METRIC/U.S. CUSTOMARY

KSC-STD-F-0004D
September 14, 1992
Supersedes
KSC-STD-F-0004C
June 1988

FIRE PROTECTION DESIGN,

STANDARD FOR

ENGINEERING DEVELOPMENT DIRECTORATE

National Aeronautics and
Space Administration

John F. Kennedy Space Center

KSC FORM 16-12 (REV. 7/92)

TRANSMITTAL SHEET

TO:
Distribution

DATE
December 8, 1998

MATERIAL TRANSMITTED

1. Change D-1: KSC-STD-F-0004D, Fire Protection Design, Standard for

   Please make the following pen/ink changes to the referenced document:

   Page 22, Paragraph 4.3 now reads "All water-based suppression system supply and distribution piping shall require schedule 40 or greater." It should be changed to read "All water-based suppression systems (including piping) shall be designed to meet or exceed the NFPA requirements."

   Page 22, Paragraph 4.4.4 now reads "This type of system shall be used at KSC only in areas where freezing is a concern or in essential electronic equipment areas." It should be changed to read "This type of system shall be used at KSC only in areas where freezing is a concern."

Wayne R. Graham
FF-D2-C

FILING INSTRUCTIONS

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FIRE PROTECTION DESIGN,

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Approved:

Walter T. Murphy
Director of Engineering Development

JOHN F. KENNEDY SPACE CENTER, NASA

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LIST OF ILLUSTRATIONS

ABBREVIATIONS AND ACRONYMS

ac	alternating current
ACT	activate
AHJ	authority having jurisdiction
AHU	air handling unit
ALM	alarm
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
BOC	Base Operations Contract
CDSC	Communications Distribution and Switching Center
cfm	cubic foot per minute
CFMS	Central Fire Monitoring System
CGU	color graphics unit
CLS	closed
CMS	Center Monitoring System
CPU	central processing unit
CR	conditional requirements; control relay
CRT	cathode-ray tube
EEE	essential electronic equipment
e.g.	for example
EPROM	Erasable Programmable Read-Only Memory
FACP	fire alarm control panel
FM	Factory Mutual Engineering Division
GN_2	gaseous nitrogen
HAD	heat-actuated detector
HRT	historical recording terminal
HVAC	heating, ventilating, and air conditioning
Hz	hertz
i.e.	that is
IR	infrared
KHB	KSC Handbook
KMI	KSC Management Instruction
kPa	kilopascal
KSC	John F. Kennedy Space Center
lb	pound
LCC	Launch Control Center
LED	light-emitting diode
LS	limit switch
MLP	Mobile Launcher Platform
mm	millimeter
MPa	megapascal
MPS	manual pull station

ABBREVIATIONS AND ACRONYMS (cont)

NASA	National Aeronautics and Space Administration
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NFC	National Fire Code
NFPA	National Fire Protection Association
NHB	NASA Handbook
OPN	open
OS&Y	outside stem and yoke
PER	preliminary engineering report
PIV	positional indicator valve
PRI	primary
PS	pressure switch
psi	pound per square inch (static pressure)
psig	pound per square inch (gage pressure)
RDN	redundant
SOV	solenoid valve
SOW	statement of work
STD	standard
SW	switch
TFE	tetrafluoroethylene
TDR	time-delay relay
UL	Underwriters Laboratories, Inc.
UV	ultraviolet
VABR	Vehicle Assembly Building Repeater
V	volt
V ac	volt, alternating current
V dc	volt, direct current

FIRE PROTECTION DESIGN, STANDARD FOR -

1. SCOPE

1.1 Purpose. - This document provides additional fire protection design standards to be used in conjunction with NASA Handbook (NHB) 1700.1, Volume 9, for the design or modification of facilities and systems under the design jurisdiction of John F. Kennedy Space Center (KSC), NASA.

1.2 General. - The minimum basic requirements for the design of a fire protection system shall be in accordance with the applicable provisions of the latest revision of the National Fire Code (NFC) published by the National Fire Protection Association (NFPA). If there are inconsistencies or conflicts between these requirements and other NASA documents, then the Statement of Work (SOW), this standard, and NHB 1700.1, Volume 9, shall take precedence in that order.

The coordination and the resolution of questions and conflicts concerning the application of this standard to a design shall be the responsibility of the Lead NASA Design Engineer, with support from the NASA System Engineer and the NASA Fire and Rescue Office. Where NHB's, NFPA, etc., refer to the authority having jurisdiction (AHJ), the Lead Design Engineer shall coordinate with the responsible NASA System Engineer and the Fire and Rescue Office for an AHJ-related decision. The ultimate AHJ authority resides with the NASA Fire Protection Risk Review Board.

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

2. APPLICABLE DOCUMENTS

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

2.1 Governmental.

2.1.1 Standards.

John F. Kennedy Space Center (KSC), NASA

KSC-STD-E-0002	Hazard Proofing of Electrically Energized Equipment
KSC-STD-SF-0004	Safety Standard for Ground Piping Systems Color Coding and Identification
KSC-STD-152-2	Graphical Symbols for Drawings, Part II: GSE/Vehicle Support Systems

2.1.2 Drawings.

79K32573	Standard Push Button Control Station for KSC Type II Fire Water Deluge System
81K03000 through 81K03020	Central Station Configuration Drawings

2.1.3 Directives.

National Aeronautics and Space Administration (NASA)

NHB 1700.1 (Volume 9 and Appendix E)	NASA Safety Manual, Fire Protection
NHB 5300.4(1C)	Inspection System Provisions for Aeronautical and Space System Materials, Parts, Components and Services
NHB 7320.1B	Facilities Engineering Handbook

2.1.4 Other.

GP-435	Engineering Drawing Practices
SPECSINTACT	NASA KSC Shelf Masters

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

2.2 Non-Governmental.

National Fire Protection Association (NFPA)

All volumes of NFPA, including appendices and recommended practices

(Application for copies should be addressed to the National Fire Protection Association, 1 Batterymarch Park, Quincy, Massachusetts 02269.)

Southern Building Code Congress International, Inc.

Standard Building Code

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

American National Standards Institute (ANSI)

ANSI A17.1	Safety Code for Elevators and Escalators

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

American Society for Testing and Materials (ASTM)

ASTM E84	Test Method for Surface Burning Characteristics of Materials

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.)

3. FIRE DETECTION AND ALARM

3.1 General. - The KSC fire alarm detection and reporting system shall be composed of local systems and a Centerwide proprietary protective signaling system as described in NFPA 71 and 72. All new local fire detection and alarm systems shall be capable of individual zone reporting to the existing Simplex Model-2120-based Central Fire Monitoring System (CFMS) (see figure 1). This standard does not preclude the possibility of interfacing another manufacturer's system with the Model 2120 CPU. If this option is chosen, testing must be performed in accordance with SPECSINTACT KSC Shelf Master, Section 16722, to verify compatibility. Local fire alarm systems shall be installed in KSC buildings and aboard the mobile launch structures in accordance with 3.1.1. The CFMS is installed to monitor and control the local fire alarm systems and accept signals from the mobile launch equipment at selected interface points.

3.1.1 Requirements.

3.1.1.1 Structures Requiring Fire Detection and Alarm. - A complete fire alarm and detection system shall be required in facilities meeting any of the following conditions:

a. Subject to occupancy by 50 or more occupants as determined using Life Safety Code (NFPA 101) criteria.

b. Floor area greater than 280 square meters (3,000 square feet).

c. The facility has one or more floors above or below the level of exit discharge.

d. Houses sleeping quarters

Note

Sleeping quarters shall be protected by single-station detectors that have an integral audible device capable of producing 85 dBa at 3 meters (10 feet). When more than one of these devices is required, all the devices in the same room should be tandem connected. Access corridors shall be protected by smoke detectors directly connected to the facility fire alarm control panel.

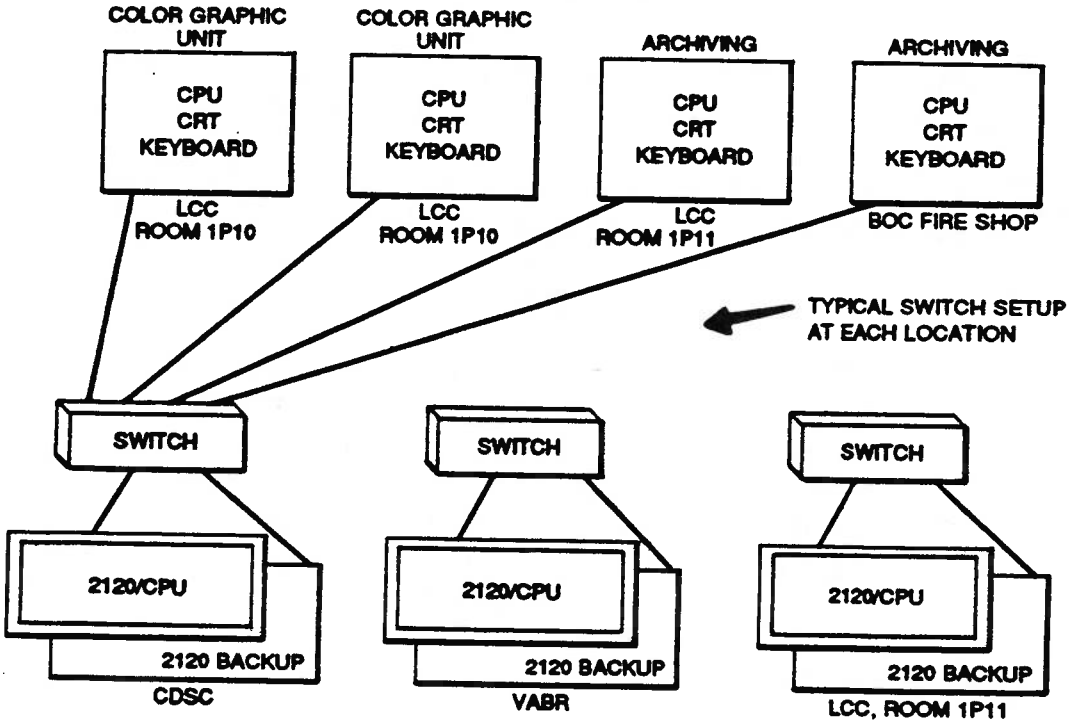

Figure 1. KSC Fire Monitoring System

e. Houses computer rooms and essential electronic equipment (EEE) areas as defined by NHB 1700.1, Volume 9.

Note

The computer rooms or EEE areas will be equipped with photoelectric smoke detection on the ceiling and below raised floors.

f. Facilities with partitions arranged in such a manner to prevent occupants from readily identifying fire effects and the subsequent need to evacuate.

g. The occupancy or defined area within the facility has or requires a fixed fire suppression system in accordance with NHB 1700.1, Volume 9.

Note

Where automatic suppression is installed, heat or smoke detection is not generally required to interface with the FACP. Pull stations, flow switches, tamper switches, and air conditioning duct detectors are required. Smoke detection may be required to operate an automatic suppression system.

h. Other instances as determined by the Fire and Rescue Office.

3.1.1.2 Retrofitting/Expansion of Existing Fire Alarm Systems. During field investigations for planning, studies, preliminary engineering reports (PER's), and designs that require existing fire alarm systems to be modified (e.g., air handling unit (AHU) shutdowns, modifying or adding space to a facility, adding or modifying sprinkler systems, etc.), designers shall ensure that the existing fire alarm control panel (FACP) meets the following requirements:

a. Is still required according to the guidelines in 3.1.1.1.

b. Has sufficient capacity or can be expanded to accommodate additional initiating, indicating, signaling, or control zones as required by the modifications or additions.

c. Where more than six zones are reported, the panel must communicate directly with the CFMS.

d. The fire alarm control panel complies with the requirements of NFPA 72 and the power source is backed up by a battery-powered backup system.

If there is insufficient capacity or capability to expand a facility's existing FACP, then the plan, study, preliminary engineering report, design, etc., shall include the replacement of the existing panel with a new panel (reference 3.1.2.2). A determination shall be made whether to upgrade the circuitry to comply with 3.1.2.8.

If the panel does not require replacement for the above reasons and is not yet reporting all zones to the CFMS via the Simplex 2120 CPU's in accordance with 3.1.1.2, then the necessary equipment shall be included to report the facility as a single zone to the existing Simplex Model 4100 panel located in the Vehicle Assembly Building Repeater (VABR) or Communications Distribution and Switching Center (CDSC). Refer to the CFMS connecting block diagrams for small facilities (see figure 2).

3.1.2 System Description.

3.1.2.1 Local Fire Alarm Systems. - Local fire alarm system components (including initiating, indicating, and signaling devices and fire alarm control units) shall be designed, installed, and acceptance tested in compliance with NFPA regulations as a minimum. The individual facility fire alarm systems must be compatible with remote monitor, control, reporting, and archiving requirements for reporting by zone to the CFMS.

3.1.2.2 Fire Alarm Subsystems. - Local fire alarm systems installed in a group of buildings, trailers, or areas where a high-hazard fire potential exists shall be centralized in a common system and shall be reported on a common annunciator and control unit. Fire alarm signals shall be reported by individual hazard area, zone, or building to the CFMS.

Control units shall be listed by Underwriters Laboratories, Inc. (UL) or approved by Factory Mutual Engineering Division (FM) or any other recognized testing laboratory as noncoded, continuous-ringing fire alarm systems. Power for control units shall be battery backed up (see appendix B). The control units shall comply with NFPA 72 with initiating device circuits designed to Style D, indicating appliances circuits designed to Style Z and signaling line circuits designed to Style 7. New local control units shall provide the Centerwide fire-monitoring equipment with alarm and trouble indication for each zone of alarm-initiating devices and/or each addressable initiating device (see figure 2). Test switches, alarm-silencing switches, and other local fire-alarm system control devices shall be located within the control unit and shall be accessible only by unlocking and opening the unit. Control unit enclosures shall be dustproof, shall have a hinged cover, and shall be provided with an integral key lock that accepts the KSC-specified Best Company seven-pin lock cylinder.

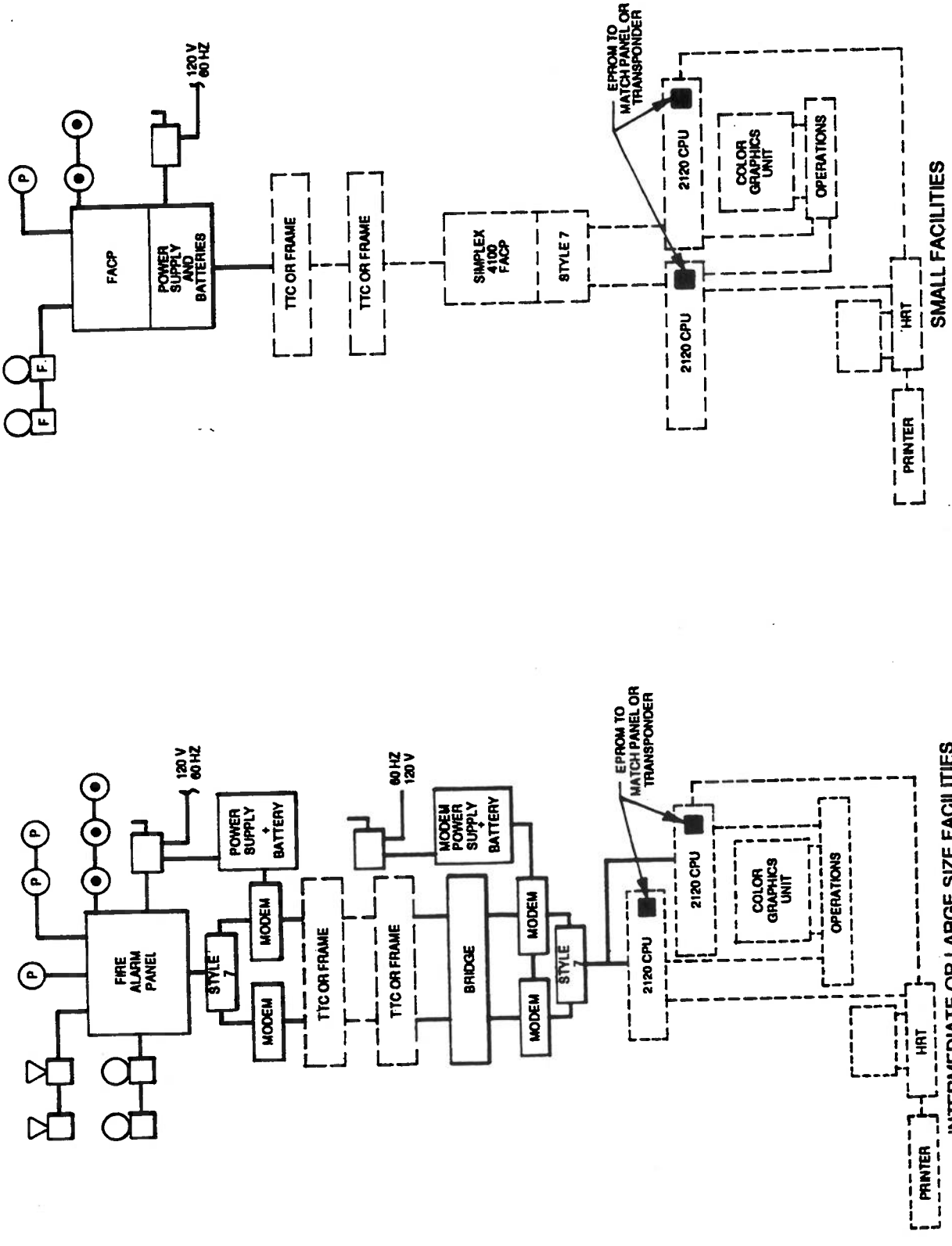

Figure 2. Central Station Connecting Block Diagrams (Sheet 1 of 2)

LEGEND AND NOTES

ITEM	DESCRIPTION
———	NEW WORK
— — — —	EXISTING
- - - - - - -	EXISTING CENTRAL STATION EQUIPMENT
⊙	HEAT ACTUATED DETECTOR
Ⓘ	SMOKE DETECTOR, IONIZATION (EXISTING)
Ⓟ	SMOKE DETECTOR, PHOTOELECTRIC
	BELL, FIRE ALARM (10 INCH)
	SPEAKER, FIRE ALARM (BELL SOUND)
FIRE ALARM PANEL	FIRE ALARM CONTROL PANEL COMPATIBLE WITH SIMPLEX 2120 CPU
	SAFETY SWITCH FOR 120 VOLT SINGLE PHASE 60 HZ POWER
ZAM	ZONE ADDRESSABLE MODULE CONVERTS THE ALARM AND TROUBLE SIGNAL OUTPUT OF A SINGLE ZONE PANEL TO A FORMAT FOR THE TRANSPONDER
TRANSPONDER	INTERFACE DEVICE FOR EXISTING PANELS TO COMMUNICATE WITH SIMPLEX 2120 CPU
RELAYS	REQUIRED TO INTERFACE EXISTING FIRE ALARM PANELS TO SIMPLEX TRANSPONDERS
BRIDGE	MULTIMODEM INTERFACE CARD

NOTES:

1. INDICATING AND SIGNALING DEVICES THAT ARE NOT COMPATIBLE WITH THE NEW FIRE ALARM CONTROL PANEL WILL REQUIRE REPLACEMENT. THIS WILL INCLUDE BUT NOT BE LIMITED TO 120 V AC BELLS, 120 V AC SMOKE DETECTORS, ETC.

2. 2120 CPU's ARE LOCATED IN THE VABR, CDSC, AND LCC ROOM 1P11. UNLESS OTHERWISE DIRECTED, THE CPU's IN THE CDSC AND VABR WILL BE USED. EACH NEW PANEL OR TRANSPONDER WILL REQUIRE TWO MATCHING EPROM's TO BE INSTALLED IN THE PRIMARY AND REDUNDANT CPU TO IDENTIFY THE NEW PANEL TO THE SYSTEM.

3. WHERE THE NAME "SIMPLEX" IS USED ON NEW EQUIPMENT, IT IS INTENDED AS EQUIPMENT MANUFACTURED BY THE SIMPLEX TIME RECORDER COMPANY OR THE FUNCTIONAL EQUIVALENT. THE EQUIVALENT EQUIPMENT MUST COMMUNICATE WITH THE CENTRAL STATION EQUIPMENT IN EXACTLY THE SAME MANNER AS THE SIMPLEX EQUIPMENT, MUST BE UL LISTED OR FACTORY MUTUAL OR OTHER RECOGNIZED TESTING LABORATORY APPROVED FOR THE APPLICATION, AND MUST MEET THE KSC REQUIREMENTS FOR FIRE ALARM AND REPORTING AND CONTROL EQUIPMENT.

Figure 2. Central Station Connecting Block Diagrams (Sheet 2 of 2)

The following FACP types shall be installed in facilities as listed below:

a. Small facilities with six connected initiation zones or less that do not require addressable devices or individual zones reporting to the CFMS shall utilize an FACP with a minimum capacity of eight zones. A summary alarm and trouble signal shall report to the CFMS via the Simplex Model 4100 systems located in the VABR (Launch Complex 39 area) or CDSC (Industrial Area).

b. Medium size facilities, with 25 connected initiation zones or less that require zone reporting to and/or remote control from the CFMS but do not require addressable devices, shall incorporate a Simplex Model 4002, (or approved equal) FACP. The panel shall interface with the CFMS via the Simplex Model 2120 multiplexing unit indicated.

c. Large size and high-bay facilities [ceiling height greater than 10 meters (30 feet)], with addressable devices or greater than 26 connected initiation zones that require zone reporting and/or remote control from the CFMS, shall incorporate a Simplex Model 4100 (or approved equal) FACP. The panel shall interface with the CFMS via the Simplex Model 2120 multiplexing unit indicated.

3.1.2.3 Installation of Local Fire Alarm Systems in Hazardous Areas. - Local fire alarm systems installed in hazardous areas shall comply with NEC Article 500, Hazardous Location (NFPA 70) and KSC-STD-E-0002.

3.1.2.4 Fire Alarm Zones. - Alarm-initiating devices installed in multistoried buildings or selected building groups shall be zoned by device type and area. Where alarm-initiating devices are zoned, the local fire alarm system shall have an FACP with an annunciator panel in an entrance lobby or in a location designated by the responsible Lead Design Engineer. The following device types shall be individually addressable (status is uniquely identified at the FACP):

a. Water suppression system flow/pressure switches

b. Supervisory tamper switches

c. Suppression system control panels

d. AHU duct detectors (common unit supply and return detectors may share the same zone)

e. Ultraviolet (UV)/infrared (IR) flame detectors installed in high bays where flight vehicles or payloads are processed (see 3.1.2.7.3)

f. Concealed smoke detectors when required by the Lead Design Engineer

g. Devices required to report individually to the CFMS

Devices can be made individually addressable by one of two methods: (1) connecting the device to a dedicated FACP monitor zone circuit or (2) connecting an addressable device to an FACP with multiplexing capability.

Based on an engineering survey, zoning requirements for the number of zones reporting to the CFMS shall be consistent with the hazard involved. Generally, individually addressable initiation devices such as smoke or flame detectors will not report individually to the CFMS but will be grouped by programming (software zoning) to report by geographic area or device type (e.g., a UV/IR alarm on a specific platform level); an exact alarm or trouble condition will be determined by inspection at the FACP.

Alarm systems shall be zoned to sound alarm devices within a building as designated by the responsible Lead Design Engineer following consultation with the Fire and Rescue Office.

3.1.2.5 Fire Control and Extinguishing System Reporting. - Each fixed fire suppression system control panel shall be interconnected to the facility FACP for monitor and alarm notification only, except when the FACP is utilized as the preaction control panel (see 4.4.5.1). All suppression systems shall be monitored by the facility fire alarm system by one or more zones per system. One zone will monitor suppression system pressure/flow switch (e.g., sprinklers, etc.). Additionally, a second zone will monitor the suppression system control panel when provided (e.g., Halon control, preaction system control panel, deluge, etc.) Dry or wet chemical systems shall be monitored on a separate zone at their control unit (e.g., cafeteria range hoods, etc.). The interface points between the FACP and any suppression system control panel must be external to both panels. The facility fire alarm system will control the facility evacuation alarm and reporting circuit to the CFMS.

Water-flow indication devices for fire protection systems shall be installed on separate zone-indicating modules without any other type of indicating device. As a minimum, water-flow alarms, interconnected with the building fire alarm system and central fire alarm reporting system, shall be provided for each floor level protected by an automatic sprinkler system. For smaller buildings where it would be readily apparent as to the location of a fire, only one water-flow alarm is necessary. Each water-flow switch shall report as a single zone or be addressable.

Tamper switches shall indicate supervisory alarm when the valve is closed more than approximately 25 percent.

3.1.2.6 Shunt Trip. - Shunt trips shall be supplied with all sprinkler systems that are installed to protect electrical/electronic equipment (see 4.4.2) and shall be installed to shut down all electrical cooking appliances protected by dry or wet chemical extinguishing systems.

3.1.2.7 Annunciators. - Location and type of the annunciator panel shall be specified by the Lead Design Engineer following consultation with the Fire and Rescue Office.

3.1.2.7.1 System Annunciators. - System annunciators either integral to the FACP or of the remote type shall be supervised and consist of a display unit with alarm and trouble signals distinctively annunciated. Illuminating indicators [e.g., light-emitting diode (LED) or liquid crystal displays for addressable capabilities] shall be used; red for alarm, amber for trouble indication.

3.1.2.7.2 Detector Annunciators. - The alarm-indicating lamps of smoke detectors located above ceilings, under raised floors, and in other concealed areas shall be installed in locations readily visible and accessible to the Fire Department or, as an alternative, the detectors must be addressable. Remote indicators shall be logically grouped by zone or area and shall be displayed on a common annunciator. The annunciator shall be mounted in or on the wall of a major hall or passageway. The annunciator shall be of the graphic display type or shall have a graphic locator posted adjacent to it. If the facility fire alarm panel accepts addressable devices, the concealed detectors shall be addressable.

3.1.2.7.3 Flame Detectors (UV/IR). - Where flame detectors are located in high-bay areas [ceiling height greater than 10 meters (30 feet)] and where flight vehicles or payloads are processed, flame detectors shall be individually addressable for both alarm and trouble conditions (uniquely identified at the FACP; see 3.1.2.4). In other locations, UV/IR flame detectors shall include features to readily determine if the individual devices are either in alarm or in trouble or shall be addressable.

3.1.2.8 Circuitry. - Local fire alarm system circuitry external to the control unit shall be installed in accordance with NFPA 70 and NFPA 72. All wiring shall be continuous between system components such as detectors, bells, control units, and manual pull stations. Splices, solder connections, "T" taps, or other type connections are not acceptable. Where continuous wiring is not possible, terminations shall be made on clearly marked and protected on terminal strips. Alarm-initiating circuits shall be in accordance with NFPA 72, Style D, alarm-signaling circuits shall be in accordance with NFPA 72, Style Z, and alarm-indicating circuits in accordance with NFPA 72, Style 7. The positive wire from the zone module to the last initiating device and returning from the last device to the zone module shall be blue. The wire from the negative shall be black and shall be identified

numerically at each conductor termination point. Numerical identification shall correspond with the zone or alarm circuit number and shall be by plastic-coated, self-sticking, printed markers or by heat-shrink-type sleeves. Series-wired, alarm-signaling circuits shall have both wires colored red; parallel-wired, alarm-signaling circuits shall use a red wire for the positive leg and an orange wire for the negative leg.

3.1.2.9 Control Circuit Supervision. - The wiring to emergency control devices shall be monitored (supervised) to within 1 meter (3 feet) of the device to be actuated in accordance with NFPA 101.

NOTE

Separation of auxiliary device (e.g., AHU, HVAC, etc.) control wiring and fire alarm system wiring shall be in accordance with NFPA 70, Article 760. Auxiliary device control wiring shall not enter FACP's.

3.1.2.10 Initiating Devices (Appliances). - The design between disciplines shall be coordinated to ensure the proper location of devices and prevent the installation of devices in locations that might cause false alarms (such as near chemical processing equipment). In addition to all the referenced requirements including NFPA, standards, guides, etc., all detectors shall be installed in accordance with the manufacturer's recommendations. Ease of maintenance shall be considered during design. All initiating devices shall be of the terminal block type.

3.1.2.10.1 Automatic Fire Detectors. - Detectors installed in local fire alarm systems shall be UL-listed or FM-approved for use with the applicable control panel or approved for use by a recognized testing laboratory and shall meet the requirements of NFPA 72E.

NOTE

Rate-compensated detectors are approved to be used only in locations where explosion-proof requirements do not allow usage of other heat detectors.

Photoelectric-type smoke detectors shall be standard for use in low-energy-heat-release fire applications, such as under raised computer floors (see figure 3). In areas subject to changes in atmospheric pressure [pressurized areas such as the Mobile Launcher Platform (MLP)], detectors that are not susceptible to false activation from pressure change shall be used. [Rate-of-rise heat-actuated detectors (HAD's) are susceptible to such pressure changes.]

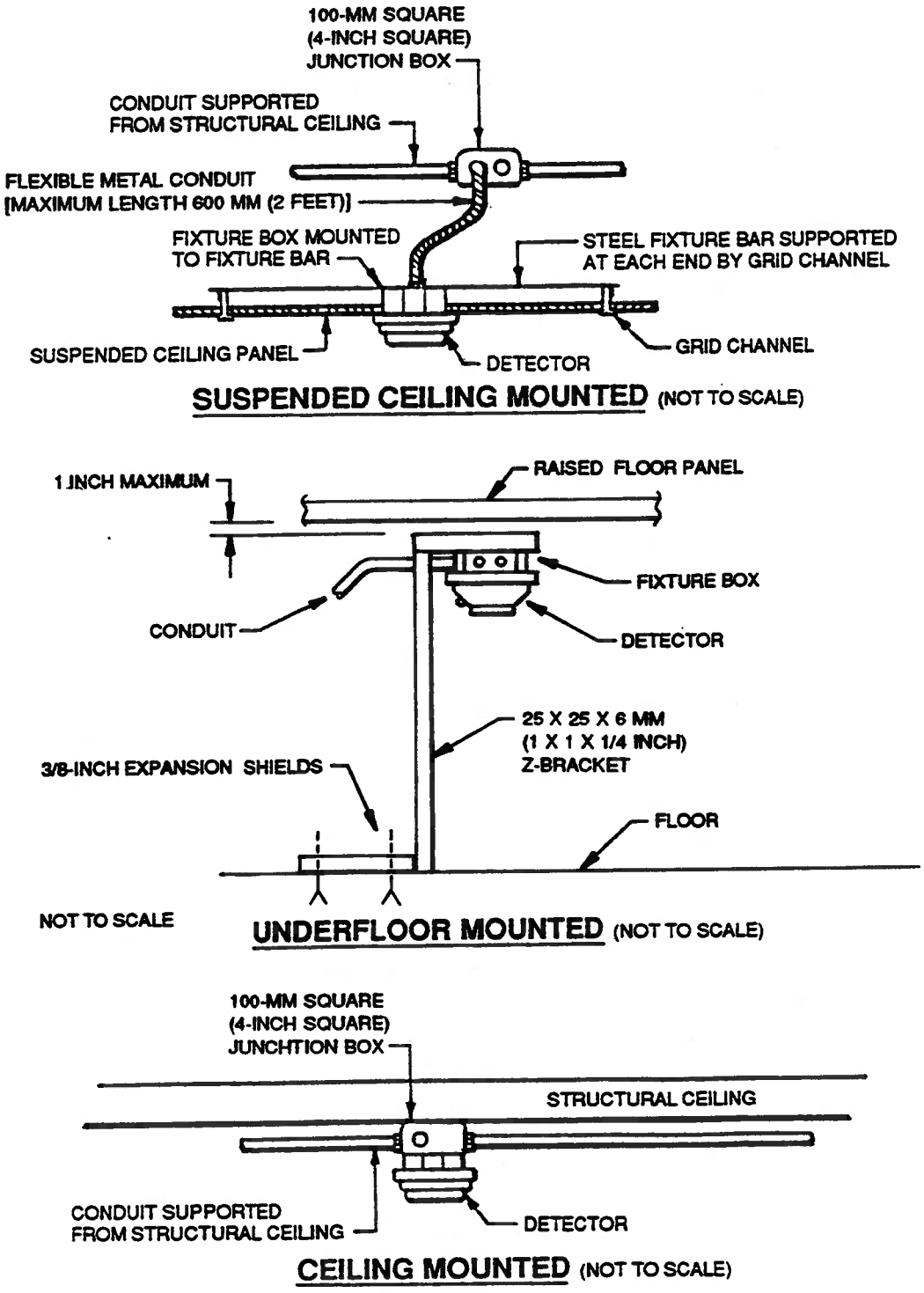

Figure 3. Typical Smoke Detector Mountings

Where flame detectors are required in high-bay applications, they shall be UV/IR type.

3.1.2.10.2 Smoke Detectors. - All smoke detectors shall be photoelectric type (see figure 3 for typical mounting details). Ionization detectors shall not be used at KSC. Existing ionization detectors shall be replaced with the photoelectric type when the FACP is replaced during system modification or maintenance.

3.1.2.10.2.1 Duct Detectors. Photoelectric-type duct smoke detectors shall be installed in air handling system supply and return ducts in accordance with NFPA 90A. Duct smoke detectors shall be individually addressable or zoned per AHU. Upon activation of an AHU's duct detectors, AHU's shall be shut down by the facility FACP (see 3.1.2.9), and the building fire alarm shall be activated.

3.1.2.10.2.2 Essential Electronic Equipment Areas. - Photoelectric-type smoke detectors shall be installed in essential electronic equipment areas in accordance with NFPA 75. Detectors installed under false computer floors, or otherwise concealed, shall be identifiable in accordance with 3.1.2.7.2. Where smoke detectors supplement other initiating devices (e.g., HAD's, sprinkler flow switches, etc.), the smoke detector alarm condition shall notify the CFMS, but not ring facility bells.

Under-floor smoke detectors shall be mounted in the pendant position (see figure 3).

3.1.2.10.2.3 Other Areas. - Photoelectric-type smoke detectors installed in other areas shall notify the CFMS and activate the building fire alarm except where the detectors supplement other initiating devices, in which case they will notify the CFMS only.

3.1.2.10.3 Manual Fire Alarm Stations. - Manual fire alarm stations shall be UL-listed or FM-approved for NFPA style D systems, and their construction shall be such that a tell-tale sign (e.g., glass or plastic rod) is left during actuation of or tampering with the station. Hammer-and-glass or palm-plunger-through-glass types are not acceptable. Each station shall have provision for authorized personnel to use an appropriate tool to gain entrance to the interior of the station without actuating the station. Stations with a pushbutton, which depends upon a spring-loaded device to close the contacts when the handle is pulled, are not acceptable. Plastic or composite materials are not acceptable.

Design of manual stations shall incorporate an internal toggle switch that is factory wired to a terminal block for field connections. In areas classified as hazardous because of the presence of hydrogen, a Class 1, Division 1 or 2, Group B, UL-listed or FM-approved or recognized-testing-laboratory-approved switch is required and shall be enclosed in a red metal housing having provision

for a plastic seal. Stations shall not be resettable without the use of a key wrench or another tool except for Class 1, Division 1 or 2, Group B switches (in accordance with NFPA 70, Article 500).

3.1.2.11 Indicating Devices. - All indicating devices shall be installed in accordance with NFPA 72G.

3.1.2.11.1 Sound Devices. - Alarm signals have been standardized at KSC to be a noncoded bell-ringing sound. Fire alarm signals shall not be used for any other purposes. In general, alarm bells shall be electric, solenoid-operated, plunger-type, vibrating, underdome alarm-indicating devices not less than 250 millimeters (10 inches) in diameter. Where audio speakers are used as signaling devices, a bell tone shall be used as the evacuation signal unless otherwise specified by the Lead Design Engineer and concurred with by the Fire and Rescue Office. Alarm signal devices shall be located outside the facility and shall be audible at all entrances.

NOTES

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

2. The use of a horn is not acceptable since this tone is already in use at KSC as a warning of a moving structure.

3. The use of a device that accurately reproduces a bell sound is acceptable.

3.1.2.11.2 Visual Devices. - The requirement of visual alarms shall be determined by the Fire and Rescue Office. Strobe lights, if installed, shall be 75 candela (minimum). In areas of severe noise levels where occupants wear protective ear devices or where occupants are hearing impaired, revolving beacons or other adequate means of visible signaling shall also be provided. [A beacon or flasher (strobe) shall always be used in conjunction with, but never substituted for, a bell.]

3.1.2.12 Lightning Protection Requirements. - Fire alarm system design shall incorporate lightning/surge protection supplemental to that provided with FACP components. Protection shall be installed at the fire alarm power disconnect switch for each phase and neutral conductor for incoming 120 volt alternating current (V ac) power. Protection shall also be installed on each conductor of the initiating and/or indicating circuits leaving the building. Signaling/communication

service (outside cable plant). Such protection shall be installed in a location in close proximity to where the circuit leaves the building. Lightning/surge suppressors shall be connected to the building earth ground electrode system.

3.1.2.13 Centerwide Fire Monitoring System. - The CFMS is an existing assembly of Simplex Time Recorder Company equipment. The main part of the system is a group of three Simplex Model 2120 CPU's. Each of these three CPU's has an identical redundant Simplex Model 2120 CPU adjacent to the primary CPU and on-line as a backup in case of failure of the primary unit. These CPU's are located in the VABR, Building K6-1193; the CDSC, Building M6-138; and the Launch Control Center (LCC), Building K6-900. These CPU's receive alarms and trouble signals from or send signals to the local systems via outside cable plant telephone pairs. The alarm and trouble signals are then transmitted via the outside cable plant telephone pairs to the Simplex color graphics unit (CGU) and the Simplex historical recording terminal (HRT) (with printer) located in LCC room 1P10. Command or control signals may be programmed into the CPU's or transmitted from the operator's keyboard at the CGU. The CGU is the operator's station. When a new local system is added or the number of reporting zones or devices is modified, a modification is required to the Erasable Programmable Read-Only Memory (EPROM) in the CPU and redundant CPU to which the local system is connected. This modification shall be performed by Simplex under contract to the fire alarm or construction contractor installing the system or modification. A modification to the graphics and programs in the CGU's is also required. The construction specification shall require a submittal of the data necessary for BOC to modify the graphics and programs in the CGU's.

3.1.2.14 Transmission. - Additions and modifications to the CFMS shall be in accordance with NFPA 72, style 7, using primary and secondary full duplex frequency-shift-keyed modems fully compatible with the existing central equipment. Communication pairs used for transmitting an alarm from the local fire alarm system to LCC room 1P10 shall be protected with red protective terminal caps.

Each FACP shall require two modems at the FACP and two (or a bridge network) at the Simplex Model 2120 CPU to maintain the style 7 configuration. Modems may not be required when the facility is within an acceptable circuit distance from the CPU or an acceptable distance from another modem setup.

All communication lines should be requested in advance for use as fire alarm communication circuits to the CFMS.

3.1.2.15 Elevator Recall. - Elevator recall systems shall be designed and installed in accordance with ANSI A17.1 and NFPA requirements. The elevator recall system shall interface with the FACP. Zoning at the FACP shall be by floor and device type.

3.2 Design Notes.

3.2.1 General Information. - The following drawings depict KSC's fire monitoring system and components:

a. 81K03000, the CFMS drawing index.

b. 81K03001, the Simplex 2120 located in LCC room 1P11 and all facilities currently reporting through that 2120.

c. 81K03002, the Simplex 2120 located in the CD&SC and all facilities currently reporting through that 2120.

d. 81K03003, the Simplex 2120 located in the VABR and all facilities currently reporting through that 2120.

e. 81K03004 through 81K03008 and 81K03012 thru 81K03018 are reserved for any future expansion required of the CFMS.

f. 81K03009, standardized Simplex Model 4002 FACP and modem cabinet for KSC installations. The Lead Design Engineer shall reference additional components or capability to be incorporated on shop drawing submittals when required.

g. 81K03010, standardized Simplex Model 4100 FACP with audio capability and modem cabinet for KSC installations. The Lead Design Engineer shall reference additional components or capability to be incorporated on shop drawing submittals when required.

h. 81K03011, standardized Simplex Model 4100 FACP (without audio capability) and modem cabinet for KSC installations. The Lead Design Engineer shall reference additional components or capability to be incorporated on shop drawing submittals when required.

i. 81K03019, Simplex Model 4100 FACP located at the VABR. The panel is used to monitor summary alarm and trouble signals for small facility FACP's located in the Launch Complex 39 area.

j. 81K03020, Simplex Model 4100 FACP located at the CDSC. The panel is used to monitor summary alarm and trouble signals for small facility FACP's located in the Industrial Area.

3.2.2 Specifications. - The construction specifications to be used for all projects, which include fire detection and alarm and that are the responsibility of KSC, shall be NASA/KSC SPECSINTACT, Section 16722. The contents of this specifica-

tion section shall be modified to fit the particular project under design. In the event that the project is fire alarm work only, SPECSINTACT, Sections 16003 and 01300 shall be included in the construction specifications.

3.2.3 Drawing Preparation. - The design organization shall follow the following guidelines when preparing design documentation for fire alarm systems:

a. Drawings for fire alarm systems shall be computer generated using Intergraph-compatible software or format. Symbols used on fire alarm system drawings shall be in accordance with GP-435 and appendix A of this document.

b. Fire alarm plans shall clearly define geographic zone boundaries as well as the location of all addressable devices.

c. Riser diagrams indicating all control equipment and devices connected, zone identification, addressable device indication, alternating current power connections, and base telephone communications interface shall be provided.

d. Elevation and detail sheets showing all major areas affected by the project with details of areas where work is concentrated shall be provided. Fire alarm terminal cabinet terminations, panel connections, modem connections, etc., shall be drawn and identified. Where existing fire alarm panels or other fire alarm equipment is to be modified, the equipment model type and manufacturer's name shall be shown on the drawings.

e. Reference KSC standard FACP drawings (81K03009, 81K03010, and 81K03011) where Simplex equipment is to be employed. Reference shall include all deviations from the standard configuration required to be detailed on the shop drawing submittals.

3.2.4 Interfaces to the CFMS. - Each system to be tied into the CFMS shall be assigned address points from the Simplex Model 2120 to which it is to be reported. Updated Center Monitoring System (CMS) files shall be submitted during construction and shall be approved by the Lead Design Engineer with concurrence from the NASA System Engineer. The EPROM associated with the Simplex Model 2120's shall be updated when a new system is added. The contractor adding the new system is responsible for the EPROM update, installation, and testing utilizing the original equipment manufacturer for support.

3.3 Installation and Test. - Installation and test shall be in accordance with SPECSINTACT, Section 16722, and shall include the following requirements:

a. The specification shall require a certified fire alarm contractor to be present during installation and testing of the fire alarm system.

b. All shop drawings and test procedures shall be approved before implementation.

c. Upon completion of an installation, a complete functional test of the protective system, including testing of connections to any equipment that is monitored or controlled by the protective system, shall be conducted for the purpose of verification of compliance with the applicable contract documents and NFPA standard. All necessary documentation, including as-built drawings, connection drawings, schematics, all software program, and the manufacturer's manual, shall be available one week prior to the test for verifying the connected equipment with the documentation. The acceptance test procedure shall be submitted for approval prior to the test being scheduled and, as a minimum, be in accordance with NFPA 72H. A certification of compliance (written statement) by the installing contractor shall be made that the system has been installed and performs in accordance with the design drawings and specifications. This shall be submitted in accordance with the contract. Upon receiving a copy, the Lead Design Engineer will send a copy to the Fire and Rescue Office. Deviations from these requirements shall be approved in writing by the Lead Design Engineer and the Fire and Rescue Office.

d. All schematics, connection diagrams, as-built drawings, and software programs shall be present at the test site at the time of the final acceptance test. If all documentation is not present and acceptable, the test shall be postponed until the requirement is met.

4. WATER-BASED SUPPRESSION SYSTEMS

4.1 General. - All water-based suppression systems shall be designed and installed in accordance with NFPA criteria, except as specified by this document. Specific types of systems shall be determined by the Lead Design Engineer and the Fire and Rescue Office. Suppression system electrical control and detection design shall be in accordance with the applicable subsections in Section 3 of this standard.

4.2 Control Valves. - All control valves installed in these systems shall be the visually indicating type and must meet NFPA codes. Valve tamper switches shall be installed on the system main isolation valves at the water supply to the system. This valve tamper shall be monitored directly from the facility fire alarm panel as a separate zone (this requirement is not met by monitoring from the control panel).

A valve tamper switch is required for the suppression system isolation valve located directly upstream of the system alarm check, activation valve, or flow/pressure switch. A valve tamper switch is required for the deluge, sprinkler system, or water spray system downstream of the test leg/header isolation valve. A valve tamper switch is required for the primary interior facility water supply isolation valve (facilities provided with redundant supplies are exempt from this requirement). - All positional indicator valves (PIV's) and remaining system outside stem and yoke (OS&Y) gate valves may be required to be locked with nonfrangible locks, double cored.

All other valves capable of isolating all or portions of the system shall be lock wired or integrity sealed. All systems subject to freezing shall have the capability of being isolated and drained for freeze protection or designed to prevent freezing.

4.3 Piping. - All water-based suppression system supply and distribution piping shall require schedule 40 or greater.

4.4 Sprinkler Systems. - All sprinkler systems must meet NFPA codes.

4.4.1 General Requirements in Sprinkler Systems. - On-off sprinkler heads shall not be used. Sprinkler heads shall be pendant type or upright type. The inspector's test valves shall be readily accessible for testing purposes. A means to discharge water from the test valve to the outside of the facility is required. Drainage shall be provided and location approved by the Lead Design Engineer. The siamese connections for Fire Department use shall be installed in locations that are practical for access and in accordance with NFPA.

4.4.2 Shunt Trip. - Manually activated shunt-trip circuits for power circuits and HVAC equipment in sprinkler-protected computer/electronic equipment rooms shall be provided in accordance with NFPA 75 and NFPA 70 (NEC), Article 645. Requirements for automatically activated shunt-trip circuits and shunt-trip circuits in areas other than computer/electronic equipment rooms shall be specified by the Lead Design Engineer. Where automatically activated shunt-trip circuits are installed, maintenance bypass provisions shall be incorporated.

Note

Care should be taken that the power panel with the shunt-trip main breaker feeds only equipment in the affected area.

4.4.3 Wet-Pipe Sprinkler Systems. - All systems shall be hydraulically calculated and the calculations, formulas, and pipe sizes furnished in the design data manual. The design drawings shall show design details for the water supply system up to the building interface only. The design drawings may also show a pictorial representation of the system inside the building interface, in which case the drawing shall be noted identifying the pictorial as referenced information. The final system design inside the building shall be provided by a certified fire protection contractor.

4.4.4 Dry-Pipe Sprinkler Systems. - This type of system shall be used at KSC only in areas where freezing is a concern or in essential electronic equipment areas.

4.4.5 Preaction Sprinkler System.

4.4.5.1 General. - The design of preaction sprinkler systems shall be composed of a preaction control panel, detectors (cross-zoned photoelectric smoke detector preferred), manual mechanical activation stations located in the riser trim piping, strobes, bells, water control valves, piping, and nozzles. When less than 50 percent of the facility floor area is protected by a preaction sprinkler system or where the preaction sprinkler system protects multiple operational areas within the building, the control system shall contain a preaction control panel for each operational area affected and shall be separate from the facility FACP. In facilities with greater than 50 percent facility floor protection, an analysis shall be made to determine whether to provide separate panels or to utilize the FACP as the preaction control panel. The sprinkler piping of a preaction sprinkler system shall be dry and pressurized with not greater than 35-kilopascal (kPa) (5-psi) supervisory air. A pressure switch shall sense loss in pressure due to piping leaks or an open sprinkler head. This low-air-pressure condition shall be reported as a trouble condition to the control panel that is monitored by the facility FACP. As a minimum, smoke detectors and supervisory air pressure shall be monitored at the preaction system control panel (see figure 4). A water pressure switch monitored by the FACP shall activate facility evacuation upon sprinkler system charging.

4.4.5.2 Automatic Operations. - During a fire condition, a photoelectric smoke detector in the first zone shall activate a local trouble bell and strobes, illuminate a zone indicator light on the control panel, and transmit an alarm signal to the CFMS through the facility FACP. A detector in the second zone shall open the

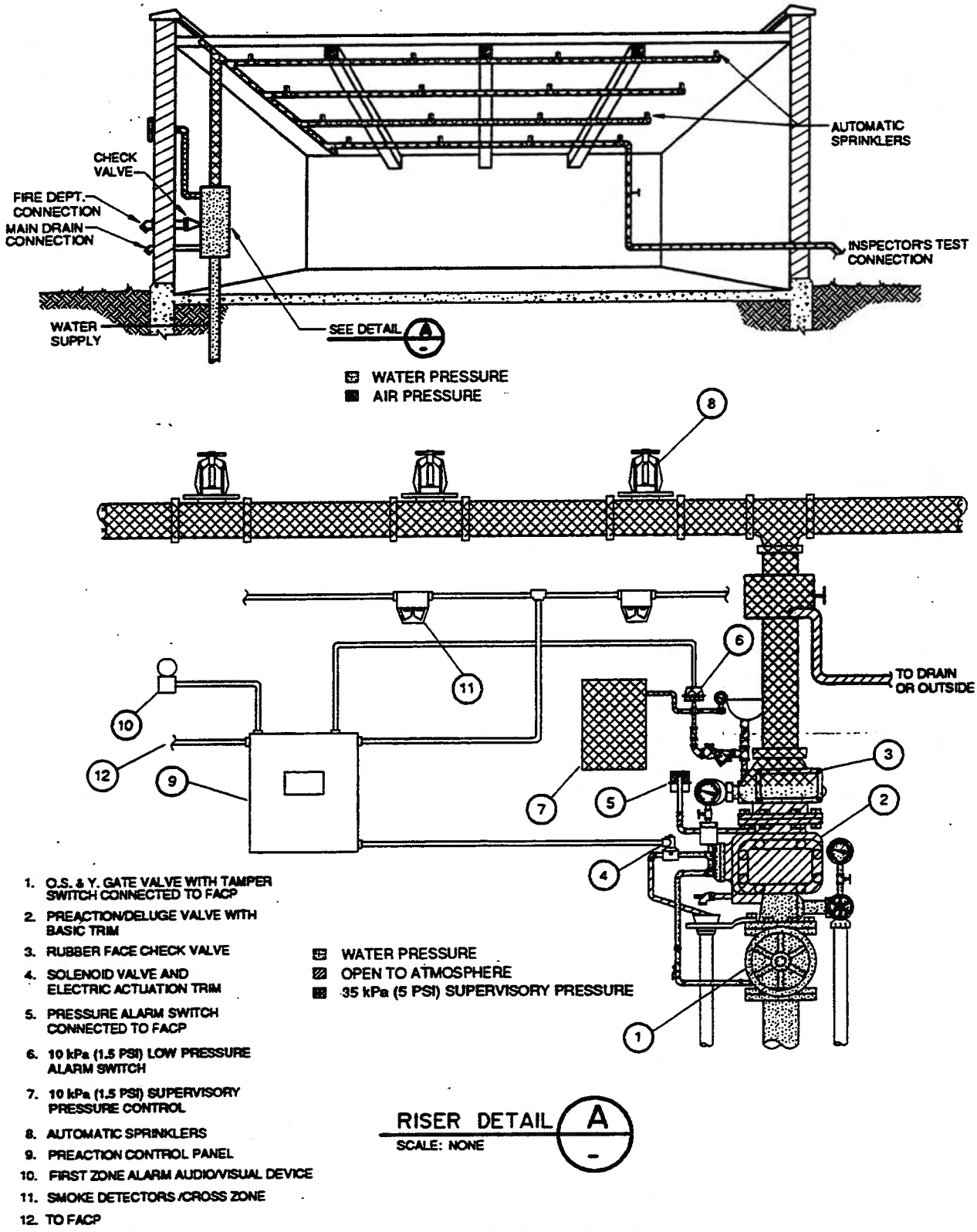

Figure 4. Preaction Sprinkler System

water control valve and sound facility evacuation. Heat from further combustion shall open the necessary sprinkler heads and allow the water to extinguish the fire. Water pressure or flow signal shall be routed to the facility FACP either reported as an individual zone or an addressable device.

4.4.5.3 Manual Mechanical Activation Stations. - The activation of the manual activation station shall result in the following actions:

a. The water control valve is opened and the sprinkler system is charged.

b. The facility evacuation system is activated.

c. The water pressure switch is activated and the alarm signal is transmitted to the CFMS through the FACP.

Manual activation stations shall leave a tell-tale sign of activation and be labeled to indicate opened and closed positions. A quarter turn manual ball valve shall be installed at the riser for manual activation of the preaction valve.

4.4.6 Deluge Systems.

4.4.6.1 General. - The general intent of the deluge systems is to quickly extinguish a fire yet limit the destruction of the facility and/or contents of the facility during a fire condition. Deluge water on the payload and Shuttle flight hardware may destroy the hardware or cause extensive damage. With this in mind, each facility where deluge systems are required shall have a Type I, Type II, or Type III system as described below. Deluge systems shall be installed with a manual shutoff valve (as described in 4.4.6.5) located outside of the hazardous area.

For deluge systems not protecting payload/flight hardware areas, nozzle systems shall be designed such that all headers can be prefilled. Deluge water control valve stations shall consist of butterfly valves with double-acting pneumatic actuators powered by compressed air or dry nitrogen as specified herein. Design densities shall be as specified in NHB 1700.1, Volume 9, Chapter 5.

4.4.6.2 Regulators. - The use of regulators in water-type fire protection systems at KSC is prohibited. System pressure regulation shall only be accomplished by the use of orifice plates, strategically located to ensure balanced water flow to all subsystems.

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

4.4.6.4 Types of Deluge Systems. - One of three types of fixed-deluge water systems shall be used. Type I systems shall be used in areas where the consequences of inadvertent actuation are not great (e.g., propellant transfer areas, etc.). Type II systems shall be used where payload or flight hardware is present but no damage would occur due to inadvertent actuation. Flight crew egress water systems are an example of Type II. Type III systems shall be used where payload or flight hardware is susceptible to damage due to inadvertent activation. In areas where periodic flow testing of the deluge system cannot be accomplished through its nozzles due to facility operations, a test branch shall be provided that will properly model the flow characteristics of the nozzle system.

4.4.6.4.1 Type I Deluge Water Systems. - Type I systems shall be configured in accordance with figure 5. The major components for Type I systems shall consist of manual cutoff valve, a pneumatically operated butterfly valve with solenoid and position switches, an orifice, a pressure switch, a strainer, and appropriate nozzles. If the system is located in an area requiring explosionproofing, the solenoid shall be installed in accordance with NFPA 70 requirements for explosionproof devices. Otherwise, it may be mounted directly on the valve/actuator assembly. Type I systems shall have all major components electronically supervised for trouble or position indication within the deluge control panel. The facility FACP shall monitor the deluge control panel utilizing supervisory circuits. Flow/pressure switches will be monitored by the facility FACP; it may be monitored by the deluge panel also (see figures 5 and 6). Type I systems shall be automatically activating where approved by the Lead Design Engineer in consultation with the Fire and Rescue Office. A manual shutoff valve (see 4.4.6.5) shall be installed outside the processing area [15 to 30 meters (50 to 100 feet) from the facility structure where practical] and shall be clearly marked in an open or closed position. The valve shall be positively identifiable as a deluge water system valve through the use of placards, signs, or other methods approved by the Lead Design Engineer in consultation with the Fire and Rescue Office.

4.4.6.4.2 Type II Deluge Water Systems. - Type II systems shall be configured in accordance with figure 7. Major system components are the same as type I except that four butterfly valves are required with two ARM valves on the down-stream side of the two activate valves. Solenoid valves for the Type II system shall be enclosed in a properly rated National Electrical Manufacturer's Association (NEMA) enclosure in accordance with figure 7. The deluge systems shall be monitored by the facility FACP utilizing supervisory circuits. Flow/pressure switches shall be monitored by the facility FACP; it may also be monitored by the deluge panel. A valve tamper switch shall also be located on the manual shutoff valve located outside the hazardous area [15 to 30 meters (50 to 100 feet) from the facility structure where practical] and shall be clearly marked in an open or closed position. The valve shall be positively identifiable as a deluge water system valve through the use of placards, signs, or other methods approved by the Lead Design Engineer in consultation with the Fire and Rescue Office.

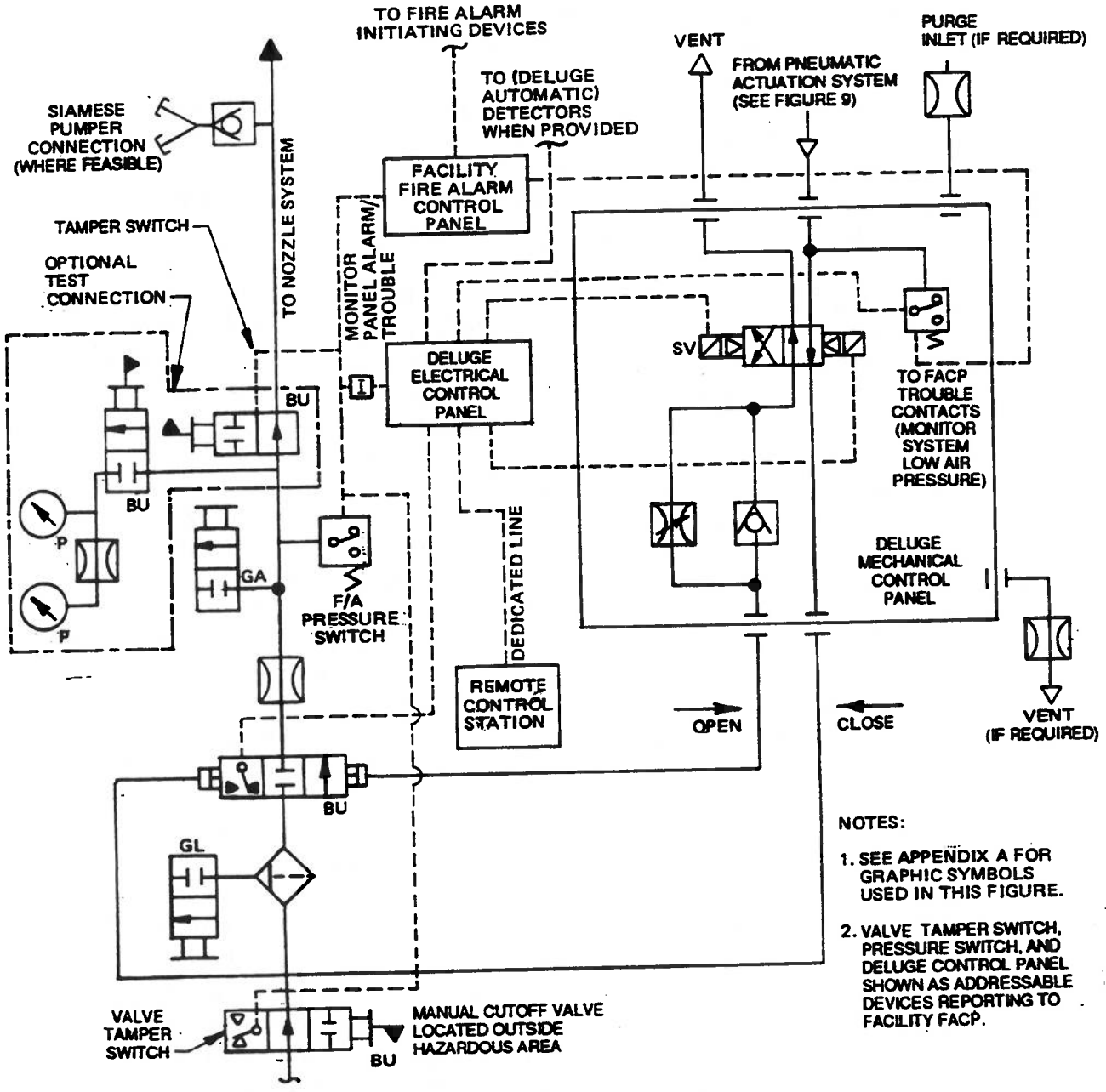

Figure 5. Type I Deluge Water System

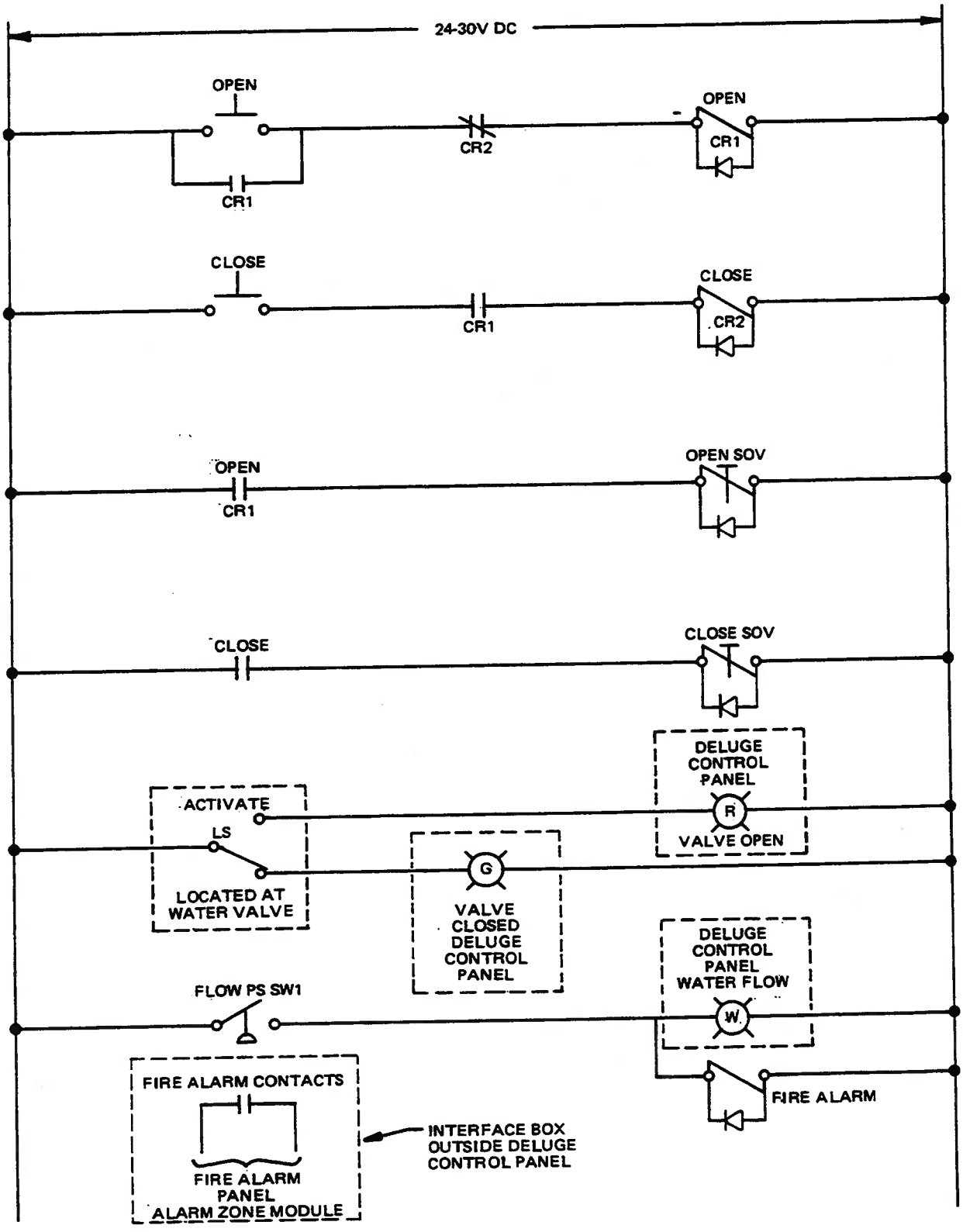

Figure 6. Electrical Controls for Type I Deluge Water System

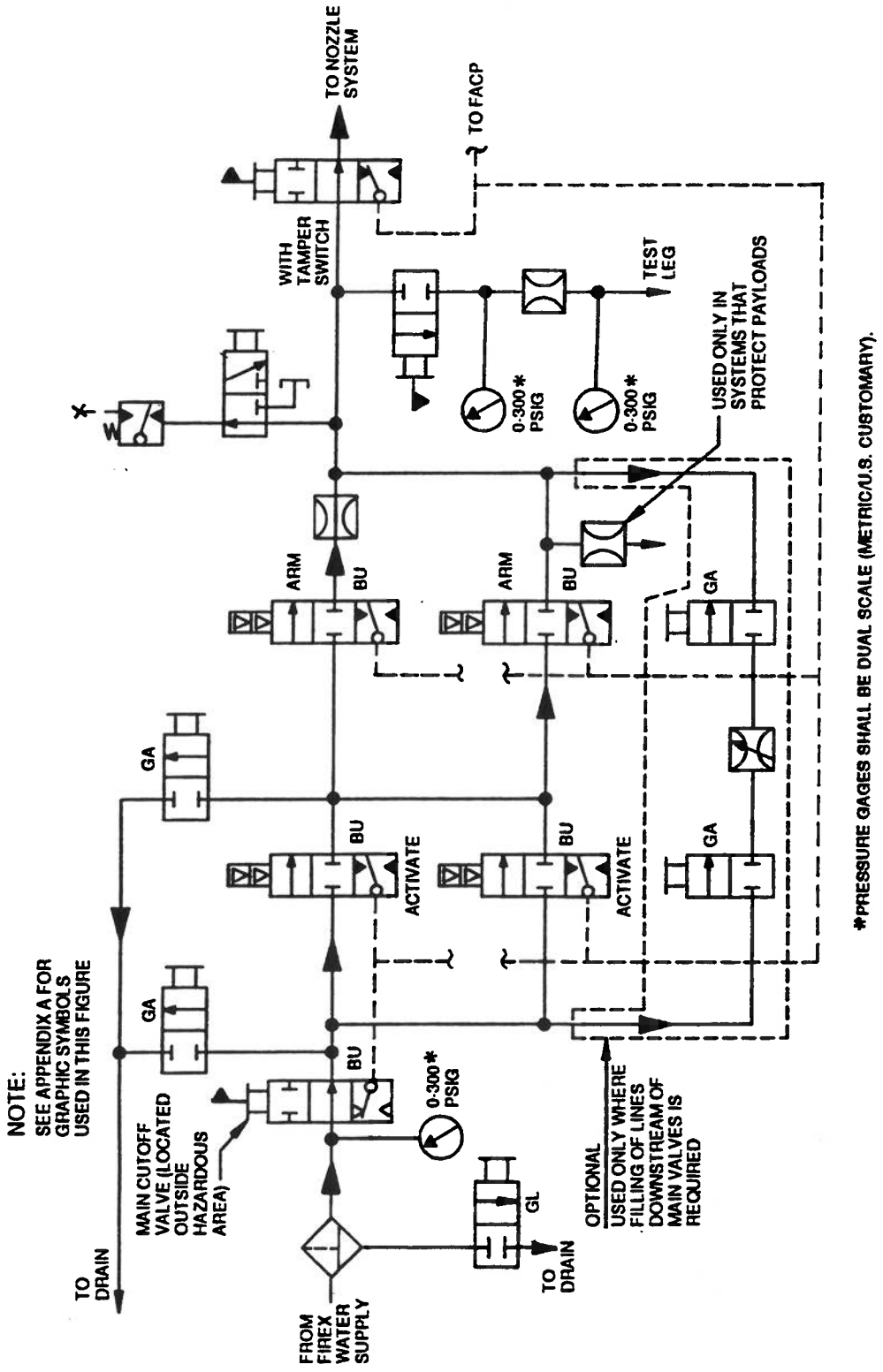

Figure 7. Type II Deluge Water Sprinkler (Mechanical) (Sheet 1 of 2)

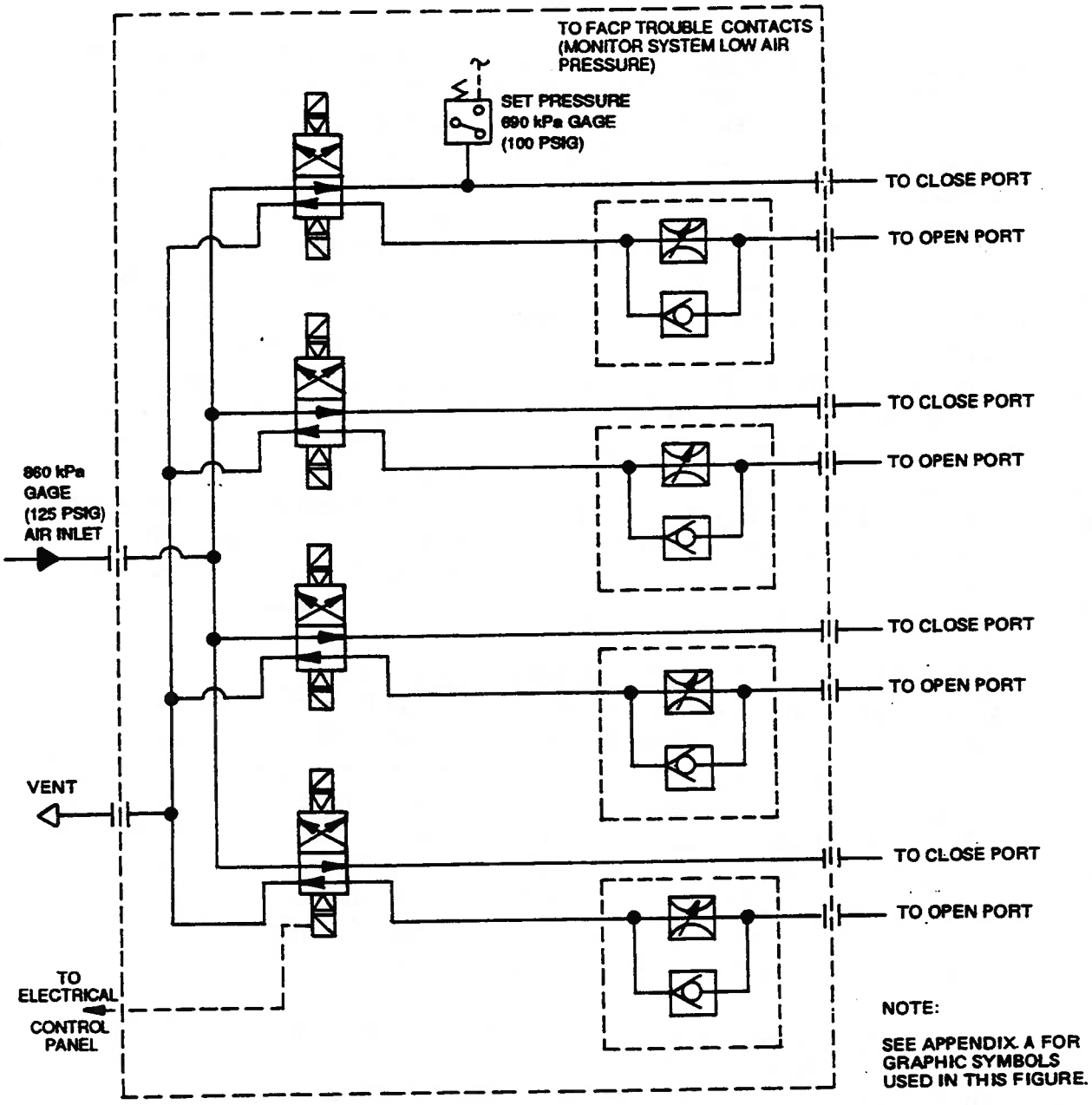

Figure 7. Type II Deluge Water Sprinkler (Mechanical) (Sheet 2 of 2)

4.4.6.4.3 Type III Deluge Water Systems. Type III systems shall be configured in accordance with figure 8. Major system components are two series manual activation valves located in an area safe for occupation during hazardous operations [15 to 30 meters (50 to 100 feet) from the facility structure where practical]. The valve shall be positively identifiable as a deluge water system valve through the use of placards, signs, or other methods approved by the Lead Design Engineer in consultation with the Fire and Rescue Office. Communication with the test conductor in a remote control room or location shall be provided for granting approval to activate the system. The test conductor shall have video and/or audio communication with the protected facility adequate to provide verification of the need for system activation. The position of both valves shall be monitored. If either valve is opened, a local and remote indication shall be provided. The status of the system shall be monitored independently by the FACP. Opening of either valve shall ring the facility bells and notify the CFMS through the FACP. Where planning, studies, preliminary engineering reports, and/or designs require either the modification, retrofit, or expansion of the existing Type I or Type II deluge water system to a Type III system, an analysis shall be conducted as to the cost effectiveness and the need to remove the Type I or Type II system.

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

4.4.6.6 Actuation Systems. - Actuation of fixed-deluge systems shall be with compressed air or dry nitrogen. Actuation systems shall be designed in accordance with figure 9. The deluge control panel shall monitor pressure in the system.

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

4.4.6.7 Deluge Water Control Valve Actuators. - Valve actuators shall be the double-acting type, rated for at least 1.035 MPa (150 psi). They shall be sized to open the butterfly valves under full system pressure with 690 kPa (100-psi) air

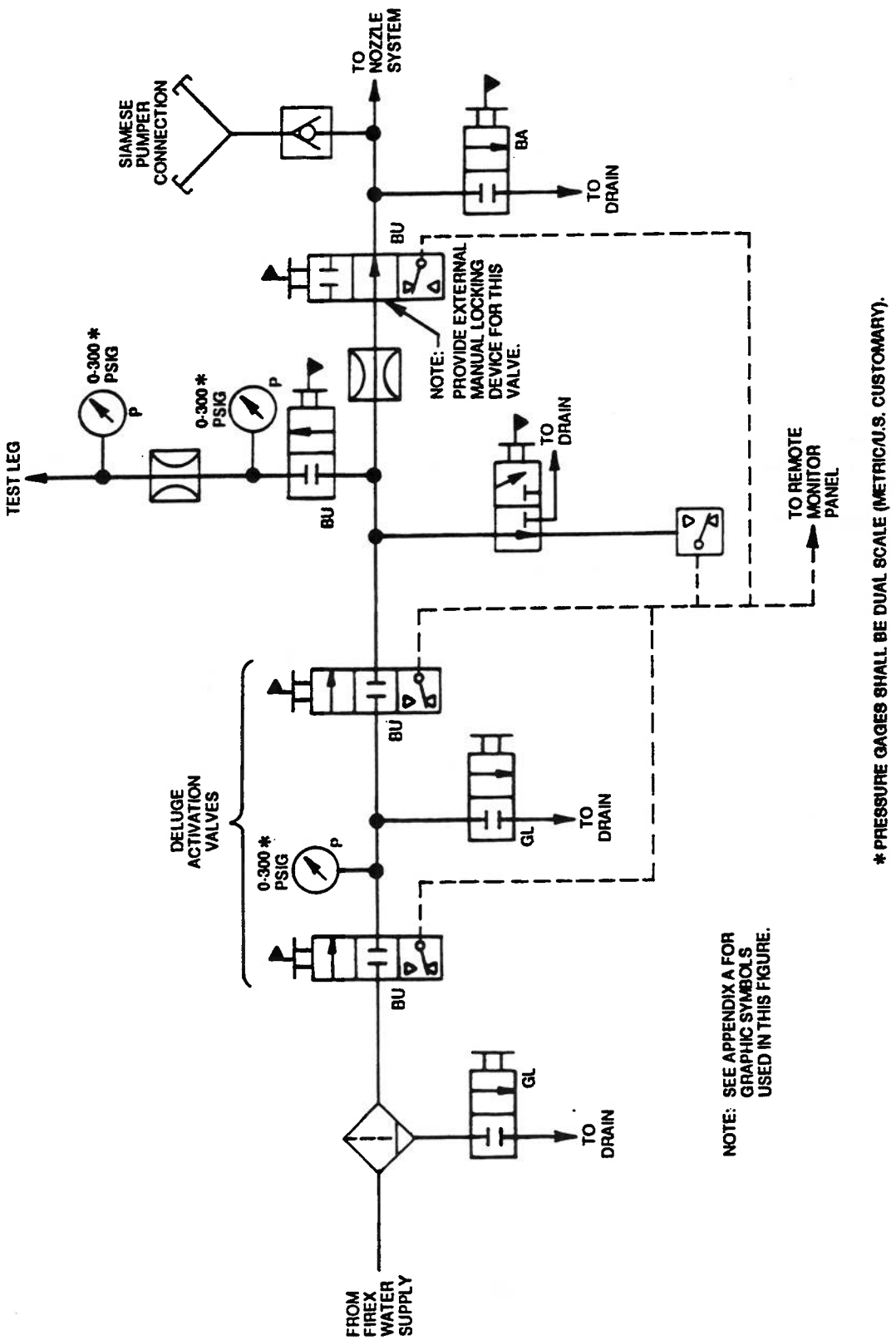

Figure 8. Type III Deluge Water System

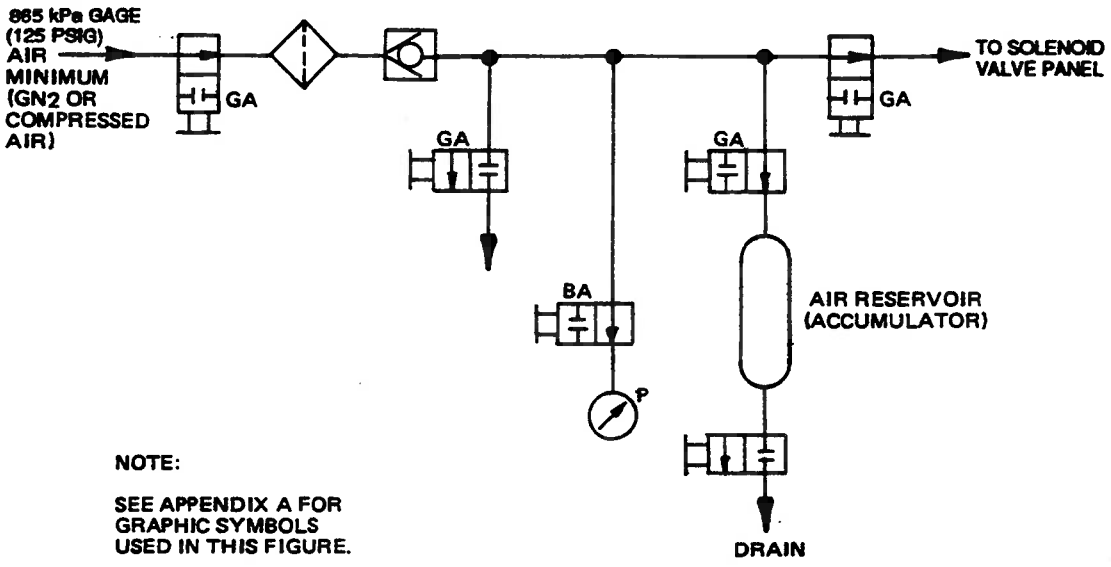

Figure 9. Deluge Water System Actuation System

available. Valve actuators shall be type ST 200 or ST 400 by Jamesbury Corporation or an approved equal. Shutoff valves shall have manual gear actuators clearly marked OPEN and SHUT and shall have electrical supervision tied to the fire alarm system to indicate a TROUBLE condition when closed. Valve tamper switches shall be installed on all manual shutoff valves on the critical flow path, where practical. Valve tamper switches shall be monitored directly from the facility FACP as a separate zone (not from the deluge control panel). Tamper switches are typically not required on individual platform isolation valves inside controlled facility space (e.g., high bays, clean rooms, etc.).

4.4.6.8 Solenoid Valves . - Solenoid valves shall be four-way with two positions and dual coils. The valves shall be designed to operate on 24 volts direct current (V dc). Solenoid valves shall be ASCO Model 8344 or an approved equal. ASCO valves shall be mounted horizontally. See appendix C for operation and maintenance requirements for the ASCO valve. The deluge control panel shall monitor and annunciate which valve was operated (not a summary annunciation of all valves).

4.4.6.9 Fixed-Deluge System Electrical Controls. - Fixed-deluge electrical control systems shall incorporate a dedicated control panel. All deluge system initiation and activation devices shall be directly connected to the deluge system control panel. Control power for fixed-deluge systems shall be dedicated 24 V dc with automatic battery backup (see appendix B). When the command is given to begin waterflow, latching-type control relays shall keep the circuit energized until the command is given to stop waterflow. Electrical controls for fixed-deluge systems shall be configured in accordance with figures 6 and 10 (supersedes flag note 2 of drawing 79K32573). Type II systems shall be controlled by manual dual pushbutton control stations, in accordance with 79K32573, equipped with transparent protective covers to prevent accidental actuation. The covers shall be designed such that they are not self-closing. Each pushbutton shall have double contacts. The controls shall require personnel to push two separate buttons in order to initiate waterflow. The initiation shall result in the following:

a. When either the arm or activate pushbutton is pushed:

   (1) The horn and flashing light at the pushbutton station sounds.

   (2) A signal is sent to the CFMS through the facility FACP.

b. When the second pushbutton is pushed, the deluge control panel opens the valves to discharge water and the FACP rings facility bells and shuts down the heating, ventilating, and air conditioning (HVAC).

A remote control station shall be provided within sight of the area protected but removed from the immediate hazard. This control station shall permit operating

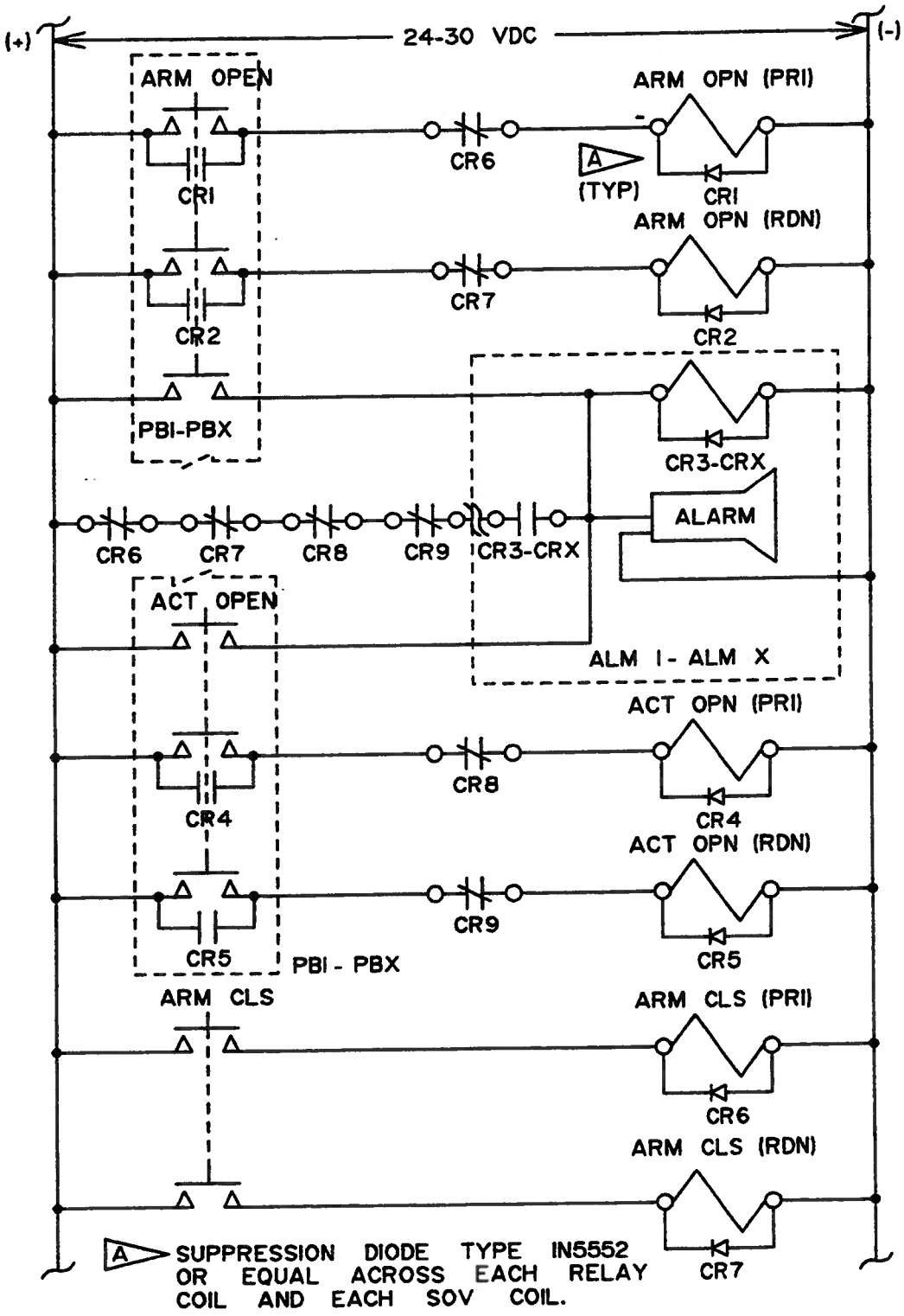

Figure 10. Type II Deluge Water Sprinkler (Electrical) (Sheet 1 of 4)

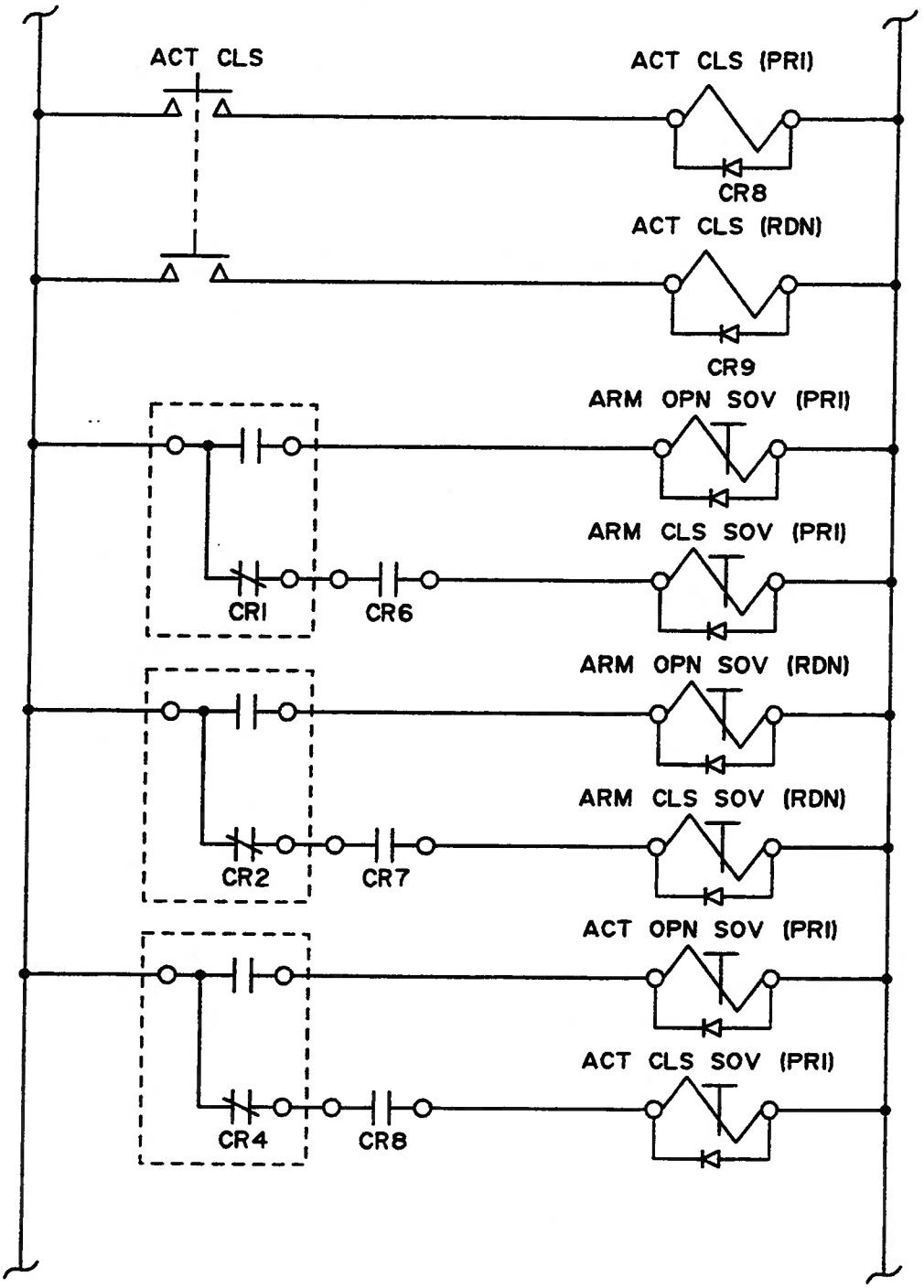

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Figure 10. Type II Deluge Water Sprinkler (Electrical) (Sheet 2 of 4)

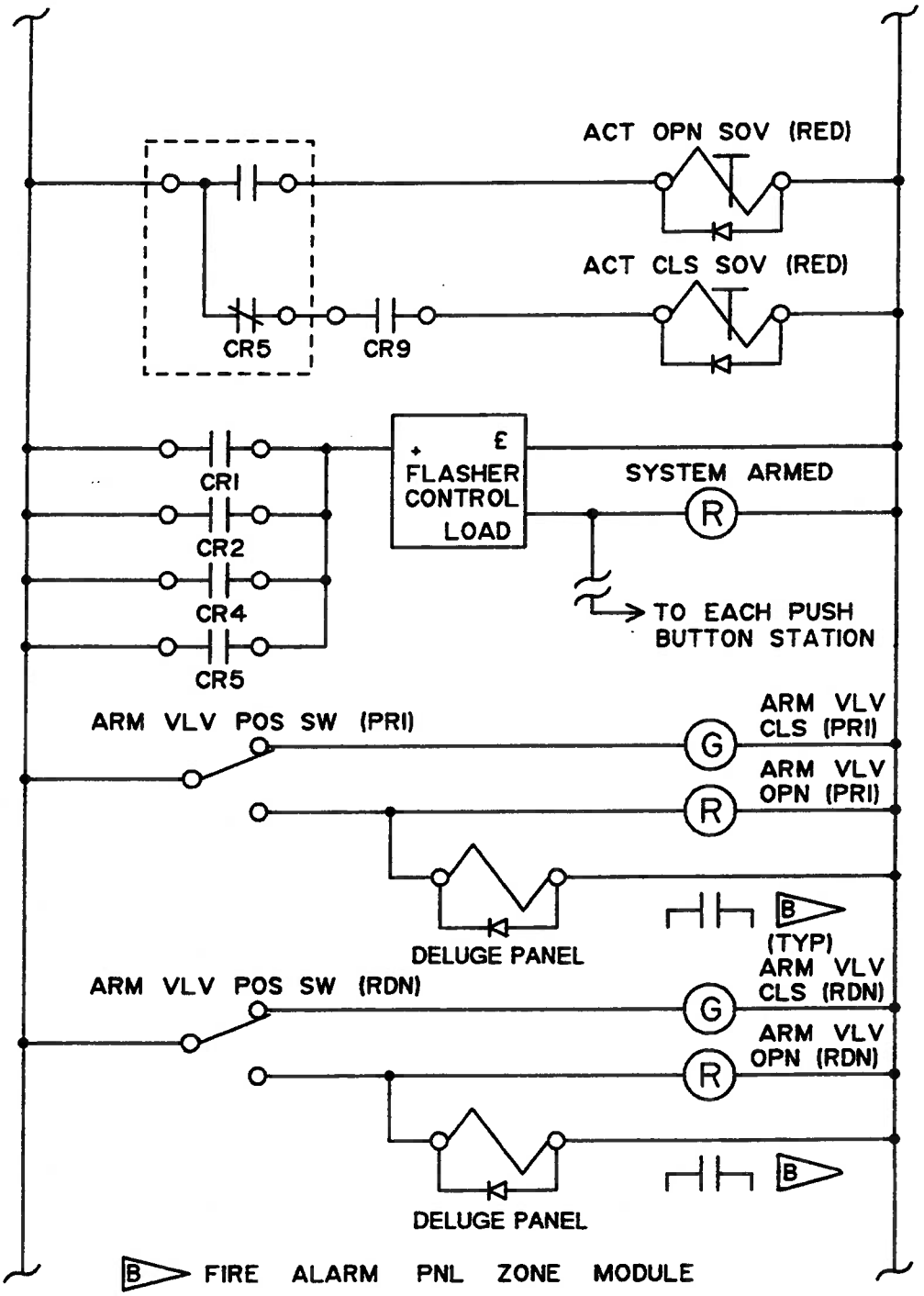


Figure 10. Type II Deluge Water Sprinkler (Electrical) (Sheet 3 of 4)

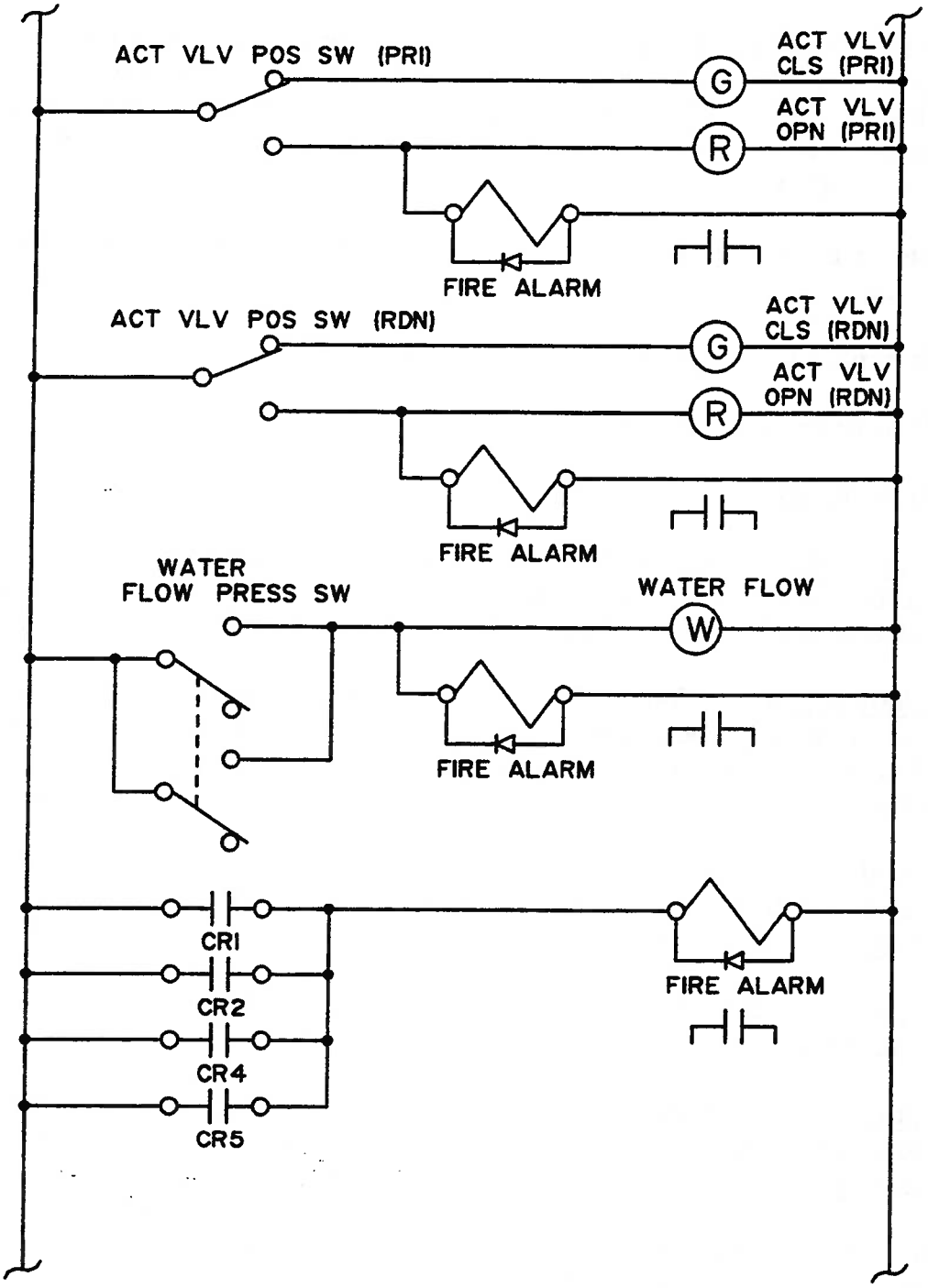


Figure 10. Type II Deluge Water Sprinkler (Electrical) (Sheet 4 of 4)

personnel to operate the deluge system. The location of all remote control stations shall be as directed by the Lead Design Engineer following consultation with the Fire and Rescue Office. The control wiring shall not be routed through communication terminal distribution racks and/or main frames. Separate dedicated wiring shall be run for these control circuits.

Three zones or addresses shall be allocated in the facility FACP to monitor the deluge system:

a. Summary of deluge control panel status

b. Flow or pressure monitoring

c. Valve tamper-switch monitor

4.4.6.10 Monitoring. - Control logic shall be designed so that traceability is provided to indicate how the system was activated (i.e., which pushbutton or station was activated). Control logic is shown on drawing 79K32573.

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

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

4.4.7 Standpipes. - Standpipes shall be provided in accordance with NHB 1700.1, Volume 9, and shall comply with NFPA 14 for Class I.

4.4.7.1 Outdoor, Indoor High-Hazard Areas or Work Platforms. - The standard KSC outdoor, indoor high-hazard area or work platform hose station shall consist of the following UL-listed or FM-approved equipment:

a. One valved water connection [minimum 38-millimeter (1-1/2-inch) connection with one-quarter-turn ball valve or butterfly valve]

b. One flow-through hose reel

c. One length of 38-millimeter (1-1/2-inch) inside diameter, rubber-lined, rubber-covered fire hose no longer than 30 meters (100 feet)

d. One combination spray, straight stream, shutoff nozzle

4.4.8 Fire Pumps. - Fire-pump installation shall comply with NFPA 20 except as noted below.

4.4.8.1 Pump Redundancy Requirements. - For extra hazard occupancy areas, as defined by the Lead Design Engineer following consultation with the Fire and Rescue Office, fire pump installations providing primary fire protection water shall contain not less than two diesel-driven pumps or two electric-motor-driven pumps with a redundant source of power or one electric pump with a diesel backup that must meet all demands with the largest pump disconnected from the system. A single pump and driver may be used to provide 100 percent of the system's flow and pressure requirement for light and ordinary hazards.

4.4.8.2 Fire Pump Controls. - Fire pumps shall be water pressure controlled by either a hydropneumatic tank system as shown in figure 11 (the electrical control system for figure 11 is shown in figure 12) or jockey pump system as shown in figure 13. Direction as to which control system to use shall be given by the Lead Design Engineer following consultation with the Fire and Rescue Office. Fire pump controllers shall comply with NFPA 20.

4.4.8.3 Testing. - Provision for testing shall be provided in accordance with NFPA 20. A suitable flowmeter shall be installed to permit acceptance and annual flow testing. (See NHB 1700.1, Volume 9, Chapter 5, for additional details.)

4.4.8.4 Monitoring. Fire pumps shall be monitored per NFPA 20, including the following:

a. Pump running

b. Loss of primary power to the electrical pump

c. Controller main switch off/manual

d. Failure of diesel engine to start automatically (a common signal can be used)

4.5 Design Notes.

4.5.1 Specifications. - The construction specifications to be used for all projects, which include sprinkler systems and are the responsibility of KSC, shall be NASA/KSC SPECSINTACT, Sections 15300 and 15501. The contents of these specification sections shall be modified to fit the particular project under design.

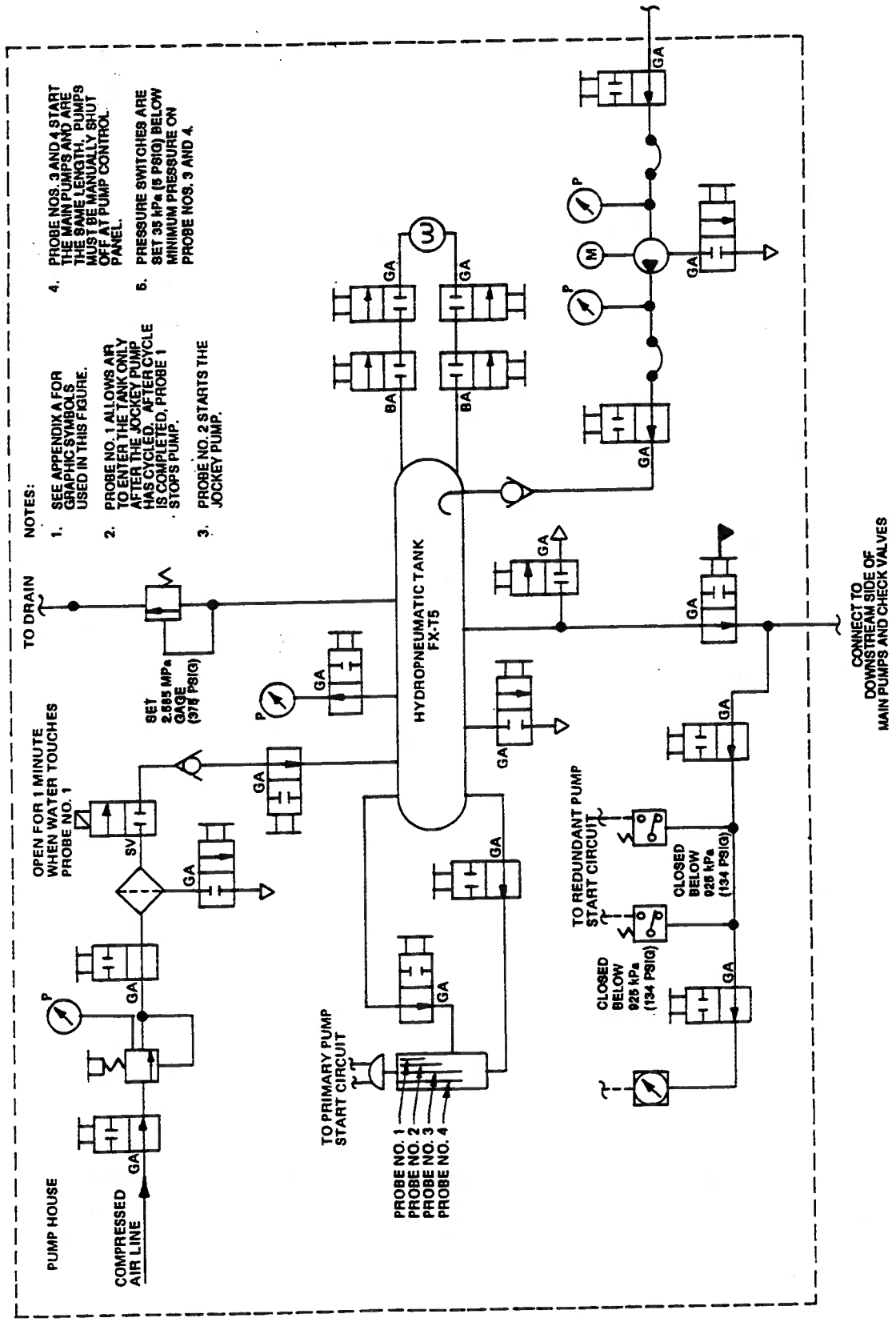


Figure 11. Hydropneumatic Tank for Pump Starting Control System

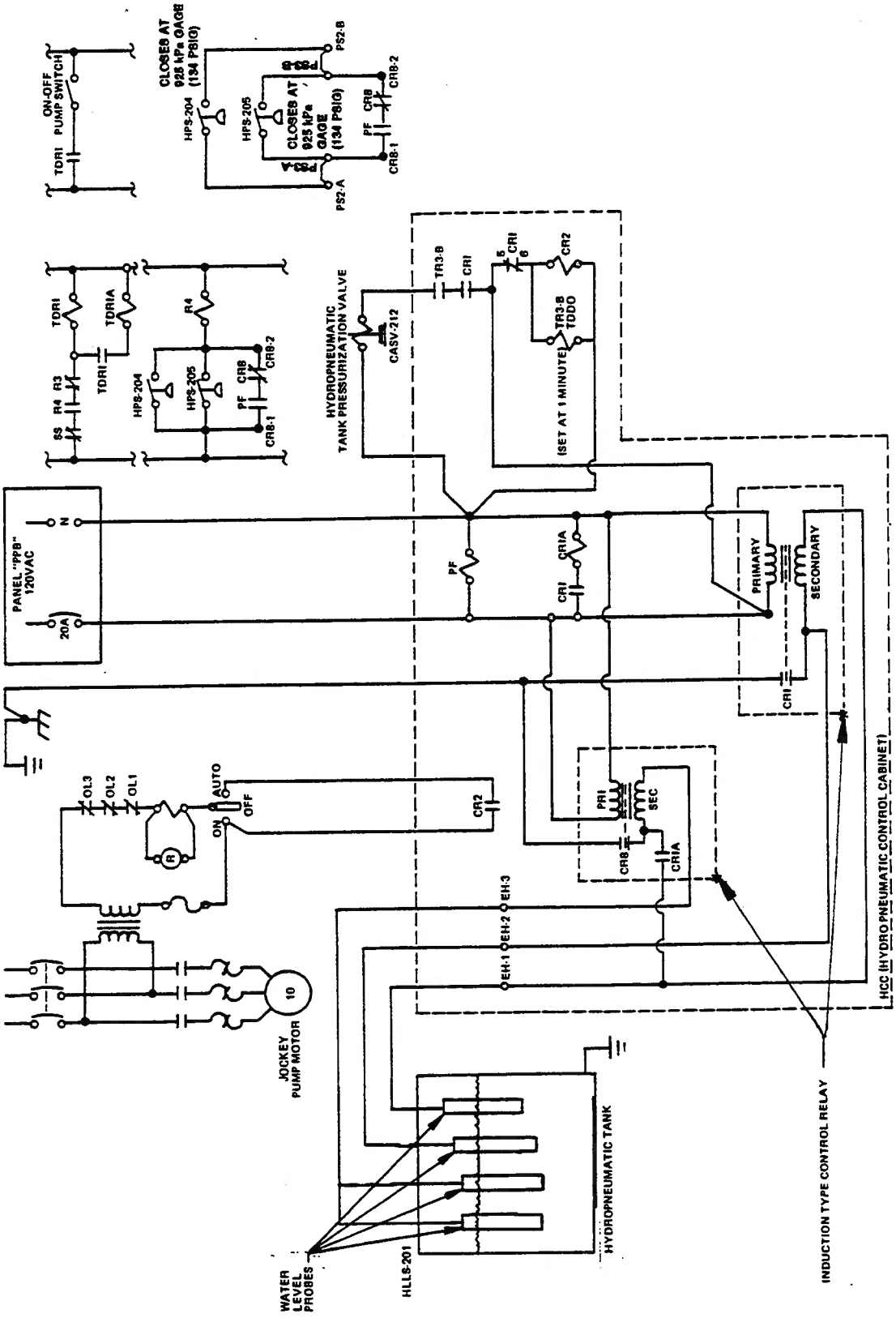


Figure 12. Partial Wiring Diagram for Firex Diesel Pumps

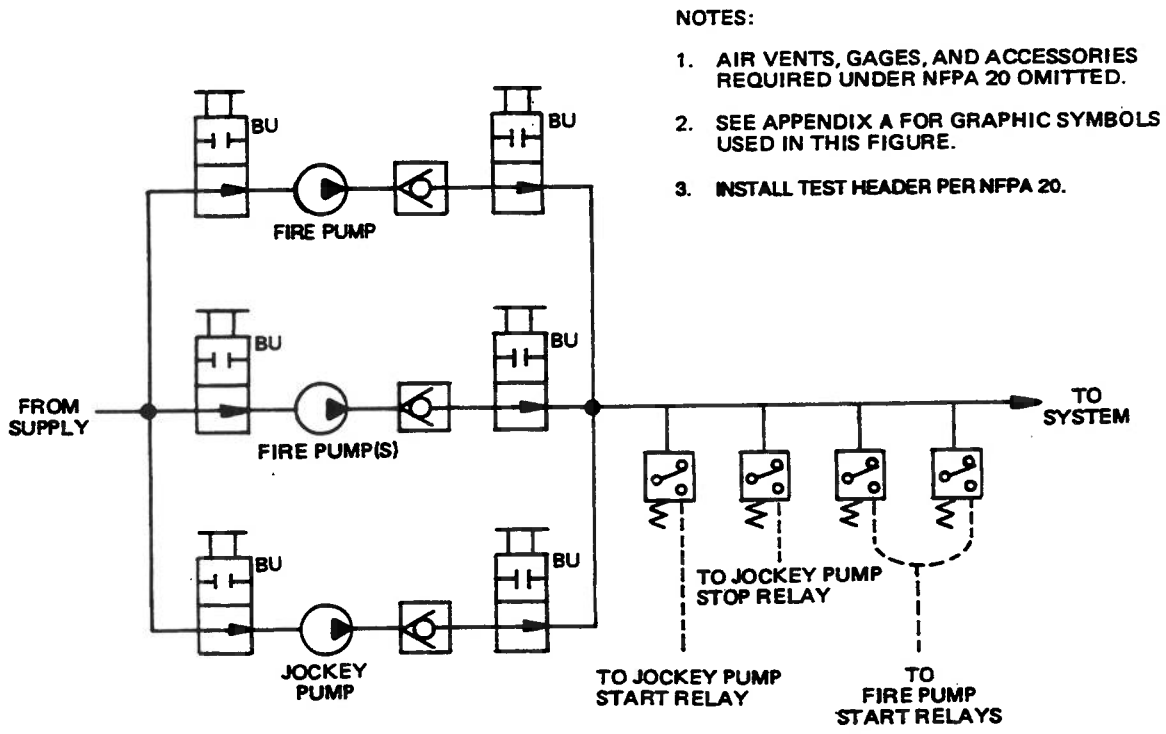


Figure 13. Arrangement of Major Components - Booster Fire Pumps

4.5.2 Drawing Preparation. - The design organization shall adhere to the following guidelines when preparing design documentation for fire suppression systems:

a. Drawings for sprinkler systems shall be computer generated using Intergraph-compatible software or format. Symbols used on sprinkler system drawings shall be in accordance with GP-435 and appendix A of this document.

b. Sprinkler plans shall clearly define geographic zone boundaries as well as the location of all dedicated components.

c. Riser diagrams indicating all control equipment and trim shall be provided.

d. Elevation and detail sheets showing all major areas affected by the project with details of areas where work is concentrated shall be provided.

4.5.3 Installation and Test. - Installation and test shall be in accordance with SPECSINTACT, Section 16722, and shall include the following requirements:

a. The specification shall require a certified fire sprinkler contractor to be present during installation and testing of the fire sprinkler system.

b. All shop drawings and test procedures shall be approved before implementation.

c. Upon completion of an installation, a complete functional test of the protective system, including testing of connections to any equipment that is monitored or controlled by the protective system, shall be conducted for the purpose of verification of compliance with the applicable contract documents and NFPA standard. All necessary documentation, including as-built drawings, connection drawings, schematics, all software programs, and the manufacturer's manual, shall be available one week prior to the test for verifying the agreement between the connected equipment and the documentation. The acceptance test procedure shall be submitted for approval prior to the test being scheduled and, as a minimum, be in accordance with NFPA 13. A certification of compliance (written statement) by the installing contractor shall be made that the system has been installed and performs in accordance with the design drawings and specifications. This shall be submitted in accordance with the contract. Upon receiving a copy, the Lead Design Engineer will send a copy to the Fire and Rescue Office. Deviations from these requirements shall be approved in writing by the Lead Design Engineer and the Fire and Rescue Office.

d. All schematics, connection diagrams, as-built drawings, and software programs shall be present at the test site at the time of the final acceptance test. If all documentation is not present and acceptable, the test shall be postponed until the requirement is met.

5. CHEMICAL-BASED SUPPRESSION SYSTEM

5.1 General. - All chemical-based suppression systems shall be designed in accordance with NHB 1700.1, Volume 9. Electrical control and detection design shall be in accordance with the applicable subsections under Section 3 of this standard.

5.2 Halon System. - Halon systems shall not be installed at KSC without NASA Headquarters approval.

5.3 Dry Chemical System. - Fixed dry chemical systems are suitable for fire protection of kitchen hoods, ducts, and the cooking surfaces of cooking appliance and, in special cases, the protection of dip tanks, paint booths, and other flammable liquid operations. In general, dry chemical systems are installed at KSC for the protection of cooking appliances against fire hazards. Dry chemical systems shall comply with NFPA 17. Activation of the dry chemical system shall indicate an ALARM condition on the facility FACP (see 3.1.2.5).

5.4 Wet Chemical System. - Fixed wet chemical systems are suitable for fire protection of kitchen hood, ducts, and cooking surfaces of cooking appliances. Wet chemical systems shall comply with NFPA 17A. Activation of the wet-chemical system shall indicate an ALARM condition on the facility FACP (see 3.1.2.5).

5.5 Carbon Dioxide System. - Carbon dioxide fire suppression systems shall only be installed in unoccupied areas (i.e., below raised floors) and shall be installed in accordance with NFPA 12.

6. FIRE-RESISTANT CONSTRUCTION

6.1 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 Lead Design Engineer following consultation with the Fire and Rescue Office. The construction of permanent facilities shall be either fire resistant, protected noncombustible, or unprotected noncombustible. The detailed requirements for the various classes of construction shall be in accordance with the requirements of NHB 7320.1B. Area limits shall conform to NHB 1700.1, Volume 9, Chapter 3. (For NASA KSC purposes, the term "protected" shall mean protected with an automatic suppression system.)

6.2 Discharge From Exits. - All exits shall discharge directly to the street, to a yard or court, or to other open spaces that provide 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 150 meters (500 feet) from the facility or, if less than 150 meters (500 feet), the fence contains sufficient gates to accommodate the number of personnel discharged into the area. Exit arrangements shall comply with NFPA 101, NFPA 220, and the Standard Building Code.

6.3 Panic Hardware. - Panic hardware shall be provided to meet the requirements of NFPA 101 and for the following locations:

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

6.4 Elevators. - Elevators shall not be recognized as required exitways. The design and construction shall be in accordance with ANSI A17.1. Suppression system requirement shall be determined by the Fire and Rescue Office.

6.5 Fire Escapes. - Fire-escape stairs that are 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 Lead Design Engineer following consultation with the Fire and Rescue Office.

6.6 Interior Finishes. - Interior finishes shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less when tested in accordance with ASTM E84. Exceptions may be allowed if approved by the Lead Design Engineer following consultation with the Fire and Rescue Office.

6.7 Carpeting Systems and Underlay. - Flammability and radiant flux standards apply to carpets and their underlay. Federal law requires that all carpets manufactured for sale shall comply with NFPA 101, Class I. For areas completely protected with an automatic suppression system, exceptions to the requirements specified herein shall be granted by the Lead Design Engineer following consultation with the Fire and Rescue Office.

7. SAFETY, RELIABILITY, AND QUALITY ASSURANCE PROVISIONS

Quality Assurance shall review designs and modifications for fire protection in accordance with KSC requirements and ensure compliance with NHB 5300.4(1C).

8. PREPARATION FOR DELIVERY

There are no applicable requirements.

9. NOTES

9.1 Intended Use. - This standard is intended for use as a fire-protection design guide for all new facilities and modifications to existing facilities under design jurisdiction of KSC.

9.2 Definitions. - For the purpose of this standard, the following definitions shall apply:

a. Authority Having Jurisdiction. The Authority Having Jurisdiction for design-related issues shall be the responsibility of the NASA Lead Design Engineer in consultation with the responsible NASA System Engineer and the NASA Fire and Rescue Office. The ultimate authority for resolving AHJ issues is the NASA Fire Protection Risk Review Board.

b. Central Station System. A system or group of systems in which the operations of circuits and devices are signaled automatically to, recorded in, and maintained and supervised from an approved central station.

c. 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, elevator, etc.).

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

e. Fire Alarm Box (or Station). A manually operated device that, when operated, closes or opens one or more sets of contacts and generally locks the contacts in the operated position until the box is reset.

f. Fire Alarm Control Panel (FACP). A device with the control circuits necessary to: (1) furnish power to a fire alarm system, (2) receive signals from alarm-initiating appliances and transmit them to alarm-indicating appliances and accessory equipment, and (3) electrically supervise the system installation wiring and primary (main) power. The FACP can be contained in one or more cabinets in adjacent or remote locations.

g. Fire Detection and Alarm. Systems and devices that monitor conditions within a specific area and give early warning of a fire.

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

i. Fire Prevention. Measures directed towards avoiding the inception of fire.

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

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

l. Heat Detector. A device that detects an abnormally high temperature or rate-of-temperature rise.

m. Horns. An audible signal appliance in which energy produces a sound by imparting motion to a flexible component that vibrates at some nominal frequency.

n. Indicating Appliance. Any audible or visible signal employed to indicate a fire, supervisory, or trouble condition. Examples of audible signal appliances are bells, horns, sirens, electronic horns, buzzers, and chimes. A visible indicator consists of a lamp, target, meter deflection, or equivalent.

o. Initiating Device (Appliance). A manually or automatically operated device, the normal intended operation of which results in a fire alarm or supervisory signal indication from the FACP.

p. Portable Fire Extinguishers. All extinguishing devices that are movable and not permanently attached to a facility.

q. Signaling Line Circuit. A circuit over which multiple signals are transmitted and received.

r. Smoke Detector. A device that detects visible or invisible particles of combustion.

s. Water Deluge System. A water-based suppression system characterized by open discharge nozzles and an electromechanically and/or manually activated control valve.

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

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

Custodian:

NASA - John F. Kennedy Space Center

Preparing Activity:

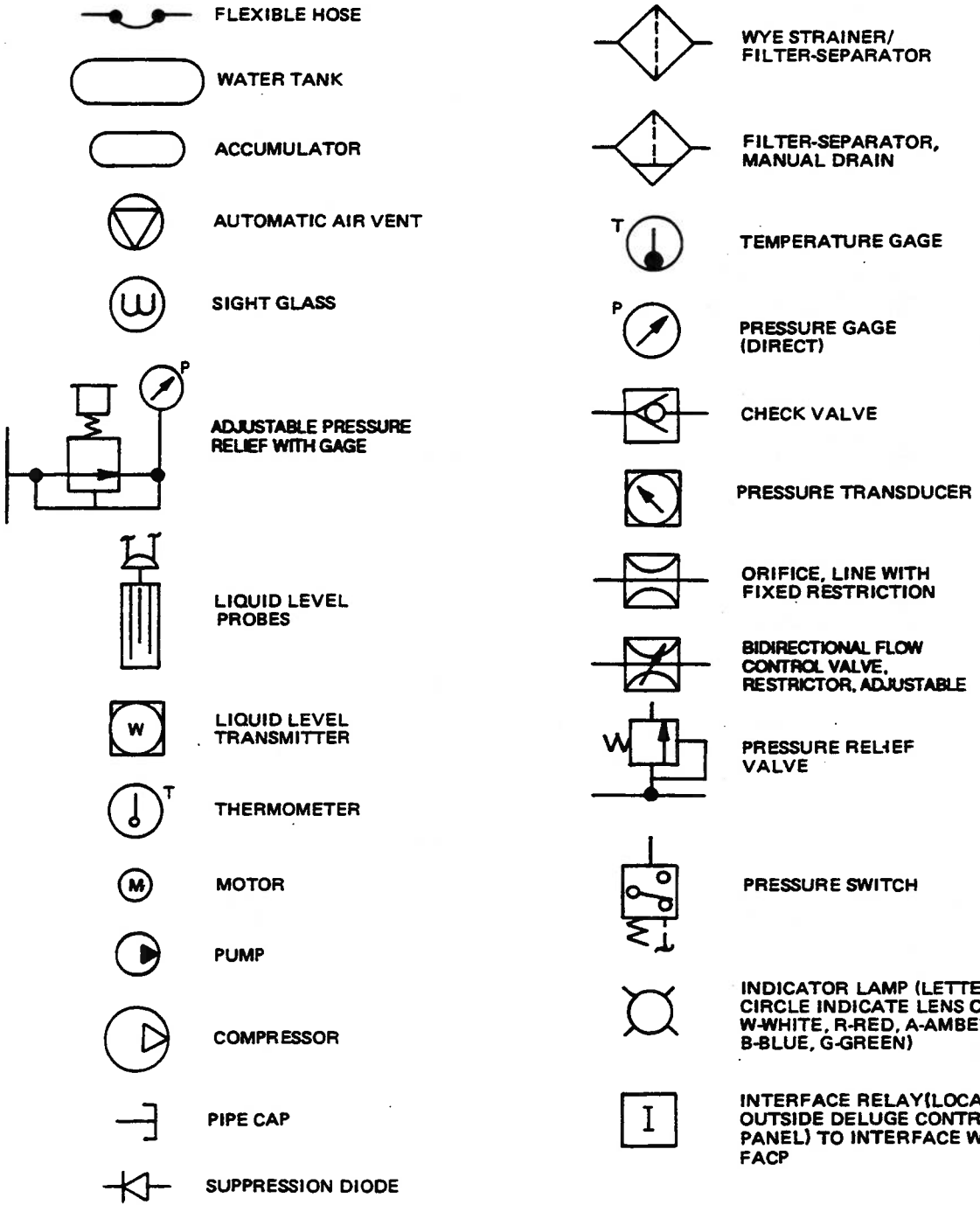
John F. Kennedy Space Center
Facilities Engineering Division
Engineering Development Directorate

APPENDIX A

GRAPHIC SYMBOLS FOR FIREX AND FIRE ALARM SYSTEM

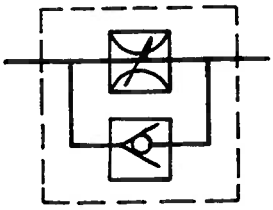
APPENDIX A

GRAPHIC SYMBOLS FOR FIREX AND FIRE ALARM SYSTEM



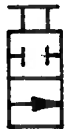

RELAY


SOLENOID

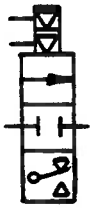

REVERSIBLE FLOW CONTROL VALVE WITH REVERSE FLOW BYPASS


VALVE, MANUAL, 3-WAY, 2 POSITION


ELECTROMECHANICAL SOLENOID VALVE, 3 WAY, SPRING RETURN


VALVE, MANUAL (NORMALLY OPEN)


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


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

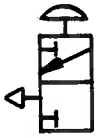

ELECTROMECHANICAL DUAL COIL SOLENOID VALVE


MANUAL VALVE WITH LOCAL AND REMOTE INDICATOR


VALVE, DIAPHRAM OPERATED


VALVE, METER, THERMOSTATIC


VALVE, NEEDLE, MANUAL


VALVE, SOLENOID, PILOT OPERATED


VALVE, 2 POSITION, 4-WAY, MANUAL


VALVE WITH POSITION INDICATOR, MANUAL


MUFFLER

FIRE ALARM PLAN AND RISER SYMBOLS:

F	FIRE ALARM CONTROL PANEL	A	REMOTE LED ANNUNCIATOR
A	AUXILIARY CONTROL PANEL	T	TRANSFORMER
MZAM 5	MONITOR ZONE ADDRESSABLE MODULE - SUBSCRIPT INDICATES ZONE NUMBER		POWER DISCONNECT SWITCH
SZAM	SIGNAL ZONE ADDRESSABLE MODULE	F	FUSED POWER DISCONNECT SWITCH
CZAM	CONTROL ZONE ADDRESSABLE MODULE	CB	CIRCUIT BREAKER
S	SUPPRESSION SYSTEM CONTROL PANEL	T	TELEPHONE JACK
ML	MOBILE LAUNCHER INTERFACE PANEL	R	AUXILIARY REMOTE CONTROL RELAY
TTC	TELEPHONE TERMINAL CABINET		BUZZER
FATC	FIRE ALARM TERMINAL CABINET	T	FIRE ALARM TROUBLE OR EARLY WARNING BELL
FATB	FIRE ALARM TERMINAL BOX	F	FIRE ALARM BELL
CT	CODE TRANSMITTER	S F	FIRE ALARM SPEAKER
M	MODEM	F	FIRE ALARM STROBE LIGHT
A 5A 5T	ANNUNCIATOR PANEL SUBSCRIPT INDICATES NUMBER OF WINDOWS; SUBSCRIPT "A" INDICATES ALARM; SUBSCRIPT "T" INDICATES TROUBLE	F	FIRE ALARM ROTATING BEACON

INITIATION DEVICE NOTE:

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

F	MANUAL PULL STATION	P	PHOTOELECTRIC HVAC DUCT SMOKE DETECTOR
P	PHOTOELECTRIC SMOKE DETECTOR		HEAT-ACTUATED DETECTOR

WATER FLOW SWITCH

PRESSURE SWITCH

TAMPER SWITCH

UV/IR FLAME DETECTOR

VALVE TYPES

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

NOTES:

REFERENCE DOCUMENTS:
- 79K09579 OMD BASELINE NO. 402.00
- 79K29921 SYSTEM DOCUMENTATION LIST
- 79K29849 LRU PARTS LIST

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

SYMBOLOGY IS PER KSC-STD-152-2. (SPECIAL SYMBOLS FOR WATER SYSTEM ADDED AS REQUIRED.)

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

EXAMPLE:

UNACTUATED ACTUATED

APPENDIX B

POWER SUPPLY REQUIREMENTS FOR FIRE ALARM AND FIRE EXTINGUISHING SYSTEMS

Power to fire alarm and fire extinguishing equipment shall be supplied from a reliable source of 120-volt alternating current power and shall be a battery-backed-up system. Batteries shall operate the systems in their normal supervisory mode for a minimum of 24 hours and shall operate alarm-indicating appliances, bells, or strobes for a period of 15 minutes.

APPENDIX C

OPERATION AND MAINTENANCE OF THE ASCO VALVE

C.1 OPERATION

For operation of the ASCO valve, see figure C-1. The valve operates when one solenoid is energized and remains in the position of the last solenoid energized when power to the solenoid is disconnected. The valve will not return to the original position until the opposite solenoid is energized. Solenoids may be energized momentarily or continuously, depending upon the application. Minimum "ON" time for valves is 0.3 second for air service.

CAUTION

Do not energize solenoids "A" and "B" simultaneously as this will cause the valve to malfunction.

IMPORTANT

The minimum operating pressure differential is 70 kPa (10 psi).

C.2 MAINTENANCE REQUIREMENTS

During any operation requiring the solenoid valve to be taken out of operation, the following steps must be performed:

a. Close the isolation valve to the system to prevent discharges.

b. Take off the air pressure to the solenoid valve.

c. Take off the air control power to the solenoid valve.

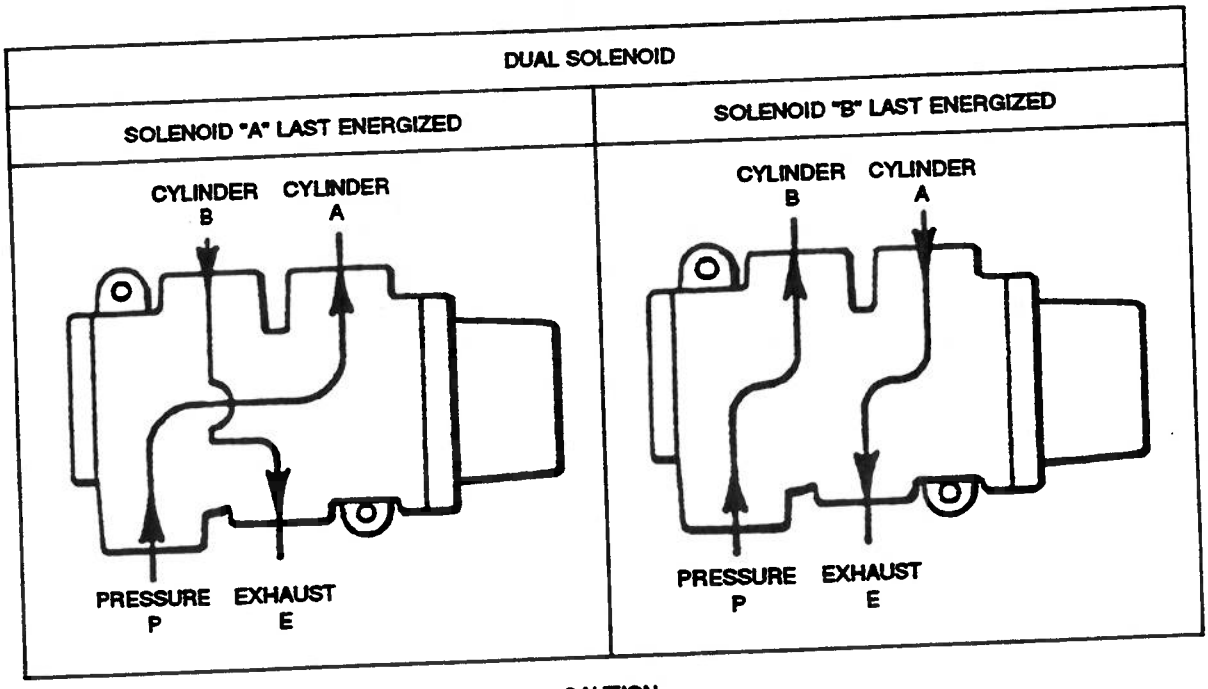
When bringing the system back on line, perform the following steps:

a. Apply control power to the solenoid valve and issue a close command.

b. Apply air pressure to the solenoid valve.

c. Verify the valve is closed.

d. Open the isolation valve to the system to restore to normal.



CAUTION

TO PREDETERMINE THE POSITION OF AN ACTUATING CYLINDER OR OPERATOR DURING A LOSS OF PRESSURE SITUATION, SOLENOID "B" MUST BE THE LAST SOLENOID ENERGIZED OR CYLINDER "B" MUST BE CHARGED PRIOR TO A LOSS OF PRESSURE CONDITION . IF SOLENOID "A" IS THE LAST SOLENOID ENERGIZED OR CYLINDER "A" PORT IS CHARGED PRIOR TO A LOSS OF PRESSURE , THE VALVE MAY SHIFT POSITION WITH A REAPPLICATION OF LINE PRESSURE.

NOTES

1. SOLENOID "A" LAST ENERGIZED: FLOW IS FROM PRESSURE "P" TO CYLINDER "A" AND FROM CYLINDER "B" TO EXHAUST "E."

2. SOLENOID "B" LAST ENERGIZED: FLOW IS FROM PRESSURE "P" TO CYLINDER "B" AND FROM CYLINDER "A" TO EXHAUST "E."

Figure C-1. Flow Diagrams of the ASCO Valve