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FIRE PROTECTION DESIGN FOR FACILITIES, STANDARD FOR

MARCH 1984

ENGINEERING DEVELOPMENT DIRECTORATE

National Aeronautics and
Space Administration

John F. Kennedy Space Center

NASA

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KSC-STD-F-0004B

FIRE PROTECTION DESIGN FOR FACILITIES, STANDARD FOR

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MARCH 1984

JOHN F. KENNEDY SPACE CENTER, NASA

Approved:

Peter A. Minderman
Director of Engineering Development

TABLE OF CONTENTS

TABLE OF CONTENTS (CONT)

TABLE OF CONTENTS (CONT)

TABLE OF CONTENTS

TABLE OF CONTENTS (CONT)

TABLE OF CONTENTS (CONT)

TABLE OF CONTENTS (CONT)

TABLE OF CONTENTS (CONT)

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS AND ACRONYMS

ac	alternating current
AWG	American Wire Gage
C	centigrade
CCS	Complex Control System
CO_2	carbon dioxide
CD&SC	Communications Distribution & Switching Center
dc	direct current
F	Fahrenheit
FM	Factory Mutual Engineering Division
ft	foot
GN_2	gaseous nitrogen
GOX	gaseous oxygen
gpm	gallons per minute
GSE	ground support equipment
Halon 1301	bromotrifluoromethane
HMF	Hypergol Maintenance Facility
I.D.	internal diameter
KSC	John F. Kennedy Space Center
LC 39	Launch Complex 39
LCC	Launch Control Center
LH_2	liquid hydrogen
LN_2	liquid nitrogen
LOX	liquid oxygen
MDP	monoammonium dihydrogen phosphate
MMH	monomethyl hydrazine
NASA	National Aeronautics and Space Administration
NBC	National Building Code
N.C.	noncombustible
NEC	National Electrical Code (NFPA No. 70)
NFPA	National Fire Protection Association
NST	National Standard Hose Thread
POL	paints, oils, and lubricants
Purple K	potassium bicarbonate
SBC	Southern Building Code
SF	Safety & Fire Directorate
sq ft	square feet
UDMH	unsymmetrical dimethyl hydrazine
UEW	unit exit width
UL	Underwriters' Laboratories, Inc
VABR	Vehicle Assembly Building Repeater
vol	volume
SBC	Southern Building Code

JOHN F. KENNEDY SPACE CENTER, NASA

FIRE PROTECTION DESIGN FOR FACILITIES, STANDARD FOR

1. SCOPE

1.1 Scope. This document establishes minimum fire protection standards to be used in the design of new facilities and the modification of existing facilities under the design jurisdiction of John F. Kennedy Space Center (KSC).

1.2 General. The requirements of this standard are based on existing installations and acceptable practices in use at KSC. The designer should keep in mind that cost effectiveness is a prime objective in the design of any fire protection system. This objective can be accomplished only by giving serious "systems engineering" consideration to all features of facility design.

In applying this standard, the following procedure is recommended: The user should first look up the summary data about a facility or usage area in the requirements matrix in paragraph 3.5. The details of these requirements may then be determined by referring to paragraphs 3.1 through 3.3 as indicated at the head of the columns of the matrix.

NOTE

Paragraph cross references appear throughout the requirements sections. The user is cautioned to read all referenced paragraphs in order to gain a full understanding of the relationships between various fire protection considerations.

1.3 Basic Goals of KSC Fire Protection. The designer should be governed by the general consideration that fire protection features are required in KSC facilities to accomplish the following goals, listed in order of importance:

a. To safeguard human life and prevent injury to personnel

b. To preserve critical launch and landing equipment and facilities

c. To protect valuable materials, equipment, and records

d. To minimize/prevent fire damages to KSC facilities

The order of importance of KSC fire protection goals differs from that applicable to nonfederal government agencies. NASA-KSC, as an agency of the Federal Government, is self-insured and functions as "the authority having jurisdiction" in the interpretation and enforcement of existing nationally recognized codes and standards such as the National Fire Codes, The Southern Building Code, and

various Underwriters' Laboratories, Inc. standards. Deviations from stated or implied requirements and, in some instances, more restrictive and stringent interpretations of these industry codes and standards are necessary in order to maintain the management risk factor (possible loss of life and property by fire) to a level considered reasonable and economically feasible. In no cases, however, will any deviations result in reducing minimum protection of NASA-KSC facilities.

1.4 Description of KSC Fire Protection. Fire protection, as practiced at NASA-KSC, is made up of six basic elements, each performing multiple functions (see figure 1). Three of these elements -- Fire Detection and Alarm, Fire Control and Extinguishment, and Fire-Resistant Construction -- constitute the scope of this standard.

1.4.1 Fire Detection and Alarm. This is defined as "Systems which monitor or supervise conditions within specific areas to give prompt and timely warning of fire or incipient fire." These systems are required to perform one or more of seven functions at KSC:

a. Sound a local general alarm to initiate evacuation

b. Summon fire fighting aid

c. Actuate fire-suppression systems

d. Monitor normally unmanned areas

e. Initiate shutdown of equipment and start protective measures

f. Monitor the condition of fire alarm systems

g. Monitor the condition of fire-suppression systems

1.4.2 Fire Control and Extinguishment. This element is defined as "Fixed systems and portable equipment located within or adjacent to areas of potential fire for immediate use in control, suppression, and extinguishment of fire." These systems are required to perform one or more of the following functions at KSC:

a. Aid the escape of personnel from high hazard areas

b. Control spread of fire

c. Extinguish fires

d. Prevent fires of flammable fluids by inertion, chemical blocking, dilution, dispersion, and cooling

e. Provide exposure protection from nearby fires

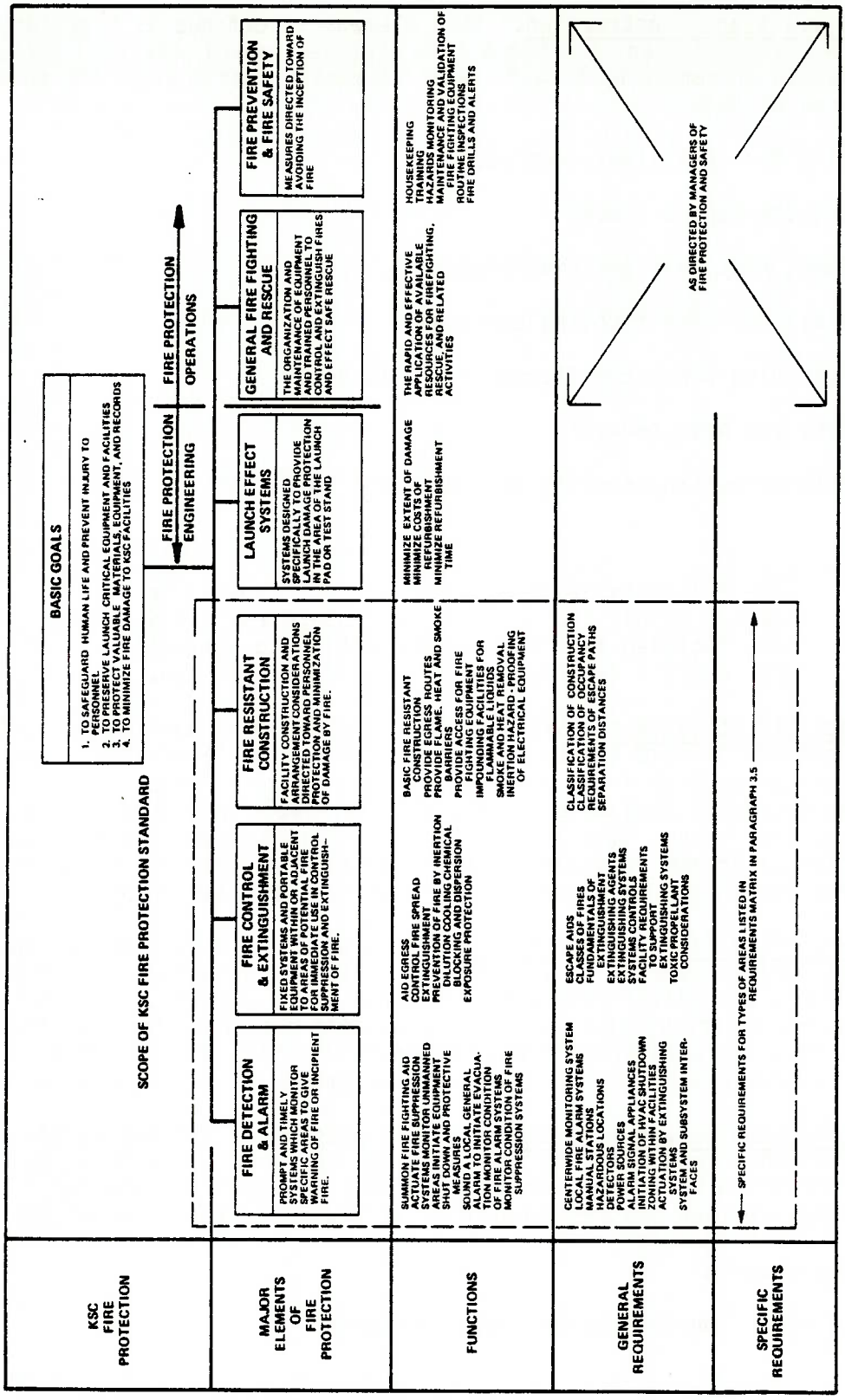

Figure 1. KSC Fire Protection

1.4.3 Fire-Resistant Construction. This element is defined as "Facility construction and arrangement considerations directed toward personnel protection and minimization of damage by fire." Facility design must provide the following basic features at KSC:

a. Basic fire resistant construction

b. Adequate egress routes

c. Flame, heat, and smoke barriers

d. Access for fire-fighting equipment

e. Impounding ponds and flammable liquid dikes

f. Smoke and heat removal

g. Inertion/hazard-proofing of electrical equipment

NOTE

The following basic elements are not covered in detail within the scope of this standard. They are included by title and definition to complete the overall description of KSC Fire Protection.

1.4.4 Launch Effect Systems. Systems within this element are unique to launch facilities and static test stands. They are defined as "Special systems which provide damage protection from launches and tests." Their functions are to minimize the degree of damage, the cost, and the time required to refurbish the launch pad or test stand. Characteristically, these systems are high-volume, short-duration water-spray systems. Ablative coatings and special paints are also used for equipment beyond the reach of effective water spray.

1.4.5 General Fire Fighting and Rescue. This element is defined as "The organization and maintenance of equipment and trained personnel to control and extinguish fires and effect rescue of personnel and equipment." Its function is the rapid and effective application of available resources for fire fighting, rescue, and other related activities. Essentially, this element of fire protection is provided by the equipment and personnel of the KSC Fire Services.

1.4.6 Fire Prevention and Fire Safety. This element is defined as "Those measures directed toward avoiding the inception of fire." Generally, these are the activities of the safety department and of the fire services when not fighting fires, and they include the performance of at least six functions at KSC:

a. Housekeeping

b. Training (non-professional base personnel)

c. Hazard monitoring

d. Maintenance and validation of fire equipment

e. Routine inspections

f. Fire drills and alerts

2. APPLICABLE DOCUMENTS

2.1 Governmental. The latest revision of the following documents form a part of this standard to the extent referenced herein:

2.1.1 Standards.

National Aeronautics and Space Administration (NASA)

NHB 7320.1	Facilities Engineering Handbook
NSS/FS-1740.3	NASA Safety Standard for the Fire Protection of Essential Electronic Equipment Operations

Kennedy Space Center(KSC)

KSC-STD-S-0004	Color Coding of Fluid System Piping
KSC-STD-E-0002	Hazard Proofing of Electrical Equipment

(Copies of NASA and KSC specifications, standards, drawings, and publications may be obtained from the KSC Library, Specifications and Standards).

2.1.2 Other Publications.

U. S. Department of Commerce

RP-1	Standard Practice for the Fire Protection of Essential Electronic Equipment Operations

(Applications for copies should be addressed to the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402).

2.2 Non-Governmental. The latest revision of the following documents forms a parts of this standard to the extent referenced herein:

National Fire Protection Association (NFPA)

National Fire Codes, All Volumes

Fire Protection Handbook

(Applications for copies should be addressed to the National Fire Protection Association, Batterymarch Park, Quincy, Massachusetts 02269)

Southern Building Code Congress International, Inc.

SBC	Southern Building Code

(Applications for copies should be addressed to the Southern Building Code Congress International, Inc., 900 Montclair Road, Birmingham, Alabama 35213.)

Underwriters' Laboratories, Inc.

No. 864	Control Units for Fire Protection Signaling Devices
No. 246	Hydrants for Fire Protection Service
No. 448	Pumping Equipment for Private Fire Service
--	Approved Equipment Lists

(Application for copies should be addressed to the Underwriters' Laboratories, Inc., Publications Stock, 333 Pfingsten Road, Northbrook, Illinois 60062.)

American National Standards Institute, Inc.

A117.1	Specifications for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People

(Application for copies should be addressed to the American National Standards Institute, Inc., 1430 Broadway, New York, New York 10018.)

3. REQUIREMENTS

3.1 Fire Detection and Alarm Systems.

3.1.1 Fire Alarm System - General. The fire alarm system at KSC is comprised of local fire alarm systems and a centerwide fire monitoring system. Local fire alarm systems are installed in the majority of KSC buildings and aboard the

mobile launch structures. The centerwide fire monitoring system is installed to monitor the local fire alarm systems and is designed to accept signals from the mobile launch equipment at selected interface points.

3.1.2 Local Fire Alarm Systems. Local fire alarm system components (including detectors, signaling appliances, manual fire alarm stations, and control units) shall be designed and installed in compliance with NFPA regulations 72A, 72D, and 72E and the requirements of this standard. Where the requirements of this standard and the referenced standards conflict, the requirements of this standard shall govern.

The components comprising a local fire alarm system shall constitute a unified system for proper operation. New fire alarm system components shall be compatible with the existing equipment in use.

3.1.2.1 Fire Alarm Zones. Alarm initiating devices installed in multistoried buildings or selected building groups shall be zoned for fire reporting purposes. Where alarm-initiating devices are zoned, the local fire alarm system shall contain an annunciator panel located in an entrance lobby or in a location designated by the KSC Fire & Rescue Branch. Zoning and requirements for the number of zones reporting to the centerwide fire monitoring station shall be consistent with the hazard involved, based on an engineering survey. Alarm systems shall be zoned to sound alarm devices within a building as directed by the KSC NASA Branch having design responsibility in consultation with fire protection and rescue management.

3.1.2.2 Fire Alarm Subsystems. Local fire alarm systems installed in a group of buildings, trailers, or in areas where a high-hazard fire potential exists should be centralized in a common subsystem and would be reported on a common lamp-type annunciator and control unit. The annunciator shall be so located as to immediately alert occupant personnel of the fire condition. Fire alarm signals shall be reported by individual hazard area or building to the centerwide fire monitoring equipment.

3.1.2.3 Auxiliary Fire Detection Systems. Fire-monitoring systems installed for monitoring a particular hazard, such as systems using hydrogen and hypergolic fuel leak detectors or infrared, ultraviolet or hot-wire flame detectors are of a specialized nature and are not within the scope of this standard.

3.1.2.4 Fire Control and Extinguishing System Reporting. Except for Halon 1301 systems, a circuit shall be installed between the actuating devices of a fixed fire control and extinguishment system and the local fire alarm system, as part of the local fire alarm system, to report the activation of that fixed system. This circuit shall be connected into the alarm initiating circuit for the area in which the control and extinguishment equipment is installed. Halon 30 extinquishing systems shall meet the requirements of paragraph 3.2.7.8.9.

3.1.2.5 Installation of Local Fire Alarm Systems in Hazardous Areas. Local fire alarm systems installed in hazardous areas shall comply with Article 500, Hazardous Location, of the NFPA No. 70 (NEC).

3.1.2.6 Control Units. Control Units shall be Underwriters' Laboratories, Inc. (UL)-listed or Factory Mutual Engineering Division (FM)-approved as a non-coded, continuous-ringing fire alarm system. Basic units that are so approved but require modification by the manufacturer to the extent that the unit becomes a one-of-a-kind item may be approved by the authority having design jurisdiction. Such approval shall be dependent on the submittal by the manufacturer of certification that the unit complies with the intent of Underwriters' Laboratories Standards for Safety UL-864, "Control Units for Fire Protection Signaling Devices" and the requirements of this standard.

Control units shall be NFPA No. 72D with Class-A supervised circuitry which will allow the receipt of an alarm signal over a trouble condition of the initiating circuit. The local control unit shall provide the centerwide fire monitoring equipment with a normally open alarm contact and a normally closed trouble contact for each zone of alarm initiating devices. The control unit shall contain, as necessary, the components and circuitry required for operation of an annunciator for monitoring and supervising auxiliary fire detection systems and for air handling equipment and ventilating fan control. Test switches, alarm-silencing switches, and other local fire alarm system control devices shall be located within the control unit and shall be accessible only by unlocking and opening the unit. Control unit enclosures shall be dust-proof, have a hinged cover, and be provided with an integral key lock which will accept the KSC-specified lock cylinder.

Power for the control unit shall be supplied from the most reliable source in the local facility and shall have a backup source of power either from an automatically switched alternate source or from a battery supply. Interruption of the main source of power shall cause a trouble signal to be sent to the centerwide fire monitoring system. For buildings having a single source of power, the local fire alarm system shall be connected on the line side of the main service disconnect of the building, with separate transformer and disconnect switch as required, in accordance with NFPA No. 70 (NEC). Disconnect switches shall be equipped with a dual element, high-interrupting-capacity fuses. Limited access provisions shall be incorporated with the circuit disconnecting devices, and it shall be permanently identified by placard and shall be painted red to preclude inadvertent operation by unauthorized personnel.

Storage batteries shall be located or enclosed so that the control unit equipment and wiring will not be affected adversely by battery gases. If the power supply to the charger is disconnected, the battery shall be capable of operating the control unit in normal supervisory condition for 24 hours minimum. Alarm-signal receipt during battery backup operation will cause an alarm signal to be sent to the centerwide fire monitoring station and will sound the local alarm signaling appliances for 5 minutes minimum.

3.1.2.7 Local System Annunciators. Local system annunciators of the combination annunciator/control-unit type or the separate remote-annunciator type shall consist of a lamp-type display unit with alarm signals indicted by red lamps and trouble signals by white or amber lamps. Flashing versus continuous illumination of lamps for the purpose of distinguishing between trouble and alarm signals is not acceptable. The annunciator shall be equipped with a test switch to test all lamps. Location of the annunciator panel shall be specified by the authority having design jurisdiction after consultation with the KSC Fire Protection and Rescue Management.

3.1.2.7.1 Combination Annunciators/Control Unit. Annunciator units which perform control functions or provide alarm initiation or other external circuits shall meet the requirements of 3.1.2.6 and 3.1.2.7.

3.1.2.7.2 Remote Annunciators. Local system remote annunciators shall meet the requirements of 3.1.2.7 and shall consist of a back-lighted, lamp-type display unit with windows suitable for engraving the zone or area identification information.

3.1.2.7.3 Detector Annunciators. The alarm-indicating lamps of products-of-combustion-type detectors located above ceilings, under raised floors, and in other concealed areas, shall be installed in locations readily visible and accessible to the Fire Department. Remote indicators shall be logically grouped, by zone or area, and displayed on a common annunciator. The annunciator shall be mounted in or on the wall of a major hall or passageway. The annunciator shall be of the graphic-display type or shall have a graphic locator posted adjacent to it. Location of the annunciator panel shall be specified by the authority having design jurisdiction after consultation with the KSC Fire Protection and Rescue management.

3.1.2.8 Circuitry. Local fire alarm system circuitry external to the control unit shall be installed in accordance with NFPA No. 70 (NEC) and NFPA 72D. All wiring shall be continuous between system components such as detectors, bells, control units, and manual pull stations. Splices, solder connections, or other type connections are not acceptable. Alarm initiating circuits shall be double-loop systems, color coded with one black loop and one blue loop. Series wired alarm signaling circuits shall have both wires colored red; parallel wired alarm signaling circuits shall use a red wire for the positive leg and orange wire for the negative leg. Each alarm initiating circuit shall be individually and independently arranged so that an open circuit, a ground, or an open circuit and a ground occurring at the same time in the same circuit will not prevent the transmission of a

clear and intelligible alarm signal before the trouble is cleared. The performance of the initiating device circuits shall be Style 'D' as defined by NFPA 72D 1983 edition. Signaling line circuits which meet the performance requirements of Style 7 NFPA 72D 1983 edition are acceptable and preferred but are not mandatory.

3.1.2.9 Automatic Fire Detectors. Detectors installed in local fire alarm systems shall be UL listed or FM approved and shall meet the requirements of NFPA No. 72E. Detectors approved for use at KSC are heat-actuated fixed-temperature, combination fixed-temperature and rate-of rise, rate-compensated, and products-of-combustion type.

3.1.2.9.1 Fixed-Temperature Detectors. Fixed-temperature detectors shall be nonrestoring eutectic-metal type. Eutectic metals, alloys of bismuth, lead, tin, and cadmium which melt rapidly at a predetermined temperature shall act as a solder to secure a spring under tension. When the element fuses, the spring action shall close a set of contacts. Fixed temperature ratings shall be 190 degrees F for detectors installed in high ambient temperature areas such as boiler rooms and 136 degrees F for all other installations.

3.1.2.9.2 Fixed-Temperature, Rate-of-Rise Detectors. The fixed-temperature element of the combination fixed-temperature, rate-of-rise detector shall be as described in 3.1.2.9.1. The rate-of-rise contacts shall close when the rate of temperature rise exceeds 15 degrees F per minute. Detectors of this type must be able to withstand repeated tests of the rate-of-rise feature.

3.1.2.9.3 Rate-Compensated Detectors. Rate-compensated detectors actuate at a predetermined maximum temperature with compensation for rapid changes in the rates of temperature rise. The detector shall be rated 140 degrees F unless otherwise specified by the authority having design jurisdiction.

3.1.2.9.4 Products-of-Combustion Detectors. Products-of-combustion detectors shall be the ionization type with dual ionization chambers and the necessary related amplification circuits. The unit shall have a field-adjustable sensitivity range to compensate for various environments such as under-floor or ceiling installations, etc. The detector shall contain an alarm-indicating light. The detector shall respond in advance of visible smoke, flame, convected, or radiated heat due to combustion.

3.1.2.9.5 Spacing and Location of Detectors. The recommended spacing of detectors in UL listings and manufacturers' catalogs

is maximum and shall be used only in areas having smooth ceilings and minimum fire-hazard potential. The maximum areas to be protected by products-of-combustion-type detectors are 500 sq ft for detectors mounted under raised floors and 900 sq ft for ceiling-mounted detectors. The maximum area for combination and fixed temperature rate-of-rise detectors is 2500 sq ft. The maximum area for fixed-temperature-type detectors is 225 sq ft. Detectors shall be located in all rooms, halls, storage areas, basements, tunnels, stairways, work areas, janitor closets, equipment rooms, and other subdivisions of a building unless protected by an automatic fire extinguishing system. Detectors installed under raised floors shall be mounted in an inverted position. Overhead detectors shall be mounted directly on ceilings where practical. In no case shall ceiling-mounted detectors be mounted greater than 24 inches from the highest ceiling surface. The location of product-of-combustion type detectors shall be based on an engineering survey conducted in accordance with the NFPA No. 72E. An engineering survey shall be conducted by the installation contractor to ensure a reliable signal in the event of smoke in any portion of the protected area. The resultant analysis shall establish the location and spacing of product-of-combustion detectors based upon air velocity and travel and diffusion or stratification of smoke in a typical area cross section. Prior to installation of any equipment, the contractor shall report his findings, together with a statement including all other factors or methods used to determine location and spacing of detectors, to the design authority for approval. Acceptance of this report does not relieve the installation contractor of the responsibility for reliable system operation. The contractor shall perform operational tests necessary to verify smoke detection within the entire protected area prior to system installation acceptance.

3.1.2.10 Manual Fire Alarm Stations. Manual fire alarm stations shall be UL listed or FM approved, and their construction shall be such that a tell-tale glass or plastic rod or wire seal is broken during actuation of or tampering with the station. Hammer-and-glass or palm-plunger-through-glass types are not acceptable. Each station shall have provision for authorized personnel to use an appropriate tool to gain entrance to the interior of the station without actuating the station.

Design of manual stations shall incorporate an internal toggle switch rated for both ac and dc and factory-wired to a terminal block for field connections. In areas classified as hazardous because of the presence of hydrogen, class 1, division 1, group B UL-listed or FM-approved switches are required. Stations shall not be resettable without the use of a key-wrench or other tool except for the above described class 1, division 1, group B switches which shall be enclosed in a red sheet metal or plastic housing having provision for a plastic or wire seal.

A manual fire alarm station shall be installed as required by NFPA No. 72A and mounted adjacent to each normal egress exit from a building and every life safety exit from each floor in multi-storied facilities. Buildings having large bays or open areas shall have stations located so that it is not necessary to travel more than 200 feet to reach a station from any normal work area. Buildings having outside machinery rooms with solely exterior ingress/egress shall be provided with manual fire alarm stations not more than 200 feet outside the machinery room exit. In hazardous areas, stations shall be located so as to be accessible along evacuation routes. In propellant storage areas, stations shall be located throughout the area, based on an engineering survey.

3.1.2.11 Alarm Signal Appliances. Alarm signals shall be distinctive enough that they cannot be confused with other signals in the area. Fire alarm signals shall not be used for any other purposes. In general, alarm bells shall be electric solenoid-operated, plunger-type, vibrating, no-contact, under-dome alarm-indicating devices not less than 10 inches in diameter. Series-connected bell circuits are preferred, but parallel connected bell circuits (where electrical supervision of the bell coils is not provided) may be installed provided two bells are installed in each space so that loss of one bell will not leave the space without audible alarm. In areas of severe noise levels where occupants wear protective ear devices, revolving beacons or other adequate means of visible signaling shall also be provided. A beacon or flasher must always be used in conjunction with, never substituted for, a bell or horn.

NOTE

The use of a modulating tone or "warbler" horn is not acceptable, since this tone is already in use at KSC as a general evacuation signal.

Alarm signaling appliances shall operate continuously until reset. These appliances shall be located throughout the building or facility so that they may be clearly heard or seen regardless of maximum noise level or obstructions. All appliances shall be UL listed or FM approved.

3.1.2.12 Visual Alarms. The requirement for visual alarms shall be determined by the authority having design jurisdiction. If provided, electrically powered internally illuminated emergency exit signs shall flash as a visual alarm in conjunction with audible alarms. The flashing frequency of visual alarm devices shall be less than 5 Hz and more than 1 Hz. Reference American National Standard A117.1 for specifications for making buildings and facilities accessible to and usable by physically handicapped people.

3.1.3 Centerwide Fire Monitoring System. The centerwide fire monitoring system consists of monitoring equipment providing a central gathering point for alarm and trouble signals from each local fire-alarm-system, initiating device circuit. Additions and modifications to the centerwide fire monitoring system shall be in accordance with NFPA No. 72D.

3.2 Fire Control and Extinguishment.

3.2.1 Egress Aids. Successful escape from high-hazard fire is one of the prime goals of KSC Fire Protection. Within the element of Fire Control and Extinguishment, two egress aids are employed, i.e., water spray and fixed extinguishing system actuation warning.

3.2.1.1 Water Spray. In high-hazard work areas and where the egress route is considered complicated (see definitions, section 6.2), water spray shall be provided to aid egress by:

a. Providing a screen against radiant heat through which personnel may move easily

b. Producing an evaporative cooling effect of the air into which it is sprayed

c. Wetting the skin and clothing of the escapee to cool and dilute any propellant contaminants on the skin

The minimum spray rate shall be 0.2 gpm/sq ft of egress path, over a width of 6 feet and height of 8 feet, up to the first heat barrier (such as a platform bulkhead). A like amount shall be sprayed along the prescribed egress route beyond the first heat barrier for a minimum distance of 20 feet or to an area of refuge. The pattern of nozzles employed must provide the minimum required horizontal and vertical coverage in areas when subjected to wind and draft effects. The egress aid spray system shall be activated with the fixed fire extinguishing system serving the hazardous area.

3.2.1.2 System Actuation Warning. In areas where fixed fire extinguishing systems present a safety hazard to occupants, warning signs and alarm signaling appliance shall be provided. Audible alarm devices shall be of the style and type as set forth in 3.1.2.11. These audible alarms shall be activated with the fixed fire extinguishing system and shall have delay periods as described herein.

3.2.1.2.1 Deluge Systems. Concurrent with the actuation of the fixed fire extinguishment system, a warning alarm shall be sounded in all areas served by that system. Built-in delays in deluge systems, including preprimed, millisecond response systems, are not permitted.

NOTE

Except for millisecond response systems, the time for deluge valves to open, fill the lines to the spray heads, and develop a spray pattern allows sufficient time for personnel to take appropriate action.

3.2.1.2.2 Inerting/Extinguishing Agents Other Than Water. Where the agent presents or produces a suffocating potential or impairs visiblity (CO_2, Dry Chemical, Foam, GN_2 or Halon 1301), a warning device shall be sounded in all areas served by the system prior to (or upon) delivery of the agent into the area. An actuation delay period, if any, shall be determined after considering the following:

a. The safety hazard to occupants

b. The evacuation routes available to occupants

c. The risk to the facility and contents

d. The risk to nearby personnel and adjacent facilities

The delay time used shall be approved by the authority having design jurisdiction.

3.2.2 Safety and Rescue Aids. The facility designer shall make provision for the installation of safety showers, basket stretchers, life lines, oxygen rebreather apparatus, and other equipment as directed by the authority having design jurisdiction.

NOTE

The selection and placement of safety and rescue aids are within the responsibility of the KSC Fire and Safety Departments and outside the scope of this standard. The necessary cabinets, racks, water supplies, wall niches, etc., to be provided

are, however, within the scope of this standard. Provisions for installation of this type of equipment is considered a part of the facilities fire protection design.

3.2.3 Fire Classes. Fire hazards at KSC are divided into the following four major classifications which follow those defined in NFPA No. 10.

3.2.3.1 Class A - Ordinary Combustible Solids. Fires in ordinary combustible materials such as wood, cloth, paper, rubber, and many plastics.

3.2.3.2 Class B - Flammable Liquids and Gases. Fires in flammable liquids, gases, greases, tars, oil-base paints, and lacquers.

3.2.3.3 Class C - Electrical Fires. Fires which involve energized electrical equipment where the electrical nonconductivity of the extinguishing media is of importance (when electrical equipment is deenergized, extinguishers for Class A or B fires may be used safely).

3.2.3.4 Class D - Combustible Metals and Extinguishing Agent Reactive Materials. Fires in combustible metals such as magnesium, titanium, zirconium, sodium, potassium, and lithium (see also 3.2.5.5).

3.2.4 Fundamentals of Extinguishment. KSC fire protection philosphy recognizes four extinguishing methods which may be employed singly or in combination depending upon the fire class and agent(s) available.

3.2.4.1 Cooling. Cooling is the most widely used and, in the case of fires in ordinary combustible materials, the most effective means of extinguishment. Extinguishment occurs when the surface of a burning material is cooled to a point where it ceases to release enough vapors to maintain a combustible mixture in the combustion zone. The efficiency of an extinguishing agent as a cooling medium depends upon its specific and latent heats. One reason for the effectiveness of water as an extinguishing agent is that its specific and latent heats are higher than those of other extinguishing agents. Heat is carried away from a fire by radiation, conduction, and convection as well as being absorbed by the cooling agent. It is standard procedure to ventilate a fire as a fire control aid. Products of combustion, including heat, are thus removed from the fire area, and, at the same time, some of the unburned combustible vapors or gases are removed. Inert dusts, and, to some extent, inert gases, through heat absorption also have a cooling effect on the fire.

3.2.4.2 Fuel Isolation, Dilution, or Emulsification.

3.2.4.2.1 Fuel Isolation. Fuel isolation is the simplest means by which fire may be extinguished, i.e., isolating the combustible material from its source of oxygen. This method is most effective where fuel shutoff is possible.

Similarly, various foams may be applied to form a barrier blanket to separate the fuel from its source of atmospheric oxygen. In the case of Class D fires, special agents may be applied to form an isolating crust to separate the fuel from its oxygen source.

3.2.4.2.2 Fuel Dilution. Fuel dilution is an effective means of extinguishment in cases where a flammable liquid fuel is water soluble. The concentration of combustible material is reduced by dilution to a point below its flammable limit. This method has the added advantage of lowering the toxic concentrations in fires involving the hydrazine-based fuels.

3.2.4.2.3 Fuel Emulsification. Fuel emulsification is employed in cases where the fuel is not soluble in water but will form an emulsion with water. The agitation of the fuel with water forms an incombustible surface which produces the same net effect as that of dilution.

3.2.4.3 Oxygen Displacement. This method differs from fuel isolation (3.2.4.2.1) in that the availability of oxygen to the fuel is diminished or eliminated rather than isolating the fuel from any oxygen source. Although the effect of the two methods is the same, the effectiveness of agents and their application varies widely. Generally, oxygen displacement is an effective means of extinguishment for small Class A, B, and C fires. However, the problems of maintaining an inert atmosphere in the open or around large fires usually preclude the use of agents which extinguish by this method. Successful extinguishment requires that the oxygen-displacement atmosphere be maintained long enough for the combustible material to cool below its self-ignition temperature as well as that of other potential ignition sources. This method has limited value in cases where the combustible material has a hot ember stage. This method is of no value in cases of materials which contain their own oxygen supply. Agents which have high molal heats, such as CO_2 and Halon 1301, are the most effective in displacing oxygen. (Molal heat = specific heat x molecular weight.) Thermal conductivity of inert gases is a factor of secondary importance; gases with relatively high conductivity are more effective.

3.2.4.4 Chemical Blocking. This method refers to the flame inhibition which occurs when halogenated hydrocarbons, alkali metal salts, or ammonium salts are introduced into the combustion process. Upon injection of these substances into flames, the substances thermally dissociate into their anionic and cationic "free radicals" and catalyze the union of the OH and H combustion reaction "chain carriers," thereby mitigating their influence upon the continuation of the flame. By this action the flame becomes inhibited, and extinguishment is accomplished when proper amounts of the agents are applied.

3.2.5 Extinguishing Agents. The KSC fire protection philosophy regarding extinguishing agents is that the number of different agents used will be held to a minimum. The designer should endeavor to work with the agents and techniques already in use at KSC as listed herein. As new extinguishing agents or application techniques develop and are proven, consideration will be given their use at KSC.

The final choice depends largely upon the effects of the agent and a full evaluation of the property to be protected.

3.2.5.1 Water. Water is applied by three methods at KSC and usually is the best choice for Class A or B fires (see table 1).

Table 1. Water as an Extinguishing Agent

Method of Application	Usual Class of Fire Usage
Hose Streams	A, B
Sprinklers	A, C
Deluge Systems	A, B, C

NOTE

The use of water in any form on Class C fires is subject to a full evaluation of the hazard, the equipment involved, and the inherent risks to personnel.

3.2.5.2 Foam. Selection of ingredients for foam systems must be based on the fuel present to ensure compatability and effectiveness.

3.2.5.3 Gases. Three gases are used at KSC as extinguishing agents: carbon dioxide (CO_2), bromotrifluoromethane (Halon 1301), and nitrogen (GN_2).

3.2.5.3.1 CO_2. CO_2 is generally the most practical agent in use to extinguish small Class B and C fires, especially indoors where wind effect is minimized. CO_2 from both portable and fixed systems, because it is nonconductive, is the most commonly used agent against non-deep-seated Class C fires. An attractive characteristic of CO_2 is the lack of cleanup and damage to equipment. In cases of deep-seated electrical fires, total-flooding CO_2 systems are usually required to effect estinguishment.

3.2.5.3.2 Halon 1301. Halon 1301 is effective against Class A, B, and C fires. Because of its high cost, however, its use at KSC should be carefully evaluated in relationship to other equally effective but less costly agents. Refer to NASA NSS/FS-1740.3 and U. S. Department of Commerce RP-1 for guidance.

3.2.5.3.3 Nitrogen. Gaseous nitrogen is used primarily in hazard-proofing electrical equipment enclosures and is not commonly used at KSC for extinguishment. The use of a nitrogen flooding system may, however, be considered

where a generous supply of nitrogen exists in the area to be protected and where oxygen displacement is the only feasible and practical means of extinguishment. (See 3.2.7.5.3.)

3.2.5.4 Dry Chemicals. The dry chemical agents in use at KSC are sodium bicarbonate, potassium bicarbonate (Purple K) and monoammonium dihydrogen phosphate (MDP). All of these agents are effective in Class B and C fires, while MDP is also effective in Class A fires. Extinguishment is achieved solely by the chemical blocking method and little cooling effect takes place. This lack of cooling effect and the resulting re-ignition hazard from hot surfaces limits the use of dry chemical at KSC to portable equipment, small fires, or suitably sized fixed systems.

3.2.5.5 Special Purpose Agents. The use of special purpose agents at KSC is limited to Class D fires. The selection, location, and application of special agents against these hazards are within the responsibility of the KSC Fire Services.

3.2.6 Extinguishing Agent/Method/Fire Class Matrix. The extinguishing methods and fire classes previously discussed are shown in graphic form to illustrate the relationships between various agents in use at KSC, their extinguishing methods, and the class or classes of fires against which they are effective. (See figure 2.)

3.2.7 Extinguishing Systems.

3.2.7.1 Standpipes and Hose Systems. The design of standpipes and hose systems shall conform to NFPA No. 14. Standpipes shall be pre-primed type. Standpipes are required for the following types of facilities and areas:

a. In buildings either four or more stories in height or 75 feet or more above grade

b. On each side of any stage arranged or intended for use with movable scenery, rigging, loft, etc.

c. In large areas such as warehouses and storage buildings where there is a heavy concentration of combustibles

d. Windowless or underground buildings having unbroken lengths or blank walls, or buildings where the dimensions are such that all areas cannot be reached by large hose lines not exceeding 300 feet in length when supplied from exterior hydrants or fire-department pumpers

e. On each service structure level in the working area and on that same level immediately outside of the first heat barrier, preferably along the egress route; hoses shall be of sufficient length to reach all portions of the platform. (See 3.2.8.5.2.)

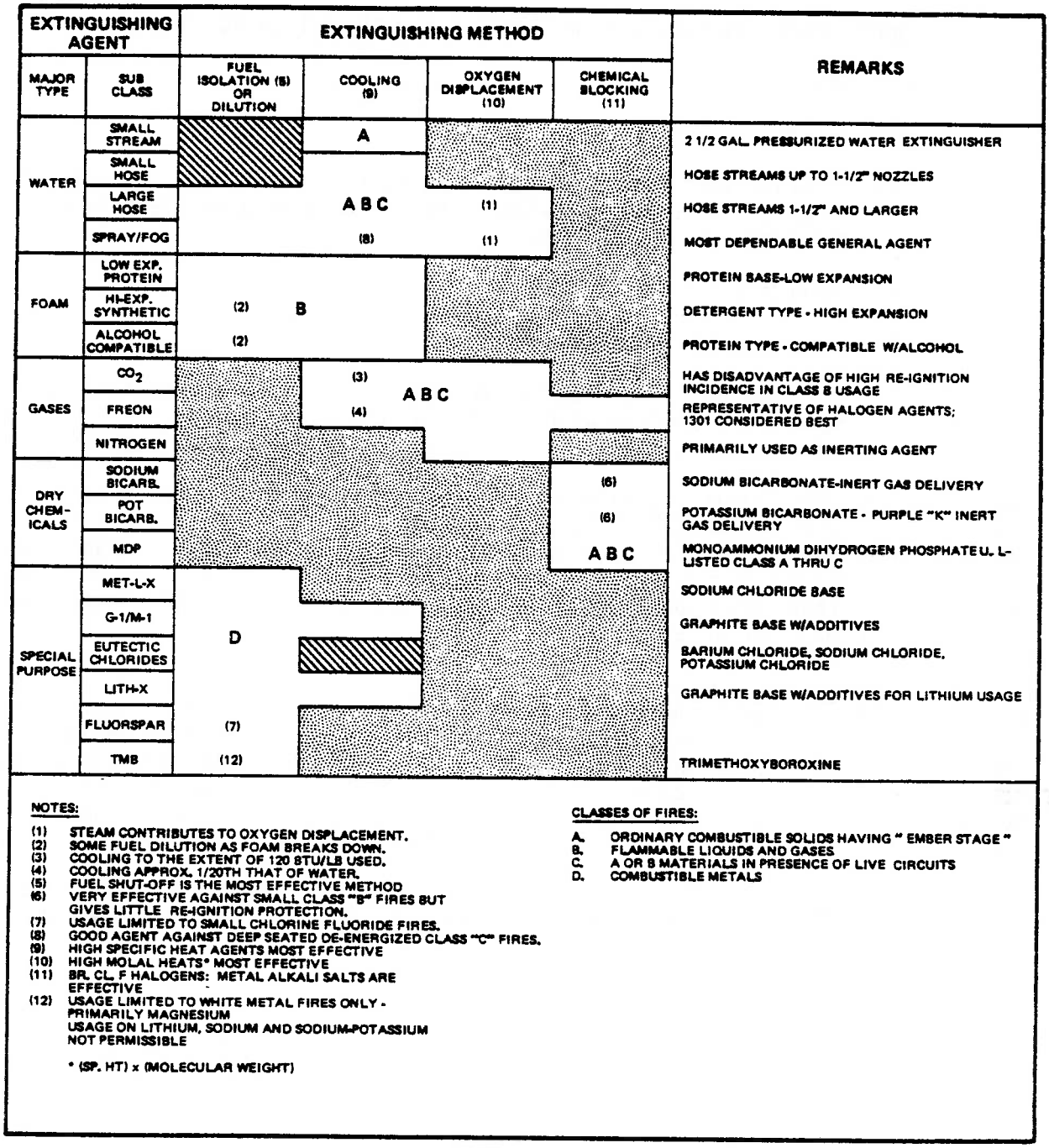

Figure 2. Extinguishing Agent Matrix

f. When specified by NFPA No. 101

g. Additions to the foregoing will be based on the following considerations:

(1) Area

(2) Height

(3) Interior partition arrangement being such as to make it difficult to extend exterior fire-hose lines to provide adequate service to all areas in the building

(4) Combustibility of contents

(5) Automatic sprinkler protection

(6) Isolated buildings located beyond the range of organized fire-department service with consideration given to type of construction, class of occupancy, and importance of facility

3.2.7.1.1 Size and Interconnection. Standpipes shall be sized based on complete hydraulic calculations based on the maximum water flow of all fire protection devices connected at any one floor or platform level served by that standpipe. Standpipes exceeding 75 feet or four stories in height shall be at least 6 inches in diameter. Others shall be at least 4 inches in diameter. Multiple standpipes in a facility shall be interconnected.

3.2.7.1.2 Number of Fire Department Connections. All standpipes shall be equipped with a fire department connection. Interconnecting piping for standpipes in buildings facing more than one street shall have at least two fire department connections, each located so as to be readily accessible from the facing streets. Mobile launch support structures shall have at least two fire department connections located on opposite sides of the structure and arranged so that they are accessible regardless of structure location. (See 3.2.8.4 and 3.2.7.3.5.)

3.2.7.1.3 Capacity. Standpipe shall be sufficient to provide the capacity and pressure requirements as set forth in NFPA No. 14. The minimum quantities shall be as set forth in table 2.

Table 2. Hosestream Flow Requirements
Light and Ordinary Hazards*

Height and Fire Area (net sq feet)	Unsprinkled Facility		Sprinkled Facility	
	Fire Resistive, N.C. (Masonry), Ordinary, and Heavy Timber	Frame, N.C. (All Metal)	Fire Resistive, N.C. (Masonry), Ordinary, Heavy Timber	Frame, N.C. (All Metal)
1 story	(gallons per minute)			
0-10,000	750	1250	250	250
10,000-20,000	1000	1750	250	250
20,000-80,000	1250	2500	250	500
Multi-Story				
0-10,000	1000	2000	250	500
10,000-20,000	1250	2500	250	500
20,000-80,000	1750	3000	500	750

*Extra hazards require hose streams 50 percent greater than those shown

3.2.7.1.4 Hose Connections. Standpipes shall be equipped for Class III service (as defined in NFPA No. 14). At KSC, the standard Class III arrangement shall be:

A standpipe shall be located in each stairwell with valve, rack, and hose at each floor or platform level located outside the stairwell where possible. The hose connection shall be one 2-1/2-inch valve with 2-1/2-inch NST threads fitting with a 2-1/2 by 1-1/2-inch adapter fitting.

3.2.7.1.5 Hose. Hose shall be 1-1/2-inch woven jacket, rubber-lined type and shall not exceed 100 feet in length. Hose shall be UL listed.

3.2.7.1.6 Hose Nozzles. Nozzles shall be combination spray, straight stream, shutoff type and shall be UL listed or FM approved.

3.2.7.2 Sprinkler Systems. The design of sprinkler systems shall conform to NFPA No. 13 and NFPA No. 231C. Sprinkler systems at KSC shall be of the wet-pipe type, preaction type or the deluge type as defined by NFPA No. 13. Wet-pipe sprinkler systems utilizing approved on-off-type sprinkler heads are the standard means of protection for essential electronic areas (NASA NSS/FS-1740.3).

All piping, valves, sprinkler heads and related accessories shall be UL listed or FM approved components. The requirements for sprinkler systems at KSC facilities are divided into three groups: Mandatory, Optional, and Conditional.

3.2.7.2.1 Mandatory. Sprinkler systems shall be provided in the following facilities:

a. Warehouses and other indoor storage areas wherein the area involved is 20,000 sq ft or greater; where the stored contents are considered mission critical; where the stored value exceeds $1,000,000; or where the stored contents are of an extra-flammable nature

b. Indoor areas occupied by motor vehicles for purposes of storage or maintenance including those portions of fire stations occupied by motor-driven fire-fighting apparatus; sprinkler systems in such areas shall meet the requirements of NFPA No. 88, A or B, as applicable

c. Paint shops shall be sprinkler protected and shall be provided with a 1-1/2-inch hose station for every 100 feet of perimeter wall. (See 3.2.8.5.) Sprinklers shall meet the requirements of NFPA No. 33.

d. Oil-fired boiler rooms shall be sprinkler protected, and the burner equipment shall contain combustion safeguard equipment as specified in 3.2.10.

e. Required per NFPA No. 101

f. Kitchens shall be sprinkler protected if an adequate supply of water is available. Where not so protected, one 1-1/2-inch hose station shall be provided for every 200 feet of perimeter wall (see 3.2.8.5).

g. Indoor petroleum, oil, and lubricants (POL) storage where 100 or more gallons of flammable liquids are stored shall be sprinkler protected if an adequate water supply is available.

3.2.7.2.2 Optional. Sprinkler systems are recommended but are optional in lieu of other fixed extinguishing systems in the following facilities:

a. Where kitchens are not sprinkler protected per 3.2.7.2.1.f, grills and related ventilators shall be protected by automatic sprinkler equipment over the grill and in related ventilators only, by a fixed automatic/manual CO_2 system, or a fixed dry chemical system. Any such equipment or system shall be interlocked with the fan motor and a fire damper. Fire protection for cooking equipment and related ventilating systems shall meet the requirements of NFPA No. 96.

b. If an adequate water supply is not available where 100 or more gallons of flammable liquids (petroleum, oil, and lubricants) are stored indoors or if the cost of providing such a supply exceeds the cost of a fixed automatic/manual total flooding CO_2 system, then such a CO_2 system shall be provided.

c. Hydraulic equipment rooms utilizing combustible fluids should be sprinkler protected. Where an adequate supply of water is not available where the cost ratio is as stated in b. above, or where the equipment must operate while the water supply is disconnected (as in the case of mobile equipment during transit), this requirement is optional in lieu of automatic/manual fixed CO_2, dry chemical or totally stored foam systems. The final choice of protection shall be based on a complete and thorough evaluation of the fire hazard and the costs of the optional systems.

3.2.7.2.3 Conditional. Sprinkler systems designed to protect against the hazards present shall be provided in the following facilities if the mission criticality of the installation so dictates:

a. The base of elevator shafts which, if lost by fire damage, would seriously impact KSC mission operations

Examples: Applicable - High rise elevators in the Vehicle Assembly Building

Not Applicable - Personnel elevators in the Headquarters Building

b. Laboratories in which vehicle or related components are cleaned or calibrated which, if lost by fire damage, would seriously impact KSC mission capability

Examples: Applicable - Propellant Systems Component Laboratory

Not Applicable - Malfunction Investigation Laboratory

c. Cable tunnels in which launch critical cables are located which, if lost by fire damage, would delay launch capability

3.2.7.2.4 Number of Fire Department Connections. Fire department connections shall be provided in each sprinkler or standpipe riser of 4-inch or greater diameter where the riser is not interconnected to other risers or to a yard piping system. When sprinkler or standpipe risers are interconnected, a minimum of two fire department connections shall be provided. (See 3.2.8.4.)

3.2.7.2.5 Spacing, Location, and Position of Sprinklers. The selection of the number and size of the sprinklers, the spacing between lines, and the feed piping shall be developed from hydraulic calculations only after a complete analysis

of the fire and occupancy hazard involved. The determination of these variables shall be guided by the spacing rules as set forth in NFPA No. 13. Because of variances in construction, occupany, and stored material hazards, the authority having design jurisdiction and the KSC fire protection and rescue management will supply criteria information prior to the design of sprinkler protection in any specific area at KSC.

3.2.7.2.6 Sprinkler Discharge Densities. Where sprinkler systems are required, the sprinkler discharge densities shall be as set forth in the design criteria for that installation. In cases where the criteria does not specify discharge densities, the densities shall not be less than those shown in table 3. (See 3.3.3 and 3.3.5.)

Table 3. Sprinkler Discharge Densities - Gpm/Sq Ft

Fire Hazard Classification	Construction Classification						
	Fire Resist. "A"	Fire Resist. "B"	Prot. Non-Comb.	Unprot. Non-Comb.	Heavy Timber	Ordinary	Wood Frame
Light	.12	.12	.15	.18	.20	.20	.22
Ordinary Group 1	.20	.20	.22	.25	--	--	--
Ordinary Group 2	.30	.30	.33	.36	--	--	--
Ordinary Group 3	.35	.35	.38	.40	--	--	--
Extra	.50	.50	.50	.50	--	--	--

3.2.7.2.7 Minimum Water Quantities Supplied to Sprinkler Systems. All water supplies serving sprinkler systems shall be not less than 6 inches in diameter.

3.2.7.2.8 Fixed Deluge Systems. The design of deluge systems shall conform to NFPA No. 15. With the exception of preprimed, millisecond response systems, Deluge systems at KSC shall be of the dry pipe, deluge valve, open spray nozzle type. Deluge systems shall be interconnected to the local fire alarm system as specified in 3.1.2.4. Piping valves, spray nozzles, and related accessories shall be UL listed or FM approved. Pneumatically operated ball valves or butterly valves and water operated globe valves may be used in deluge valve service if approved by the authority having design jurisdiction. The requirements for deluge systems at KSC are divided into four functional categories, i.e., sized for extinguishment, sized for fire control, sized for exposure protection and special purpose high speed systems.

3.2.7.2.9 Deluge - Extinguishment. Deluge systems sized to extinguish the fire hazard present shall be provided in the following facilities:

a. Parking areas adjacent to launch pads where there are transfer units containing hydrazine-based fuels shall be provided with fixed spray systems delivering a coarse spray of not less than 0.5 gpm/sq ft. The area to be protected shall be calculated as the square feet of parking area plus the area of the sides of the transfer unit. The spray pattern shall be essentially vertically downward in direction. The system control shall be by manual means with the controls mounted on two suitable pedestals located on opposite sides of the parking area immediately adjacent to the hose reel station. (See 3.2.9.4.) Curbs, dikes, perimeter trenches, and impounding facilities shall be provided as specified in 3.3.7.3.

b. Propellant testing laboratories, except solid propellant testing areas, shall be protected with deluge systems sized and arranged to extinguish propellant fires that might break out. Where multiple fuels are handled or processed, the system shall be designed to extinguish the most dangerous fire. Personnel safety exits and other area construction features shall be as specified in section 3.3.

c. Hazardous spacecraft systems test facilities such as cryogenic, hypergolic, and environmental systems test facilities shall be provided with deluge systems sized and arranged to extinguish the greatest hazard present during normal test operations. Information regarding the quantities of flammables involved will be supplied at the time of design. Life safety exits and other construction features shall be as specified in section 3.3.

3.2.7.2.10 Deluge - Fire Control. Deluge systems sized and arranged for fire control shall be provided in the following facilities:

a. Parking areas adjacent to launch pads for transfer units containing nitrogen tetroxide propellant oxidizer shall be provided with deluge water spray systems delivering a coarse spray of not less than 0.25 gpm/sq ft. The area to be covered and location of controls shall be as specified in 3.2.7.3.1. Curbs, dikes, and related impounding facilities shall be as specified in 3.3.7.3.

b. Service structure and assembly building work platforms shall be provided with deluge systems, sized and arranged to provide full coverage over the deck areas as shown in table 4. Platform deluge systems shall be controlled manually by pushbutton control stations located on each work platform within the work area and adjacent to the platform exitway. Figures 3 indicates the basic arrangement and design philosophy of control components in the principal, Deluge systems at KSC. (See also 3.2.7.8.7.)

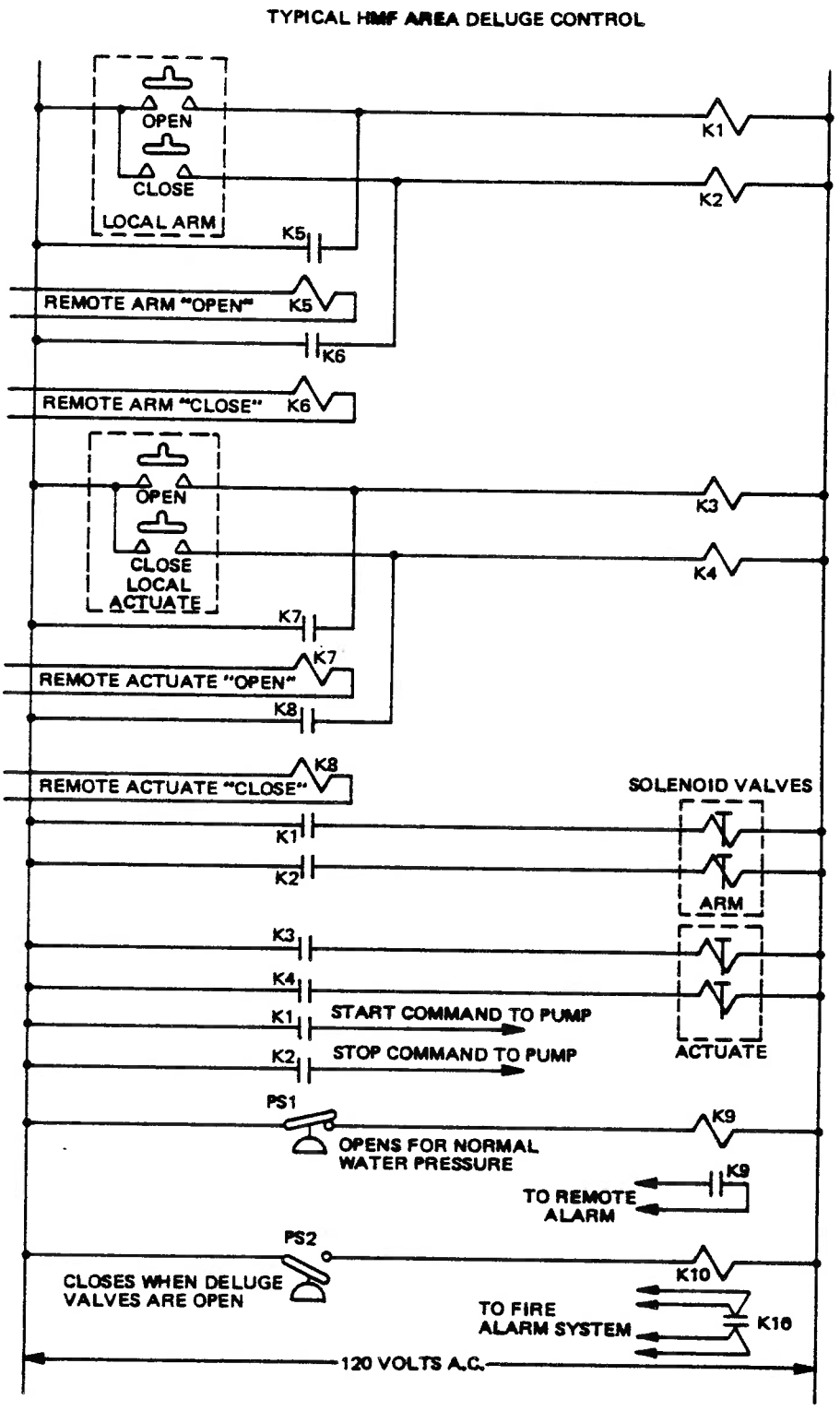

Figure 3. Deluge System Control Schematics (Sheet 1 of 6)

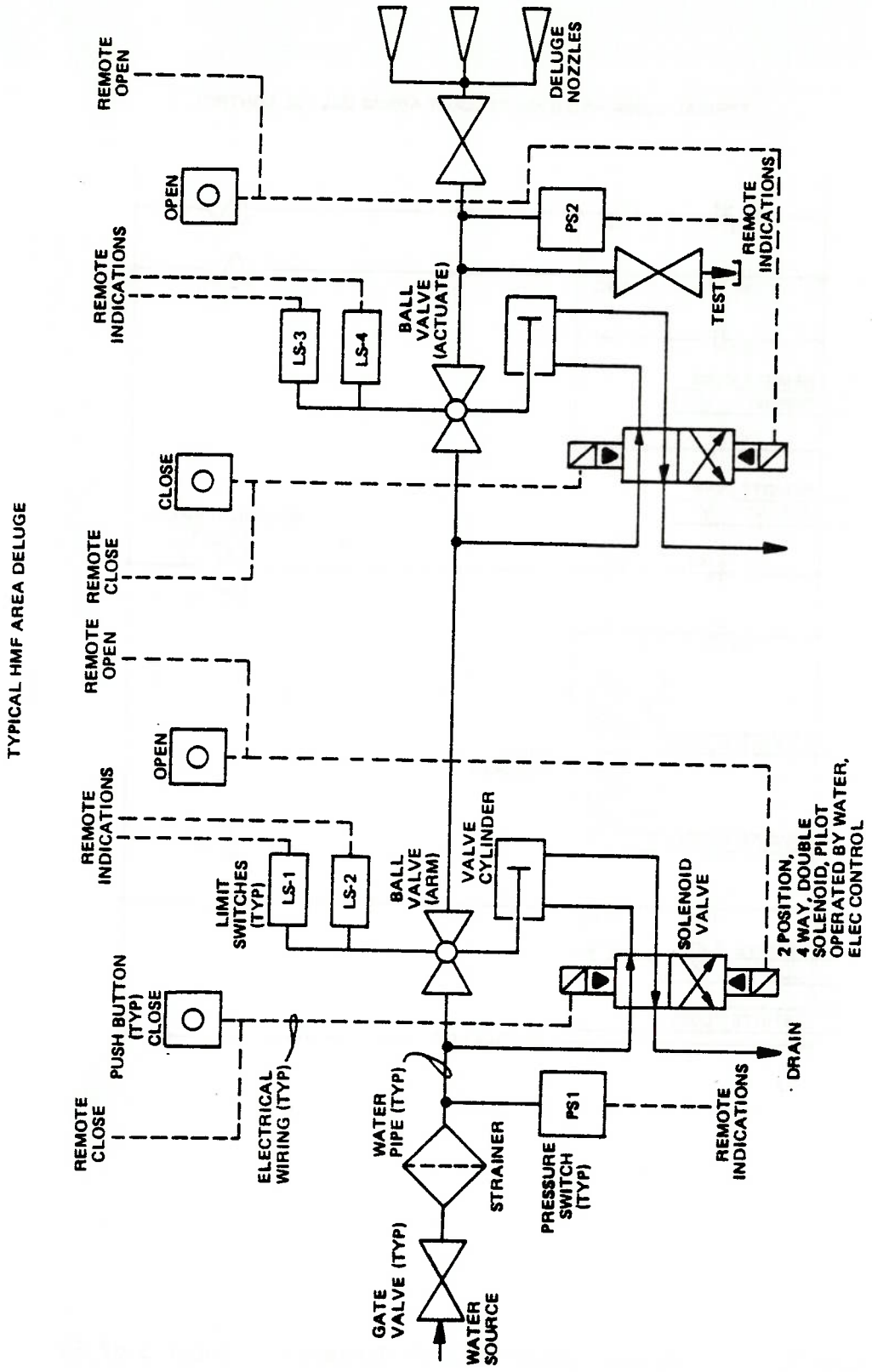

Figure 3. Deluge System Control Schematics (Sheet 2 of 6)

TYPICAL LC39A AND B PROPELLANT AREAS DELUGE CONTROL

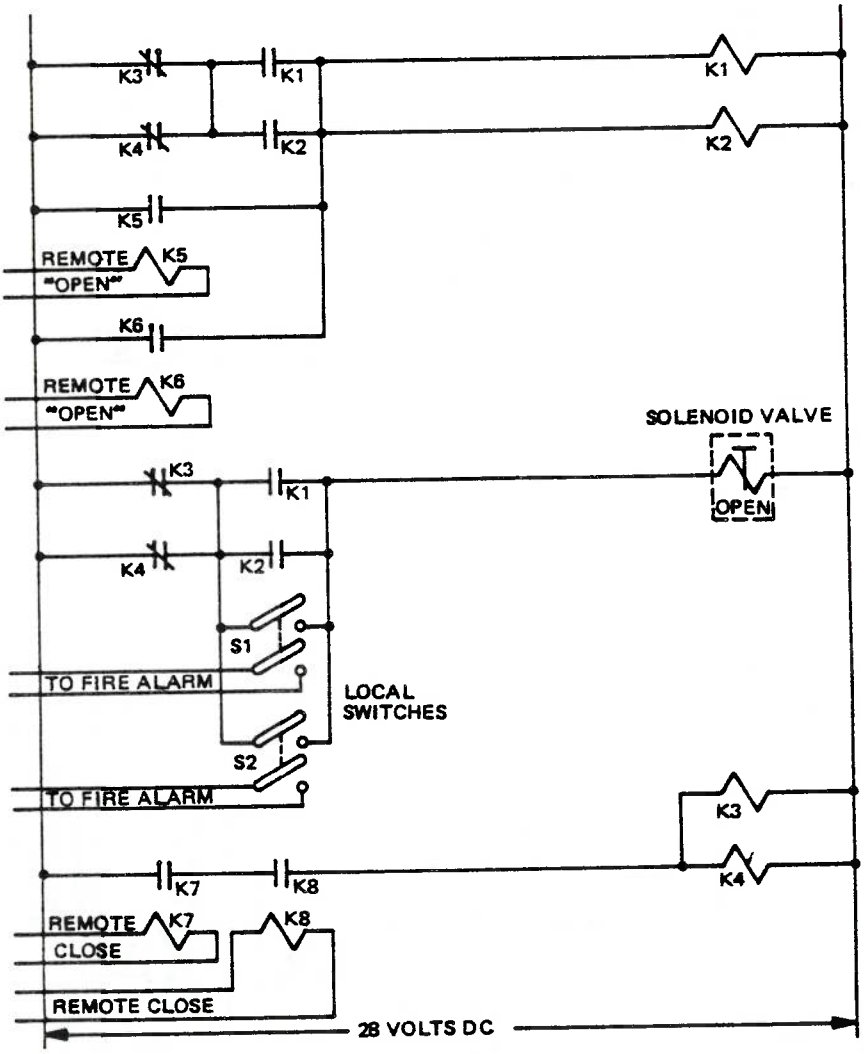

Figure 3. Deluge System Control Schematics (Sheet 3 of 6)

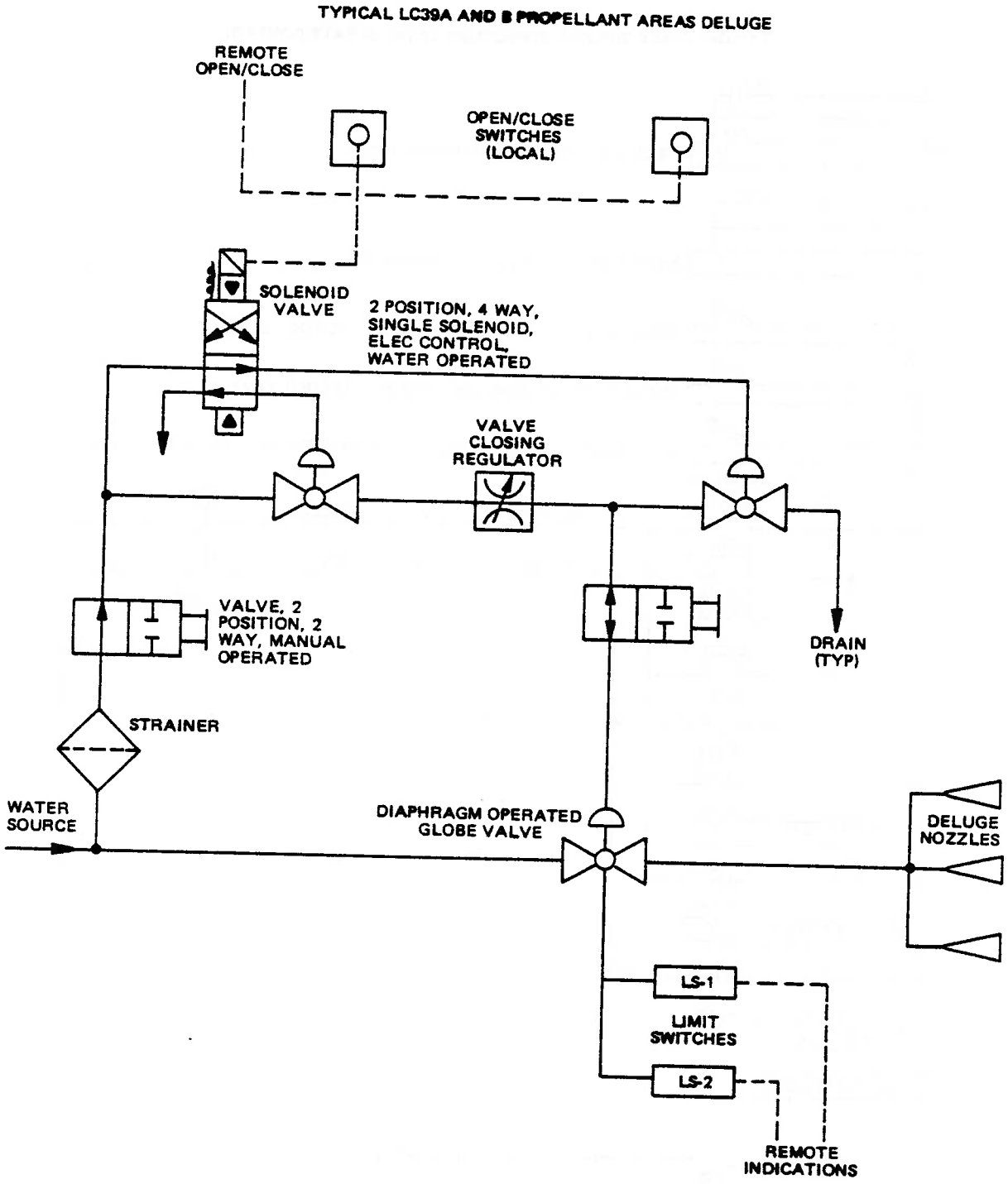

Figure 3. Deluge System Control Schematics (Sheet 4 of 6)

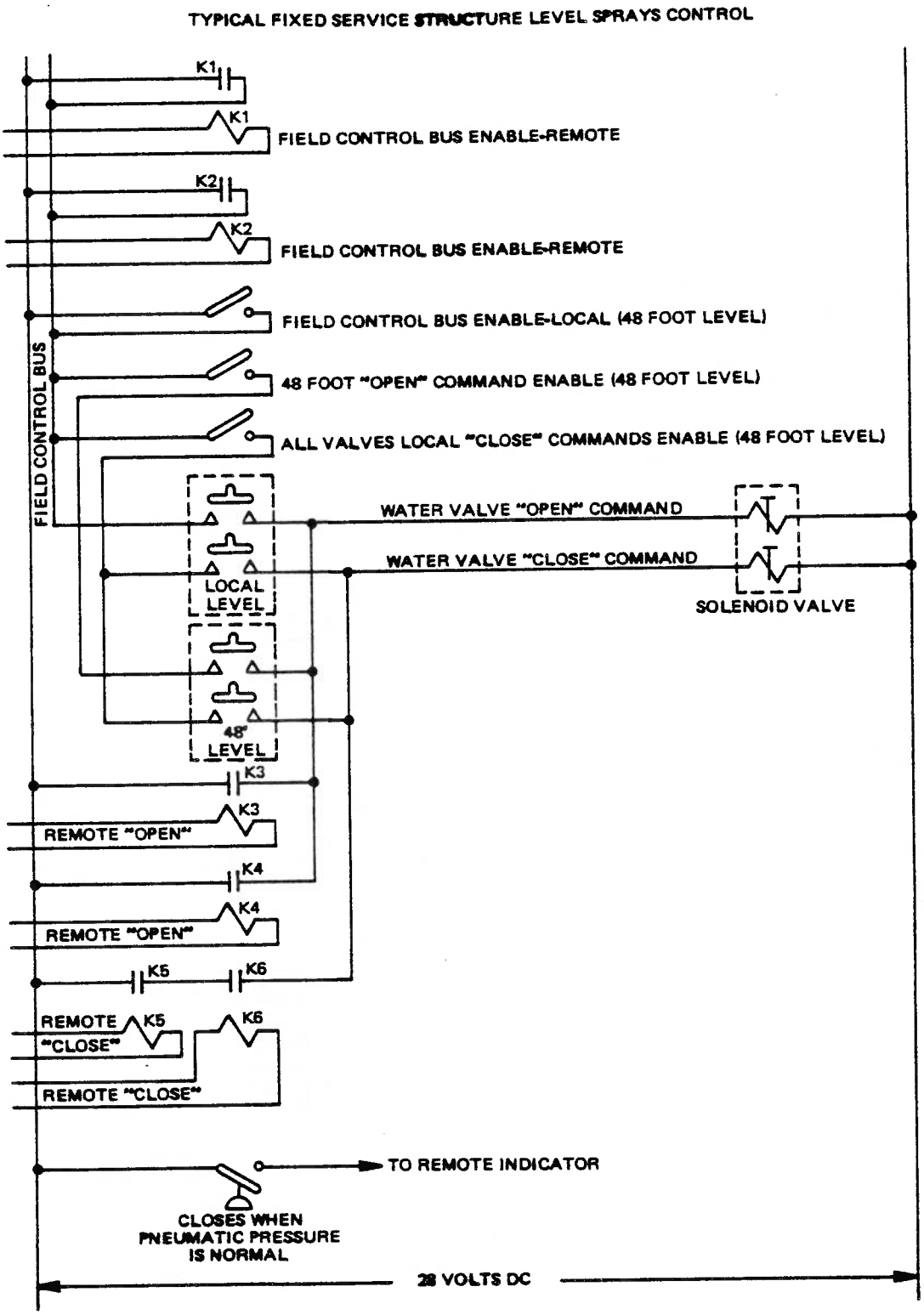

Figure 3. Deluge System Control Schematics (Sheet 5 of 6)

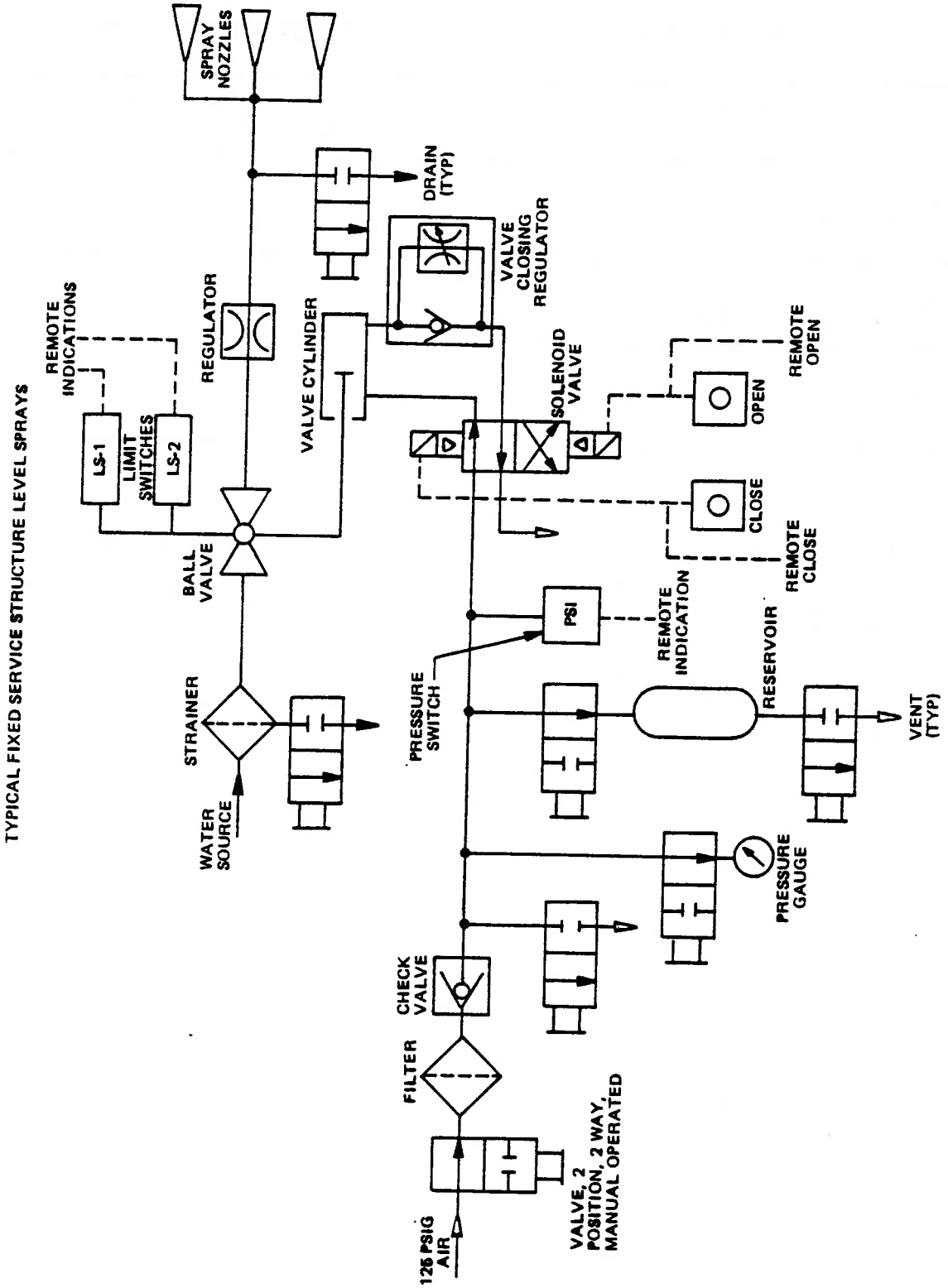

Figure 3. Deluge System Control Schematics (Sheet 6 of 6)

Table 4. Service Platform Spray Coverage and Densities

Type of Platform Activity	Coverage (Percent of Area)	Spray Density (Gpm/Sq Ft)
Normal Checkout and Assembly No Propellant Transfer	100	0.25 (2)
Normal Checkout With Propellant Transfer	100	0.50 (2)
Areas Used Exclusively for Solid Rocket Motor Handling and Servicing	(1)	(1)

(1) See 3.2.7.2.12

(2) Spray nozzles shall be arranged to develop a pattern from above the hazard, and such pattern shall impinge on cable trays, items of GSE and all similar equipment normally in use on such platforms.

c. Service structure exit passageways shall be provided with deluge systems to aid egress as set forth in 3.2.1.1. The egress aid spray shall be connected to and activated with the fire protection spray serving that platform level.

d. Toxic propellant transfer control manifolds located adjacent to the launch vehicle shall be provided with deluge systems sized for fire control.

3.2.7.2.11 Deluge - Exposure Protection. Deluge systems, sized to cool and protect against exposure from nearby fires, shall be provided for cryogenic and gaseous oxygen and hydrogen storage containers and grouped piping and pumps and shall be arranged to deliver a uniform spray pattern over 100 percent of the container surface, pumps, and adjacent piping. The minimum spray rate acceptable shall be 0.2 gpm/sq ft of exposed surface. Control shall be with manual control stations located outside the hazardous area but within effective sight of the facility protected. Remote control capability shall be provided as directed by the authority having design jurisdiction.

3.2.7.2.12 Deluge - Preprimed, Millisecond Response. High speed deluge systems controlled by an automatic detector with manual override shall be provided at ordnance inspection areas where solid propellant grains are exposed for purposes of visual, optical, or mechanical examination. Facilities where solid propellant grains are X-rayed through their cases do not require these systems.

NOTE

Preprimed, millisecond response systems are considered special purpose systems. Such systems shall be designed by and installed under the supervision of personnel experienced in this specialized field.

3.2.7.2.13 Fire Department Connections. A fire department connection shall be provided for each deluge system supply. The connection shall be located near grade level and at a safe distance from the hazardous area. (See also 3.2.7.1.2 and 3.2.8.4.)

3.2.7.4 Fixed Foam Systems. The design of fixed foam systems shall conform to the requirements of NFPA No. 11. Fixed foam systems at KSC shall be of the low expansion, mechanically generated protein type. Piping, foam-making equipment, valves, foam nozzles, sprinkler heads and related accessories shall be UL listed or FM approved. Fixed foam extinguishing systems are required in all petroleum based rocket fuel pump rooms and valve manifolds. These areas shall be protected by fixed foam systems sized and arranged to give complete coverage of the fire area. Controls shall be automatic with manual override capability.

3.2.7.4.1 High Expansion and Alcohol-Compatible Foam Systems. The use of high-expansion synthetic foam and alcohol-compatible, low-expansion foams at KSC is limited to mobile fire-fighting apparatus. No fixed systems utilizing these extinguishing agents are contemplated.

3.2.7.5 Fixed Gas Systems. The design of fixed gas systems shall conform to the requirements of NFPA No. 12. The requirements for fixed gas systems at KSC are divided into three groups: CO_2, Halon 1301, and nitrogen. Fixed gas-extinguishing systems are required in the following facilities.

3.2.7.5.1 CO_2. Fixed, automatic, total-flooding CO_2 systems shall be located so as to protect the following equipment:

a. Cable terminal facilities where loss by fire would seriously impact the KSC mission capability. In large instrumentation cabling termination rooms (10,000 terminations or more), consideration should be given to the use of fixed CO_2 backed up with automatic sprinklers. The degree of sprinkler backup in such cases shall be directed by the authority having design jurisdiction.

b. Chemical cleaning tanks utilizing flammable solvents, kitchen grills, and related ventilator systems, indoor POL storage, and hydraulic equipment rooms where automatic sprinklers are not provided

3.2.7.5.2 Halon 1301. Bromotrifluoromethane extinguishing systems are considered special-nature, special-purpose systems. Their use shall be as directed by the authority having design jurisdiction and in accordance with NASA NSS/FS 1740.3 for essential electronic equipment operations.

Halon 1301 systems are in use at KSC in extraordinary situations where there is a:

a. Critical need to protect data in process

b. Desire to reduce equipment fire damage through early automatic fire extinguishment

c. Need to protect void spaces not suited for sprinkler protection (for example, beneath the raised floor areas)

d. Critical need to facilitate return to service

3.2.7.5.3 Nitrogen. Gaseous nitrogen systems are not presently employed at KSC for purely extinguishing purposes. The use of nitrogen in future fixed extinguishing systems shall be at the direction of the authority having design jurisdiction.

3.2.7.6 Fixed Dry Chemical. The design of fixed dry chemical systems shall conform to the requirements of NFPA No. 17. Fixed, automatic dry chemical systems may be substituted for CO_2 systems where it can be shown that significant cost savings can be achieved. Such substitutions are permitted wherever CO_2 may be used except for protection of electrical apparatus.

3.2.7.7 Special Agents. The selection, sizing, and placement of special extinguishing agents, primarily those effective against Class D fires, is considered solely within the jurisdiction of the KSC fire protection and rescue management and is not within the scope of this standard.

3.2.7.8 Fixed System Controls.

3.2.7.8.1 General. Manual controls for the activation of any fixed extinguishing system shall meet the following general criteria:

a. The controls shall be located so as to be readily available to occupants. Control switches shall be equipped with protective guards.

b. The necessary path from the normal work area to the controls and the path from the controls to the normal exitway shall be unobstructed.

c. The controls shall be clearly visible and permanently identified.

d. The controls shall be made as simple as possible and shall be arranged so that their operation is easily understood.

3.2.7.8.2 Types of Controls. Fixed extinguishing systems shall be controlled by either electrical or pneumatic or combination circuits. Electrical control is preferred but is subject to an evaluation of power reliability.

3.2.7.8.2.1 Electrical Controls. Two control voltages are in use at KSC for auxiliary (control) circuits. These same voltages shall be utilized in future designs. Nominal voltages in use are 28 volts dc and 120 volts ac.

3.2.7.8.2.2 Pneumatic Controls. Compressed air or dry nitrogen shall be considered in facilities where an automatic secondary source of power is not available or in National Electrical Code (NEC) Class I, Division I, Group B hazardous areas where the cost of electrical equipment would increase total costs to more than that of a pneumatic system.

3.2.7.8.3 Connection to Alarm Systems. Interconnection of fire protection systems with alarm systems shall comply with NFPA No. 72A and as specified in 3.1.2.4.

3.2.7.8.4 Connection to Pump House Controls. Actuation of any fixed deluge or sprinkler protection system shall send a signal to the pump starting controls at the appropriate pump house and, at the same time, shall start the main fire pump. (See also 3.2.8.6.6.2.)

3.2.7.8.5 Connection to Booster Fire Pump Controls. In facilities requiring booster pumps to supply fire protection equipment at high elevations, actuation of any deluge or sprinkler system shall send a signal to the associated booster pump controls and, at the same time, start the booster pump. (See also 3.2.8.6.6.2.)

3.2.7.8.6 Water System Shutoff Valves. Shutoff valves for sprinkler systems shall conform to NFPA No. 13. Valves for standpipe and hose systems shall conform to NFPA No. 14. Valves for fixed deluge systems shall conform to NFPA No. 15.

3.2.7.8.7 Fixed Deluge System Controls. Fixed deluge systems that cover flight hardware, such as that contained in the HMF area, shall be controlled by manual dual pushbutton control stations equipped with protective guards to prevent accidental actuation. The controls shall require personnel to push the two separate buttons in order to initiate spray. Control stations for fixed deluge systems at propellant transfer areas, or other areas where no water damage to flight hardware would occur, shall be equipped with single pushbutton or lever-operated switches. All control stations shall provide for deluge stop for the area at which the control station is located. A remote control station shall be provided within sight of the area protected, but removed from the immediate hazard. This control station shall permit operating personnel to activate or

stop the entire deluge system. In addition, similar remote controls shall be provided from other points as specified by the authority having design jurisdiction. See figure 3 for typical control schematics.

3.2.7.8.8 Fixed Gas or Dry Chemical Systems Controls. Fixed gas or dry chemical systems may be electrically or pneumatically controlled as permitted under the appropriate NFPA Codes. In all cases, components shall be UL listed or FM approved.

3.2.7.8.9 Halon 1301 System Controls. Halon 1301 extinguishing systems shall consist of a Halon control panel, a quantity of agent sufficient for 5-7 percent concentration by volume, control valves, a piping system to conduct the agent to the fire hazard, a "cross zoned" ionization (products of combustion) detector system, and secondary control and monitoring accessories.

For release of Halon, manual and automatic modes of operation shall be key-switch selectable at the Halon control panel. The manual mode will include two guarded toggle switches, one for "arming" and the other for "releasing" the extinguishing agent. In the automatic mode the Halon control panel shall receive an ionization detector alarm signal from each of the two "crossed zones" before a fire signal is received and subsequent automatic release of the suppression agent can take place. Actuation of one of the toggle switches or a fire signal from only one ionization detector will result in an "early warning" signal to the base fire monitoring station.

3.2.8 Facility Requirements in Support of Fixed Extinguishing Systems.

3.2.8.1 Water Supplies and Stored Quantities.

3.2.8.1.1 Source and Replenishment. Throughout KSC, water for fire protection purposes is drawn from the potable utility mains (smallest normally used is 6 inches) and stored in welded steel ground-level and elevated storage tanks. In the KSC Industrial Area the primary fire water supply is fed from the potable water mains, a 1,000,000-gallon ground storage tank, and an elevated tank. In outlying areas, storage tanks are the primary source of supply. Certain KSC operations require large quantities of water during launch periods, and many outlying fire protection systems draw from these same sources. Generally, the stored quantities required for launch purposes exceed the quantities required for fire protection. However, there is a high probability of a fire water requirement immediately following launch. Therefore, in the design of a system used for both purposes, the fire protection water requirements must be considered in addition to the normal launch requirements. Full consideration must be given to the replenishment rate. Factors which must be evaluated include: the reliability of the resupply source, method of operation (automatic refill is required) and flow rate limitations of the treatment and distribution system. Complete fire protection water storage replenishment shall be accomplished within 8 hours with concurrent normal consumption.

3.2.8.1.2 Fire Flow. The fire flow requirement, expressed in gallons per minute, includes the quantities required for hose streams plus 25 percent of a sprinkler system demand or plus 100 percent of a deluge system demand within the area of greatest fire hazard in a facility. Twelve percent of the fire flow shall be added if the fire protection supply also serves domestic demands. The total fire flow requirement for a facility is the figure to be used in designing water supply systems from the supply mains to the facility itself. Additional requirements for outlying hydrants must be considered when designing the supply mains serving an area.

3.2.8.1.3 Changing Fire Flows. KSC operations involve relatively large mobile launch support structures which, depending upon location and stage of launch activity, create widely fluctuating fire protection water demands. The design of fire protection water supplies serving these structures and adjacent facilities shall be based on the maximum connected demand.

3.2.8.1.4 Stored Quantity and Fire Flow Duration. Quantities of stored water for fire protection shall be determined through a complete engineering evaluation of the hazards involved and the required fire flow. (See 3.2.8.1.2.) The minimum stored quantities shall be based on the pumping times indicated in table 5 and the greatest single fire flow requirement. Multiple fire requirements shall not be used as a basis for design with the exception of service structures which draw their fire protection water from sources normally used during launch operations.

Table 5. Minimum Fire Flow Duration

Fire Hazard Classification	Duration (Hours)
Light	2
Ordinary Group 1	2-1/2
Ordinary Group 2	3
Ordinary Group 3	3-1/2
Extra	4

3.2.8.1.5. Quality. The design of fire-protection water storage facilities shall make provision for chemical treatment of stored water to suppress the growth of algae, bacteria, and marine parasites common to Central Florida and to inhibit corrosion of tankage and associated equipment. Provisions for flushing, draining, and maintenance access shall be provided throughout the storage system. Fill piping shall be of the open air-break type to ensure that

a siphon, resulting in contamination of the potable water supply mains, cannot be established. Cathodic protection shall be provided and shall be of a type approved by the authority having design jurisdiction.

3.2.8.2 Distribution.

3.2.8.2.1 Hydraulic Calculations. Fire protection piping systems shall be designed using the hydraulic calculation methods outlined in NFPA Nos. 15 and 13. Velocity head calculations shall be taken into account.

3.2.8.2.2 Piping. Piping used in fire protection systems shall be of those UL listed or FM approved materials listed in NFPA No. 13 and No. 24 and shall be color coded in accordance with KSC-STD-S-0004. The use of cast iron pipe where exposed to fire is prohibited.

3.2.8.2.3 Valves.

3.2.8.2.3.1 Shutoff Valves. Shutoff valves shall be provided in each source of fire water to a facility except fire department connections. Valves shall be post-indicator type or outside stem and yoke valves located in a suitable concrete pit. They shall be marked to indcate their function in the system and shall meet the requirements of NFPA No. 13 and No. 24.

3.2.8.2.3.2 Check Valves. Where more than one source of water supplies a facility, each supply shall be provided with an approved check valve.

3.2.8.2.3.3 Isolation Valves. Isolation valves shall be provided in distribution systems so that not more than three hydrants or two automatic sprinkler systems shall be out of service due to a single break.

3.2.8.2.4 Looped Systems. The requirements for looped system design shall be as directed by the authority having design jurisdiction.

3.2.8.3 Hydrants. Fire hydrants shall be UL listed or FM approved and shall have two 2-1/2-inch and one 4-1/2-inch outlets with NST fire hose threads as defined in NFPA No. 1963. Except as noted herein, hydrants shall conform to UL Standard 246. Hydrants shall be of the 90-degree elbow inlet type and shall be equipped with an upward-closing horizontal seat main valve. Barrels shall be not less than 6 inches in diameter. Fire hydrants shall be connected to a 6-inch (minimum) distribution main. Hydrants shall be of the Class-B type (500 to 1000 gpm capacity). A shutoff valve shall be installed in the connection to the distribution main. All hydrants shall be installed adjacent to paved areas accessible to fire department apparatus. Along streets, hydrants shall be installed no less than 3 feet nor more than 7 feet from the curb line. In general, hydrants should be located not less than 50 feet from the building they are intended to protect. The pumper connection shall have a minimum 18-inch clearance between the center of the pumper connection and grade. The surrounding area shall be graded so that drainage is away from the hydrant.

3.2.8.3.1 Hydrant Spacing. While the number of fire hydrants in a given area depends on the spacing requirements, no more than 1000 gpm of fire flow demand shall be provided from a single hydrant. Minimum requirements for number and spacing of hydrants are as follows:

a. Single buildings of light-hazard occupancy in nonbuilt-up areas -- two hydrants within 500 feet of each building

b. Single buildings of ordinary-hazard occupancy in nonbuilt-up areas -- two hydrants within 500 feet of each building

c. Warehouses and technical and industrial buildings shall have hydrants spaced at 400-foot intervals.

d. Each building or group of adjoining buildings having over 40,000 sq ft in first floor area shall be supplied with one hydrant for each building.

e. High-hazard areas shall have hydrants spaced at 300-foot intervals.

f. Highways and roadways without built-up adjacent areas shall have hydrants at 1000-foot (maximum) intervals.

g. There shall be a fire hydrant within 200 feet of each fire department connection. This also applies to mobile service structure connections when the structure is located at the operational or parking site.

h. There shall be a hydrant within 200 feet of groups of office trailers totaling ten or more.

i. There shall be a hydrant outside combustible materials storage areas.

j. There shall be a hydrant in the general area of outdoor cable runs.

3.2.8.4 Fire Department Connection. Fire department connections shall be provided in each sprinkler or standpipe riser of 4-inch or greater diameter where the riser is not interconnected to other risers or to a yard piping system. When sprinkler or standpipe risers are interconnected, a minimum of two fire department connections shall be provided. The standard arrangement shall be two 2-1/2-inch NST threaded inlets with independent clappers and threaded caps. Outlet size shall not be less than 4 inches.

3.2.8.4.1 Location. Except for service structures, fire department connections shall be located on exterior walls of not less than 1-hour fire resistance rating. Fire department connections for service structures shall be fastened to structural steel members near grade level. Where fire resistive walls of at least 1-hour rating are not available, the fire department connection shall be located at least 50 feet from the facility to be protected.

3.2.8.4.2 Height. All fire department connections shall be located approximately 3 feet 0 inches above grade.

3.2.8.5 Hose Stations - General. Hose stations shall be located within reach of the greatest hazard in the area they serve. Mechanical equipment rooms shall have a hose station within 50 feet of the entrance. Spacecraft and vehicle assembly areas shall be provided with hose stations not greater than 150 feet apart. Where specified in this standard as "hose station," the following arrangement of equipment shall be provided.

3.2.8.5.1 Indoor Nonhazardous Areas. The standard KSC indoor nonhazardous area hose station shall consist of the following UL-listed or FM-approved equipment:

a. One 1-1/2-inch valved hose connections (2-1/2 x 1-1/2-inch adapter at standpipes)

b. One semi-automatic hose rack

c. One length of 1-1/2-inch woven single-jacketed rubber-lined hose not exceeding 100 feet in length

d. One combination spray, straight stream shutoff nozzle

3.2.8.5.2 Outdoor or Indoor Hazardous Areas or Work Platforms. The standard KSC outdoor or indoor hazardous area or work platform hose station shall consist of the following UL-listed or FM-approved equipment:

a. One valved water connection (minimum 1-1/2-inch connection with 1/4-turn ball valve, butterfly valve, or equal)

b. One flow-through hose reel

c. One length of 1-1/2-inch I.D. rubber-lined, rubber-covered fire hose not exceeding 100 feet in length

d. One combination spray, straight stream, shutoff nozzle

3.2.8.6 Pumps and Drivers.

3.2.8.6.1 General. Fire pumps shall meet the requirements of NFPA No. 20, except as described herein and shall be UL listed or FM approved. In cases where the fire flow requirements exceed the capacity of those pumps listed under NFPA No. 20, the intent of NFPA No. 20 still applies, i.e., workmanship, materials of construction, arrangement of controls, and performance curve rating points.

Example: Horizontal Centrifugal Pumps

Percent of Rated Capacity	0	100	150
Percent of Rated Head	120	100	65

3.2.8.6.2 Booster Fire Pump Configuration. Figure 4 represents the standard arrangement of major components for installations of fire pumps in booster service. Automatic air vents, pressure gages, and related accessories are not shown but are required as set forth in NFPA No. 20.

3.2.8.6.3 Permissible Types of Pumps. Where fire pumps are to be installed as a primary supply or where fire pumps are required to boost pressure to reach extreme heights, two types of fire pumps are acceptable: horizontal, split-case, centrifugal type and vertical-shaft, turbine type. Horizontal split-case pumps are preferred where suction is taken at a positive pressure and when the total boosted pressure is within the limits of industry-standard equipment. When total pressures exceed the capability of industry-standard equipment or would require special construction, a vertical-shaft turbine-type pump, mounted in a suitable steel suction well, may be used. Each fire pump installation shall be sized so that the pressure at the highest level served will be no less than that required by the fire protection equipment connected at that level with all intermediate demands considered.

3.2.8.6.4 Drive Units. Diesel engine or electric motor drive units are the required power source for fire pumps. Jockey and pressure makeup pumps shall be electric-motor driven.

3.2.8.6.5 Capacity and Number of Pumps.

3.2.8.6.5.1 Primary Supplies. Fire pump installation providing primary fire protection water shall contain not less than two pumps and drivers and shall be sized at rated capacity and head to provide 150 percent of the greatest fire flow encountered in the area(s) served.

3.2.8.6.5.2 Boosted Pressure Supplies - Light and Ordinary Hazards. Fire pump installation requiring boosted pressure to reach high elevations of light and ordinary hazards may utilize as few as one pump and driver sized to meet the pressure and capacity requirements.

3.2.8.6.5.3 Boosted Pressure Supplies - Extra Hazards. In cases of boosted pressure to high elevation extra hazards where the operations are mission critical or where the protected value or potential loss of life requires a degree of pumping redundancy, the authority having design jurisdiction shall direct the degree of redundancy to be designed into the pumping system. The degree of redundancy may vary upwards to a maximum of 100 percent of capacity and head. In no pump/driver failure case shall the delivered pressure at the highest level served fall below 50 percent of the normally required pressure at that level.

3.2.8.6.6 Fire Pump Controls. Except for specialized systems fire pump controllers shall be UL listed and meet the requirements of NFPA No. 20. Automatic start systems are preferred, but nonautomatic controls are acceptable where fire water systems have other connected demands. All controllers shall be arranged in such a manner that failure of the normal start signal may be overridden at the pump controller and the pumps started manually.

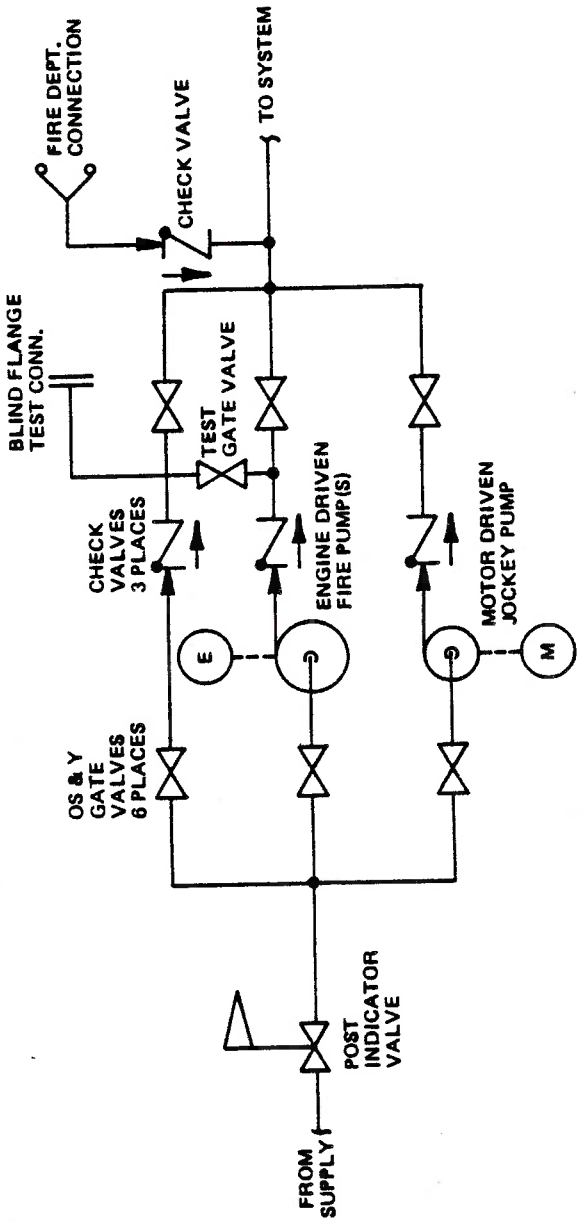

Figure 4. Arrangement of Major Components - Booster Fire Pumps

3.2.8.6.6.1 Automatic Start. Automatic controllers shall initiate primary or booster fire pump start by direct sensing of pressure loss as a result of actuation of deluge valves or sprinkler systems. Sensing of conditions solely in pressure maintenance hydropneumatic tanks does not meet this requirement.

3.2.8.6.6.2 Nonautomatic Start. Nonautomatic start controllers shall initiate primary or booster fire pump start by receiving a suitable signal from the controls of

3.2.8.6.6.3 Systems Utilizing Surge Tanks. Where initial fire flow is provided by pressure or surge tanks, an additional fire pump start circuit shall be provided through a low level sensing device in the tank.

3.2.8.7 Portable Extinguishing Equipment.

3.2.8.7.1 General. The selection of agents, the sizing of extinguishers, and the placement and maintenance of portable equipment is solely the responsibility of the KSC Director of Fire Protection and Rescue and KSC Fire Services and is beyond the scope of this standard.

3.2.8.7.2 Facility Requirements. As discussed in 3.2.2, the facility designer must provide the necessary brackets, wall niches, and cabinets required to house the various safety items. Similarly, the brackets and cabinets required to house portable extinguishing equipment are considered part of facilities design. The designer shall provide, as directed by the authority having design jurisdiction, the necessary related facility items required for portable extinguishing equipment.

3.2.9 Toxic Propellant Considerations.

3.2.9.1 General. Toxic propellants are present in single locale quantities in excess of 60,000 pounds. The presence of large quantities of toxic propellants represents a serious threat to life as well as a fire hazard. The fire protection system's design aimed toward complete extinguishment of this hazard is considered unfeasible and unrealistic. Fire control and containment of toxic materials is considered feasible if the spill or fire condition is such that automatic and remotely controlled extinguishing systems may be deployed rapidly and effectively.

3.2.9.2 Spill - With or Without Fire. In the event of any major spill from a fueled launch vehicle, all immediately available fire protection and washdown systems will be deployed in the most effective manner possible. These actions are based upon the following considerations set forth in order of importance for service structures and similar facilities:

a. Optimize escape conditions for personnel in the area

b. Fire prevention by dilution and cooling

c. Supress spread of fire to the greatest degree possible

d. Extinguish fire, if possible

e. Minimize fire damage by exposure protection spray

f. Minimize hazardous conditions encountered during subsequent fire attack by the KSC Fire Department

3.2.9.3 Effective Extinguishment and Re-Ignition Considerations. Four extinguishing agents are effective for initial extinguishment of hydrazine-type fuel fires. (See table 6.) Water spray is considered the best overall agent since its continued use serves to dilute the toxic materials, lower their temperature and toxic vapors, and cool surrounding surfaces which may cause re-ignition. Although dry chemicals have demonstrated a faster extinguishment time than water spray, no cooling and dilution characteristics are offered.

Table 6. Effective Hydrazine Fuel Extinguishing Agents

Agent	Method
Forceful, vertically downward, water spray	Dilution by generating a water-rich layer
Dry chemicals	Chemical blocking
National "100" Foam	Fuel Isolation

3.2.9.4 Recommended Fire Protection System - Propellant Transfer Facilities. In all cases of spills, water deluge is the most effective means of dilution and extinguishment. The use of any other extinguishing agent in areas exposed to toxic propellant spills is not acceptable. All designs for facilities involving toxic propellant storage, transfer, or disposal shall provide deluge systems sized for extinguishment or control as set forth in 3.2.7.3.1 and 3.2.7.3.2. Storage and transfer tanker areas shall be provided with a minimum of two 1-1/2-inch washdown hoses, one located on each side of the area not farther than 50 feet from the propellant container. (See 3.2.8.5.2.)

3.2.10 Combustion Safeguards. All oil or gas-fired boilers and heating equipment shall be equipped with UL-listed or FM-approved combustion safeguard devices and automatic fuel shutoff devices. These devices shall meet the requirements of NFPA No. 86A.

3.3 Fire-Resistant Construction.

3.3.1 General. The aspects of fire-resistant construction in facilities at KSC shall conform to the requirements of this standard and the reference standards and codes. Where the requirements of this standard and the referenced standards or codes conflict, the requirements of this standard shall govern.

3.3.2 Classification of Occupancies. The occupancy classifications for facilities at KSC are given in table 7. Any occupancy or use not specifically provided for, or where there is any uncertainty as to its classification, shall be placed in the classifiation that most resembles it with respect to use, life-safety, and fire hazards. The occupancy classifications shall be used to determine specific provisions or exemptions from the general requirements of the referenced standards or the National Fire Codes. Facilities used for high-hazard occupancies not specifically covered in the National Fire Codes shall be constructed to provide reasonable safety to life and property from fire and explosion as directed by the authority having design jurisdiction.

3.3.3 Classification of Fire Hazards. The degree of fire hazard in a building or area is largely determined by the occupancy or activity taking place in that area. Fire hazards at KSC have been divided into five major categories based on the hazards defined in NFPA No. 13. The standard KSC fire hazard classifications are listed in table 8.

3.3.4 Classification of Construction. Seven basic types of construction are utilized at KSC depending upon the expected life, current or future multiple usage of the facility, and environmental condition requirements within the facility. The types of construction are listed below by title and generally follow NFPA No. 220. For specific fire-rating classifications refer to NFPA No. 220.

Table 7. Standard KSC Occupancies - From NFPA 101, 231, and 231C

Classification	Description	Example
Assembly		
Class B	300 to 1000 persons	LCC (During Launch)
Class C	50 to 300 persons	Visitors Information Center
Educational	6 or more persons for instruction	KSC Training Auditorium
Residential		
Apartments	Sleeping quarters for two	Astronauts' Apartments
Dormitories	Sleeping quarters for two or more	Firemen's Dormitory
Business	Normal business transactions	KSC Headquarters
Industrial		
General	Assembly of machinery	O&C High Bay
Special Purpose	Low population density in building designed for particular operation	Automotive Service Station
High Hazard	Buildings with flammable or toxic contents or danger of explosion	Service Structure
Mixed	Buildings occupied for both industrial and other purposes	O&C Building
Health Care	Medical treatment	Occupational Health
Unusual structure	Open air operations	Liquid hydrogen storage area

Table 7. Standard KSC Occupancies - From NFPA 101, 231, and 231C (Cont)

Classification	Description	Example
General Storage Class I	Class I commodity is defined as essentially noncombustible products on combustible pallets, or in ordinary corrugated cartons with or without single thickness dividers, or in ordinary paper wrappings with or without pallets.	Oil-filled and other types of distribution transformers; cement in bags; electrical insulators; gypsum board; inert pigments; dry insecticides. Metal disks with plastic tops and trim; electrical coils; electrical devices in their metal enclosures; pots and pans; electrical motors; dry cell batteries. Metal parts, empty cans, stoves, washers, dryers, and metal cabinets.
Class II	Class II commodity is defined as Class I products in slatted wooden crates, solid wooden boxes, multiple thickness paperboard cartons or equivalent combustible packaging material with or without pallets.	Thinly coated fine wire such as radio coil wire on reels or in cartons; incandescent or fluorescent light bulbs; and Class I products if in small cartons or small packages placed in ordinary paperboard cartons.
Class III	Class III commodity is defined as wood, paper, natural fiber cloth or products thereof with or without pallets. Products may contain a limited amount of plastics. Metal bicycles with plastic handles, pedals, seats, and tires are an example of commodity with a limited amount of plastic.	Books; magazines; stationery; plastic-coated paper food containers; newspapers; paper or cardboard games; tissue products. Doors; windows, door and window frames, combustible fireboard; wood cabinets, furniture and other wood products.

Table 7. Standard KSC Occupancies - From NFPA 101, 231, and 231C

Classification	Description	Example
Class IV	Class IV commodity is defined as Class I, II or III products containing an appreciable amount of plastics in ordinary corrugated cartons and Class I, II, and III products in ordinary corrugated cartons with plastic packing with or without pallets. An example of packing material is a metal typewriter in a foamed plastic cocoon in an ordinary corrugated carton.	Small appliances, typewriters, and cameras with plastic parts; plastic backed tapes and nonviscose synthetic fabrics or clothing. Telephones; vinyl floor tiles; wood or metal frame upholstered furniture or mattresses with plastic covering and/or padding; plastic/padded metal bumpers and dashboards; insulated conductor and power cable on wood or metal reels or in cartons; inert solids in plastic containers; and building construction insulating panels of polyurethane sandwiched between nonplastic material.
Rack Storage	Rack storage applies to storage of materials representing the broad range of combustibles stored over 12 feet in height on racks. Material classifications same as General Storage.	

Table 8. Standard KSC Fire Hazard Classification - From NFPA 13

Fire Hazard Classification	Description of the Fire Hazard Occupancy or activity
Light	Occupancies or portions of other occupancies where the quantity and/or combustibility of contents is low and fires with relatively low rates of heat release are expected
Ordinary, Group 1	Occupancies or portions of other occupancies where combustibility is low, quantity of combustibles is moderate, stock piles of combustibles do not exceed 8 feet and fires with moderate rates of heat release are expected
Ordinary, Group 2	Occupancies or portions of other occupancies where quantity and combustibility of contents is moderate, stock piles do not exceed 12 feet, and fires with moderate rate of heat release are expected
Ordinary, Group 3	Occupancies or portions of other occupancies where quantity and/or combustibility of contents is high and fires of high rate of heat release are expected
Extra	Occupancies or portions of other occupancies where quantity and combustibility of contents is very high, flammable liquids, dust, lint, or other materials are present, introducing the probability of rapidly developing fires with high rates of heat release

3.3.4.1 Types of Construction.

Fire-Resistive, Type "A" (3 hours)
Fire-Resistive, Type "B" (2 hours)
Protected Noncombustible
Unprotected Noncombustible
Heavy Timber
Ordinary
Wood Frame

3.3.4.2 Fire Tests. Standard fire tests for all building materials, particularly those for fire resistance of structural assemblies, shall conform to NFPA No. 251; tests for surface flame spread and other features shall conform to NFPA No. 255.

3.3.4.3 Responsible Agency. The determination of the class of construction to be used at KSC for buildings and structures (facilities) shall be the responsibility of the authority having design jurisdiction. In general, the construction of permanent facilities shall be either Fire-Resistive, Type A; Fire-Resistive, Type B; protected noncombustible, or unprotected noncombustible. The detailed requirements for the various classes of construction shall be in accordance with the requirements of the Southern Building Code.

3.3.5 Means of Egress.

3.3.5.1 General Provisions. Properly designed and constructed means of personnel egress shall be provided for assembly, educational, business, and health care facilities in compliance with ANSI A117.1 and for all facilities in compliance with NFPA No. 101, unless otherwise required by this standard. In open structures and high-hazard areas where usual means of egress are not practical, special methods shall be devised to facilitate the rapid evacuation of personnel to safe areas in the event of fire or explosion.

3.3.5.2 Common Requirements - All Occupancies. The following requirements are common to all facilities at KSC regardless of occupancy classification.

3.3.5.2.1 Parts of a Means of Egress. Means of egress is a protected continuous path of travel from any point in a facility to the open air outside at ground level. A means of egress comprises the horizontal and vertical path of travel including room space, doorways, corridors, hallways, passageways, stairs, and other necessary escape paths to reach open air outside the facility at ground level. Means of egress is made up of three parts:

a. Exit Access - that portion of a means of egress which leads to an exit

b. Exit - that portion of a means of egress which provides a clear protected path to the exterior of a facility

c. Exit Discharge - that portion of a means of egress between the termination of the exit and the exterior of the facility at ground level

3.3.5.2.2 Measurement of Width of Means of Egress. Means of egress shall be measured in Units of Exit Width (UEW). One UEW shall be taken as 22 inches. UEW's shall be taken in full units except that 12 inches added to one or more full units may be counted as half a UEW.

NOTE

Reduction of means-of-egress width in the direction of egress is prohibited in KSC facilities.

3.3.5.2.3 Protection of Building Exits. Where exits are required to be protected from other parts of a building, the separation construction shall meet the following requirements:

a. Buildings three stories or less in height shall have separation construction of at least a 1-hour fire-resistance rating.

b. Buildings four stories or more in height shall have separation construction of at least 2-hour fire-resistance rating, shall be of noncombustible materials, and shall be supported by construction of at least a 2-hour-fire-resistance rating.

c. Any opening in protective construction shall be protected by an approved self-closing fire door.

3.3.5.2.4 Capacity of Means of Egress. The capacity of means of egress shall be calculated based on the population loadings by occupancy as indicated in Table 9. Where mixed occupancies occur in the same facility, capacity must be calculated for each occupancy area.

3.3.5.2.5 More Than One Exit. When more than one exit is required from a story or level, at least two of the exits shall be remote from each other and so arranged as to minimize any possibility that both may be blocked by any one fire.

3.3.5.2.6 Measurement of Distance to Exits (Exit Access). The measurement of exit access distance shall be as set forth in NFPA No. 101, Chapter 5.

3.3.5.2.7 Dead-End Limits. Dead-end corridors shall not exceed lengths specified in NFPA No. 101.

3.3.5.2.8 Exterior Paths to Exits. No exterior paths to exits are permitted with the exception of paths from building roofs carrying antennae or similar transmitting/receiving equipment.

3.3.5.2.9 Discharge from Exits. All exits shall discharge directly to the street, to a yard or court, or to other open space that provides safe and unobstructed access to open areas away from the facility. Exits may discharge into fenced open areas only if the fence is at least 500 feet from the facility; or if less than 500 feet, if it contains at least one gate that is attended 24 hours per day.

3.3.5.2.10 Headroom. All exits and exit access paths shall have a minimum ceiling height of 7 feet 6 inches with any projection at least 6 feet 8 inches above the floor.

3.3.5.2.11 Exit Doors. All exit doors shall swing in the direction of exit travel. A door, during its swing, shall not block stairs or landings and in no case shall it reduce the effective width of stair or landing to less than 22 inches, nor, when open, shall it interfere with the full use of the stairs. An exit door or an exit access door swinging into an aisle or passageway shall not restrict the effective width thereof at any point durings its swing to less than 1/2 the required widths. The fire resistance rating of exit doors shall conform to the requirements for the class of wall opening in accordance with NFPA No. 80.

3.3.5.2.12 Panic Hardware. Panic hardware shall be provided to meet the requirements of NFPA No. 101 on the following doors:

a. Doors opening directly to the exterior from exit passages, corridors, or fire stairs

b. Doors leading from high-hazard occupancy areas

c. Doors leading from flammable liquid storage areas

d. Doors leading from buildings having an occupancy of more than 150 persons

3.3.5.2.13 Interior Stairs. All interior stairways shall be enclosed unless otherwise permitted by the authority having design jurisdiction. Stairway enclosures shall have an interior finish with flame-spread rating of less than 25 in accordance with NFPA No. 101. (See also 3.3.5.2.3.) Guards and handrails shall conform to NFPA No. 101.

3.3.5.2.14 Exterior Stairs. Outside stairs shall be constructed of non-combustible material and shall be separated from the interior of the building by walls having a fire-resistance rating of 2 hours. Guards and handrails shall conform to the requirements of NFPA No. 101.

3.3.5.2.15 Elevators. Elevators shall not be recognized as required exitways.

3.3.5.2.16 Fire Escapes. Fire-escape stairs exterior to buildings shall not be accepted as part of the required exits for new facilities. The use of fire-escape stairs, ladders, slides, or other unique means of egress shall be limited to special structures and towers and shall be approved by the authority having design jurisdiction.

3.3.5.3 Specific Requirements - By Occupancy. The required number of exits calculation shall be made on a net area and occupancy loading per Table 9. Net area of a facility is considered gross area less the sum of corridors, machinery room, maintenance equipment rooms, and all other normally unoccupied areas.

Table 9. Occupancy Loadings

Type of Occupancy	Net Area Per Occupant (Sq Ft)
Assembly	
General, Seated	15
Concentrated	7
Standing or Waiting	3
Educational	20
Residential	
Apartments	200
Dormitory	100
Business	100
Industrial	100
Storage	1000
Health Care	120

3.3.5.3.1 Number of Occupants. Where actual population is unknown, the number of occupants used in determining exit requirements shall not be less than the occupancy load stated in table 9. The occupancy load in places of assembly having fixed seating shall be taken as the number of seats installed.

3.3.5.3.2 Number of Exits, Widths, and Travel Distance. The minimum requirements for exits at KSC are set forth in Table 10.

3.3.6 Flame, Heat, and Smoke Barriers.

3.3.6.1 Protection of Vertical Openings. All stairways, elevator shafts, chutes, and other openings between stories shall be enclosed or be protected to prevent the spread of fire or smoke by special features approved by the authority having design jurisdiction.

3.3.6.2 Firestopping Concealed Spaces. Concealed spaces which contain materials having a flame-spread rating greater than 25 (see NFPA No. 101) shall be effectively firestopped. Areas under raised floors or above suspended ceilings shall be firestopped for the full depth of the space along the line of support members to form maximum areas of 1000 sq ft, unless otherwise approved by the authority having design jurisdiction. In no case shall the area formed by fire-stopping exceed 10,000 sq ft. The firestops shall be designed to facilitate penetrations by cables, conduits, pipes, duct work, etc., but still maintain their effectiveness as a barrier. In vertical cable chases and utility shafts, firestops shall be installed at each floor level or at maximum intervals of 50 feet.

3.3.6.3 Interior Finishes. All interior finishes, including acoustical treatment, shall be noncombustible construction having a flame-spread rating of 25 or less. Ten percent of the aggregate wall of an unsprinklered space may have materials with a flame-spread rating of 200, such as combustible paneling, if approved by the design authority. A noncombustible backing shall be provided if combustible paneling is used. The percentage of aggregate wall may be increased to 25 percent where there are sprinklers.

3.3.6.4 Fire Walls and Fire Doors. Fire walls shall be located to limit aggregate floor area between the exterior walls and/or fire walls as indicated in Table 11. Fire walls shall conform to the requirements of the SBC. Fire doors shall conform to the requirements of NFPA No. 80.

3.3.6.5 Ducts, Shafts, and Air Filters. Ducts used for air-conditioning and ventilating systems shall conform to the requirements of NFPA No. 90A and No. 91. Walls of utility shafts shall be constructed of noncombustible material meeting the requirements of NFPA No. 251 and having a fire resistance rating of not less than 2 hours. Air-conditioning filtration equipment shall be UL Class 1 or 2 as set forth in NFPA No. 90.

Table 10. Exits - Number, Width, and Travel Distance

Type of Occupancy (Table 8)[3]	Occupants Per UEW[2], Ground Level	Occupants Per UEW[2], Other Levels	Min. No. of Exits	Min. Width (Units)	Max. Travel Distance (Ft) Sprinklered No	Max. Travel Distance (Ft) Sprinklered Yes
Assembly B	100	75	3	2	150	200
Assembly C	100	75	2	2	150	200
Educational	100	60	2	2	150	200
Residential All	100	75	2	1-1/2	100	150
Business	100	60	2 each floor	2	200	300
Industrial General	100	60	2 each floor	2	100	150
Special Purpose	100	60	2 each floor	2	100	150
High Hazard	100	50	2 each level	2	75	75[1]
Storage I	10	10	2	1-1/2	200	400
II	10	10	2	1-1/2	200	400
III	10	10	2	1-1/2	200	400
Health Care	100	60	2 each floor	2	150	200
Unusual Structures	100	60	2 each level	2	100	150

[1]Approved slide escape permitted for service structures

[2]Unit exit width (see 3.3.5.2.2)

[3]See 3.3.2

3.3.6.6 Roof Coverings. Classes of roof coverings shall conform to the classification of roof covering materials as defined in NFPA No. 256. Roof coverings for facilities at KSC shall be either Class A or Class B.

3.3.6.7 Parapets. Parapets (low, protective barriers or walls) shall conform to the requirements of the SBC.

3.3.6.8 Roof Superstructures. Walls and roofs of roof superstructures shall be constructed of noncombustible material and shall have a fire-resistance rating not less than the main facility requirements.

3.3.6.9 Windowless Buildings. Outside access panels shall be provided on each floor level of windowless buildings, except launch control centers, for purposes of ventilation and rescue of trapped occupants.

Table 11. Area Limits Within Firewalls

Type of Construction	No Sprinklers		Sprinklers (Sq Ft)	
	One Story	Multi-Story	One Story	Multi-Story
Fire-Resistive, Type A	No limit	No limit	No limit	No limit
Fire-Resistive, Type B	No limit	No limit	No limit	No limit
Protected Non-combustible	18,000	12,000	48,000	24,000
Unprotected Non-combustible	9,000	6,000	27,000	12,000
Heavy Timber	12,000	8,000	36,000	16,000
Ordinary	9,000	6,000	27,000	12,000
Wood Frame	6,000	4,000	18,000	8,000

3.3.7 Reduction of Overall Hazard.

3.3.7.1 Separation of Occupancies and Protection from Hazards. Any facility used for high-hazard occupancy shall be of noncombustible construction. In mixed occupancies the high-hazard occupancy shall be separated from other occupancies by walls, ceilings, and floors of noncombustible materials having a fire-resistance rating of not less than 2 hours. Where an explosion hazard is inherent to a high-hazard occupancy, mixed occupancies shall not be permitted. The use of combustible materials in structural applications shall be restricted to minor structures, as defined by the authority having design jurisdiction, in nonhazardous locations and areas protected by automatic sprinkler systems.

3.3.7.2 Smoke and Heat Venting. In storage occupancies, high-hazard areas, and large open areas not effectively separated by fire walls or fire-resistive partitions, adequate means for venting heat, smoke, and toxic fumes shall be provided. Provisions for venting shall conform to NFPA No. 204.

3.3.7.3 Drainage and Diked Areas. Curbs, dikes, flumes, and impounding basins shall be provided to prevent migration of spilled flammable liquids and toxic propellants where such migration presents a fire hazard to adjacent or surrounding property.

3.3.7.3.1 Flammable Liquids. The area surrounding storage tanks containing flammable liquids, including flammable oil-filled transformers, shall be provided with drainage or dikes designed to contain at least 110 percent of the volume of liquid stored in the largest container protected. Dikes or curbs shall be constructed of earth, steel, or concrete. Where drainage systems lead the liquid away from the property protected, the associated ditches, flumes, or piping shall terminate in an impounding basin having a capacity of at least 150 percent of the volume of the largest tank protected.

3.3.7.3.2 Toxic Propellant Impounding Facilities. As referenced in paragraph 3.2.7.3.1, toxic propellant transfer units shall be provided with pitched concrete parking areas surrounded by curbs and trenches having grated covers. The trenches shall interconnect to an open flume running downslope a distance of not less than 100 feet to an open concrete basin sized to hold 200 percent of the volume of the transfer unit. Drains in toxic propellant impounding basins are not permitted.

NOTE

To preclude accidental discharge of toxic materials into ground waters, drains are omitted from the design. Accumulated rain water will be removed with portable pumps prior to arrival of the propellant transfer unit. Neutralized spilled propellants will also be removed in the same manner by the disposal crew.

3.3.8 Separation of Buildings. The minimum clear-space separation between structures, as required for fire protection, shall be not less than the distances stated in NHB 7320.1. The minimum separation of buildings and structures used for high-hazard occupancies shall be 150 feet. Groups of office trailers shall be located not less than 50 feet from permanent buildings.

3.4 Special Facilities.

3.4.1 Hybrid Fire-Protection Systems. Certain facilities at KSC are used for such different functions that they cannot be categorized as a single specific fire hazard. These hybrid buildings need hybrid fire protection systems designed for their special cases. The following areas at KSC need the specialized fire systems described.

3.4.2 Launch Vehicle and Spacecraft Assembly, Test, or Checkout Areas. The VAB, OPF, and O&C are the main buildings used for this function. As a minimum, a manual alarm system and a heat-actuated detection system and/or an ionization detector system are needed for these areas. The ionization system need not ring a local alarm. All systems must report to the centerwide fire monitoring station. Fire hose and standpipe stations are necessary to provide first-aid fire-fighting capability in the area.

3.4.2.1 Water on Flight Hardware. Deluge water systems capable of spraying flight hardware should be designed to reduce the probability of inadvertent actuation.

3.4.2.1.1 Manual Actions Required to Spray Flight Hardware. Two separate manual actions, "arm" and "activate," shall be required to turn on water that can spray flight hardware. The "arm" and "activate" actions shall initiate functions with logic to prevent water flow until both the "arm" and "activate" actions are completed. Both of the valves and the electrical switches which make up the "arm" and "activate" actions shall be located away from the flight hardware area. Exception: the two-action requirement may be reduced to a single action if it is determined that the resulting spray on flight hardware will have no more effect than ordinary rainfall.

3.4.2.1.2 Prevention of Inadvertent Activation of Deluge Systems. When electrical circuits are used as a part of the "arm" and "activate" functions, separate electrically isolated control circuits shall be provided between operating switches and electric valves to prevent inadvertent actuation due to a single electrical short. Where a high degree of environmental hazard is involved, such as on the MLP, design consideration shall be given to providing physical separation of the "arm" and "activate" function conductors and terminations. In environmentally protected areas such as the Pad Terminal Connection Room (PTCR), LCC, and underground duct banks, the "arm" and "activate" electrical circuits will not normally require physically separate circuits. Circuits shall have a redundant power supply from storage batteries in case of power failure.

3.4.2.1.3 Use of Existing Hardware. Maximum use will be made of existing hardware. All piping, valves, nozzles, and related accessories shall be UL-listed or FM-approved components.

3.4.3 Vehicle Launch Areas. The detection system should consist of manual stations, heat-actuated detectors, and/or ionization detectors. Ionization detector early warning systems shall signal alarm at the fire station only. An emergency egress sprinkler system as well as hose and standpipe stations should be used in areas that might have to be evacuated.

3.4.4 Special Structures for Vehicle or Spacecraft Handling and Testing. The mobile launcher platform and the crawler transporter are structures which fall into this category. The detection systems on these structures will be for the most part local alarm systems. Heat-actuated detectors and ionization detectors should be part of the local alarm system and shall report to the centerwide fire-monitoring station.

3.4.5 Electronic Equipment Areas. Large areas in the LCC, Central Instrumentation Facility (CIF), O&C, and the launch pads contain expensive electronic equipment. While the fire hazard to the equipment is moderate, the cost to replace it makes fire protection necessary. The detection system shall include manual alarm stations, heat actuated detectors, and ionization detectors.

3.5 Fire Protection Requirements Matrix.

3.5.1 Data Arrangement. The information is arranged in two groups. The general fire protection requirements are presented first (see figure 5), followed by specific fire protection requirements (see figure 6) for various areas at KSC. The specific requirements are arranged by area usage in groups of like activities or function.

3.5.2 Use of the Matrix. The requirements matrix is a summary of the general and specific fixed fire-protection requirements for the various area usages at KSC. The requirements for portable devices/systems must be determined in addition to those contained in the matrix. Users of the matrix should familiarize themselves with the abbreviations and footnotes applicable to the matrix. The appearance of the letter "R" opposite an area indicates a firm requirement for that fire protection feature in that space or facility. The symbol "CR" indicates that the feature may be required if certain other conditions are present. An evaluation of the need for such features shall be made based upon criteria contained in the text of this standard and upon economic and operational requirements dicated by the function of the area. The appearance of a dash (-) indicates that the fire protection feature listed is not normally required. However, the designer should evaluate the need for fire protection features, other than those shown as required, based on the specific function of the area. The symbol "AA" indicates that the referenced fire protection feature is an acceptable alternate to another feature. The criteria for acceptable alternates

is primarily based on economic considerations provided the level of fire protection afforded is essentially equal to that provided by the preferred feature.

3.5.3 Notes and Remarks.

a. Computer rooms and other data processing equipment rooms must meet the requirements of NFPA No. 75.

b. Mechanical equipment areas require fixed temperature rate-of-rise detectors. Electrical equipment areas require products of combustion-type detectors.

c. Requirements shown apply to CD&SC Building and VABR only.

d. Fire protection requirements shown do not include hazard monitoring systems. (See 3.1.2.3.)

e. High speed response systems of a special nature may be required. (See text.)

f. Drains and dikes are not required for buried tanks.

g. Construction must comply with NFPA-30. Only atmospheric and low pressure tanks are permitted at KSC.

h. Construction and arrangement shall meet the requirements of NFPA-30.

i. Flammable solvent cleaning tanks shall be provided with dump valves and suitable safe waste drains and holding tanks.

j. Construction and arrangement shall meet the requirements of NFPA-31.

k. Construction shall meet the requirements of NFPA-33.

l. No combustible material with a flame spread rating greater than 25 is permitted.

m. Ultraviolet-type detectors are required.

3.5.4 Abbreviations Used in Matrix.

Key	Symbol
Occupancy Classifications	
Assembly Class B	A-B
Assembly Class C	A-C
Educational	ED
Residential - Apartments	R-A
Residential - Dormitory	R-D
Business	B
Industrial - General	I-G
Industrial - Special Purpose	I-SP
Industrial - High Hazard	I-HH
Industrial - Mixed	I-M
Health Care	HC
Unusual Structure	US
General Storage Class I	GS-I
General Storage Class II	GS-II
General Storage Class III	GS-III
Rack Storage Class I	RS-I
Rack Storage Class II	RS-II
Rack Storage Class III	RS-III
Not Applicable	NA
Fire Hazard Classifications	
Light	L
Ordinary Group 1	O-1
Ordinary Group 2	O-2
Ordinary Group 3	O-3
Extra Hazard	EH
Fire Classification	
Ordinary Combustible Solids	A
Flammable Liquids and Gases	B
Electrical	C
Combustible Metals	D
Requirements	
Required	R
Preferred	P
Acceptable Alternate	AA
Conditional Requirement (Refer to text)	CR
Not Normally Required	-

4. QUALITY ASSURANCE PROVISIONS

There are no applicable requirements.

5. PREPARATION FOR DELIVERY

There are no applicable requirements.

6. NOTES

6.1 Intended Use. This standard is intended for use as a fire-protection design guide for all new facilities and modifications to existing facilities under design jurisdiction of John F. Kennedy Space Center.

7.0 Definitions.

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

b. Fire Prevention - Measures directed towards avoiding the inception of fire

c. Fire Detection and Alarm - Systems and devices which monitor conditions within a specific area and give early warning of fire

d. Electrical Supervision - Monitoring the flow of controlled electrical current through nonoperative circuits to assure the continuity of the circuit

e. 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)

f. Fire Fighting - The physical deployment of available fixed or portable extinguishing agents for the purposes of aiding escape or rescue, suppression of fire spread, and extinguishment

g. Complicated Escape Route - A condition in which the physical arrangement of equipment requires an escapee to follow two or more passageways to accomplish escape; e.g., platform deck/ships ladder/elevator

h. Water Spray - A directed stream of high velocity, divided water droplets having a uniform full 90-degree conical pattern produced by conversion of pressure energy by shear, swirl, or momentum change in a nozzle device specifically designed for the purpose

i. Water Fog - Finely divided water spray characterized by a fine mist appearance

j. Portable Fire Extinguishers - All extinguishing devices that are movable and not permanently attached to the facility

PRIMARY BUILDING OR AREA USAGE	GENERAL FIRE PROTECTION REQUIREMENTS																					NOTES AND REMARKS
	DETECTION, ALARM, EXTINGUISHMENT									BUILDING CONSTRUCTION									OTHER FEATURES			
	DETECTOR CONTROL UNIT	REPORT TO CENTERWIDE MONITOR	DETECTION	MANUAL PULL STATION	ALARM SIGNAL APPLIANCES	HYDRANT IN THE AREA	STANDPIPE SYSTEM			FIRE RESISTANT TYPE A	FIRE RESISTANT TYPE B	PROTECTED NON-COMBUSTIBLE	UNPROTECTED NON-COMBUSTIBLE	HEAVY TIMBER	ORDINARY	WOOD FRAME			FIRE AREA LIMITS	EXITS			
REFERENCE PARAGRAPH	3.1.2.6			3.1.2.10	3.1.2.11	3.2.8.3	3.2.7.1			3.3.5	3.3.5	3.3.5	3.3.5	[illegible]	3.3.5	3.3.5			3.3.7.4	3.3.6			
OFFICES	R	R	R	R	R	R	R			AA	P	AA	AA	–	–	–			R	R			
SHOPS	R	R	R	R	R	R	R			–	P	AA	AA	–	–	–			R	R			
LABORATORIES	R	R	R	R	R	R	R			AA	P	AA	AA	–	–	–			R	R			
FOOD SERVICE	CR	R	CR	R	R	–	CR			AA	P	AA	–	–	–	–			R	R			SEE SPECIFICS
STORAGE	R	R	R	R	R	R	R			AA	AA	AA	P	–	–	–			R	R			
MECHANICAL EQUIPMENT	R	R	R	–	CR	–	R			AA	P	AA	AA	–	–	–			–	–			SEE SPECIFICS
ELECTRICAL EQUIPMENT	R	R	R	–	–	–	R			AA	P	AA	AA	–	–	–			–	–			
ELECTRONIC EQUIPMENT	R	R	R	R	R	–	R			AA	P	–	–	–	–	–			R	CR			SEE SPECIFICS
CABLING	–	–	–	–	–	R	–			AA	P	AA	AA	–	–	–			–	–			
COMMUNICATIONS EQUIPMENT	R	R	R	R	R	–	R			AA	P	AA	AA	–	–	–			–	–			

(SEE PARAGRAPHS 3.5.3 AND 3.5.4 FOR EXPLANATION OF SYMBOLS.)

Figure 5. General Fire Protection Requirements (Sheet 1 of 2)

PRIMARY BUILDING OR AREA USAGE	GENERAL FIRE PROTECTION REQUIREMENTS																						NOTES AND REMARKS
	DETECTION, ALARM, EXTINGUISHMENT									BUILDING CONSTRUCTION									OTHER FEATURES				
	DETECTOR CONTROL UNIT	REPORT TO CENTER/WIRE MONITOR	DETECTION	MANUAL PULL STATION	ALARM SIGNAL APPLIANCES	HYDRANT IN THE AREA	STANDPIPE SYSTEM			FIRE RESISTANT TYPE A	FIRE RESISTANT TYPE B	PROTECTED NON-COMBUSTIBLE	UNPROTECTED NON-COMBUSTIBLE	HEAVY TIMBER	ORDINARY	WOOD FRAME			FIRE AREA LIMITS	EXITS			
REFERENCE PARAGRAPH	3.1.2.6	3.1.2.7	3.1.2.7	3.1.2.10	3.1.2.11	3.2.8.3	3.2.7.1			3.3.5	3.3.5	3.3.5	3.3.6	3.3.5	3.3.5	3.3.5			3.3.7.4	3.3.6			
SERVICE STRUCTURE	CR	CR	CR	CR	R	R	R			–	–	–	P	–	–	–			–	R			SEE SPECIFICS
PROPELLANTS AND GASES	R	R	CR	R	R	R	R			–	AA	AA	P	–	–	–			–	–			
S/C AND L/V ASSEMBLY AND TEST	R	R	R	R	R	R	R			AA	P	AA	AA	–	–	–			R	R			
ORDNANCE	R	R	CR	R	R	R	–			AA	P	–	–	–	–	–			–	R			
PERSONNEL ASSEMBLY	R	R	R	R	R	R	R			AA	P	–	–	–	–	–			R	R			
TRANSPORTATION TERMINALS	–	R	–	R	R	R	–			–	P	AA	AA	–	–	–			–	–			
MISCELLANEOUS																							SEE SPECIFICS

(SEE PARAGRAPHS 3.5.3 AND 3.5.4 FOR EXPLANATION OF SYMBOLS.)

Figure 5. General Fire Protection Requirements (Sheet 2 of 2)

PRIMARY BUILDING OR AREA USAGE	SPECIFIC FIRE PROTECTION SYSTEM REQUIREMENTS																					NOTES AND REMARKS
	GENERAL DATA			DETECTORS				EXTINGUISHING SYSTEMS											OTHER FEATURES				
	OCCUPANCY CLASS	HAZARD CLASS	FIRE CLASS	HAZARD MONITORING	HEAT ACTUATED	PRODUCTS OF COMBUSTION		SPRINKLER SYSTEM	FIRE HOSE STATION	Deluge Spray (EXTINGUISHING)	Deluge Spray (CONTROL)	Deluge Spray EXPOSURE PROTECTION	LOW EXPANSION FOAM	FIXED CO_2	FIXED DRY CHEMICAL	BOOSTER PUMP	HALON 1301		COMBUSTION SAFEGUARDS	DRAINS AND CURBS	SMOKE AND HEAT RELEASE	FIRE STOPS	
REFERENCE PARAGRAPH	3.3.2	3.3.3	3.3.2	3.1.2.3	3.1.2.8	3.1.2.9		3.2.7.2	3.2.8.5	3.2.7.2.9	3.2.7.2.10	3.2.7.2.11	3.2.7.4	3.2.7.5.1	3.2.7.6	3.2.8.6.2	3.2.7.6.2		3.2.10	3.3.8.3	3.3.8.2	3.3.7.2	
OFFICES																						
ADMINISTRATIVE	B	L	A	–	R	–		–	R	–	–	–	–	–	–	–	–		–	–	–	–	
COMPUTER SUPPORT	B	L	A	–	R	–		–	R	–	–	–	–	–	–	–	–		–	–	–	–	
SHOPS																							
CARPENTER	I–G	0–2	A, C	–	–	–		R	R	–	–	–	–	–	–	–	–		–	–	R	–	
ELECTRICAL	I–G	0–1	A, B, C	–	CR	CR		–	R	–	–	–	–	–	–	–	–		–	–	–	–	
MECHANICAL	I–G	0–1	A, B, C	–	R	–		–	R	–	–	–	–	–	–	–	–		–	–	–	–	
PAINT	I–G	EH	B, C	–	–	–		R	R	–	–	–	–	–	–	–	–		–	–	–	–	(k)
VEHICLE REPAIR	I–G	0–2	A, B, C	–	–	–		R	R	–	–	–	–	–	–	–	–		–	–	–	–	
WELDING	I–G	0–3	A, C	–	R	–		–	R	–	–	–	–	–	–	–	–		–	–	–	–	

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(SEE PARAGRAPHS 3.5.3 AND 3.5.4 FOR EXPLANATION OF SYMBOLS.)

Figure 6. Specific Fire Protection System Requirements (Sheet 1 of 13)

PRIMARY BUILDING OR AREA USAGE	SPECIFIC FIRE PROTECTION SYSTEM REQUIREMENTS																					NOTES AND REMARKS
	GENERAL DATA			DETECTORS				EXTINGUISHING SYSTEMS											OTHER FEATURES				
	OCCUPANCY CLASS	HAZARD CLASS	FIRE CLASS	HAZARD MONITORING	HEAT ACTUATED	PRODUCTS OF COMBUSTION		SPRINKLER SYSTEM	FIRE HOSE STATION	Deluge Spray (EXTINGUISHING)	Deluge Spray (CONTROL)	Deluge Spray EXPOSURE PROTECTION	LOW EXPANSION FOAM	FIXED CO_2	FIXED DRY CHEMICAL	BOOSTER PUMP	HALON 1301		COMBUSTION SAFEGUARDS	DRAINS AND CURBS	SMOKE AND HEAT RELEASE	FIRE STOPS	
REFERENCE PARAGRAPH	3.3.2	3.3.3	3.2.3	3.1.2.3	3.1.2.9	3.1.2.9		3.2.7.2	3.2.8.5	3.2.7.2.9	3.2.7.2.10	3.2.7.2.11	3.2.7.4	3.2.7.5.1	3.2.7.6	3.2.8.6.2	3.2.7.5.2		3.2.10	3.3.8.3	3.3.8.2	3.3.7.2	
LABORATORIES																						
CALIBRATION	I–G	L	A, C	–	CR	CR		–	R	–	–	–	–	–	–	–	–		–	–	–	–	(b)
CHEMICAL	I–SP	0–2	A, B, C, D	–	R	–		–	R	–	–	–	–	–	–	–	–		–	–	–	–	
CLEANING	I–HH	EH	A, B, C	–	R	–		CR	R	–	–	–	–	CR	CR	–	–		–	–	–	–	(l)
FILM PROCESSING	I–SP	0–1	A, C	–	R	–		–	R	–	–	–	–	–	–	–	–		–	–	–	–	
PROPELLANT TEST	I–HH	EH	A, B, C, D	–	R	–		–	R	R	–	–	–	–	–	–	–		–	–	R	–	
FOOD SERVICE																							
DINING AREA	A–C	L	A, C	–	R	–		–	R	–	–	–	–	–	–	–	–		–	–	–	–	
KITCHEN	I–SP	L	A, B, C	–	CR	–		CR	R	–	–	–	–	CR	AA	–	–		–	–	–	–	
SNACK BAR	A–C	L	A, C	–	R	–		–	–	–	–	–	–	–	–	–	–		–	–	–	–	

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(SEE PARAGRAPHS 3.5.3 AND 3.5.4 FOR EXPLANATION OF SYMBOLS.)

Figure 6. Specific Fire Protection System Requirements (Sheet 2 of 13)

PRIMARY BUILDING OR AREA USAGE	SPECIFIC FIRE PROTECTION SYSTEM REQUIREMENTS																					NOTES AND REMARKS
	GENERAL DATA			DETECTORS				EXTINGUISHING SYSTEMS											OTHER FEATURES				
	OCCUPANCY CLASS	HAZARD CLASS	FIRE CLASS	HAZARD MONITORING	HEAT ACTUATED	PRODUCTS OF COMBUSTION		SPRINKLER SYSTEM	FIRE HOSE STATION	Deluge Spray (EXTINGUISHING)	Deluge Spray (CONTROL)	Deluge Spray EXPOSURE PROTECTION	LOW EXPANSION FOAM	FIXED CO_2	FIXED DRY CHEMICAL	BOOSTER PUMP	HALON 1301		COMBUSTION SAFEGUARDS	DRAINS AND CURBS	SMOKE AND HEAT RELEASE	FIRE STOPS	
REFERENCE PARAGRAPH	3.3.2	3.3.3	3.2.3	3.1.2.3	3.1.2.9	3.1.2.9		3.2.7.2	3.2.8.5	3.2.7.2.9	3.2.7.2.10	3.2.7.2.11	3.2.7.4	3.2.7.5.1	3.2.7.8	3.2.8.6.2	3.2.7.5.2		3.2.10	3.3.8.3	3.3.8.2	3.3.7.2	
STORAGE																						
OUTDOOR–CABLE	NA	0–1	A	–	–	–		–	–	–	–	–	–	–	–	–	–		–	–	–	–	
OUTDOOR–FLAMMABLE LIQUIDS	NA	EH	B	–	–	–		–	–	–	–	–	–	–	–	–	–		–	–	–	–	(h)
OUTDOOR–H.P. GAS BOTTLES	NA	EH	B, C	–	–	–		–	–	–	–	–	–	–	–	–	–		–	–	–	–	
OUTDOOR–HEAVY EQUIPMENT	NA	0–1	B, C	–	–	–		–	–	–	–	–	–	–	–	–	–		–	–	–	–	
INDOOR–NON COMBUSTIBLE CLASS I	GS–I	0–1	A	–	CR	–		CR	R	–	–	–	–	–	–	–	–		–	–	R	–	
INDOOR–COMBUSTIBLE CLASS II	GS–II	0–2	A	–	CR	–		CR	R	–	–	–	–	–	–	–	–		–	–	R	–	
INDOOR–COMBUSTIBLE CLASS III	GS–III	0–2	A	–	CR	–		CR	R	–	–	–	–	–	–	–	–		–	–	R	–	
MOTOR FUEL	I–SP	EH	B	–	–	–		–	–	–	–	–	–	–	–	–	–		–	–	–	–	(g)
MOTOR VEHCILE	I–SP	0–3	B, C	–	–	–		R	R	–	–	–	–	–	–	–	–		–	–	R	–	

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(SEE PARAGRAPHS 3.5.3 AND 3.5.4 FOR EXPLANATION OF SYMBOLS.)

Figure 6. Specific Fire Protection System Requirements (Sheet 3 of 13)

PRIMARY BUILDING OR AREA USAGE	SPECIFIC FIRE PROTECTION SYSTEM REQUIREMENTS																				NOTES AND REMARKS
	GENERAL DATA			DETECTORS				EXTINGUISHING SYSTEMS										OTHER FEATURES				
	OCCUPANCY CLASS	HAZARD CLASS	FIRE CLASS	HAZARD MONITORING	HEAT ACTUATED	PRODUCTS OF COMBUSTION		SPRINKLER SYSTEM	FIRE HOSE STATION	Deluge Spray (EXTINGUISHING)	Deluge Spray (CONTROL)	Deluge Spray EXPOSURE PROTECTION	LOW EXPANSION FOAM	FIXED CO_2	FIXED DRY CHEMICAL	BOOSTER PUMP	HALON 1301		COMBUSTION SAFEGUARDS	DRAINS AND CURBS	SMOKE AND HEAT RELEASE	FIRE STOPS	
REFERENCE PARAGRAPH	3.3.2	3.3.3	3.2.3	3.1.2.3	3.1.2.9	3.1.2.9		3.2.7.2	3.2.8.5	3.2.7.2.9	3.2.7.2.10	3.2.7.2.11	3.2.7.4	3.2.7.5.1	3.2.7.6	3.2.8.6.2	3.2.7.5.2		3.2.10	3.3.8.3	3.3.8.2	3.3.7.2	
MECHANICAL EQUIPMENT																							
AIR HANDLERS AND FILTERS	NA	L	A, C	–	R	–		–	R	–	–	–	–	–	–	–	–		–	–	–	–	
BOILERS (FURNACES)	NA	0–3	B, C	–	CR	–		CR	–	–	–	–	–	–	–	–	–		R	–	–	–	(j)
COMPRESSORS (PUMPS)	NA	L	C	–	R	–		–	R	–	–	–	–	–	–	–	–		–	–	–	–	
HYDRAULIC EQUIPMENT	NA	0–2	B, C	–	–	–		–	R	–	–	–	CR AA	CR AA	CR AA	–	–		–	–	–	–	
ELEVATOR HOISTING EQUIPMENT	NA	L	C	–	R	–		–	–	–	–	–	–	–	–	–	–		–	–	–	–	
ELEVATOR SHAFTS	NA	L	A, C	–	–	–		–	–	–	–	–	–	–	–	–	–		–	–	–	–	
ENGINES, FUEL	NA	0–2	B, C	–	R	–		–	–	–	–	–	–	–	–	–	–		–	–	–	–	
ENGINES, PORTABLE	NA	0–2	B, C	–	–	–		–	–	–	–	–	–	–	–	–	–		–	–	–	–	

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(SEE PARAGRAPHS 3.5.3 AND 3.5.4 FOR EXPLANATION OF SYMBOLS.)

Figure 6. Specific Fire Protection System Requirements (Sheet 4 of 13)

PRIMARY BUILDING OR AREA USAGE	SPECIFIC FIRE PROTECTION SYSTEM REQUIREMENTS																						NOTES AND REMARKS
	GENERAL DATA			DETECTORS				EXTINGUISHING SYSTEMS												OTHER FEATURES				
	OCCUPANCY CLASS	HAZARD CLASS	FIRE CLASS	HAZARD MONITORING	HEAT ACTUATED	PRODUCTS OF COMBUSTION		SPRINKLER SYSTEM	FIRE HOSE STATION	Deluge Spray (EXTINGUISHING)	Deluge Spray (CONTROL)	Deluge Spray EXPOSURE PROTECTION	LOW EXPANSION FOAM	FIXED CO_2	FIXED DRY CHEMICAL	BOOSTER PUMP	HALON 1301		COMBUSTION SAFEGUARDS	DRAINS AND CURBS	SMOKE AND HEAT RELEASE	FIRE STOPS	
REFERENCE PARAGRAPH	3.3.2	3.3.3	3.2.3	3.1.2.3	3.1.2.9	3.1.2.9		3.2.7.2	3.2.8.5	3.2.7.2.9	3.2.7.2.10	3.2.7.2.11	3.2.7.4	3.2.7.5.1	3.2.7.6	3.2.8.6.2	3.2.7.5.2		3.2.10	3.3.8.3	3.3.8.2	3.3.7.2	
ELECTRICAL EQUIPMENT																							
CIRCUIT BREAKERS, INDOOR	NA	L	C	–	–	–		–	–	–	–	–	–	–	–	–	–		–	–	–	–	
CIRCUIT BREAKERS, OUTDOOR	NA	L	C	–	–	–		–	–	–	–	–	–	–	–	–	–		–	–	–	–	
MOTORS AND HEAVY POWER EQUIPMENT	NA	L	C	–	–	–		–	–	–	–	–	–	–	–	–	–		–	–	–	–	
PANELBOARDS AND MOTOR CONTROL CENTERS	NA	L	C	–	–	–		–	–	–	–	–	–	–	–	–	–		–	–	–	–	
PRIMARY SWITCH GEAR	NA	L	C	–	–	–		–	–	–	–	–	–	–	–	–	–		–	–	–	–	
SECONDARY SWITCH GEAR	NA	L	C	–	–	–		–	–	–	–	–	–	–	–	–	–		–	–	–	–	
TRANSFORMERS, INDOOR, ASKERAL	NA	L	C	–	–	CR		–	R	–	–	–	–	–	–	–	–		–	–	–	–	
TRANSFORMERS, INDOOR, DRY	NA	L	C	–	–	CR		–	R	–	–	–	–	–	–	–	–		–	–	–	–	
TRANSFORMERS, OUTDOOR, OIL	NA	0–2	B, C	–	–	–	–	–	–	–	–	–	–	–	–	–	–		–	R	–	–	

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(SEE PARAGRAPHS 3.5.3 AND 3.5.4 FOR EXPLANATION OF SYMBOLS.)

Figure 6. Specific Fire Protection System Requirements (Sheet 5 of 13)

PRIMARY BUILDING OR AREA USAGE	SPECIFIC FIRE PROTECTION SYSTEM REQUIREMENTS																						NOTES AND REMARKS
	GENERAL DATA			DETECTORS				EXTINGUISHING SYSTEMS												OTHER FEATURES				
	OCCUPANCY CLASS	HAZARD CLASS	FIRE CLASS	HAZARD MONITORING	HEAT ACTUATED	PRODUCTS OF COMBUSTION		SPRINKLER SYSTEM	FIRE HOSE STATION	Deluge Spray (EXTINGUISHING)	Deluge Spray (CONTROL)	Deluge Spray EXPOSURE PROTECTION	LOW EXPANSION FOAM	FIXED CO_2	FIXED DRY CHEMICAL	BOOSTER PUMP	HALON 1301		COMBUSTION SAFEGUARDS	DRAINS AND CURBS	SMOKE AND HEAT RELEASE	FIRE STOPS	
REFERENCE PARAGRAPH	3.3.2	3.3.3	3.2.3	3.1.2.3	3.1.2.9	3.1.2.9		3.2.7.2	3.2.8.5	3.2.7.2.9	3.2.7.2.10	3.2.7.2.11	3.2.7.4	3.2.7.5.1	3.2.7.6	3.2.8.6.2	3.2.7.6.2		3.2.10	3.3.8.3	3.3.8.2	3.3.7.2	
ELECTRONIC EQUIPMENT																							
CONCEALED CABLEWAY	NA	0–1	C	–	–	R		–	CR	–	–	–	–	–	–	–	–		–	–	–	R	
COMPUTER ROOM	I–SP	0–1	A, C	–	R	R		CR	R	–	–	–	–	–	–	–	CR		–	–	–	R	(a)
COMPUTER ACCESSORY EQUIPMENT ROOM	I–SP	0–1	A, C	–	R	R		CR	R	–	–	–	–	–	–	–	CR		–	–	–	R	(a)
COMPUTER PAPER STORES	GS–II	0–2	A	–	CR	–		CR	R	–	–	–	–	–	–	–	–		–	–	–	–	(a)
COMPUTER TAPE STORES	GS–II	0–2	A	–	CR	–		CR	R	–	–	–	–	–	–	–	–		–	–	–	–	(a)
FIRING ROOMS	I–SP	0–1	A, C	–	–	R		–	R	–	–	–	–	–	–	–	CR		–	–	–	R	(a)
DATA LINK REPEATER	US	L	C	–	–	–		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
TERMINAL DISTRIBUTOR	US	L	C	–	–	R		CR	–	–	–	–	–	–	–	–	–	–	–	–	–	–	

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(SEE PARAGRAPHS 3.5.3 AND 3.5.4 FOR EXPLANATION OF SYMBOLS.)

Figure 6. Specific Fire Protection System Requirements (Sheet 6 of 13)

* DENOTES CHANGE

PRIMARY BUILDING OR AREA USAGE	SPECIFIC FIRE PROTECTION SYSTEM REQUIREMENTS																						NOTES AND REMARKS
	GENERAL DATA			DETECTORS				EXTINGUISHING SYSTEMS												OTHER FEATURES				
	OCCUPANCY CLASS	HAZARD CLASS	FIRE CLASS	HAZARD MONITORING	HEAT ACTUATED	PRODUCTS OF COMBUSTION		SPRINKLER SYSTEM	FIRE HOSE STATION	Deluge Spray (EXTINGUISHING)	Deluge Spray (CONTROL)	Deluge Spray EXPOSURE PROTECTION	LOW EXPANSION FOAM	FIXED CO_2	FIXED DRY CHEMICAL	BOOSTER PUMP	HALON 1301		COMBUSTION SAFEGUARDS	DRAINS AND CURBS	SMOKE AND HEAT RELEASE	FIRE STOPS	
REFERENCE PARAGRAPH	3.3.2	3.3.3	3.2.3	3.1.2.3	3.1.2.9	3.1.2.9		3.2.7.2	3.2.8.5	3.2.7.2.9	3.2.7.2.10	3.2.7.2.11	3.2.7.4	3.2.7.5.1	3.2.7.6	3.2.8.6.2	3.2.7.5.2		3.2.10	3.3.8.3	3.3.8.2	3.3.7.2	
CABLING																							
TUNNELS AND VAULTS	NA	L	C	–	–	CR		–	CR	–	–	–	–	–	–	–	–		–	–	–	–	
VERTICAL, INDOOR	NA	L	C	–	–	CR		–	–	–	–	–	–	–	–	–	–		–	–	–	–	
VERTICAL, OUTDOOR	NA	L	C	–	–	–		–	–	–	–	–	–	–	–	–	–		–	–	–	–	
COMMUNICATIONS																							
TELEPHONE FRAME ROOMS	I–SP	L	C	–	–	CR		CR	–	–	–	–	–	–	–	–	CR		–	–	–	R	(c)
TELEVISION STUDIO	I–SP	0–1	A, C	–	R	–		–	R	–	–	–	–	–	–	–	–		–	–	–	–	
FILM EDITING ROOMS	I–SP	0–1	A, C	–	R	–		–	R	–	–	–	–	–	–	–	–		–	–	–	–	
SERVICE STRUCTURE																							
LAUNCH VEHICLE ACCESS PLATFORMS	I–HH	0–2	A, B, C, D	(d)	CR	–	–	–	–	R	–	–	–	–	–	R	–		–	–	–	–	(b) (e)

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(SEE PARAGRAPHS 3.5.3 AND 3.5.4 FOR EXPLANATION OF SYMBOLS.) Figure 6. Specific Fire Protection System Requirements (Sheet 7 of 13)

PRIMARY BUILDING OR AREA USAGE	SPECIFIC FIRE PROTECTION SYSTEM REQUIREMENTS																						NOTES AND REMARKS
	GENERAL DATA			DETECTORS				EXTINGUISHING SYSTEMS												OTHER FEATURES				
	OCCUPANCY CLASS	HAZARD CLASS	FIRE CLASS	HAZARD MONITORING	HEAT ACTUATED	PRODUCTS OF COMBUSTION		SPRINKLER SYSTEM	FIRE HOSE STATION	Deluge Spray (EXTINGUISHING)	Deluge Spray (CONTROL)	Deluge Spray EXPOSURE PROTECTION	LOW EXPANSION FOAM	FIXED CO_2	FIXED DRY CHEMICAL	BOOSTER PUMP	HALON 1301		COMBUSTION SAFEGUARDS	DRAINS AND CURBS	SMOKE AND HEAT RELEASE	FIRE STOPS	
REFERENCE PARAGRAPH	3.3.2	3.3.3	3.2.3	3.1.2.3	3.1.2.8	3.1.2.9		3.2.7.2	3.2.8.5	3.2.7.2.9	3.2.7.2.10	3.2.7.2.11	3.2.7.4	3.2.7.5.1	3.2.7.6	3.2.8.6.2	3.2.7.5.2		3.2.10	3.3.8.3	3.3.8.2	3.3.7.2	
PROPELLANTS AND GASES																							
LH_2 STORAGE	US	EH	B, C	(d)	CR	–		–	R	–	–	R	–	–	–	–	–		–	–	–	–	
LH_2 TRANSFER EQUIPMENT	US	EH	B, C	(d)	CR	–		–	R	–	R	–	–	–	–	–	–		–	–	–	–	
GH_2 STORAGE	US	EH	B, C	(d)	CR	–		–	R	–	–	R	–	–	–	–	–		–	–	–	–	
GH_2 TRANSFER EQUIPMENT	US	EH	B, C	(d)	CR	–		–	R	–	R	–	–	–	–	–	–		–	–	–	–	
GH_2 DISPOSAL POND	US	EH	B, C	–	–	–		–	–	–	–	–	–	–	–	–	–		–	–	–	–	
LOX STORAGE	US	EH	C	–	CR	–		–	R	–	–	R	–	–	–	–	–		–	–	–	–	
LOX TRANSFER EQUIPMENT	US	EH	C	–	CR	–		–	R	–	–	R	–	–	–	–	–		–	–	–	–	
GOX STORAGE	US	EH	C	–	CR	–		–	R	–	–	R	–	–	–	–	–		–	–	–	–	
GOX TRANSFER EQUIPMENT	US	EH	C	–	CR	–		–	R	–	–	R	–	–	–	–	–		–	–	–	–	

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(SEE PARAGRAPHS 3.5.3 AND 3.5.4 FOR EXPLANATION OF SYMBOLS.)

Figure 6. Specific Fire Protection System Requirements (Sheet 8 of 13)

PRIMARY BUILDING OR AREA USAGE	SPECIFIC FIRE PROTECTION SYSTEM REQUIREMENTS																						NOTES AND REMARKS
	GENERAL DATA			DETECTORS				EXTINGUISHING SYSTEMS													OTHER FEATURES				
	OCCUPANCY CLASS	HAZARD CLASS	FIRE CLASS	HAZARD MONITORING	HEAT ACTUATED	PRODUCTS OF COMBUSTION		SPRINKLER SYSTEM	FIRE HOSE STATION	Deluge Spray (EXTINGUISHING)	Deluge Spray (CONTROL)	Deluge Spray EXPOSURE PROTECTION	LOW EXPANSION FOAM	FIXED CO_2	FIXED DRY CHEMICAL	BOOSTER PUMP	HALON 1301		COMBUSTION SAFEGUARDS	DRAINS AND CURBS	SMOKE AND HEAT RELEASE	FIRE STOPS	
REFERENCE PARAGRAPH	3.3.2	3.3.3	3.2.3	3.1.2.3	3.1.2.9	3.1.2.9		3.2.7.2	3.2.8.5	3.2.7.2.9	3.2.7.2.10	3.2.7.2.11	3.2.7.4	3.2.7.5.1	3.2.7.6	3.2.8.6.2	3.2.7.5.2		3.2.10	3.3.8.3	3.3.8.2	3.3.7.2	
RP-1 STORAGE	US	EH	B, C	–	CR	–		–	R	–	–	–	–	–	–	–	–		–	R	–	–	(b)
RP-1 TRANSFER EQUIPMENT	US	EH	B, C	–	CR	–		–	R	–	–	–	R	–	–	–	–		–	–	–	–	
UDMH/MMH STORAGE	US	EH	B, C	(d)	CR	–		–	R	R	–	–	–	–	–	–	–		–	R	–	–	
UDMH/MMH TRANSFER EQUIPMENT	US	EH	B, C	(d)	CR	–		–	R	–	R	–	–	–	–	–	–		–	R	–	–	
UDMH/MMH VAPOR DISPOSAL	US	EH	B, C	(d)	–	–		–	R	–	–	–	–	–	–	–	–		–	–	–	–	
N_2O_4 STORAGE	US	EH	C	–	CR	–		–	R	–	–	R	–	–	–	–	–		–	R	–	–	
N_2O_4 TRANSFER EQUIPMENT	US	EH	C	–	CR	–		–	R	–	–	R	–	–	–	–	–		–	R	–	–	
N_2O_4 VAPOR DISPOSAL	US	EH	C	–	–	–		–	R	–	–	–	–	–	–	–	–		–	–	–	–	
LN_2 STORAGE	US	L	C	–	–	–		–	R	–	–	–	–	–	–	–	–		–	–	–	–	
GN_2 STORAGE	US	L	C	–	–	–		–	R	–	–	–	–	–	–	–	–		–	–	–	–	

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(SEE PARAGRAPHS 3.5.3 AND 3.5.4 FOR EXPLANATION OF SYMBOLS.)

Figure 6. Specific Fire Protection System Requirements (Sheet 9 of 13)

PRIMARY BUILDING OR AREA USAGE	SPECIFIC FIRE PROTECTION SYSTEM REQUIREMENTS																						NOTES AND REMARKS
	GENERAL DATA			DETECTORS				EXTINGUISHING SYSTEMS												OTHER FEATURES				
	OCCUPANCY CLASS	HAZARD CLASS	FIRE CLASS	HAZARD MONITORING	HEAT ACTUATED	PRODUCTS OF COMBUSTION		SPRINKLER SYSTEM	FIRE HOSE STATION	Deluge Spray (EXTINGUISHING)	Deluge Spray (CONTROL)	Deluge Spray EXPOSURE PROTECTION	LOW EXPANSION FOAM	FIXED CO_2	FIXED DRY CHEMICAL	BOOSTER PUMP	HALON 1301		COMBUSTION SAFEGUARDS	DRAINS AND CURBS	SMOKE AND HEAT RELEASE	FIRE STOPS	
REFERENCE PARAGRAPH	3.3.2	3.3.3	3.2.3	3.1.2.3	3.1.2.9	3.1.2.9		3.2.7.2	3.2.8.5	3.2.72.9	3.2.7.2.10	3.2.7.2.11	3.2.7.4	3.2.7.5.1	3.2.7.6	3.2.8.6.2	3.2.7.5.2		3.2.10	3.3.8.3	3.3.8.2	3.3.7.2	
S/C AND L/V ASSEMBLY AND TEST																							
ALTITUDE CHAMBER	I–SP	EH	B, C	–	CR	–		–	–	(a)	–	–	–	–	–	–	–		–	–	–	–	(m)
CRYOGENIC SYSTEM TEST	I–HH	EH	C	–	CR	–		–	R	–	R	–	–	–	–	–	–		–	–	–	–	
ECS SYSTEM TEST	I–HH	EH	B, C	(d)	R	–		–	R	–	CR	–	–	–	–	–	–		–	–	–	–	
HYPERGOLIC SYSTEM TEST	I–HH	EH	B, C	(d)	CR	–		–	R	R	–	–	–	–	–	–	–		–	R	–	–	
ORDNANCE INSTALLATION	I–HH	EH	C, D	–	CR	–		–	R	–	R	–	–	–	–	–	–		–	–	–	–	
S/C ASSEMBLY	I–SP	0–2	A, B, C	–	R	CR		–	R	–	–	–	–	–	–	–	–		–	–	–	–	
L/V ASSEMBLY	I–SP	0–2	A, B, C	–	R	CR		–	R	–	–	–	–	–	–	–	–		–	–	–	–	

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(SEE PARAGRAPHS 3.5.3 AND 3.5.4 FOR EXPLANATION OF SYMBOLS.)

Figure 6. Specific Fire Protection System Requirements (Sheet 10 of 13)

PRIMARY BUILDING OR AREA USAGE	SPECIFIC FIRE PROTECTION SYSTEM REQUIREMENTS																						NOTES AND REMARKS
	GENERAL DATA			DETECTORS				EXTINGUISHING SYSTEMS												OTHER FEATURES				
	OCCUPANCY CLASS	HAZARD CLASS	FIRE CLASS	HAZARD MONITORING	HEAT ACTUATED	PRODUCTS OF COMBUSTION		SPRINKLER SYSTEM	FIRE HOSE STATION	Deluge Spray (EXTINGUISHING)	Deluge Spray (CONTROL)	Deluge Spray EXPOSURE PROTECTION	LOW EXPANSION FOAM	FIXED CO_2	FIXED DRY CHEMICAL	BOOSTER PUMP	HALON 1301		COMBUSTION SAFEGUARDS	DRAINS AND CURBS	SMOKE AND HEAT RELEASE	FIRE STOPS	
REFERENCE PARAGRAPH	3.3.2	3.3.3	3.2.3	3.1.2.3	3.1.2.9	3.1.2.9		3.2.7.2	3.2.8.5	3.2.72.9	3.2.72.10	3.2.7.2.11	3.2.7.4	3.2.7.5.1	3.2.7.6	3.2.8.6.2	3.2.7.5.2		3.2.10	3.3.8.3	3.3.8.2	3.3.7.2	
ORDNANCE																							
ORDNANCE RECEIVING	I–HH	EH	A, C, D	–	–	–		–	R	–	–	–	–	–	–	–	–		–	–	–	–	
ORDNANCE STORAGE	I–HH	EH	A, C, D	–	–	–		–	R	–	–	–	–	–	–	–	–		–	–	–	–	
ORDNANCE TEST	I–HH	EH	A, C, D	–	–	–		–	R	–	–	–	–	–	–	–	–		–	–	–	–	
PERSONNEL ASSEMBLY																							
AUDITORIUM	A–B	L	A, C	–	R	–		–	R	–	–	–	–	–	–	–	–		–	–	–	–	(1)
PROJECTION ROOMS	I–SP	L	A, C	–	R	–		–	–	–	–	–	–	–	–	–	–		–	–	–	–	
TRANSPORTATION TERMINALS																							
BARGE TERMINAL	I–G	L	A, B, C	–	–	–		–	R	–	–	–	–	–	–	–	–		–	–	–	–	
RAILROAD TERMINAL	US	L	A, B, C	–	–	–		–	–	–	–	–	–	–	–	–	–		–	–	–	–	

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(SEE PARAGRAPHS 3.5.3 AND 3.5.4 FOR EXPLANATION OF SYMBOLS.)

Figure 6. Specific Fire Protection System Requirements (Sheet 11 of 13)

PRIMARY BUILDING OR AREA USAGE	SPECIFIC FIRE PROTECTION SYSTEM REQUIREMENTS																						NOTES AND REMARKS
	GENERAL DATA			DETECTORS				EXTINGUISHING SYSTEMS													OTHER FEATURES				
	OCCUPANCY CLASS	HAZARD CLASS	FIRE CLASS	HAZARD MONITORING	HEAT ACTUATED	PRODUCTS OF COMBUSTION		SPRINKLER SYSTEM	FIRE HOSE STATION	Deluge Spray (EXTINGUISHING)	Deluge Spray (CONTROL)	Deluge Spray EXPOSURE PROTECTION	LOW EXPANSION FOAM	FIXED CO_2	FIXED DRY CHEMICAL	BOOSTER PUMP	HALON 1301		COMBUSTION SAFEGUARDS	DRAINS AND CURBS	SMOKE AND HEAT RELEASE	FIRE STOPS	
REFERENCE PARAGRAPH	3.3.2	3.3.3	3.2.3	3.1.2.3	3.1.2.9	3.1.2.9		3.2.7.2	3.2.8.5	3.2.7.2.9	3.2.7.2.10	3.2.7.2.11	3.2.7.4	3.2.7.5.1	3.2.7.6	3.2.8.6.2	3.2.7.5.2		3.2.10	3.3.8.3	3.3.8.2	3.3.7.2	
MISCELLANEOUS																							
CAMERA SITE	NA	L	A, C	–	–	–		–	–	–	–	–	–	–	–	–	–		–	–	–	–	
CRANE CONTROL CABS	I–SP	L	C	–	–	–		–	–	–	–	–	–	–	–	–	–		–	–	–	–	
DISPENSARY	I–SP	0–1	A, B, C	–	R	–		–	R	–	–	–	–	–	–	–	–		–	–	–	–	
FIRE STATION	I–SP	0–2	A, B, C	–	CR	–		R	R	–	–	–	–	–	–	–	–		–	–	–	–	
FLIGHT CREW TRAINING	I–SP	L	A, C	–	CR	CR		–	R	–	–	–	–	–	–	–	–		–	–	–	–	
METEORLOGICAL STATION	US	L	A	–	–	–		–	–	–	–	–	–	–	–	–	–		–	–	–	–	
PRESS SITE	A–B	L	A, C	–	R	–		–	–	–	–	–	–	–	–	–	–		–	–	–	–	
RESIDENTIAL	R–D	L	A, C	–	CR	CR		–	–	–	–	–	–	–	–	–	–		–	–	–	–	
SOFT ROOM	I–SP	L	A	–	–	–		–	R	–	–	–	–	–	–	–	–		–	–	–	–	

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(SEE PARAGRAPHS 3.5.3 AND 3.5.4 FOR EXPLANATION OF SYMBOLS.)

Figure 6. Specific Fire Protection System Requirements (Sheet 12 of 13)

PRIMARY BUILDING OR AREA USAGE	SPECIFIC FIRE PROTECTION SYSTEM REQUIREMENTS																							NOTES AND REMARKS
	GENERAL DATA			DETECTORS				EXTINGUISHING SYSTEMS													OTHER FEATURES				
	OCCUPANCY CLASS	HAZARD CLASS	FIRE CLASS	HAZARD MONITORING	HEAT ACTUATED	PRODUCTS OF COMBUSTION		SPRINKLER SYSTEM	FIRE HOSE STATION	Deluge Spray (EXTINGUISHING)	Deluge Spray (CONTROL)	Deluge Spray EXPOSURE PROTECTION	LOW EXPANSION FOAM	FIXED CO_2	FIXED DRY CHEMICAL	BOOSTER PUMP	HALON 1301		COMBUSTION SAFEGUARDS	DRAINS AND CURBS	SMOKE AND HEAT RELEASE	FIRE STOPS	
REFERENCE PARAGRAPH	3.3.2	3.3.3	3.2.3	3.1.2.3	3.1.2.9	3.1.2.9		3.2.7.2	3.2.8.5	3.2.7.2.9	3.2.7.2.10	3.2.7.2.11	3.2.7.4	3.2.7.5.1	3.2.7.6	3.2.8.6.2	3.2.7.5.2		3.2.10	3.3.8.3	3.3.8.2	3.3.7.2	
TRAILER OFFICES	B	L	A, C	–	*R	–		–	–	–	–	–	–	–	–	–	–		–	–	–	–	*GROUPS OF THREE OR MORE TRAILERS
WOODEN TOWERS	US	L	A	–	–	–		–	–	–	–	–	–	–	–	–	–		–	–	–	–	
WOODEN FILLED COOLING TOWERS	US	L	A	–	–	–		R	–	–	–	–	–	–	–	–	–		–	–	–	–	

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Figure 6. Specific Fire Protection System Requirements (Sheet 13 of 13)