KSC-STD-F-0004A

Supersedes
KSC-STD-F-0004
Dated July 31, 1968

JOHN F. KENNEDY SPACE CENTER, NASA

FIRE PROTECTION DESIGN FOR FACILITIES, STANDARD FOR

DESIGN ENGINEERING DIRECTORATE

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AUG 19 1971

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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 at the 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 section 3.4. The details of these requirements may then be determined by referring back into section 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 their order of importance:

a. To safeguard human life and prevent injury to personnel

b. To preserve launch critical equipment and facilities

c. To protect valuable materials, equipment, and records

d. To minimize/prevent fire damages to KSC facilities

Although the design of fire protection features at KSC should conform to the requirement and guidelines set forth in nationally recognized codes and standards, NASA-KSC, as an agency of the Federal Government, is self-insured and functions as its own authority in the interpretation of existing general codes and the establishment of supplementary standards. The order of importance of KSC fire protection goals differs from that employed by non-Government agencies. Deviations from stated or implied requirements and, in some instances, restrictive interpretations of the National Fire Codes and the National Building Code (NBC) are necessary in order to maintain the management risk factor (possible loss of life and property by fire) to a reasonable and economically feasible level. However, in no case will any deviations result in reducing minimum protection.

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 Safe Construction, constitute the scope of this standard.

1.4.1 Fire Detection and Alarm. - This element is defined as, 'Systems which monitor or supervise conditions within specific areas to give early warning of fire'. These systems are required to perform one or more of eight functions at KSC:

a. Initiate evacuation

b. Summon fire fighting aid

c. Actuate fire fighting systems

d. Monitor normally unmanned areas

e. Initiate shutdown of equipment and start protective measures

f. Sound a general alarm

g. Monitor the condition of fire alarm systems

h. Monitor the condition of fire fighting systems

i. Monitor the presence of flammable fluids

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 occupant personnel from high hazard areas

b. Control fire spread

c. Extinguish fires

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

e. Provide exposure protection from nearby fires.

1.4.3 Fire Safe 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 safe construction

b. Adequate escape paths

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 Department.

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 department, 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.

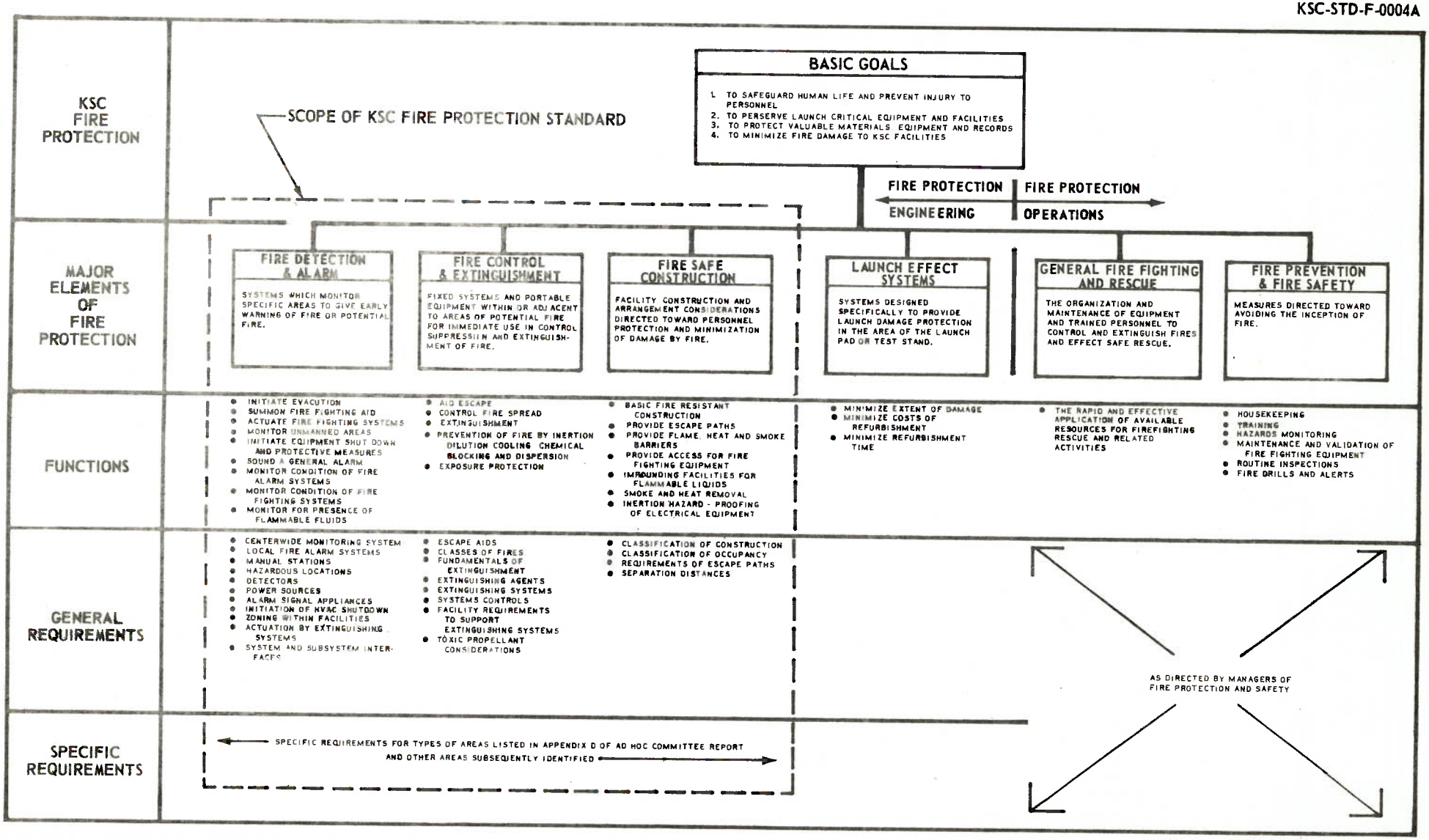

FIGURE 1. KSC FIRE PROTECTION

2. APPLICABLE DOCUMENTS

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

STANDARDS

National Aeronautics and Space Administration

NHB 7320.1	Facilities Engineering Handbook
KSC-STD-S-0004	Color Coding of Fluid System Piping
DTI-M-5A	Design Technical Instructions for Minimum Design and Operating Constraints for Pneumatic Reducing Stations
KSC-STD-E-0002	Hazard proofing of electrical equipment

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

2.2 Other Publications. - The following documents form a part of this standard to the extent referenced herein:

National Fire Protection Association

National Fire Codes, Volumes 1 through 10

Vol. 1	Flammable Liquids
Vol. 2	Gases
Vol. 3	Combustible Solids, Dusts and Explosives
Vol. 4	Building Construction and Facilities
Vol. 5	Electrical
Vol. 6	Sprinklers, Fire Pumps and Water Tanks
Vol. 7	Alarm and Special Extinguishing Systems

Vol. 8	Portable and Manual Fire Control Equipment
Vol. 9	Occupancy Standards and Process Hazards
Vol. 10	Transportation
--	Fire Protection Handbook

(Applications for copies should be addressed to the National Fire Protection Association, 60 Batterymarch Street, Boston, Massachusetts 02110.)

American Insurance Association

NBC	The National Building Code

(Applications for copies should be addressed to the American Insurance Association, 85 John Street, New York, New York 10038.)

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., 207 East Ohio Street, Chicago, Illinois 60611.)

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 each building 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. - The components comprising a local fire alarm system shall constitute a unified system for proper operation. The local fire alarm system shall provide alarm and supervisory (trouble) signals within the protected premises and cause compatible signals to be transmitted to the * base fire monitoring equipment. An exception shall be made for ionization detectors which are used as an early warning system to the fire station only. Local fire alarm system components (including detectors, signaling appliances, manual fire alarm stations, and control units) shall be designed for the purpose for which they are being installed and shall conform to the NFPA No. 72A (Vol. 7) and the requirements of this standard. Where the requirements of this standard and the referenced standard conflict, the requirements of this standard shall govern.

3.1.2.1 Fire Alarm Zones. - Alarm initiating devices installed in multi-storied 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 Department. Zoning and requirements for the number of zones reporting directly to the fire 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 fire protection and rescue management.

3.1.2.2 Fire Alarm Subsystems. - Local fire alarm systems installed in a group of buildings or areas, where a high-hazard fire potential exists, shall be centralized in a common subsystem and 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. - Specialized 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, shall provide a means of signaling abnormal conditions to the local fire alarm system or centralized subsystem. The abnormal condition signal shall be displayed at the central monitoring point as a distinct signal not easily confused with a signal from the local fire alarm system. A reporting circuit, with end-of-line resistor installed within the local control unit, shall be provided between the auxiliary system and the control unit of the local fire alarm system.

3.1.2.4 Fire Control and Extinguishing Systems Reporting. - 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.

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 (Vol. 5).

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 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. Each control unit shall contain test switches for testing each alarm initiating box circuit in the fire alarm mode. 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. Each unit shall be equipped with a supervising current meter, located so as to be visible without opening the unit. The local fire alarm system shall have provisions for manual reset from an alarm condition, at the control unit, when the cause of the alarm condition is cleared. The local fire alarm system shall have provisions for automatic reset from a trouble condition when the cause of the trouble is cleared. The control unit enclosure shall be provided with a door interlock switch arranged to transmit a trouble signal when the enclosure is opened. (See Figure 2.) 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. Power for the control unit shall be supplied from the most reliable source in the local facility, preferably a source having an alternate source for emergency conditions. 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 (Vol. 5). Disconnect switches shall be equipped with dual element, high interrupting capacity fuses. Limited access provisions shall be incorporated with the circuit disconnecting device, or it shall be permanently identified by placard and shall be painted red to preclude inadvertent operation by unauthorized personnel. Control units that are not provided with an alternate or emergency power source shall be provided with auxiliary supervisory relays for monitoring operating power. These relays shall, upon the failure of operating power, transfer the alarm initiating device (detectors, pull stations, etc.) circuits from their respective box circuits to the base monitoring circuit as shown in Figure 2. This configuration transmits a trouble signal to the base monitoring equipment during a power outage; however, should a fire alarm initiating device be actuated during this configuration, the alarm condition would be reported. The control unit shall provide components and circuitry for the center monitoring system tie as shown in Figure 2. Storage
* batteries shall be installed in a U. L. approved enclosure separate from the control unit enclosure. Battery enclosures shall be of metal construction with louvered sides, have locked doors and shall be equipped with wooden rail battery supports. If batteries are equipped with specific gravity indicators, enclosure doors shall be provided with viewing windows for determination of battery condition. Where the battery condition is determined by voltage measurement, approved "press to test" pushbottons and meters shall be provided in the enclosure door.

3.1.2.7 Local System Annunciators. - Local system annunciators shall consist of a lamp-type display unit. Display windows shall be of adequate size for zone or area identification. Each zone window shall be permanently identified by engraved lettering of 3/16-inch high minimum size. Alarm signals shall be displayed by a red lamp and trouble signals by an amber lamp. Flashing versus continuous illumination of lamps, for the purpose of distinguishing between trouble and alarm signals, is not acceptable.

3.1.2.7.1 Auxiliary Annunciators. - Auxiliary annunciators, for use by area occupants, shall be installed in accordance with the requirements of the authority having design jurisdiction. Auxiliary annunciators shall not affect the integrity of the fire alarm system.

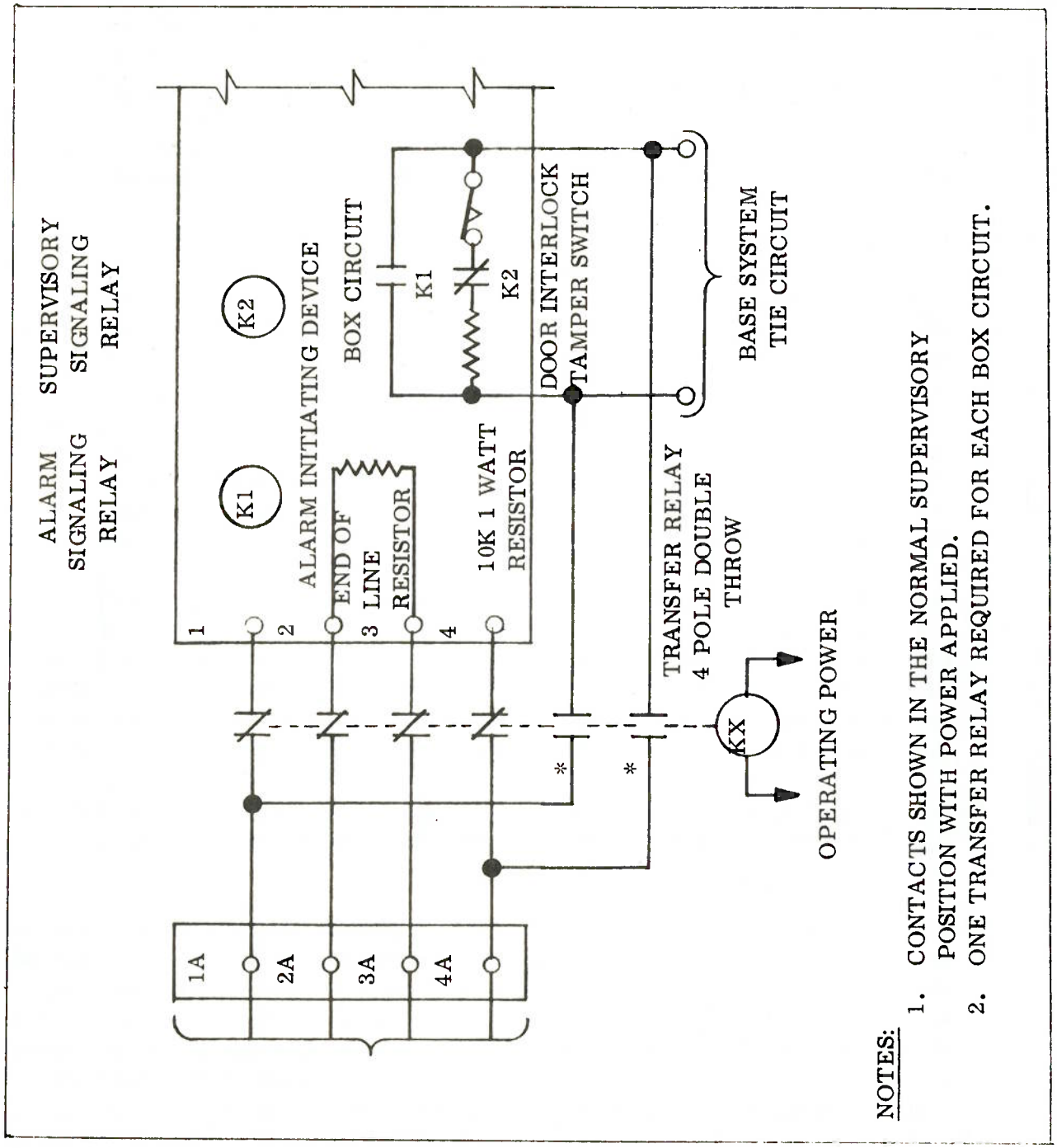

Figure 2. Arrangement of Components - Alarm System

* Denotes Change

3.1.2.7.2. 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 removed to a location readily 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 a graphic locator shall be posted adjacent to the annunciator. Location of the annunciator panel shall be specified by the authority having design jurisdiction.

3.1.2.7.3 Combination Annunciator/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.

3.1.2.8. Circuitry. - Local fire alarm system circuitry, external of the control unit shall be installed in accordance with NFPA No. 70 (Vol. 5). Alarm initiating circuits shall provide the end-of-the-line resistor device within the control unit. The circuit containint alarm signal appliances shall originate and terminate within the control unit.

3.1.2.9 Automatic Fire Detectors. - Detectors installed in local fire alarm systems shall be UL listed or FM approved. Acceptable detectors shall be either heat-actuated fixed-temperature, combination fixed-temperature and rate-of-rise, or products-of-combustion type. Photo-electric smoke detectors are not acceptable. Detectors installed in hazard monitoring systems are of a specialized nature and are not within the scope of this standard. (See 3.1.2.3.)

3.1.2.9.1 Spacing and Location of Detectors. - The recommended spacing of detectors in UL listings 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 1000 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. 72A (Vol. 7). An engineering survey

shall be conducted by the installation contractor to assure 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 gain keyed entrance to the interior of the station without actuating the station. Mercury switches shall not be used as contacts in manual stations. The station finish shall be a bright red color.

3.1.2.10.1 Location of Manual Fire Alarm Stations. - A station shall be installed 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 of 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.

3.1.2.10.2 Fire Alarm Station Identification. - Fire alarm stations shall be clearly indicated by a fixed sign above each station. The sign shall meet the standards of the KSC fire protection and rescue management. Manual stations located out-of-doors and in all high-hazard areas shall be provided with a red gooseneck light located immediately overhead.

3.1.2.11 Alarm Signal Appliances. - Alarm signals shall be distinctive, so they cannot be confused with other signals in the area. Fire alarm signals shall not be used for any other purposes. In general, electrically powered, 10-inch vibrating fire alarm bells should be used. However, the alarm signaling appliances

selected shall provide an adequate signal level to be clearly heard regardless of maximum noise level. In areas containing other equipment with similar bell-type signaling devices, fire alarm horns shall be used. 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.

3.1.3 Centerwide Fire Monitoring System. - The following description of the existing fire monitoring system is inserted for the guidance of the designer in making additions to this system. All additions shall be compatible in function to the existing installation and shall comply with NFPA No. 72-C (Vol. 7).

3.1.3.1 Monitoring Equipment Located in Watch-Dispatch Office. - The base system fire alarm monitor consists of a lamp-type display annunciator, is modular in construction, and allows for expansion of the equipment by the installation of additional trays and modules. All necessary components and circuitry for monitoring a remote local fire alarm system are contained in a single plug-in module. Signal transmission between any local fire alarm system and the center fire monitoring equipment is via a single, No. 22 AWG telephone pair for distances up to 10 miles. Telephone cable requirements are not covered in this standard.

3.1.3.2 Auxiliary Monitoring Equipment. - Auxiliary monitoring equipment is installed at a central location in the LC-39 area for the duplexing of fire alarm signals from such high-hazard areas as the mobile launch structures, launch pads, etc. This monitoring equipment is modular in construction and monitors selected local fire alarm systems through individual plug-in modules. The receipt of a fire alarm or supervisory signal by a module causes it to actuate a duplexer plug-in module that transmits a similar signal to the center fire monitoring equipment. Fire alarm signals only are transmitted to a secondary lamp-type annunciator.

3.2 Fire Control and Extinguishment.

3.2.1 Escape 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 aids to escape 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 escape route is considered complicated (see definitions, Section 6), water spray shall be provided to aid escape by:

a. Provide 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 escape 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 escape route beyond the first heat barrier, for a minimum distance of 20 feet or to an elevator landing or stairway. The escapee waiting area at elevator landings shall be protected with spray at the rate of 0.2 gpm/sq. ft. over an area of 100 sq. ft. for elevator landing areas located within 40 feet of a heat barrier, or where no heat barrier separates the fire hazard from the elevator landing. The throw of the nozzles employed must provide the minimum required horizontal and vertical coverage in areas when subjected to wind and draft effects. The escape aid spray system shall be activated with the fixed fire extinguishing system serving the hazardous area. (See Figure 5.)

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 appliances shall be provided. Warning signs shall be in accordance with 3.1.2.10.6 and 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 Fixed Spray 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 fixed spray 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 visibility (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 housed equipment

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. However, the necessary cabinets, racks, water supplies, wall niches, etc., to be provided are 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 (Vol. 8).

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, and greases.

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, and potassium. (See also 3.2.5.5.)

3.2.4 Fundamentals of Extinguishment. - KSC fire protection philosophy 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. - 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 is the simplest means by which fire may be extinguished, i.e., isolate 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 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 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) 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 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 phenomena which occur when halogenated hydrocarbons or metal alkali salts are introduced into the combustion process. Current theory regarding this method indicates that the extinguishing agent chemically reacts with the intermediate combustion products and thereby blocks further oxidation.

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, considering the hazards involved. 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 I.)

Table I. Water As An Extinguishing Agent

Method of Application	Usual Class of Fire Usage
Hose Streams	A, B
Sprinklers	A, C
Fixed Spray 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. - Three basic types of foam are used at KSC, primarily against Class B fires. (See Table II.) All foams in use at KSC are mechanically generated. Chemical reaction generated foams are not used at KSC.

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 is generally the most practical agent against 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 extinguishment.

Table II. Foams As Extinguishing Agents

Description	Usual Class of Fire Usage
Low Expansion Protein	B
Low Expansion Alcohol Compatible	B
High Expansion Synthetic (100:1 or greater)	A, B, C

3.2.5.3.2 Halon 1301 is effective against Class A, B, and C fires. It may be considered for use under circumstances where the fire hazard involved lends itself to extinguishment by Halon 1301, and where the concentrations of resulting vapors are not hazardous to personnel. Because of the high cost of Halon 1301 agent, its use at KSC should be carefully evaluated in relationship to other equally effective, but less costly, agents.

3.2.5.3.3 Gaseous nitrogen is used primarily in hazard proofing electrical equipment enclosures and is not commonly used at KSC for extinguishment. However, the use of nitrogen flooding systems may 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 reignition hazard from hot surfaces limits the use of dry chemical at KSC to portable equipment, against 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 Department.

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 3.)

EXTINGUISHING AGENT		EXTINGUISHING METHOD				REMARKS
MAJOR TYPE	SUB CLASS	FUEL ISOLATION (5) OR DILUTION	COOLING (9)	OXYGEN DISPLACEMENT (10)	CHEMICAL BLOCKING (11)	
WATER	SMALL STREAM		A			2 1/2 GAL. PRESSURIZED WATER EXTINGUISHER
	SMALL HOSE		A B C			HOSE STREAMS UP TO 1-1/2" NOZZLES
	LARGE HOSE			(1)		HOSE STREAMS 1-1/2" AND LARGER
	SPRAY/FOG		(8)	(1)		MOST DEPENDABLE GENERAL AGENT
FOAM	LOW EXP. PROTEIN					PROTEIN BASE-LOW EXPANSION
	HI-EXP. SYNTHETIC	(2)	B			DETERGENT TYPE - HIGH EXPANSION
	ALCOHOL COMPATIBLE	(2)				PROTEIN TYPE - COMPATIBLE W/ALCOHOL
GASES	CO_2		(3)			HAS DISADVANTAGE OF HIGH REIGNITION INCIDENCE IN CLASS B USAGE
	FREON		(4)	A B C		REPRESENTATIVE OF HALOGEN AGENTS. 1301 CONSIDERED BEST
	NITROGEN					PRIMARILY USED AS INERTING AGENT
DRY CHEMICALS	SODIUM BICARB.				(6)	SODIUM BICARBONATE-INERT GAS DELIVERY
	POT. BICARB.				(6)	POTASSIUM BICARBONATE - PURPLE "K" INERT GAS DELIVERY
	MDP				A B C	MONOAMMONIUM DIHYDROGEN PHOSPHATE U. L. LISTED CLASS A THRU C
SPECIAL PURPOSE	MET-L-X					SODIUM CHLORIDE BASE
	G-1/M-1					GRAPHITE BASE W/ADDITIVES
	EUTECTIC CHLORIDES		D			BARIUM CHLORIDE, SODIUM CHLORIDE, POTASSIUM CHLORIDE
	LITH-X					GRAPHITE BASE W/ADDITIVES FOR LITHIUM USAGE
	FLUORSPAR	(7)				
	TMB	(12)				TRIMETHOXYBOROXINE

NOTES:

(1) STEAM CONTRIBUTES TO OXYGEN DISPLACEMENT.
(2) SOME FUEL DILUTION AS FOAM BREAKS DOWN.
(3) COOLING TO THE EXTENT OF 120 BTU/LB USED.
(4) COOLING APPROX. 1/20TH THAT OF WATER.
(5) FUEL SHUT-OFF IS THE MOST EFFECTIVE METHOD
(6) VERY EFFECTIVE AGAINST SMALL CLASS "B" FIRES BUT GIVES LITTLE REIGNITION PROTECTION.
(7) USAGE LIMITED TO SMALL CHLORINE FLUORIDE FIRES.
(8) GOOD AGENT AGAINST DEEP SEATED DE-ENERGIZED CLASS "C" FIRES.
(9) HIGH SPECIFIC HEAT AGENTS MOST EFFECTIVE
(10) HIGH MOLAL HEATS* MOST EFFECTIVE
(11) BR, CL, F HALOGENS: METAL ALKALI SALTS ARE EFFECTIVE
(12) USAGE LIMITED TO WHITE METAL FIRES ONLY - PRIMARILY MAGNESIUM
USAGE ON LITHIUM, SODIUM AND SODIUM-POTASSIUM NOT PERMISSIBLE

* (SP. HT) x (MOLECULAR WEIGHT)

CLASSES OF FIRES:

A. ORDINARY COMBUSTIBLE SOLIDS HAVING "EMBER STAGE".
B. FLAMMABLE LIQUIDS AND GASES.
C. A OR B MATERIALS IN PRESENCE OF LIVE CIRCUITS.
D. COMBUSTIBLE METALS.

Figure 3. Extinguishing Agent Matrix

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 (Vol. 7). Standpipes shall be the 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 having a story 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 where there is a heavy concentration of combustibles such as warehouses and storage buildings

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 escape route. Hoses shall be of sufficient length to reach all portions of the platform. (See 3.2.8.5.2.)

f. Exceptions 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 fire 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. Service 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.)

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 III.

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:

Riser 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 fitted with a 2 1/2-inch by a 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 (Vol. 6) and NFPA 88 (Vol. 9). Sprinkler systems at KSC shall be of the wet pipe, preaction type, or deluge type as defined by NFPA 13. The use of sprinkler equipment in areas containing computer hardware or

electronic equipment is not approved at KSC. 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.

Table III. Hosestream Flow Requirements
Light and Ordinary Hazards *

	Unsprinkled Facility		Sprinkled Facility	
Height and Fire Area (net sq. feet)	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)
	(GPM)			
1 story				
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.

3.2.7.2.1 Mandatory. - Sprinkler systems designed to protect against the hazards present 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, or where the stored contents are considered mission critical, or where the stored value exceeds $1,000,000, or 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 (Vol. 9).

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 Standard 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.

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. Kitchens should be sprinkler protected if an adequate supply of water is available. Otherwise kitchens shall be provided with one 1 1/2-inch hose station for every 200 feet of perimeter wall. (See 3.2.8.5.) In all cases, grills and related ventilators shall be protected by either automatic sprinkler equipment, or fixed automatic/manual CO_2 system, or a fixed dry chemical system interlocked with the fan motor and a fire damper. Fire protection for cooking equipment and related ventilating systems shall meet the requirements of NFPA 96 (Vol. 4).

b. Indoor POL storage, where 100 or more gallons of flammable liquids are stored, should be sprinkler protected. This requirement is optional if an adequate water supply is not available or the cost of providing such a supply exceeds the cost of a fixed automatic/manual total flooding CO_2 system.

c. Hydraulic equipment rooms utilizing combustible fluids should be sprinkler protected. Where an adequate supply of water is not available, or where the cost ratio is as stated in b. above, or the equipment must operate while the water supply is disconnected (as is 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 made 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 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 (Vol. 6). Because of variances in construction, occupancy 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 IV. (See 3.3.3 and 3.3.5.)

Table IV. 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-inch diameter.

3.2.7.3 Fixed Spray Systems. - The design of fixed spray systems shall conform to NFPA No. 15 (Vol. 7). With the exception of preprimed, millisecond response systems, fixed spray systems at KSC shall be of the wet pipe, deluge valve, open spray nozzle type. Fixed spray 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 may be used in deluge valve service if approved by the authority having design jurisdiction. The requirements for fixed spray 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.

3.2.7.3.1 Fixed Spray - Extinguishment. - Fixed spray systems sized to extinguish the fire hazard present shall be provided in the following facilities:

a. Parking areas, adjacent to launch pads, for 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 3.2.9.5.) Curbs, dikes, perimeter trenches and impounding facilities shall be provided as specified in 3.3.8.3.

b. Propellant testing laboratories, except solid propellant testing areas, shall be protected with fixed spray systems sized and arranged to
* extinguish the fire hazard present. Where multiple fuels are handled or processed, the system shall be designed to extinguish the greatest hazard. Life 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 fixed spray 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.

3.2.7.3.2 Fixed Spray - Fire Control. - Fixed spray 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 fixed 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 3.3.8.3.

* Denotes Change

b. Service structure and assembly building work platforms shall be provided with fixed spray systems, sized and arranged to provide full coverage over the deck areas as shown in Table V. Platform spray systems shall be controlled manually by double pushbutton control stations to preclude
* accidental discharge into the flight vehicle or spacecraft. Pushbuttons shall be covered to prevent inadvertant actuation. Control stations shall be located on each work platform, within the work area and adjacent to the platform exitway. Figures 4 and 5 indicate the basic arrangement of control components in a typical electropneumatic circuit as used in service structure fixed spray systems. (See also 3.2.7.8.7.)

Table V. 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 3.2.7.3.4.

(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 fixed spray systems to aid escape as set forth in 3.2.1.1. The escape aid spray shall be connected to and activated with the fire protection spray serving that platform level.

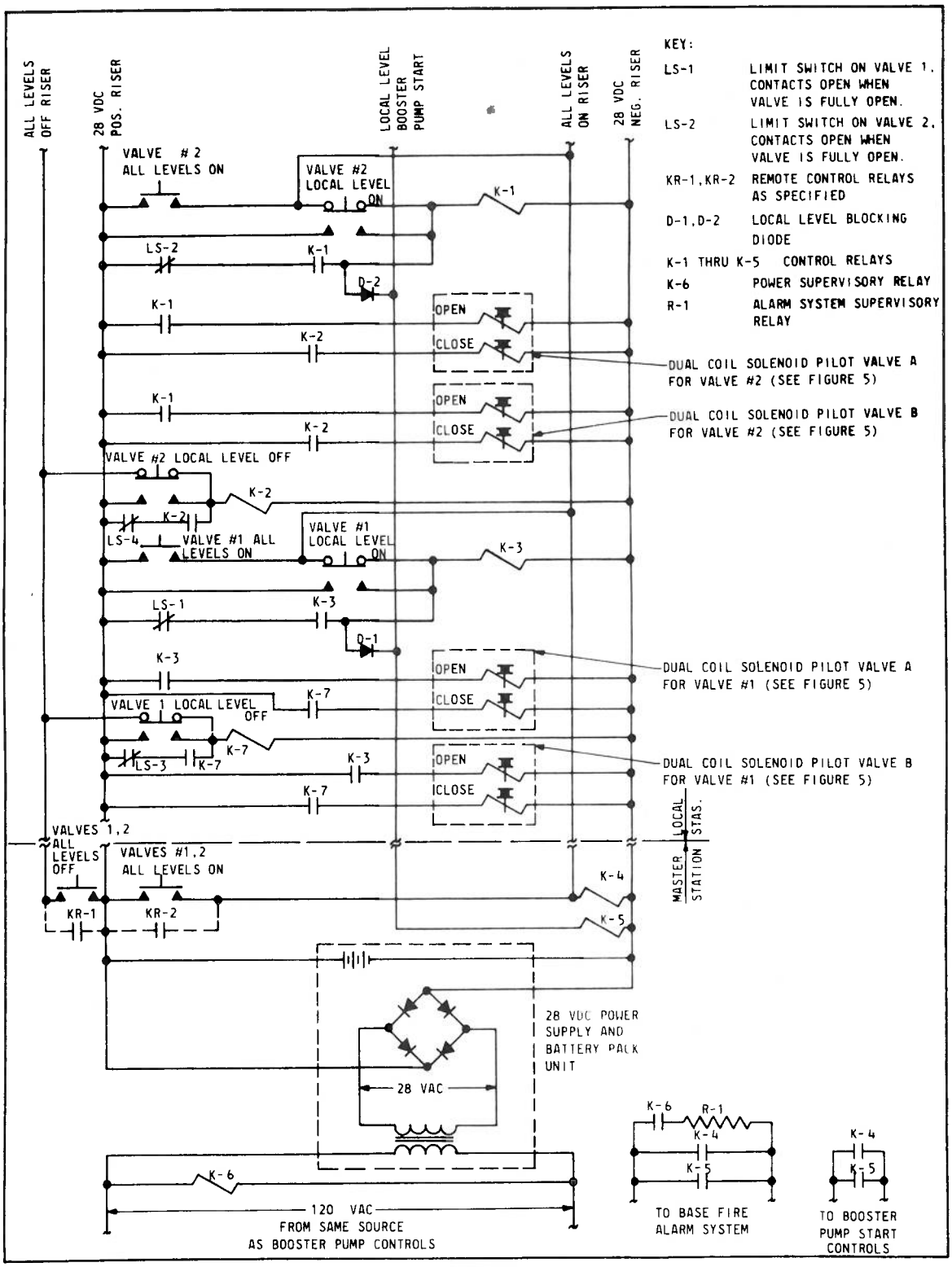

Figure 4. Arrangement of Electrical Controls - Service Structure Fixed Spray System

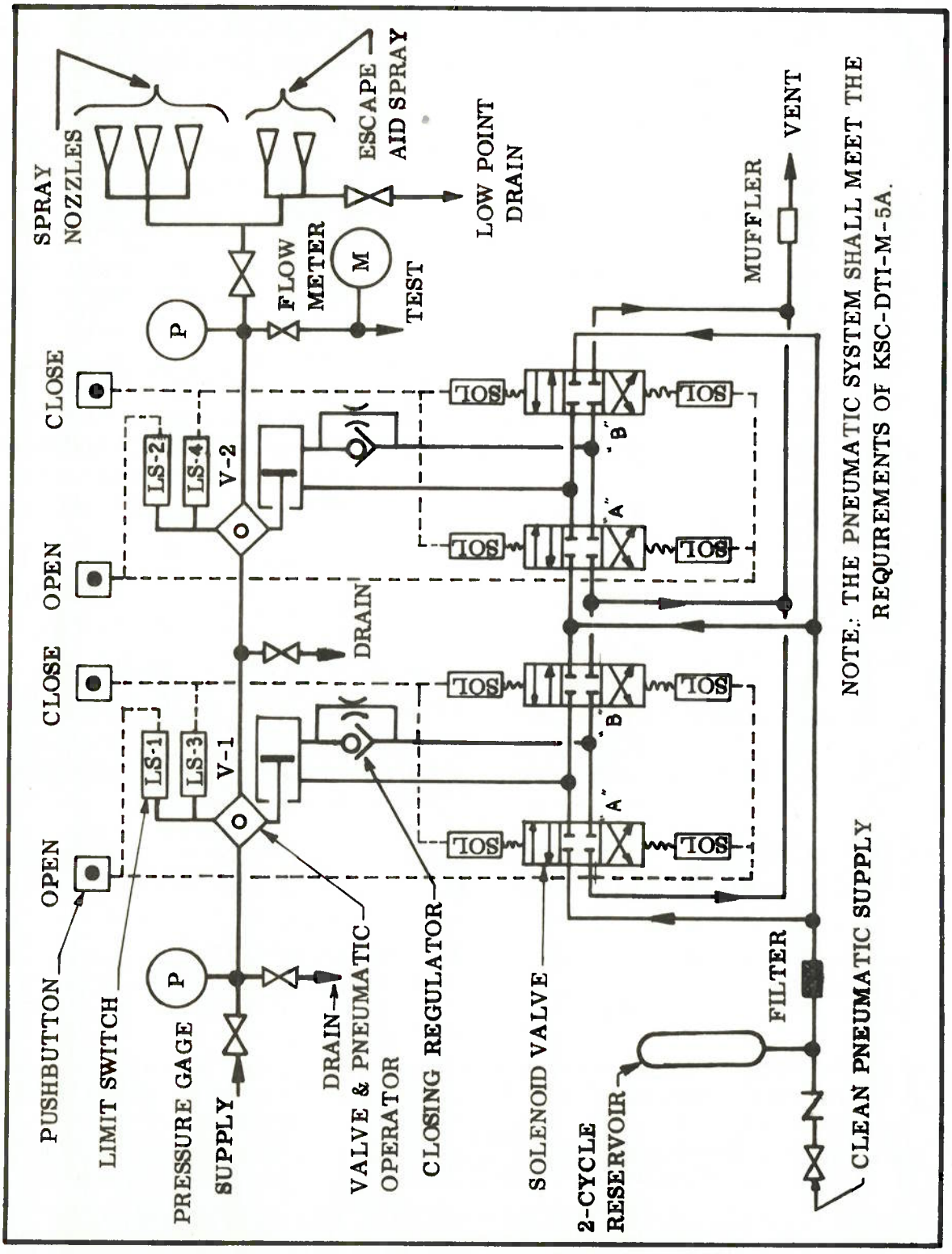

Figure 5. Arrangement of Mechanical Controls - Service Structure Fixed Spray System

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

3.2.7.3.3 Fixed Spray - Exposure Protection. - Fixed spray systems, sized to cool and protect against exposure from nearby fires, shall be provided at the following facilities:

a. Cryogenic and gaseous oxygen and hydrogen storage containers and grouped piping and pumps shall be protected with a fixed spray system sized and 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 by automatic detector with a manual override capability located outside of 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.

3.2.7.3.4 Fixed Spray - Preprimed, Millisecond Response. - Fixed spray, high speed systems controlled by automatic detector with manual override shall be provided at the following facilities:

a. Ordnance inspection areas where solid propellant grains are exposed for purposes of visual, optical or mechanical examination. Propellant grain X-ray examination facilities, when conducted 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.

3.2.7.3.5 Fire Department Connections. - A fire department connection shall be provided for each fixed spray 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 (Vol. 7). 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 (Vol. 7). 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 Systems. - Fixed, automatic, total flooding CO_2 systems shall be provided in the following locations:

a. Cable terminal cabinets 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

c. Data Link Transmission Repeater Buildings (DLTR's). These areas shall be protected with fixed CO_2 systems as directed by the authority having design jurisdiction.

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 they shall be designed by personnel of recognized experience in this field.

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 (Vol. 7). 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, as well as 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. - Three 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, 120 volts ac, and 220 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. Pneumatic system configuration shall comply with DTI-M-5A, design technical instructions for minimum design and operating constraints for Pneumatic Reducing Station.

3.2.7.8.3 Connection to Alarm Systems. - Interconnection of fire protection systems with alarm systems shall comply with NFPA No. 72A (Vol. 7) and applicable paragraphs of this document.

3.2.7.8.4 Connection to Pump House Controls. - Actuation of any fixed spray 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 fixed spray 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 (Vol. 6). Valves for standpipe and hose systems shall conform to NFPA No. 14 (Vol. 7). Valves for fixed spray systems shall conform to NFPA No. 15 (Vol. 7).

3.2.7.8.7 Service Structure Platform Controls. - Fixed spray systems on work platforms shall be controlled by manual dual pushbutton control stations equipped with protective guards to prevent accidental actuation. Such controls shall be electropneumatic type and shall be arranged as indicated in Figures 4 and 5. The manual controls shall initiate spray for that level only or spray for all levels. Control stations shall provide for spray stop for the level on which the control station is located. Controls shall require personnel to push two separate buttons in order to initiate spray on a platform or on all platforms. A sealed remote control station at grade level 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 spray system. In addition, similar remote controls shall be provided from other points as specified by the authority having design jurisdiction.

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.

3.2.8 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 fixed spray 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 VI 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 VI. 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: (1) Suppress the growth of algae, bacteria, and marine parasites common to Central Florida; and (2) 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 insure 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 (Vols. 7 and 6). 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 (Vol. 6) 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 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. Valves
* shall be marked to indicate their function in the system. Valves shall meet the requirements of NFPA No. 13 and No. 24 (Vol. 6).

3.2.8.2.3.2 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 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. 194 (Vol. 8). 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 bottom 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. 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. Within 200 feet of groups of office trailers totaling 10 or more in number

i. Outside combustible materials storage areas

j. General area of outdoor cable runs and soft room.

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 located as specified in 3.2.7.1.2 and 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. - The standard KSC indoor hose station shall consist of the following UL listed or FM approved equipment:

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

b. One folded 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. - The standard KSC outdoor hose station shall consist of the following UL listed or FM approved equipment:

a. One valved water connection (minimum 1 1/2-inch)

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 (Vol. 6), except as described herein. 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

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

Fire pumps shall be UL listed or FM approved; however, unlabeled pumps may be acceptable if they are manufactured to meet the requirements for UL listing, are so certified by the manufacturer, and are approved by the KSC authority having design jurisdiction.

3.2.8.6.2 Booster Fire Pump Configuration. - Figure 6 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: (1) Horizontal, Split-Case, Centrifugal-Type; and (2) 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 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 installations 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 installations requiring boosted pressure to reach high elevations of light

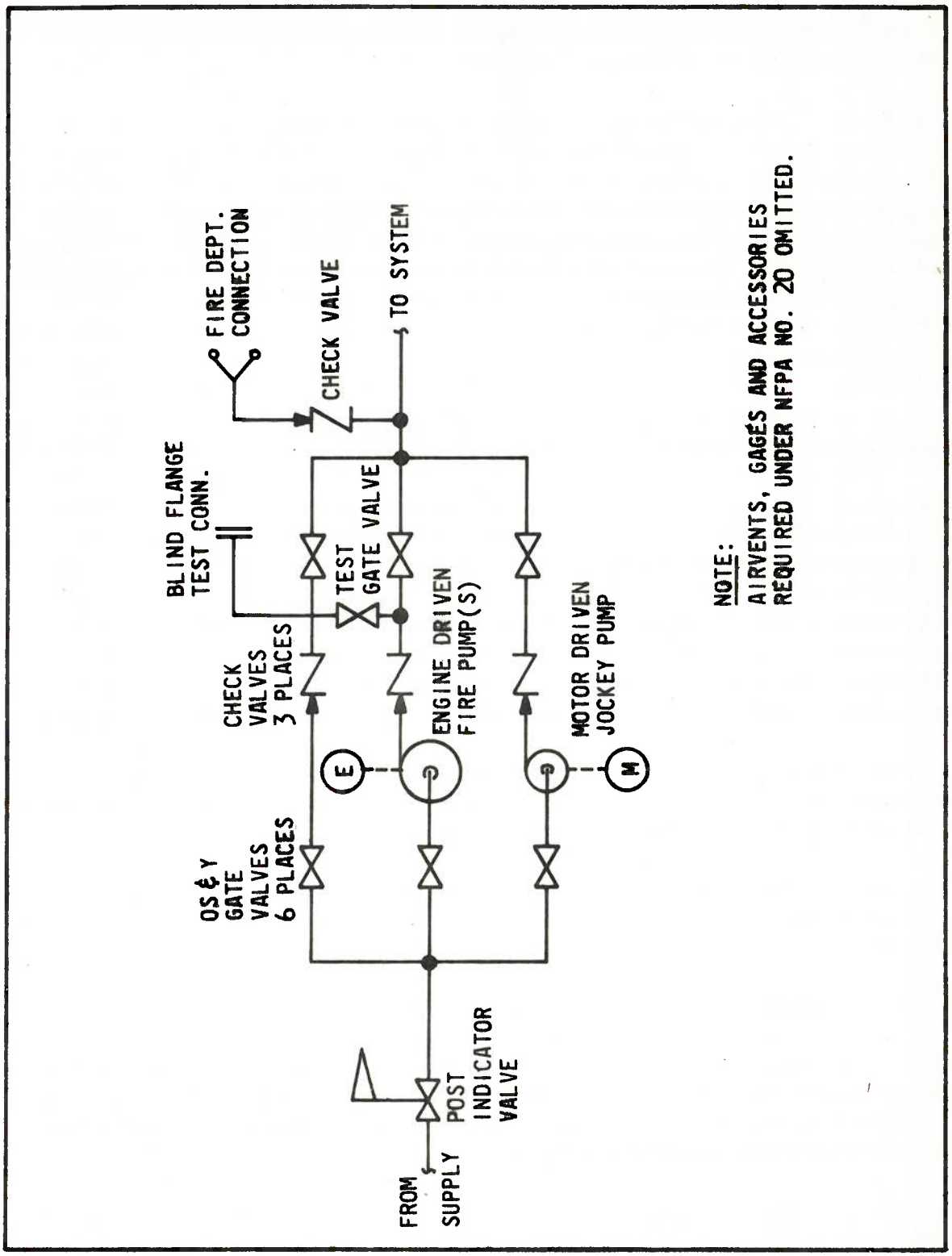

Figure 6. Arrangement of Major Components - Booster Fire Pumps

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, or where the operations are mission critical, or where the protected value or potential loss of life require 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. - Fire pump controllers shall meet the requirements of NFPA No. 20 (Vol. 6). 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.

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 fixed spray systems or flow sensing devices in sprinkler systems.

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 float switch 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 life-safety as well as fire hazard. Fire protection systems 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 wash-down 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. Suppression of fire spread to the greatest degree possible

d. Extinguishment, if possible

e. Minimization of fire damage by exposure protection spray

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

3.2.9.3 Effective Extinguishment and Reignition Considerations. - Four extinguishing agents are effective for initial extinguishment of hydrazine type fuel fires. (See Table VII.) 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 reignition. Although dry chemicals have demonstrated a faster extinguishment time than water spray, no cooling and dilution characteristics are offered.

Research of Halon 1301 effectiveness against hydrazine fires indicates that surrounding vapor concentrations approaching 50 percent by volume are required to achieve extinguishment. Research also indicates that a highly toxic smoke product is produced during the extinguishment process. As in the case of dry chemicals, Halon 1301 offers little cooling and no dilution characteristics, indicating that total flooding and continued application would be required to effect extinguishment.

Table VII. Effective Hydrazine Fuel Extinguishing Agents

Agent	Method
Forceful, vertically downward, water spray	Dilution by generating a water-rich layer
Dry chemicals	Chemical blocking
Bromotrifluoromethane (Halon 1301)	Chemical blocking
National "100" Foam	Fuel isolation

3.2.9.4 Recommended Fire Protection System - Propellant Transfer Facilities. - In all cases of spills, water spray 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 fixed spray 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 wash-down hoses, one located on each side of the area, and 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 (Vol. 9).

3.3 Fire Safe Construction.

3.3.1 General. - The aspects of fire safe 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 classification for facilities at KSC are given in Table VIII. Any occupancy or use not specifically provided for, or where there is any uncertainty as to its classification, shall be placed in the classification 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 upon the hazards defined in NFPA No. 13. The standard KSC fire hazards are listed in Table IX.

3.3.4 Occupancies and Fire Hazards. - The standard KSC occupancies and their associated fire hazards are presented in summary form in Table X. Where more than one fire hazard may be applicable to the occupancy, all are indicated.

3.3.5 Classification of Construction. - Seven basic types of construction are utilized at KSC depending upon the expected need life, current or future multiple usage of the facility, or 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.

3.3.5.1 Types of Construction. -

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

Table VIII. Standard KSC Occupancies - From NFPA 101 and 231

Classification	Description	Representative KSC Facility
Assembly		
Class B	300 to 1000 persons	LCC (During Launch)
Class C	50 to 300 persons	MSO Building Auditorium
Educational	6 or more persons for instruction	KSC Training Auditorium
Residential		
Apartments	Sleeping quarters for two	Astronaut's Apartments
Dormitories	Sleeping quarters for two or more	Firemen's Dormitory
Office	Normal business transactions	KSC Headquarters
Industrial		
General	Assembly of machinery	MSO Building High Bay
Special Purpose	Low population density in building designed for particular operation	Vehicle Assembly Building
High Hazard	Buildings with flammable or toxic contents or danger of explosion	Service Structure
Open	Open air process operations	Liquid Hydrogen Storage Farm

Table VIII. Standard KSC Occupancies - From NFPA 101 and 231 - Continued

Classification	Description	Representative KSC Facility
Storage Class I *	Combustible materials stacked in solid piles 15 to 21 ft. high or combustible materials stacked 12 to 21 ft. high with horizontal channels	Supply, Shipping and Receiving Building
Class II *	Combustible materials stacked in solid piles not over 15 ft. high or combustible materials stacked not over 12 ft. high with horizontal channels	Storage Rooms in Vertical Assembly Building
Class III *	Combustible materials in noncombustible containers with noncombustible storage aids	Spacecraft Spares
Mixed	Two or more of above occupancies in the same building	MSO Building

* Occupancies are taken from NFPA 231.

Table IX. Standard KSC Fire Hazard Classifications - From NFPA 13

Fire Hazard Classification	Description of the Fire Hazard Occupancy or Activity
Light	Areas in which the amount and combustibility of contents is low; excluding warehouse and industrial occupancies
Ordinary, Group 1	Areas in which the combustiblity of contents is low, no flammable liquids or highly combustible solids are stored, stock piles do not exceed 8 feet in height, or activity is of a light assembly nature
Ordinary, Group 2	Areas in which the combustibility of contents is moderate, less than 100 gallons of flammable liquids are stored, stock piles do not exceed 12 feet in height, or activity is of a heavy assembly nature
Ordinary, Group 3	Areas in which the combustibility of contents is high, more than 100 gallons of flammable liquids are stored, stock piles exceed 12 feet in height, or activity involves open flames
Extra	Areas in which the combustibility of contents is high and the danger of explosion or toxic gas during fire is high or where the arrangement of the facility makes escape complicated (See definitions, Section 6.)

Table X. Occupancies and Fire Hazards

KSC Occupancy Classification	KSC Fire Hazard Classification				
	Light	Ord. 1	Ord. 2	Ord. 3	Extra
Assembly, B & C	X				
Educational	X				
Residential, All	X				
Office	X				
Industrial					
General		X	X	X	
Special Purpose	X	X	X	X	X
High Hazard					X
Open				X	X
Storage					
Class I				X	(2)
Class II			X		(2)
Class III		X			(2)
Mixed (1)					

(1) Fire hazards and the required fire protection systems and class of construction must be determined by the areas involved and approved by the KSC authority having design jurisdiction of the individual areas.

(2) Storage over 15 feet high is treated as a special case.

3.3.5.2 Fire Tests. - Standard fire tests for all building materials, particularly those for fire resistance of structural assemblies, shall conform to NFPA No. 251 (Vol. 4) and for surface flame spread and other features, NFPA No. 255 (Vol. 4).

3.3.5.3 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 National Building Code (NBC) and NFPA No. 220 (Vol. 4).

3.3.6 Means of Egress.

3.3.6.1 General Provisions. - Properly designed and constructed means of personnel egress shall be provided for all facilities at KSC in compliance with NFPA No. 101 (Vol. 4), unless otherwise required by this standard. In open structures and high-hazard areas, wherein normal provisions for 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.

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

3.3.6.2.1 Parts of a Means of Egress. - Means of egress is a 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 escapee paths to reach open air outside a 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.

3.3.6.2.2 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.

3.3.6.2.3 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, which 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.

3.3.6.2.4 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 XI. Where mixed occupancies occur in the same facility, capacity must be calculated for each occupancy area.

3.3.6.2.5 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.

3.3.6.2.6 Measurement of Distance to Exits (Exit Access). - The measurement of exit access distance shall be as set forth in NFPA 101 (Vol. 4), Chapter 5.

3.3.6.2.7 Dead-End Limits. - Dead-end corridors shall not exceed 50 feet in length for all occupancies except industrial-high hazard in which case dead-end corridors are not permitted.

Table XI. 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
Office	100
Industrial	100
Storage	1000
Machine Rooms, Corridors, and Maintenance Equipment Rooms	500

3.3.6.2.8 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.

3.3.6.2.9 Discharge from Exits. - All exits shall discharge directly to the street, or to a yard or court, or 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, it contains at least one gate that is attended 24 hours per day.

3.3.6.2.10 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.

3.3.6.2.11 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 20 inches, nor, when open, interfere with the full use of the stairs. The fire resistance rating of exit doors shall conform to the requirements for the class of wall opening in accordance with NFPA No. 80 (Vol. 4).

3.3.6.2.12 Panic Hardware. - Panic hardware shall be provided, to meet the requirements of NFPA No. 101 (Vol. 4), 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.

3.3.6.2.13 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 (Vol. 4). (See also 3.3.6.2.3.) Guards and handrails shall conform to NFPA No. 101 (Vol. 4).

3.3.6.2.14 Exterior Stairs. - Outside stairs shall be constructed of noncombustible 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 (Vol. 4).

3.3.6.2.15 Elevators. - Elevators shall not be recognized as required exitways, except on service structures.

3.3.6.2.16 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.

3.3.6.3 Specific Requirements - By Occupancy. - The required number of exits calculation shall be made on a net area and actual population basis. Net area of a facility is considered gross area less the sum of corridors, machinery rooms, maintenance equipment rooms and all other normally unoccupied areas.

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

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

3.3.7 Flame, Heat, and Smoke Barriers.

3.3.7.1 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.

3.3.7.2 Firestopping Concealed Spaces. - Concealed spaces in which materials having a flame-spread rating greater than 25 (see NFPA No. 101 (Vol. 4)), 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 firestopping exceed 10,000 sq. ft. The firestops shall be designed to facilitate penetrations by cables, conduits, pipes, duct work, etc., and 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. Pressure-treated, Class A fire-retardant plywood or equivalent noncombustible material, conforming to the requirements of NFPA No. 703 (Vol. 4), are satisfactory for firestopping.

3.3.7.3 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 in sprinklered areas.

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

Type of Occupancy (Table VIII)[4]	Occupants Per UEW[3] Ground Level	Occupants Per UEW[3] Other Levels	Min. No. of Exits	Min. Width (Units)	Max. Travel Distance (Ft.) Sprinklered	
					No	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	50	30	1	1 1/2	100	150
Office	100	60	2 ea. floor	2	100	150
Industrial General	100	60	2 ea. floor	2	100	150
Special Purpose	100	60	2 ea. floor	2	100	150
High Hazard	100	50	2 ea. level	2	75	75[1]
Open	--	--	1 ea. level	1	--	--[2]
Storage I	10	10	2	1	75	100
II	10	10	2	1	100	150
III	10	10	2	1	100	150

(1) Approved slide escapes permitted for service structures
(2) For occupancies of up to 10 persons
(3) Unit Exit Width (See also 3.3.6.2.2.)
(4) See also 3.3.2.

3.3.7.4 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 XIII. Fire walls shall conform to the requirements of the NBC. Fire doors shall conform to the requirements of NFPA No. 80 (Vol. 4).

3.3.7.5 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 (Vol. 4). Walls of utility shafts shall be constructed of noncombustible material meeting the requirements of NFPA No. 251 (Vol. 4) 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.

3.3.7.6 Roof Coverings. - Classes of roof coverings shall conform to the 1960 classification of roof covering materials as defined in NFPA No. 203 (Vol. 4). Roof coverings for facilities at KSC shall be either Class A or Class B.

3.3.7.7 Parapets. - Parapets shall conform to the requirements of the NBC.

3.3.7.8 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.

3.3.7.9 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.

3.3.8 Reduction of Overall Hazard.

3.3.8.1 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.

3.3.8.2 Smoke and Heat Venting. - In storage occupancies and 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 (Vol. 4).

Table XIII. Area Limits Within Firewalls
(Area Limits for Any Story)

Type of Construction	Unsprinklered (Sq. Ft.)		Sprinklered (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

3.3.8.3 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.

* 3.3.8.3.1 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.

* Denotes Change

3.3.8.3.2 Toxic Propellant Impounding Facilities. - As referenced in 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.

3.3.9 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 Fire Protection Requirements Matrix.

3.4.1 Data Arrangement. - The information is arranged in two groups. The general systems requirements are presented first (see Figure 7), followed by specific requirements (see Figure 8) for various areas at KSC. The specific requirements are arranged by area usage in groups of like activities or function.

3.4.2 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 dictated 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 upon 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.

3.4.3 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
Office	O
Industrial General	I-G
Industrial Special Purpose	I-SP
Industrial High Hazard	I-HH
Industrial - Open	I-O
Storage Class I	S-I
Storage Class II	S-II
Storage Class III	S-III
Mixed	M
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	—

3.4.4 Notes and Remarks.

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

(2) Mechanical equipment areas require fixed temperature rate of rise detectors. Electrical equipment areas require products of combustion type detectors.

(3) Requirements shown apply to Central Telephone Building and VAB repeater station only.

(4) Fire protection requirements shown do not include hazard monitoring systems. (See 3.1.2.9.)

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

(6) Drains and dikes not required for buried tanks.

(7) Construction must comply with NFPA-30, Chapters II and VII. Only atmospheric and low pressure tanks are permitted at KSC.

(8) Construction and arrangement shall meet the requirements of NFPA-30, Chapter IV.

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

(10) Construction and arrangement shall meet the requirements of NFPA-31.

(11) Construction shall meet the requirements of NFPA-33.

(12) No combustible material with a flame spread rating greater than 25 permitted.

* (13) Ultraviolet type detectors are required.

* Denotes Change

PRIMARY BUILDING OR AREA USAGE	GENERAL FIRE PROTECTION REQUIREMENTS																NOTES AND REMARKS
	DETECTION, ALARM, EXTINGUISHMENT							BUILDING CONSTRUCTION							OTHER FEATURES		
	DETECTOR CONTROL UNIT	ALARM ANNUNCIATOR	DETECTOR ANNUNCIATOR	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	3.3.5	3.3.5	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	-	CR	-	R	AA	P	AA	AA	-	-	-	-	-	SEE SPECIFICS
ELECTRICAL EQUIPMENT	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 3.4.3 and 3.4.4 for explanation of symbols.)

Figure 7. 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	ALARM ANNUNCIATOR	DETECTOR ANNUNCIATOR	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	3.3.5	3.3.5	3.3.5	3.3.5	3.3.7.4	3.3.6	
SERVICE STRUCTURE	-	CR	-	CR	R	R	R	-	-	-	P	-	-	-	-	R	SEE SPECIFICS
PROPELLANTS AND GASES	-	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	R	R	-	AA	P	-	-	-	-	-	-	R	
PERSONNEL ASSEMBLY	-	R	-	R	R	R	R	AA	P	-	-	-	-	-	R	R	
TRANSPORTATION TERMINALS	-	R	-	R	R	R	-	-	P	AA	AA	-	-	-	-	-	
MISCELLANEOUS																	SEE SPECIFICS

(See Paragraphs 3.4.3 and 3.4.4 for explanation of symbols.)

Figure 7. 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	FIXED SPRAY (EXTINGUISHING)	FIXED SPRAY (CONTROL)	FIXED SPRAY EXPOSURE PROTECTION)	LOW EXPANSION FOAM	FIXED CO_2	FIXED DRY CHEMICAL	BOOSTER PUMP	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	3.2.7.3.1	3.2.7.3.2	3.2.7.3.3	3.2.7.4	3.2.7.5.1	3.2.7.6	3.2.8.6.2	3.2.10	3.3.8.3	3.3.8.2	3.3.7.2	
OFFICES																				
ADMINISTRATIVE	O	L	A	-	R	-	-	R	-	-	-	-	-	-	-	-	-	-	-	
COMPUTER SUPPORT	O	L	A	-	R	-	-	R	-	-	-	-	-	-	-	-	-	-	-	
SHOPS																				
CARPENTER	I-G	O-2	A,C	-	-	-	R	R	-	-	-	-	-	-	-	-	-	R	-	
ELECTRICAL	I-G	O-1	A,B,C	-	-	R	-	R	-	-	-	-	-	-	-	-	-	-	-	
MECHANICAL	I-G	O-1	A,B,C	-	R	-	-	R	-	-	-	-	-	-	-	-	-	-	-	
PAINT	I-G	EH	B,C	-	-	-	R	R	-	-	-	-	-	-	-	-	-	-	-	(11)
VEHICLE REPAIR	I-G	O-2	A,B,C	-	-	-	R	R	-	-	-	-	-	-	-	-	-	-	-	
WELDING	I-G	O-3	A,C	-	R	-	-	R	-	-	-	-	-	-	-	-	-	-	-	

(See Paragraphs 3.4.3 and 3.4.4 for explanation of symbols.)

Figure 8. 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	FIXED SPRAY (EXTINGUISHING)	FIXED SPRAY (CONTROL)	FIXED SPRAY EXPOSURE PROTECTION)	LOW EXPANSION FOAM	FIXED CO_2	FIXED DRY CHEMICAL	BOOSTER PUMP	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	3.2.7.3.1	3.2.7.3.2	3.2.7.3.3	3.2.7.4	3.2.7.5.1	3.2.7.6	3.2.8.6.2	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	-	-	-	-	-	-	-	-	-	-	-	(2)
CHEMICAL	I-SP	O-2	A,B,C,D	-	R	-	-	R	-	-	-	-	-	-	-	-	-	-	-	
CLEANING	I-HH	EH	A,B,C	-	R	-	CR	R	-	-	-	-	CR	CR	-	-	-	-	-	(9)
FILM PROCESSING	I-SP	O-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	-	CR	-	-	R	-	-	-	-	-	-	-	-	-	-	-	
KITCHEN	I-SP	L	A,B,C	-	CR	-	CR	R	-	-	-	-	CR	AA	-	-	-	-	-	
SNACK BAR	A-C	L	A,C	-	CR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

(See Paragraphs 3.4.3 and 3.4.4 for explanation of symbols.)

Figure 8. 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	FIXED SPRAY (EXTINGUISHING)	FIXED SPRAY (CONTROL)	FIXED SPRAY EXPOSURE PROTECTION)	LOW EXPANSION FOAM	FIXED CO_2	FIXED DRY CHEMICAL	BOOSTER PUMP	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	3.2.7.3.1	3.2.7.3.2	3.2.7.3.3	3.2.7.4	3.2.7.5.1	3.2.7.6	3.2.8.6.2	3.2.10	3.3.8.3	3.3.8.2	3.3.7.2	
STORAGE																				
OUTDOOR-CABLE	S-III	O-1	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
OUTDOOR-FLAMMABLE LIQUIDS	S-I	EH	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(8)
OUTDOOR-H.P.GAS BOTTLES	S-III	EH	B,C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
OUTDOOR-HEAVY EQUIPMENT	S-III	O-1	B,C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
INDOOR-NON COMBUSTIBLE CLASS III	S-III	O-1	A,B	-	CR	-	CR	R	-	-	-	-	-	-	-	-	-	R	-	
INDOOR-COMBUSTIBLE CLASS II	S-II	O-2	A,B	-	CR	-	CR	R	-	-	-	-	-	-	-	-	-	R	-	
INDOOR-COMBUSTIBLE CLASS I	S-I	EH	A,B	-	CR	-	CR	R	-	-	-	-	-	-	-	-	-	R	-	
MOTOR FUEL	I-SP	EH	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(7)
MOTOR VEHICLE	I-SP	O-3	B,C	-	-	-	R	R	-	-	-	-	-	-	-	-	-	R	-	

(See Paragraphs 3.4.3 and 3.4.4 for explanation of symbols.)

Figure 8. 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	FIXED SPRAY (EXTINGUISHING)	FIXED SPRAY (CONTROL)	FIXED SPRAY EXPOSURE PROTECTION)	LOW EXPANSION FOAM	FIXED CO_2	FIXED DRY CHEMICAL	BOOSTER PUMP	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	3.2.7.3.1	3.2.7.3.2	3.2.7.3.3	3.2.7.4	3.2.7.5.1	3.2.7.6	3.2.8.6.2	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	O-3	B,C	-	-	-	R	-	-	-	-	-	-	-	-	R	-	-	-	(10)
COMPRESSORS (PUMPS)	NA	L	C	-	R	-	-	R	-	-	-	-	-	-	-	-	-	-	-	
HYDRAULIC EQUIPMENT	NA	O-2	B,C	-	-	-	-	R	-	-	-	CR AA	CR AA	CR AA	-	-	-	-	-	
ELEVATOR HOISTING EQUIPMENT	NA	L	C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
ELEVATOR SHAFTS	NA	L	A,C	-	-	-	CR	-	-	-	-	-	-	-	-	-	-	-	-	
ENGINES, FUEL	NA	O-2	B,C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
ENGINES, PORTABLE	NA	O-2	B,C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

(See Paragraphs 3.4.3 and 3.4.4 for explanation of symbols.)

Figure 8. 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	FIXED SPRAY (EXTINGUISHING)	FIXED SPRAY (CONTROL)	FIXED SPRAY EXPOSURE PROTECTION)	LOW EXPANSION FOAM	FIXED CO_2	FIXED DRY CHEMICAL	BOOSTER PUMP	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	3.2.7.3.1	3.2.7.3.2	3.2.7.3.3	3.2.7.4	3.2.7.5.1	3.2.7.6	3.2.8.6.2	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	O-2	B, C	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	-	

(See Paragraphs 3.4.3 and 3.4.4 for explanation of symbols.)

Figure 8. 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	FIXED SPRAY (EXTINGUISHING)	FIXED SPRAY (CONTROL)	FIXED SPRAY EXPOSURE PROTECTION)	LOW EXPANSION FOAM	FIXED CO_2	FIXED DRY CHEMICAL	BOOSTER PUMP	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	3.2.7.3.1	3.2.7.3.2	3.2.7.3.3	3.2.7.4	3.2.7.5.1	3.2.7.6	3.2.8.6.2	3.2.10	3.3.8.3	3.3.8.2	3.3.7.2	
ELECTRONIC EQUIPMENT																				
CONCEALED CABLEWAY	NA	O-1	C	-	-	R	-	R	-	-	-	-	-	-	-	-	-	-	R	
* COMPUTER ROOM	I-SP	O-1	A,C	-	R	R	-	R	-	-	-	-	-	-	-	-	-	-	R	(1)/
* COMPUTER ACCESSORY EQUIPMENT ROOM	I-SP	O-1	A,C	-	R	R	-	R	-	-	-	-	-	-	-	-	-	-	R	(1)/
COMPUTER PAPER STORES	S-II	O-2	A	-	R	-	R	R	-	-	-	-	-	-	-	-	-	-	-	(1)
COMPUTER TAPE STORES	S-II	O-2	A	-	R	-	R	R	-	-	-	-	-	-	-	-	-	-	-	(1)
* FIRING ROOMS	I-SP	O-1	A,C	-	-	R	-	R	-	-	-	-	-	-	-	-	-	-	-	(1)
DATA LINK REPEATER	NA	L	C	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	
TERMINAL DISTRIBUTOR	NA	L	C	-	-	R	CR	-	-	-	-	-	-	-	-	-	-	-	-	

* Denotes Change

(See Paragraphs 3.4.3 and 3.4.4 for explanation of symbols.)

Figure 8. Specific Fire Protection System Requirements (Sheet 6 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	FIXED SPRAY (EXTINGUISHING)	FIXED SPRAY (CONTROL)	FIXED SPRAY EXPOSURE PROTECTION)	LOW EXPANSION FOAM	FIXED CO_2	FIXED DRY CHEMICAL	BOOSTER PUMP	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	3.2.7.3.1	3.2.7.3.2	3.2.7.3.3	3.2.7.4	3.2.7.5.1	3.2.7.6	3.2.8.6.2	3.2.10	3.3.8.3	3.3.8.2	3.3.7.2	
CABLING																				
TUNNELS AND VAULTS	NA	L	C	-	-	R	CR	R	-	-	-	-	-	-	-	-	-	-	-	
VERTICAL, INDOOR	NA	L	C	-	-	R	-	R	-	-	-	-	-	-	-	-	-	-	-	
VERTICAL, OUTDOOR	NA	L	C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
COMMUNICATIONS																				
TELEPHONE FRAME ROOMS	NA	L	C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(3)
TELEVISION STUDIO	I-SP	O-1	A,C	-	R	-	-	R	-	-	-	-	-	-	-	-	-	-	-	
FILM EDITING ROOMS	I-SP	O-1	A,C	-	R	-	-	R	-	-	-	-	-	-	-	-	-	-	-	
SERVICE STRUCTURE																				
LAUNCH VEHICLE ACCESS PLATFORMS	I-HH	O-2	A,B, C,D	(4)	-	-	-	-	-	R	-	-	-	-	R	-	-	-	-	(2) (5)

(See Paragraphs 3.4.3 and 3.4.4 for explanation of symbols.)

Figure 8. 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	FIXED SPRAY (EXTINGUISHING)	FIXED SPRAY (CONTROL)	FIXED SPRAY EXPOSURE PROTECTION)	LOW EXPANSION FOAM	FIXED CO_2	FIXED DRY CHEMICAL	BOOSTER PUMP	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	3.2.7.3.1	3.2.7.3.2	3.2.7.3.3	3.2.7.4	3.2.7.5.1	3.2.7.6	3.2.8.6.2	3.2.10	3.3.8.3	3.3.8.2	3.3.7.2	
PROPELLANTS AND GASES																				
LH_2 STORAGE	I-O	EH	B,C	(4)	R	-	-	R	-	-	R	-	-	-	-	-	-	-	-	
LH_2 TRANSFER EQUIPMENT	I-O	EH	B,C	(4)	R	-	-	R	-	R	-	-	-	-	-	-	-	-	-	
GH_2 STORAGE	I-O	EH	B,C	(4)	R	-	-	R	-	-	R	-	-	-	-	-	-	-	-	
GH_2 TRANSFER EQUIPMENT	I-O	EH	B,C	(4)	R	-	-	R	-	R	-	-	-	-	-	-	-	-	-	
GH_2 DISPOSAL POND	I-O	EH	B,C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
LOX STORAGE	I-O	EH	C	-	R	-	-	R	-	-	R	-	-	-	-	-	-	-	-	
LOX TRANSFER EQUIPMENT	I-O	EH	C	-	R	-	-	R	-	-	R	-	-	-	-	-	-	-	-	
GOX STORAGE	I-O	EH	C	-	R	-	-	R	-	-	R	-	-	-	-	-	-	-	-	
GOX TRANSFER EQUIPMENT	I-O	EH	C	-	R	-	-	R	-	-	R	-	-	-	-	-	-	-	-	

(See Paragraphs 3.4.3 and 3.4.4 for explanation of symbols.)

Figure 8. 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	FIXED SPRAY (EXTINGUISHING)	FIXED SPRAY (CONTROL)	FIXED SPRAY EXPOSURE PROTECTION)	LOW EXPANSION FOAM	FIXED CO_2	FIXED DRY CHEMICAL	BOOSTER PUMP	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	3.2.7.3.1	3.2.7.3.2	3.2.7.3.3	3.2.7.4	3.2.7.5.1	3.2.7.6	3.2.8.6.2	3.2.10	3.3.8.3	3.3.8.2	3.3.7.2	
RP-1 STORAGE	I-0	EH	B,C	-	R	-	-	R	-	-	-	-	-	-	-	-	R	-	-	(6)
RP-1 TRANSFER EQUIPMENT	I-0	EH	B,C	-	R	-	-	R	-	-	-	R	-	-	-	-	-	-	-	
UDMH/MMH STORAGE	I-0	EH	B,C	(4)	R	-	-	R	R	-	-	-	-	-	-	-	R	-	-	
UDMH/MMH TRANSFER EQUIPMENT	I-0	EH	B,C	(4)	R	-	-	R	-	R	-	-	-	-	-	-	R	-	-	
UDMH/MMH VAPOR DISPOSAL	I-0	EH	B,C	(4)	-	-	-	R	-	-	-	-	-	-	-	-	-	-	-	
N_2O_4 STORAGE	I-0	EH	C	-	-	-	-	R	-	-	R	-	-	-	-	-	R	-	-	
N_2O_4 TRANSFER EQUIPMENT	I-0	EH	C	-	-	-	-	R	-	-	R	-	-	-	-	-	R	-	-	
N_2O_4 VAPOR DISPOSAL	I-0	EH	C	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-	-	
LN_2 STORAGE	I-0	L	C	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-	-	
GN_2 STORAGE	I-0	L	C	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-	-	

(See Paragraphs 3.4.3 and 3.4.4 for explanation of symbols.)

Figure 8. 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	FIXED SPRAY (EXTINGUISHING)	FIXED SPRAY (CONTROL)	FIXED SPRAY EXPOSURE PROTECTION)	LOW EXPANSION FOAM	FIXED CO_2	FIXED DRY CHEMICAL	BOOSTER PUMP	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	3.2.7.3.1	3.2.7.3.2	3.2.7.3.3	3.2.7.4	3.2.7.5.1	3.2.7.6	3.2.8.6.2	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	-	R	(14)	-	-	(5)	-	-	-	-	-	-	-	-	-	-	(13)
	CRYOGENIC SYSTEM TEST	I-HH	EH	C	-	R	-	-	R	-	R	-	-	-	-	-	-	-	-	-	
	ECS SYSTEM TEST	I-HH	EH	B,C	(4)	R	-	-	R	-	R	-	-	-	-	-	-	-	-	-	
	HYPERGOLIC SYSTEM TEST	I-HH	EH	B,C	(4)	R	-	-	R	R	-	-	-	-	-	-	-	R	-	-	
	ORDNANCE INSTALLATION	I-HH	EH	C,D	-	R	-	-	R	-	-	-	-	-	-	-	-	-	-	-	
*	S/C ASSEMBLY	I-SP	O-2	A,B,C	-	R	R	-	R	-	-	-	-	-	-	-	-	-	-	-	
*	L/V ASSEMBLY	I-SP	O-2	A,B,C	-	R	R	-	R	-	-	-	-	-	-	-	-	-	-	-	

(See Paragraphs 3.4.3 and 3.4.4 for explanation of symbols.)

Figure 8. Specific Fire Protection System Requirements (Sheet 10 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	FIXED SPRAY (EXTINGUISHING)	FIXED SPRAY (CONTROL)	FIXED SPRAY EXPOSURE PROTECTION)	LOW EXPANSION FOAM	FIXED CO_2	FIXED DRY CHEMICAL	BOOSTER PUMP	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	3.2.7.3.1	3.2.7.3.2	3.2.7.3.3	3.2.7.4	3.2.7.5.1	3.2.7.6	3.2.8.6.2	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	-	-	-	-	-	-	-	-	-	-	-	(12)
PROJECTION ROOMS	I-SP	L	A,C	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
TRANSPORTATION TERMINALS																				
BARGE TERMINAL	I-G	L	A,B,C	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-	-	
RAILROAD TERMINAL	NA	L	A,B,C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

(See Paragraphs 3.4.3 and 3.4.4 for explanation of symbols.)

Figure 8. 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	FIXED SPRAY (EXTINGUISHING)	FIXED SPRAY (CONTROL)	FIXED SPRAY EXPOSURE PROTECTION)	LOW EXPANSION FOAM	FIXED CO_2	FIXED DRY CHEMICAL	BOOSTER PUMP	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	3.2.7.3.1	3.2.7.3.2	3.2.7.3.3	3.2.7.4	3.2.7.5.1	3.2.7.6	3.2.8.6.2	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	O-1	A,B, C	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-	-	
FIRE STATION	I-SP	O-2	A,B, C	-	-	-	R	R	-	-	-	-	-	-	-	-	-	-	-	
FLIGHT CREW TRAINING	I-SP	L	A,C	-	-	R	-	R	-	-	-	-	-	-	-	-	-	-	-	
METEORLOGICAL STATION	NA	L	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
PRESS SITE	A-B	L	A,C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
RESIDENTIAL	R-D	L	A,C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
SOFT ROOM	I-SP	L	A	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-	-	

(See Paragraphs 3.4.3 and 3.4.4 for explanation of symbols.)

Figure 8. 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	FIXED SPRAY (EXTINGUISHING)	FIXED SPRAY (CONTROL)	FIXED SPRAY EXPOSURE PROTECTION)	LOW EXPANSION FOAM	FIXED CO_2	FIXED DRY CHEMICAL	BOOSTER PUMP	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	3.2.7.3.1	3.2.7.3.2	3.2.7.3.3	3.2.7.4	3.2.7.5.1	3.2.7.6	3.2.8.6.2	3.2.10	3.3.8.3	3.3.8.2	3.3.7.2	
TRAILER OFFICES	O	L	A,C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
WOODEN TOWERS	NA	L	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

(See Paragraphs 3.4.3 and 3.4.4 for explanation of symbols.)

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

4. QUALITY ASSURANCE PROVISIONS

4.1 There are no applicable requirements.

5. PREPARATION FOR DELIVERY

5.1 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 at Kennedy Space Center.

6.2 Definitions.

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

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

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

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

6.2.5 Fixed Extinguishing System. - An engineered arrangement of equipment designed to provide a specified firefighting capability against a particular fire hazard within a specified area. This does not include portable fire extinguishers.

6.2.6 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.

6.2.7 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.

6.2.8 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.

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

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

6.3 Abbreviations.

ac	Alternating current
AWG	American Wire Gage
CO_2	Carbon Dioxide
dc	Direct current
DLTR	Data Link Transmission Repeater
FM	Factory Mutual Engineering Division
Ft.	Feet
GH_2	Gaseous Hydrogen
GN_2	Gaseous Nitrogen
GOX	Gaseous Oxygen
gpm	Gallons per minute
GSE	Ground Support Equipment
Halon 1301	Bromotrifluoromethane
I. D.	Internal Diameter
KSC	Kennedy Space Center
LC-39	Launch Complex 39 (Saturn V)
LCC	Launch Control Center
LH_2	Liquid Hydrogen
LN_2	Liquid Nitrogen
LOX	Liquid Oxygen
MDP	Monoammonium Dihydrogen Phosphate
MMH	Monomethyl Hydrazine
MSO	Manned Spacecraft Operations
NASA	National Aeronautics and Space Administration
NBC	National Building Code
N. C.	Noncombustible
NEC	National Electrical Code
NFPA	National Fire Protection Association
NST	National Standard Hose Thread
POL	Paints, Oils, and Lubricants
Purple K	Potassium bicarbonate
sq. ft.	Square feet
UDMH	Unsymmetrical Dimethyl Hydrazine
UEW	Unit Exit Width
UL	Underwriters' Laboratories, Inc.
Vol.	Volume

6.4.3 Vehicle Launch Areas. - The detection system should consist of manual stations, heat-actuated detectors, and ionization detectors which 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. Water systems should adhere to KSC's policy of water sprayed on flight hardware.

6.4.4 Special Structures for Vehicle or Spacecraft Handling and Testing. - The altitude chamber, the mobile service structure, the crawler, and the mobile launcher are structures which fall into this category. The detection systems on these structures will mostly be local alarm systems. The altitude chamber's system can be made part of the base monitoring system. In the altitude chamber, ultraviolet light detectors should be added to the system. These are used when the chamber is in use. Heat actuated detectors and ionization detectors should be part of the local alarm system.

6.4.5 Electronic Equipment Areas. - Large areas in the LCC, 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.

6.4 Special Facilities.

6.4.1 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.

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

6.4.2.1 Water on Flight Hardware. - The following is the policy at KSC with respect to spraying water on flight hardware.

6.4.2.1.1 There will be no automatic activation of water systems capable of spraying flight hardware.

6.4.2.1.2 Two separate manual actions, "arm" and "activate" shall be required to run 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/or the electrical switches which make up the "arm" and "activate" actions shall be located away from the flight hardware area.

6.4.2.1.3 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 ML and MSS, 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 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.

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