that do not require priming water are preferred, but not required. If the dry pipe valve chosen requires priming water, verify that appropriate trim, if available from manufacturer, is included to add that priming water to the valve.

3.3.3.1 Compressed Air Supply

A riser-mounted compressed air system or independent air compressor mounted on the floor with pressure gauges, pressure switches, air maintenance devices, desiccant air dryer, and appurtenances shall be provided. The compressed air system shall maintain the manufacturer's specified air pressure in the dry pipe system piping and comply with the fill-time requirements of NFPA 13. The pressure switch for controlling the compressor shall be field adjustable for both the "on" and "off" pressure settings. An air maintenance device with a by-pass line for fast filling the system shall be provided.

3.3.4 Pre-action Sprinkler System

3.3.4.1 General

Pre-action systems are not permitted for installation at KSC except where the KSC AHJ approves their use. The system requirement for single or double-interlock configuration will be as directed by the LDE after consultation with the KSC AHJ.

Both types of pre-action systems shall have:

a. A water flow alarm device (pressure switch) on the alarm line.

b. An alarm test valve on alarm line.

c. A locked or supervised alarm bypass valve on alarm line.

d. A drip check valve on alarm line to verify no pre-action valve seat leakage, and a drip cup for drip check valve on the alarm line flowing to the main drain line.

e. A manual release valve on the diaphragm chamber priming line.

f. A solenoid valve on the diaphragm chamber priming line and drip cups on the priming line after solenoid and after the manual release valve flowing to the main drain line.

g. An air maintenance device (air compressor) mounted on the floor or riser to supply the system with supervisory air pressure and a low-air-pressure supervisory switch mounted between the line supplying supervisory air pressure to the system and the air maintenance device.

h. Double-interlock pre-action systems shall have an air actuator between the air side of the system and the diaphragm chamber priming line positioned after the solenoid on the diaphragm chamber priming line. The air actuator shall not open unless system pressure drops (i.e. a head opens).

The design shall be in strict accordance with the required and advisory provisions of NFPA 13, 24, and 75, except as modified herein.

3.3.4.2 Automatic Operation

Pre-action sprinkler systems shall utilize an air sampling detection system for automatic actuation in accordance with this Standard. Requirements below refer to a pre-action control panel (PCP). The primary facility FACP may serve as the PCP for pre-action releasing depending on the configuration determined in consultation with the KSC AHJ, as opposed to also having a separate PCP.

The following “Sequence of Operations” shall apply to all automatically operated single-interlock pre-action sprinkler systems:

a. The following alarm conditions shall be transmitted to the PCP from the air sampling detection systems:

   (1) "Alarm Level 1 (Alert)" – Supervisory alarm.

   (2) "Alarm Level 2 (Action)" – Supervisory alarm.

   (3) "Alarm Level 3 (Fire 1)" – Silent alarm.

   (4) "Alarm Level 4 (Fire 2)" – Silent alarm.

   (5) Summary trouble alarms indicating any trouble conditions such as low air flow, high air flow, malfunctioning circuit board, etc.

   (6) Supervisory alarm when air sampling detection system has been bypassed for maintenance.

b. The PCP shall operate the strobes within the restricted area upon receipt of "Alarm Level 3."

c. The PCP shall operate the pre-action system solenoid valve upon receipt of "Alarm Level 4." This shall cause the pre-action valve to trip in the single-interlock configuration. Water will enter the system piping, but shall not discharge until any heads are activated.

d. The pressure switch shall activate and transmit an alarm to the CRMS through the facility FACP.

e. The facility notification appliances shall be activated by the facility FACP, resulting in evacuation of the facility.

f. The PCP shall interrupt power to all the fire smoke dampers that are associated with the essential electronic area upon receipt of "Alarm Level 4."

The following "Sequence of Operations" shall apply to all automatically operated double-interlock pre-action sprinkler systems:

a. The following alarm conditions shall be transmitted to the PCP from the air sampling detection systems:

   (1) "Alarm Level 1 (Alert)" – Supervisory alarm.

   (2) "Alarm Level 2 (Action)" – Supervisory alarm.

   (3) "Alarm Level 3 (Fire 1)" – Silent alarm.

   (4) "Alarm Level 4 (Fire 2)" – Silent alarm.

   (5) Summary trouble alarms indicating any trouble conditions such as low air flow, high air flow, malfunctioning circuit board, etc.

   (6) Supervisory alarm when air sampling detection system has been bypassed for maintenance.

b. The PCP shall operate the strobes within the restricted area upon receipt of "Alarm Level 3."

c. The PCP shall operate the pre-action system solenoid valve upon receipt of "Alarm Level 4." In this double-interlock configuration, water shall move past the solenoid in pre-action valve diaphragm chamber priming line, but shall be stopped be the air actuator.

d. When a sprinkler head opens in the system, air pressure will drop and the air actuator shall open, allowing water to drain from the diaphragm chamber priming line. This shall cause the pre-action valve to trip.

e. The pressure switch shall activate and transmit an alarm to the CRMS through the facility FACP. Water will enter system piping and discharge from the activated head(s).

f. The facility notification appliances shall be activated by the facility FACP, resulting in evacuation of the facility.

g. The PCP shall interrupt power to all the fire smoke dampers that are associated with the essential electronic area upon receipt of "Alarm Level 4."

3.3.4.3 Manual Mechanical Activation Stations

In both single and double-interlock configurations, the activation of the manual activation station shall result in the following actions:

a. The pre-action control valve shall open and pre-charge the sprinkler system.

b. The pressure switch shall activate and transmit an alarm to the CRMS through the facility FACP.

c. The facility notification appliances shall be activated by the facility FACP resulting in evacuation of the facility.

Manual activation shall leave a tell-tale sign of activation (broken seal) and be labeled to indicate open and closed. A manufacturer-approved manual activation valve shall be installed at the riser for manual activation of the pre-action system.

3.3.5 Deluge and Water Spray Systems

3.3.5.1 General

The general intent of deluge and water spray systems is to quickly extinguish a fire, yet limit the destruction of the facility and/or contents of the facility during a fire condition.

Design densities shall be as specified in NASA-STD-8719.11. The schematic drawings contained herein are representative of the requirements for these types of systems, however, modifications and enhancements to these requirements are acceptable on a case-by-case basis as approved by the KSC AHJ.

3.3.5.2 Testing

A functional test shall be required as a condition of acceptance for all deluge systems. In systems provided with a test branch, flow through the nozzles may not be required.

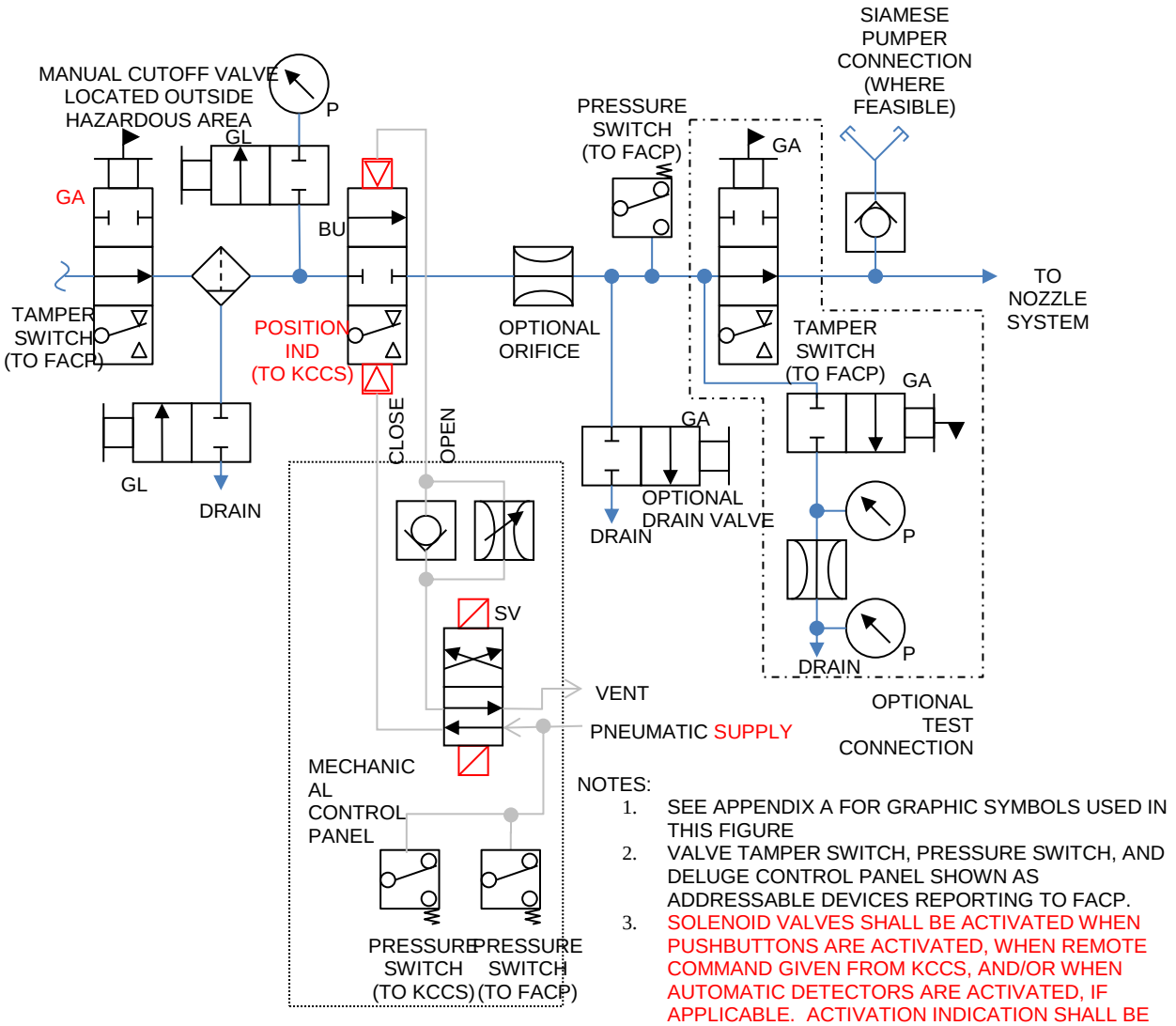
3.3.5.3 Types of Deluge Systems

One of three types of deluge systems shall be used in payload/flight hardware processing areas and flight crew egress areas. Type I systems should be used in areas where the consequences of inadvertent actuation are not great (e.g. propellant transfer areas). Type II systems should be used where payload or flight hardware is exposed in the protected area and flight hardware damage could occur due to inadvertent actuation. Type II systems should also be used where flight crew egress water spray is required. Standard deluge systems shall be used in locations where deluge systems are required, but payload/flight hardware is not processed or flight hardware cannot be damaged by inadvertent actuation. Selection of Type I and II systems shall be approved by the KSC AHJ prior to design. In areas where periodic flow testing of the deluge system cannot be accomplished through its nozzles due to facility operations, a test branch shall be provided that will properly model the flow characteristics of the system.

a. Type I Deluge Systems – Type I systems shall be configured in accordance with Figure 3 or Figure 4. Type I configurations shall have either one pneumatically actuated, normally closed butterfly valve or two butterfly valves in parallel. Parallel valves shall be used when programmatic requirements dictate the elimination of single failure points. Operating an “Activate Arm” and “Activate Open” push button or MPS shall cause the solenoid(s) to operate, opening the butterfly valve(s). Water shall enter system piping and discharge from open nozzles and/or heads.

   Solenoid valve(s) shall be housed in a weatherproof or explosion proof enclosure with nitrogen purge, if required, and located adjacent to, but not directly mounted on, the valve assembly. If the system is located in an area requiring explosion proof devices, the solenoid shall be installed in accordance with NFPA 70 requirements for explosion-proof devices. A strainer shall be installed on the system piping between the riser and open nozzles and/or heads to remove any obstructive particles. Type I systems shall have all major components electronically supervised for position indication by the

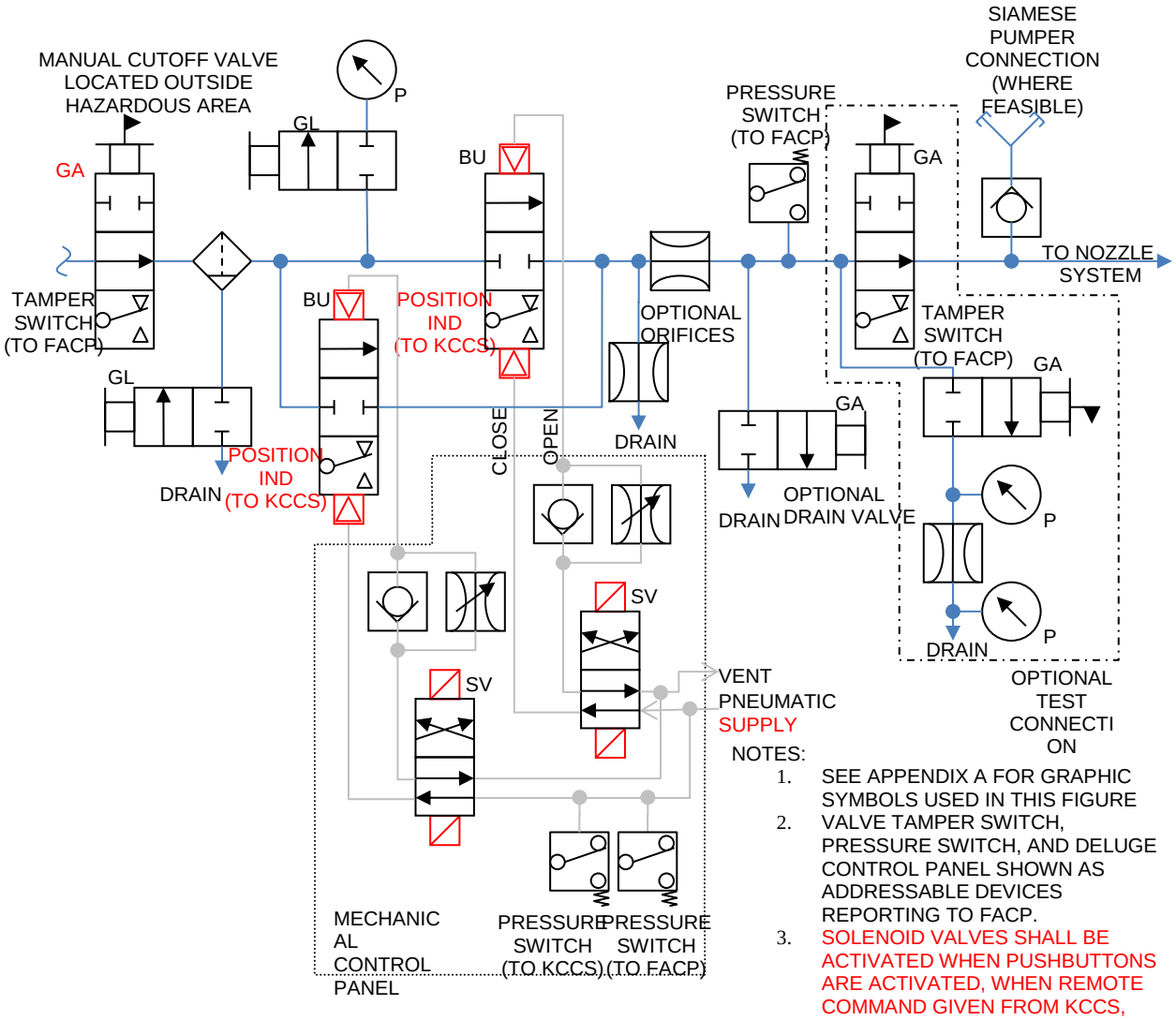
FACP, as specified in Figure 3 or Figure 4; the Kennedy Complex Control System (KCCS) may also monitor these indications. A water pressure switch shall be installed to indicate water flow and shall be monitored by the facility FACP; it may also be monitored by KCCS. Type I systems shall be automatically activated via detection when approved by the LDE after consultation with the KSC AHJ. A manual shutoff OS&Y control valve shall be installed outside the processing area (15 to 30 m [50 to 100 ft]) from the facility structure where practical and shall have a valve position indicator clearly showing open or closed position. The valve shall be positively identifiable as a deluge water system valve through the use of placards, signs, or other methods approved by the LDE after consultation with the KSC AHJ. The FACP shall monitor low air/nitrogen pressure and position indications on the butterfly valve(s); KCCS may also monitor these indications. KCCS shall be capable of remotely activating the Type I system through the FACP where required for hazardous operations and approved by the KSC AHJ.



NOTES:

1. SEE APPENDIX A FOR GRAPHIC SYMBOLS USED IN THIS FIGURE
2. VALVE TAMPER SWITCH, PRESSURE SWITCH, AND DELUGE CONTROL PANEL SHOWN AS ADDRESSABLE DEVICES REPORTING TO FACP.
3. SOLENOID VALVES SHALL BE ACTIVATED WHEN PUSHBUTTONS ARE ACTIVATED, WHEN REMOTE COMMAND GIVEN FROM KCCS, AND/OR WHEN AUTOMATIC DETECTORS ARE ACTIVATED, IF APPLICABLE. ACTIVATION INDICATION SHALL BE PROVIDED TO FACP.
4. MECHANICAL CONTROL PANEL SHALL BE PURGED IF REQUIRED.
5. SOLENOID VALVE SHALL BE MOUNTED SUCH THAT IT SHALL REMAIN CLOSED IN THE EVENT OF A LOSS OF POWER

Figure 3. Type I Deluge Water System (Single Actuation Valve)



NOTES:

1. SEE APPENDIX A FOR GRAPHIC SYMBOLS USED IN THIS FIGURE
2. VALVE TAMPER SWITCH, PRESSURE SWITCH, AND DELUGE CONTROL PANEL SHOWN AS ADDRESSABLE DEVICES REPORTING TO FACP.
3. SOLENOID VALVES SHALL BE ACTIVATED WHEN PUSHBUTTONS ARE ACTIVATED, WHEN REMOTE COMMAND GIVEN FROM KCCS, AND/OR WHEN AUTOMATIC DETECTORS ARE ACTIVATED, IF APPLICABLE. ACTIVATION INDICATION SHALL BE PROVIDED TO FACP.
4. MECHANICAL CONTROL PANEL SHALL BE PURGED IF REQUIRED.
5. SOLENOID VALVE SHALL BE MOUNTED SUCH THAT IT SHALL REMAIN CLOSED IN THE EVENT OF A LOSS OF POWER.

Figure 4. Type I Deluge Water System (Parallel Actuation Valves)

b. Type II Deluge Systems – Type II systems shall be configured in accordance with Figure 5.

Type II configurations shall have four pneumatically actuated, normally closed butterfly valves, configured in two parallel sets in series. The riser shall split into two branches downstream of the supply control valve, supplying each series of butterfly valves separately for system redundancy. The two parallel butterfly valves farthest downstream of supply shall open when an "Arm Open" push button or MPS is operated. No water shall move when the system is "Armed." Water hammer is prevented by opening this set farthest downstream of supply first. The two riser branches shall have a connection pipe between the two parallel sets of butterfly valves (i.e. "H" configuration) to maintain system redundancy. The two parallel butterfly valves nearest to the supply shall open when an "Activate Open" push button or MPS is operated, causing water to enter the system piping. The two branches of the riser shall flow back together above the parallel set of butterfly valves farthest downstream to supply open nozzles and/or heads with water.

Solenoid valves for the Type II system shall be enclosed in an explosion-proof or nitrogen-purged enclosure if the panel is located in a hazardous area or outdoor location. Solenoids shall be located adjacent to, but not directly mounted on, the valve assembly. A water pressure switch shall be installed to indicate water flow and shall be monitored by the facility FACP; and may also be monitored by KCCS. A strainer shall be installed on system piping between the riser and the open nozzles and/or heads to remove any obstructive particles where nozzle or head orifices are 6.5 mm (1/4 in) or less. A manual shutoff OS&Y control valve located outside the hazardous area (15 to 30 m [50 to 100 ft]) from the facility structure shall be installed, where practical, and shall have a valve position indicator clearly showing open or closed position. The valve shall be positively identifiable as a deluge water system valve through the use of placards, signs, or other methods approved by the LDE in consultation with the KSC AHJ. If applicable, valve tamper and low air/nitrogen pressure supervisory signals shall be monitored by the facility FACP. The FACP shall monitor low-air/nitrogen pressure and position indications on the butterfly valves; KCCS may also monitor these indications. KCCS shall be capable of remotely activating the Type II system where required for hazardous operations and approved by the KSC AHJ..

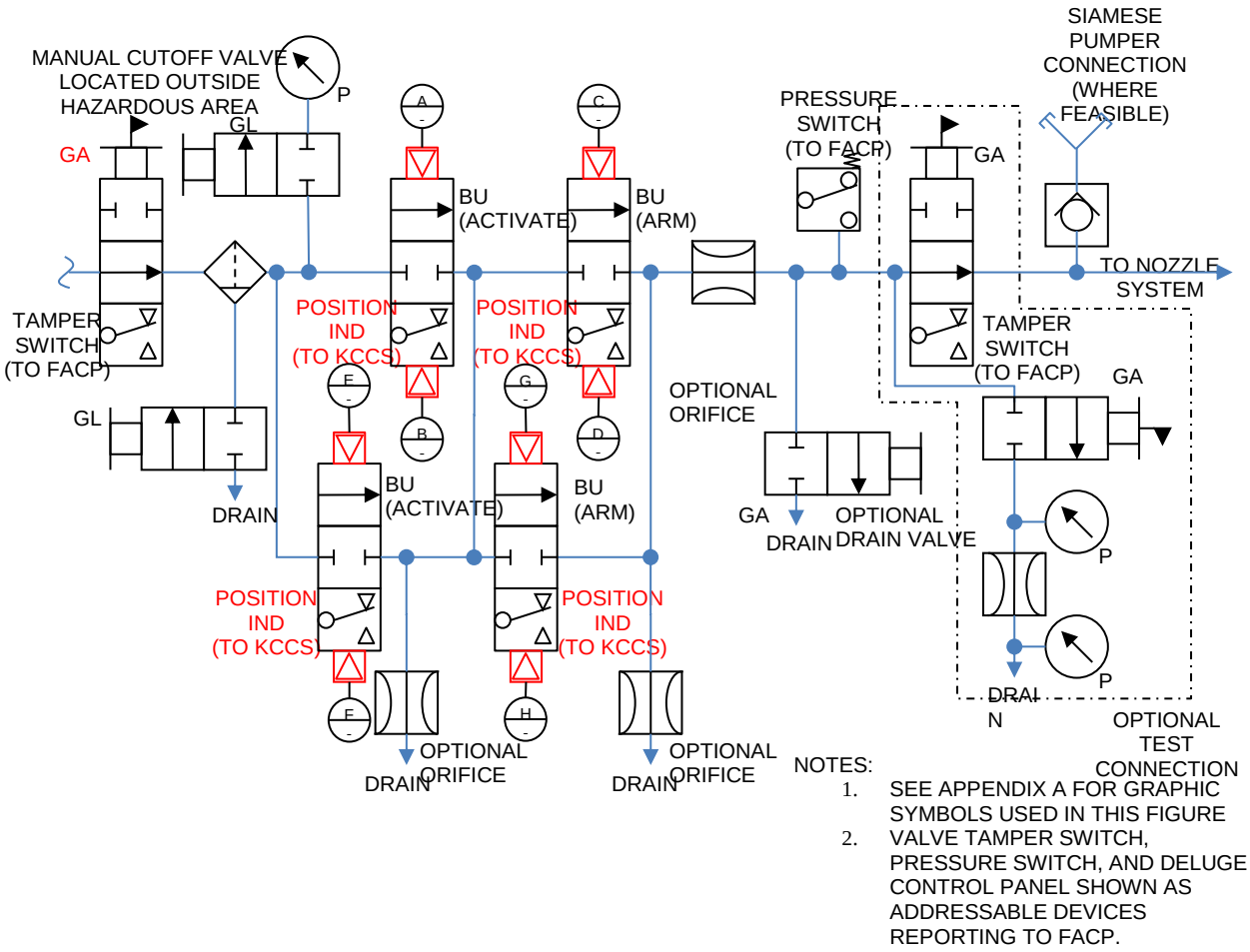


Figure 5. Type II Deluge Water Sprinkler (Mechanical) (Sheet 1 of 2)

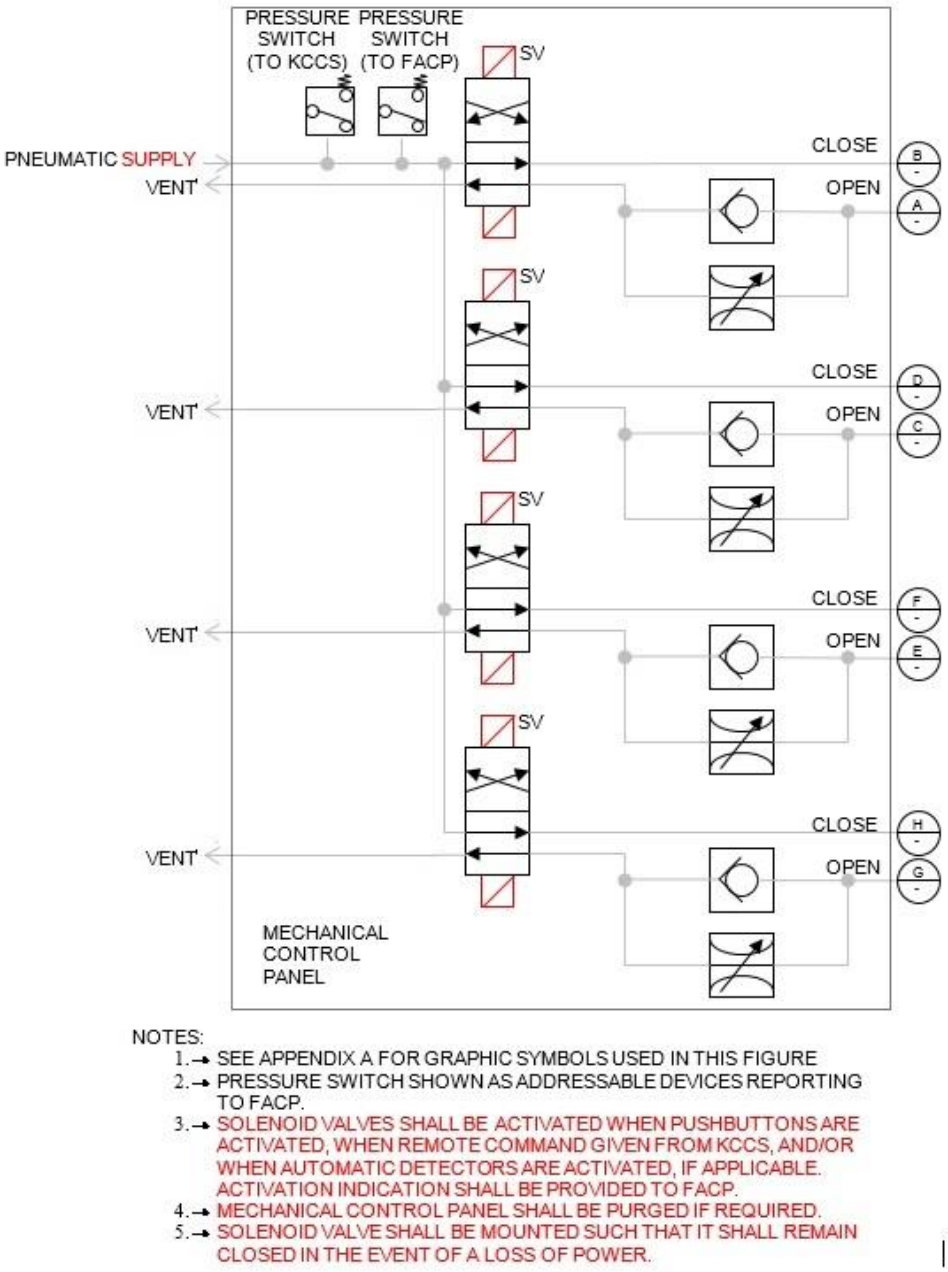


Figure 6. Type II Deluge Activation Panel (Mechanical) (Sheet 2 of 2)

c. Standard Deluge Systems – A standard deluge system shall have a riser comprised of a UL-listed deluge valve with all associated trim. The deluge valve shall be capable of actuation via electronic solenoid or manual release valve. Two solenoids shall be implemented in parallel where redundancy is required. The deluge valve shall trip and release water into system piping when water pressure is released from the diaphragm

chamber priming line either by the opening of a solenoid or the manual release valve. Water shall discharge from open, fixed spray nozzles or open sprinkler heads after the deluge valve trips. Actuation of the deluge solenoids can be by electronic push button and/or detection device, depending on facility requirements.

Deluge valves shall have a 51mm (2 in) main drain connection port. Standard deluge systems shall use water pressure switches to signal water flow alarm. The alarm test line shall include an alarm test valve, an alarm bypass valve, and a drip check valve. The alarm bypass valve shall be locked, sealed, or electronically supervised in the open position.

3.3.5.4 Deluge System Electrical Controls

Prior to deluge control system design, Fire Protection Operations and Maintenance Engineering shall be consulted to determine control system requirements. Depending on the particular circumstance, the method of control may vary and is subject to approval of the KSC AHJ. The current, typical control scheme is valve operation and primary monitoring of the deluge riser equipment through an FACP with additional monitoring and remote activation from KCCS through an interface cabinet connected to the FACP.

3.3.5.5 Deluge Water Activation Valves

Activation valves in Type I and II Deluge Systems shall be of the butterfly type with an offset shaft and eccentric disk. Both the shaft and disk shall be made of stainless steel. Valve bodies may be of carbon steel when environmental conditions permit. Valve seats shall be made of a single piece of reinforced tetrafluoroethylene (TFE) (type M). Valve shaft seals shall be virgin TFE (type T). Valve orientation shall be such that the upstream pressure tends to hold the valve closed (i.e. installed with the shaft upstream). Deluge water control valves shall be the wafer-sphere design by Jamesbury Corporation or an approved equal. Valves shall be clearly labeled open or shut/closed utilizing a valve position indicator.

3.3.5.6 Deluge Actuation Systems (Mechanical)

Actuation of Type I and II Deluge Systems shall be with compressed air or dry nitrogen. Actuation systems compressed air or dry nitrogen supply shall be designed in accordance with Figure 7. The deluge control panel shall monitor pressure in the system.

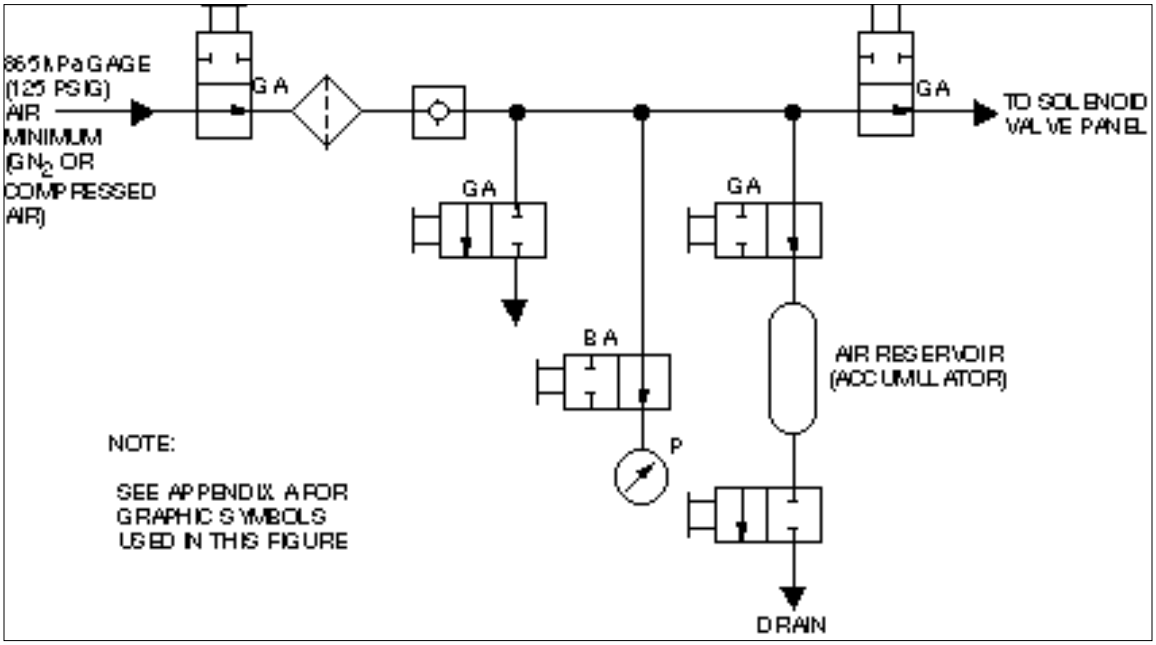


Figure 7. Deluge Compressed Air Supply Configuration

Major system components shall consist of an isolation valve, filter check valve, accumulator with an isolation valve and vent valve, flow controller, solenoid valve, pressure switch, pressure gauge with an isolation valve, and bleed valve. The accumulator shall be sized to open and close the system control valves not less than three times for a single zone from a fully charged system. Check valves shall be Circle Seal 249B or an approved equal.

3.3.5.7 Deluge Water Control Valve Actuators

Valve actuators in Type I and II Deluge Systems shall be the double-acting type, rated for at least 1.035 MPa (150 pounds per inch (psi)). They shall be sized to open the butterfly valves under full system pressure with 690 kPa (100 psi) air/nitrogen available. Valve actuators shall be type ST 200, ST 400, or the VPVL Double Acting Series by Jamesbury Corporation or an approved equal. Shutoff valves shall have manual gear actuators clearly marked OPEN and SHUT (or CLOSED) and shall have electrical supervision tied to the fire alarm system to indicate a supervisory condition when closed. Valve tamper switches shall be installed on all manual shutoff valves on the critical flow path, where practical. Valve tamper switches shall be monitored directly from the facility FACP as a separate zone (not from the deluge control panel). Tamper switches are typically not required on individual platform isolation valves inside controlled facility spaces (e.g. high bays and clean rooms).

3.3.5.8 Solenoid Valves

Solenoid valves shall be four-way with two positions and dual coils. The valves shall be designed to operate on 24 VDC. KCCS shall monitor and annunciate which valves were operated. For Type I and II Deluge Systems, solenoids shall be mounted with the spool

horizontal so that no movement shall occur in the event of a loss of power. Consult the solenoid manufacturer's instructions for the proper use of ports.

3.3.5.9 Monitoring

The control logic shall be designed so traceability is provided to indicate how the system was activated (i.e. which push button or station was activated). The control logic is shown on drawing 79K32573.

3.3.5.10 Control Lines

Control functions that require an open/closed path between two wires shall be designed and implemented so that exposed terminals are nonadjacent and are adequately protected. If possible, separate wires with waterproof insulation should be utilized, not telephone audio grade pairs.

3.3.5.11 Routing

Control wires for arm and activate valves and other critical functions shall not be routed through uncontrolled terminal distributors and frames along with other miscellaneous systems.

3.3.6 Standpipes

Standpipes shall be provided in accordance with NASA-STD-8719.11 and in special applications as directed by the KSC AHJ.

3.3.7 Fire Pumps

Fire pump installations shall comply with NFPA 20, except as clarified herein. For extra hazard occupancy areas, as defined by the LDE following consultation with the KSC AHJ, fire pump installations providing primary fire protection water shall contain not less than two diesel-driven fire pumps or two electric-motor-driven fire pumps with a redundant source of power or one electric fire pump with a redundant diesel-driven backup fire pump of the same size. When multiple fire pumps are needed to meet the demand requirements, the maximum demand (flow and pressure) shall be met without the largest pump running. A single fire pump and driver may be used to provide 100 percent of the system's flow and pressure requirement for light and ordinary hazard areas. All fire pumps shall be monitored by UL-listed FACPs for alarm condition and status.

3.4 Special Suppression Systems

3.4.1 Carbon Dioxide Systems

Carbon dioxide systems are not permitted for use at KSC except as determined in consultation with the KSC AHJ. Carbon dioxide systems shall not be installed in occupied areas. Carbon dioxide systems shall be designed in accordance with NFPA 12 and the requirements established

by the LDE after consultation with the KSC AHJ. Systems shall be UL-listed or FM-approved except where new technologies are approved by the KSC AHJ.

3.4.2 Wet Chemical Extinguishing Systems

Wet chemical kitchen suppression systems shall be installed for protection of cooking equipment and cooking exhaust hood systems. Normally, pre-engineered wet chemical systems shall be installed. The installation and operation of wet chemical extinguishing systems shall conform to NFPA 17A and the NASA KSC Specs Intact Specification Section 21 23 00.00 98. Systems shall be UL-listed or FM-approved except where new technologies are approved by the KSC AHJ.

3.4.3 Foam Extinguishing Systems for Aircraft Hangars

Foam extinguishing systems shall be installed for the protection of aircraft and research and development aircraft in specialized aircraft hangars. The installation and operation of foam extinguishing systems shall conform to NFPA 11, NFPA 11A, NFPA 16, and NFPA 409, and the NASA KSC Specs Intact Specification Section 21 13 26.00 98. Additional design guidance should be obtained from the Factory Mutual Design Data Sheets and the National Institute of Standards and Technology Technical Report NIST TN 1423, Analysis of High Bay Hangar Facilities for Detector Sensitivity and Placement. Systems shall be UL-listed or FM-approved except where new technologies are approved by the KSC AHJ.

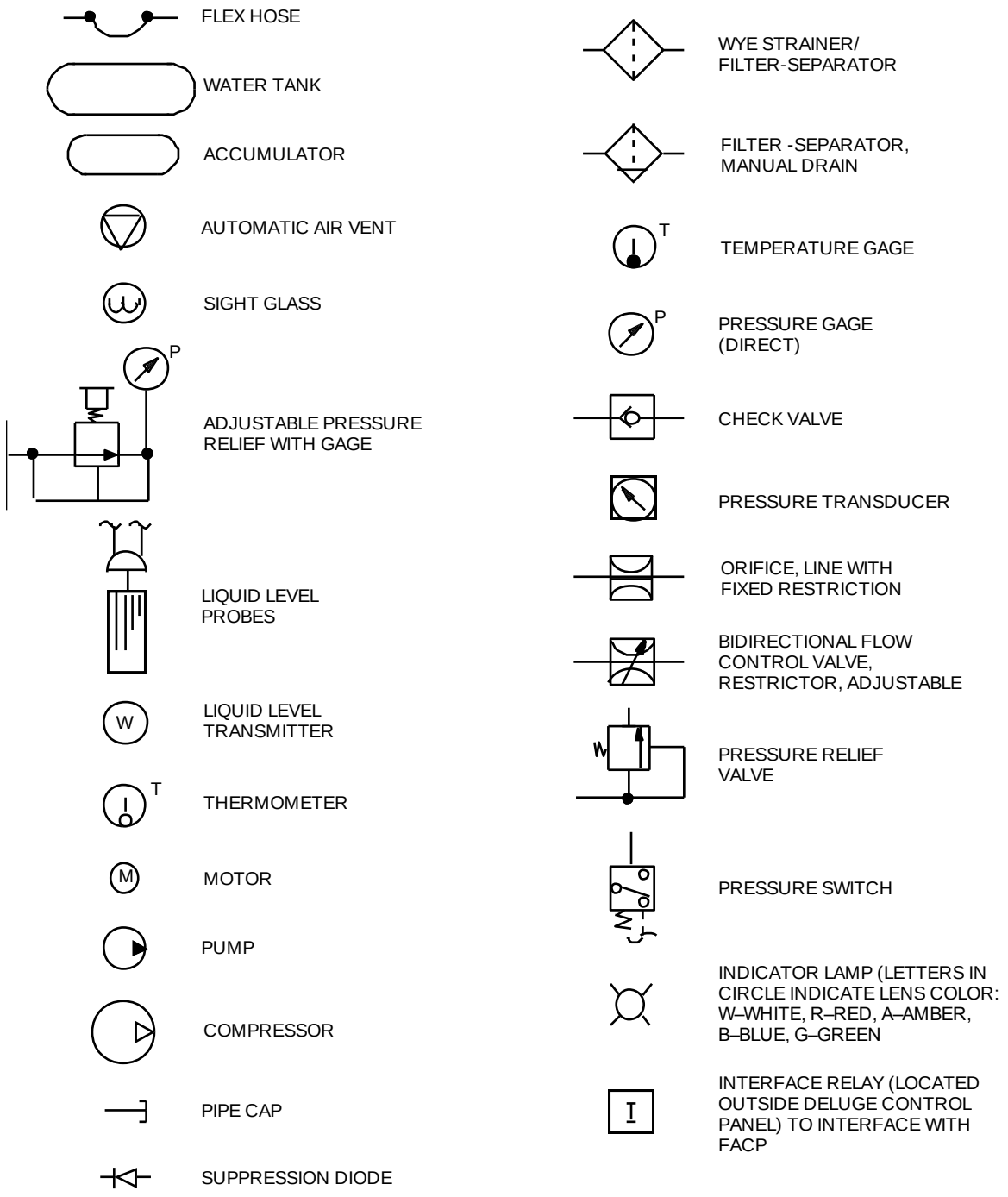
3.4.4 Halon 1301 and Clean Agent and Aerosol Extinguishing Systems

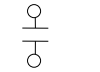
Installation of new Halon 1301 systems is prohibited. Installation of new clean agent extinguishing systems shall also require special approval by the KSC AHJ. Clean agent extinguishing systems shall be installed in accordance with NFPA 2001 and the requirements established by the LDE after consultation with the KSC AHJ. Aerosol systems shall be installed in accordance with NFPA 2010. Additional design guidance should be obtained from the Factory Mutual Design Data Sheets. Systems shall be UL-listed or FM-approved except where new technologies are approved by the KSC AHJ.

Custodian:
NASA – John F. Kennedy Space Center
Kennedy Space Center, Florida 32899

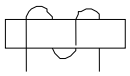
Preparing Activity:
John F. Kennedy Space Center
Center Operations Directorate

APPENDIX A. GRAPHIC SYMBOLS FOR FIRE SUPPRESSION AND ALARM SYSTEMS

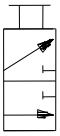




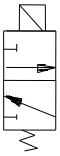
RELAY



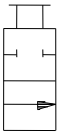
SOLENOID



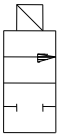
VALVE, MANUAL
3-WAY, 2 POSITION



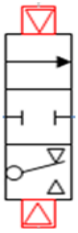
ELECTROMECHANICAL
SOLENOID VALVE,
1 WAY, SPRING RETURN



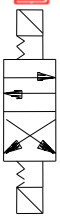
VALVE, MANUAL
(NORMALLY OPEN)



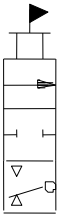
ELECTROMECHANICAL
SOLENOID VALVE,
2 WAY, 2 POSITION
(NORMALLY CLOSED)



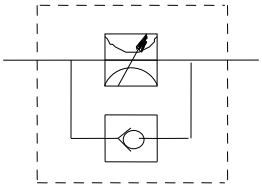
PNEUMATICALLY OPERATED BUTTERFLY
VALVE, WITH DOUBLE-ACTING
ACTUATOR AND POSITION SWITCH



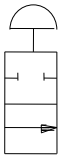
ELECTROMECHANICAL
DUAL COIL
SOLENOID VALVE



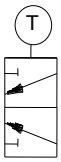
MANUAL VALVE WITH
LOCAL AND REMOTE
INDICATOR



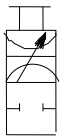
REVERSIBLE FLOW CONTROL VALVE
WITH REVERSE FLOW BYPASS



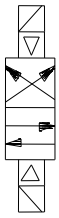
VALVE, DIAPHRAGM
OPERATED



VALVE, METER, THERMOSTATIC

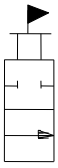


VALVE, NEEDLE, MANUAL



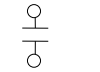
VALVE, SOLENOID, ELECTRICAL

VALVE, 2 POSITION,
4-WAY, MANUAL

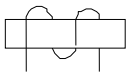


VALVE WITH POSITION
INDICATION, MANUAL

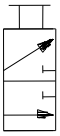
MUFFLER



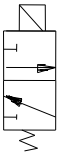
RELAY



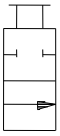
SOLENOID



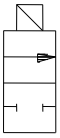
VALVE, MANUAL
3-WAY, 2 POSITION



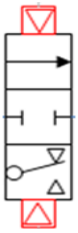
ELECTROMECHANICAL
SOLENOID VALVE,
1 WAY, SPRING RETURN



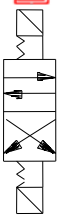
VALVE, MANUAL
(NORMALLY OPEN)



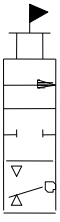
ELECTROMECHANICAL
SOLENOID VALVE,
2 WAY, 2 POSITION
(NORMALLY CLOSED)



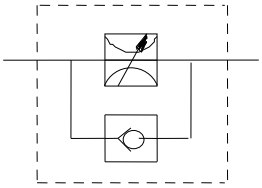
PNEUMATICALLY OPERATED BUTTERFLY
VALVE, WITH DOUBLE-ACTING
ACTUATOR AND POSITION SWITCH



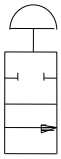
ELECTROMECHANICAL
DUAL COIL
SOLENOID VALVE



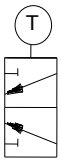
MANUAL VALVE WITH
LOCAL AND REMOTE
INDICATOR



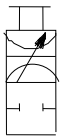
REVERSIBLE FLOW CONTROL VALVE
WITH REVERSE FLOW BYPASS



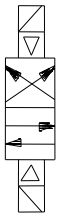
VALVE, DIAPHRAGM
OPERATED



VALVE, METER, THERMOSTATIC

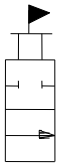


VALVE, NEEDLE, MANUAL



VALVE, SOLENOID, ELECTRICAL

VALVE, 2 POSITION,
4-WAY, MANUAL



VALVE WITH POSITION
INDICATION, MANUAL

MUFFLER

FIRE ALARM PLAN AND RISERS SYMBOLS:

——	CONDUIT ROUTED EXPOSED
◆—◆—◆	HEAT SENSITIVE CABLE
O O	HEAT SENSITIVE CABLE TEST PORT
TYP.	TYPICAL
TX/TRANSF	TRANSFORMER
DISTRIB.	DISTRIBUTION
W/	WITH
W/O	WITH OUT
⏚	ELECTRICAL GROUND
TTB	TELEPHONE TERMINAL BOARD
AFF	ABOVE FINISHED FLOOR
A.F.G.	ABOVE FINISHED GRADE
WP	WEATHERPROOF
EP	EXPLOSIONPROOF
F	FIRE ALARM CONTROL PANEL
ACP	FIRE ALARM AUXILIARY CONTROL PANEL
WC	FIRE ALARM WET CHEMICAL CONTROL PANEL
PCP	FIRE ALARM PRE-ACTION CONTROL PANEL
H	HALON CONTROL PANEL
CO_2	CO_2 CONTROL PANEL
FSCP	FOAM SYSTEM CONTROL PANEL
MOD	FIRE ALARM MODEM CABINET
ZAM	FIRE ALARM ZAM CABINET
FATC	FIRE ALARM TERMINAL CABINET
VCP	FIRE ALARM VOICE CONTROL PANEL
TSTC	TRANSIENT SURGE TERMINAL CABINET
◥◁	ULTRA-VIOLET / INFRA-RED DETECTOR TRIPLE INFRA-RED DETECTOR
PT◁	PHOTO BEAM TRANSMITTER
PR◁	PHOTO BEAM RECEIVER
SZ	SIGNAL ZAM
MZ	MONITOR ZAM
CZ	CONTROL ZAM
SV	SOLENOID VALVE
K	KEY ISOLATE SWITCH
IAM	SUPERVISED IAM
LAPS	LOW AIR PRESSURE SWITCH
ASDS	AIR SAMPLING DETECTION SYSTEM
FSD	FIRE SMOKE DAMPERS
(T)	TELEPHONE JACK
⊔□	DISCONNECT SWITCH
◇A	ANNUNCIATOR LCD PANEL
◇RT	REMOTE DUCT DETECTOR TEST SWITCH / LED
R	AUXILIARY REMOTE CONTROL RELAY

FIRE ALARM PLAN AND RISERS SYMBOLS:

F	FIRE ALARM STROBE LIGHT
F	COMBINATION FIRE BELL/STROBE
F	COMBINATION FIRE SPEAKER/STROBE
F	FIRE BELL
F	FIRE SPEAKER
DH	MAGNETIC DOOR HOLDER
CT	CODED TRANSMITTER
NAC	NOTIFICATION APPLIANCE CABINET

INITIATION DEVICE NOTE:

ALL INITIATION DEVICE SYMBOLS USED ON PLANS SHALL HAVE ZONE INDICATION SUBSCRIPTS. NUMERIC ONLY SUBSCRIPTS (FOR EXAMPLE "1") INDICATE ZONE. THE LETTER "A" FOLLOWED BY A NUMBER (FOR EXAMPLE "A1") INDICATES AN INDIVIDUALLY ADDRESSABLE DEVICE AND GROUPING FOR CENTRAL FIRE MONITOR SYSTEM REPORTING PURPOSES.

PS	PRESSURE SWITCH
FS	FLOW SWITCH
TS	TAMPER SWITCH
	HEAT-ACTUATED DETECTOR
F	MANUAL PULL STATION
P	PHOTOELECTRIC SMOKE DETECTOR
P S	PHOTOELECTRIC DUCT SMOKE DETECTOR (SUPPLY)
P R	PHOTOELECTRIC DUCT SMOKE DETECTOR (RETURN)

VALVE TYPES

BU - BUTTERFLY
GL - GLOBE
GA - GATE
CO - CONE
BA - BALL
CL - CLAPPER
PL - PLUG
SV - SOLENOID
F/A - FIRE ALARM

NOTES:

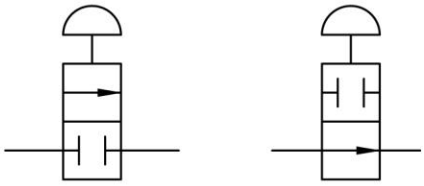
REFERENCE DOCUMENTS:
79K09579 OMD BASE LINE NO. 40200
79K29921 SYSTEM DOCUMENTATION LIST
79K29849 LRU PARTS LIST

SOLENIOD VALVES ARE DEPICTED IN THE DEENERGIZED STATE OTHER SYSTEM VALVES ARE DEPICTED IN POSITION (OPEN, CLOSED, ACTUATED, UNACTUATED) SHOWING THE WATER SYSTEM OPERATIONALLY PRESSURIZED WITH NO FLOWS.

SYMBOLOGY IS PER KSC-STD-15-2. (SPECIAL SYMBOLS FOR WATER SYSTEM ADDED AS REQUIRED.)

IN MULTIPLE ENVELOPE SYMBOLS, FLOW CONDITION SHOWN NEAREST A CONTROL SYMBOL TAKES PLACE WHEN THE CONTROL IS CAUSED OR PERMITTED TO ACTUATE.

EXAMPLE



UNACTUATED ACTUATED

APPENDIX B. DEFINITIONS

For the purpose of this Standard, the following definitions shall apply; refer to the specific NFPA standards for further clarification of definitions:

a. **Approve**: For equipment items listed for use in fire protection systems by a nationally recognized testing agency, typically UL and/or FM. For actions, acceptance by the KSC AHJ, Contracting Officer, and LDE as appropriate to the particular issue under consideration is required.

b. **Authority Having Jurisdiction**: The NASA individual or designee responsible for approving equipment, providing resolution to code related issues, and providing code interpretations for fire protection and life safety related issues.

c. **Central Station System**: A system or group of systems in which the operations of circuits and devices are transmitted automatically to, recorded in, maintained by, and supervised from a listed central station that has competent and experienced servers and operators who, upon receipt of a signal, take such action as required. Such service is to be controlled and operated by a person, firm, or corporation whose business is the furnishing, maintaining, or monitoring of supervised fire alarm systems.

d. **Compatible Equipment**: Equipment that interfaces mechanically or electrically as manufactured without field modification.

e. **Designer**: The individual responsible for investigating existing conditions, interpreting code requirements and designing (i.e., development of specs and drawings) the fire protection system. This individual is also recognized as the "engineer of record" for the design deliverable.

f. **Electrical Supervision**: Monitors the circuit integrity of interconnecting conductors so when a single open or a single ground condition occurs that would prevent normal operation, the condition is automatically transmitted and indicated at the appropriate location.

g. **Fire Alarm Control Panel (FACP)**: A system component that receives inputs from automatic and manual fire alarm devices and might supply power to detection devices and to a transponder or off-premises transmitter. The control unit might also provide transfer of power to the notification appliances and transfer of condition to relays or devices connected to the control unit. The fire alarm control unit can be a local fire alarm control unit or a master control unit.

h. **Firefighting**: The physical deployment of available fixed or portable extinguishing agents for the purposes of aiding escape or rescue, suppression of the fire spreading, and extinguishment.

i. **Fire Prevention**: Measures directed toward avoiding the inception of fire.

j. **Fixed Extinguishing System**: An engineered arrangement of equipment designed to provide a specified firefighting capability against a particular fire hazard within a specified area (does not include portable fire extinguishers).

k. **Fully Compatible**: Shall indicate the ability to communicate in two directions (duplex).

l. **General Fire Protection**: Everything relating to the prevention, detection, and extinguishment of a fire and to the reduction of losses by fire, including the safeguarding of human life and the preservation of property.

m. **Heat Detector**: A device that detects an abnormally high temperature or rate-of-temperature rise, or both.

n. **Initiating Device**: A fire alarm system component that originates transmission of a change-of-state condition, such as in a smoke detector, heat detector, manual pull station, or supervisory switch.

o. **Lead Design Engineer (LDE)**: The individual responsible for developing the design SOW and serving as the Contracting Officer Technical Representative on the design services contract. All changes to technical requirements of design SOW require the approval of the Lead Design Engineer.

p. **Listed**: A product approved for use in fire protection systems by a nationally recognized testing agency (e.g., UL, FM).

q. **Manual Pull Station**: A manually operated device used to initiate an alarm signal.

r. **Multiplex Communication Format**: A signaling method characterized by simultaneous or sequential transmission, or both, and a reception of multiple signals on a signaling line circuit, including means for positively identifying each signal.

s. **Notification Appliance**: A fire alarm system component, such as bell, speaker, strobe, or text display, that provides audible, tactile, or visible outputs or any combination thereof.

t. **Portable Fire Extinguishers**: A device containing chemicals, fluids, or gases for extinguishing fires that can be easily moved.

u. **Signaling Line Circuit**: A circuit or path between any combination of circuit interfaces, control units, or transmitters, over which multiple system input signals or output signals, or both are carried.

v. **Smoke Detector**: A device that actuates if it detects visible or invisible particles of combustion.

w. **Water Deluge System**: A sprinkler system employing open sprinklers attached to a piping system that is connected to a water supply through a valve opened manually or by the operation of a detection system installed in the same areas as the sprinklers. When this valve opens, water flows into the piping system and discharges from all the attached open sprinklers. Deluge systems provide general, uniform density of coverage over a floor area, as opposed to spraying specific areas or surfaces.

x. **Water Spray**: An automatic or manually actuated fixed pipe system connected to a water supply and equipped with water spray nozzles designed to provide a specific water discharge and distribution over the protected surfaces or area. Water spray

systems provide density of coverage over specific surfaces or areas with aimed discharge patterns, as opposed to general, uniform density of coverage over a floor area.

APPENDIX C. ABBREVIATIONS AND ACRONYMS

A&E	Architects and Engineers
ac	alternating current
ADA	Americans With Disabilities Act
AHJ	Authority Having Jurisdiction
AHU	air handling unit
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
CFMS	Central Fire Monitoring System
CFR	Code of Federal Regulations
cm	centimeter
CRAC	computer room air conditioning
CRMS	Central Radio Monitoring System
DC	direct current
e.g.	for example
FACP	fire alarm control panel
FDC	fire department connections
FED	federal
FM	Factory Mutual
FPED	Fire Protection Equipment Directory
ft	foot/feet
HVAC	heating, ventilating, and air conditioning
i.e.	that is
in	inch
IR	infrared
KCCS	Kennedy Complex Control System
kPa	kilopascal
KSC	John F. Kennedy Space Center
m	meter
m^2	meters squared
MIL	military
ML	Mobile Launcher
MLP	Mobile Launcher Platform
mm	millimeter
NASA	National Aeronautics and Space Administration
NDU	network display unit
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology
OS&Y	outside stem and yoke
PAWS	Paging and Area Warning System
PCP	preaction control panel
PLC	programmable logic controller

psi	pound per square inch (static pressure)
SOW	statement of work
STD	standard
TFE	tetrafluoroethylene
UFC	United Facilities Criteria
UL	Underwriters Laboratories Inc.
UV	ultraviolet
VABR	Vehicle Assembly Building Repeater
VDC	volt direct current