

# DOE Fire Protection Handbook - Hanford Chapter

Prepared for the U.S. Department of Energy  
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy  
under Contract DE-AC06-09RL14728



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**Richland, Washington 99352**

# DOE Fire Protection Handbook - Hanford Chapter

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Mission Support Alliance

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# **DOE FIRE PROTECTION HANDBOOK - HANFORD CHAPTER**

Revised September 2014  
Mission Support Alliance

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## 1.0 INTRODUCTION

The design of fire alarm and suppression systems at Hanford facilities shall be in accordance with National Fire Protection Association (NFPA) codes, standards, and other documents referenced herein. Additional requirements may be found in the Department of Energy (DOE) Directives. This Hanford Chapter is developed and maintained by the Hanford Fire Marshal's Office. This Chapter and its revisions are reviewed and approved by DOE-RL and the Hanford Fire Protection Forum (HFPPF). The requirements contained herein are implemented by the Hanford Fire Marshal in accordance with CRD O 420.1B Change 1 (Supplemented Rev. 0), *Facility Safety*, ENS-ENG-IP-05, R2, *ORP Fire Protection Program*, and the DOE approved Hanford Fire Marshal's Charter as applicable.

## 2.0 PURPOSE AND SCOPE

This procedure establishes the criteria necessary for the design, upgrade and modification of fire protection systems at Hanford facilities. This procedure applies to all new designs, upgrades, or modifications prepared for or by Hanford Contractors, its subcontractors, managed facilities, programs, projects, and activities. This procedure does not apply to structures that do not require fire protection systems specifically covered by this document. The revision of this document in effect at the time it is applied to a project shall be the Code of Record (COR) for that design and installation.

## 3.0 FIRE ALARM SYSTEMS

### 3.1 General

1. Fire alarm systems shall be designed and constructed in accordance with the following, as applicable:
  - a. Department of Energy Orders and Directives, including, but not limited to:
    - CRD O 420.1B Change 1 (Supplemented, Rev. 0), "Facility Safety"
    - ENS-ENG-IP-05 R0, "ORP Fire Protection Program"
  - b. The latest edition of the NFPA codes and standards, including, but not limited to:
    - NFPA 70, "National Electrical Code"
    - NFPA 72, "National Fire Alarm Code"
    - NFPA 101, "Life Safety Code "
    - NFPA 1221, "Public Fire Service Communication System"
  - c. Other standards and requirements, including:
    - 29 CFR 1910, "Occupational Health and Safety Standards"
    - 29 CFR 1926, "Safety and Health Regulations for Construction"
    - DOE-STD-1066-99, "Fire Protection Design Criteria"
    - DOE-STD-1088-95, "Fire Protection for Relocatable Structures"
    - Underwriters Laboratory product and design directories (including the periodic supplements)w
    - FM Approval Guide™

- WAC 173-303, "Hazardous Waste Regulations"
  - International Building Code (IBC)
- d. The requirements in this document.
2. New installations and modification of fire alarm system equipment shall be constructed and installed in conformity of NFPA 72 (most current edition). Equipment constructed and installed in conformity of NFPA 70, Article 760 and 72 shall be listed for the purpose for which it is used. Fire alarm system's components shall be installed, tested, and maintained in accordance with the manufacturer's published instructions and this document. New installations and modifications or additions to existing systems shall be of the manufacture and type approved, or specified, by the Hanford Fire Marshal's Office. Contractor personnel installing and programming fire alarm control units (FACU) on the Hanford site shall have had documented factory certified training. In addition, for units that are new and unique to the site they shall provide the following:
- a. Copies of applicable as-built programming files.
  - b. Factory certified software/programmer training for a minimum of two designated individuals in the Fire Systems Maintenance organization.
  - c. Factory certified operations/troubleshooting training for technicians and firefighters.
3. Normally the FACU should be in a convenient location near the building's main entrance, and shall be readily accessible and visible. Where the FACU is not at or near the main entrance, a control annunciator panel shall be there for prompt and ready fire department access. Both the FACU and Radio Fire Alarm Reporting (RFAR) box locations shall be approved by the Hanford Fire Marshal's Office prior to installation. The RFAR box shall not be used as a protected premise FACU.
4. Installation personnel shall be qualified or shall be supervised by persons who are qualified in the installation, inspection, and testing of fire alarm systems. Evidence of personnel qualifications shall be submitted to the Hanford contractor fire protection engineer before installation. Qualification shall include the following:
- a. Personnel who are factory trained and certified for fire alarm system installation of a specific type and brand of system being installed.
  - b. National Institute for Certification in Engineering Technologies (NICET) Level II (minimum) in Fire Protection Engineering Technology Fire Alarm Systems.
5. An operational test procedure (OTP) shall be performed and successfully completed on new fire alarm installations before scheduling the acceptance test procedure (ATP). The following requirement shall apply to the OTP:
- a. The OTP shall be performed by the installer(s) with support from Hanford organizations as needed (e.g., Telecommunications/Radio

- Maintenance, Hanford Fire Department (HFD)).
- b. The OTP shall be performed in accordance with NFPA 72 “Record of Completion” (ROC)
  - c. The OTP shall be completed before scheduling of the system ATP.
  - d. The ROC shall be submitted to the FMO with a written statement that the system has been installed in accordance with approved drawings and plans, and tested in accordance with the manufacturer’s published instructions and appropriate NFPA and DOE requirements.
  - e. One copy of the ROC, updated to reflect system additions or modifications and maintained in a current condition at all times, shall be stored at the facility with the system/design engineer.
  - f. As a prerequisite to performing the ATP (item 8. below), the installer(s) shall sign-off on the ATP stating that the OTP has been successfully completed.
6. RFAR box shall be installed in accordance with Sections 3.7, 3.8, 3.9, and 3.10 of this document. Contact Hanford Site Radio Maintenance manager for RFAR acquisition requirements.
  7. An ATP shall be written for each new or modified fire alarm system. The ATP is intended to ensure that the installed system includes all components and functions as required by approved design drawings, specifications, and submittals. All system components shall be functionally tested to assure they operate as intended in accordance with NFPA 72
- The design contract document shall require the installing contractor to perform and document acceptance testing, unless otherwise agreed to by the contractor and the Hanford Fire Marshal. As a minimum, the ATP must be reviewed and approved by a designated representative of the Hanford Fire Marshal’s Office. The ATP shall be performed by the installer(s) and supported by the Hanford Site IRM/Telecommunications Radio Maintenance group, HFD, and other assigned contractor personnel as needed.
- Documentation of the successfully completed ATP shall be provided to the facility system/design engineer.
8. Hardware programming (jumper cuts, DIP switch settings, etc.) and mapping shall be shown on drawings indicating system configuration.
  9. Design drawings and equipment/hardware submittals must be approved by a designated representative of the Hanford Fire Marshal’s Office prior to the start of installation.
  10. Following successful completion of the ATP the system as-built drawings shall be revised, as appropriate, walked down and approved by a designated representative of the Hanford Fire Marshal’s Office prior to acceptance of the system from the contractor.

11. Designs provided by off-site contractor(s) shall be prepared by a NICET Level III/IV Fire Alarm Designer or a licensed professional Fire Protection Engineer. The design media shall bear the stamp and signature of this individual.
12. Fire alarm systems that are modified after the initial installation shall have the original record of completion revised to show changes from the original information and shall include a revision date.

### 3.2 Fire Alarm Control Units (FACU)

1. A FACU shall be installed as follows:
  - a. There shall be, at a minimum, actuating devices to trip the RFAR box or point reporting to the RFAR transceiver, as required by the Hanford Fire Marshal's Office.
  - b. There shall be at least one alarm indicator for each floor or each fire zone of the building.
  - c. Future expansion capability shall be provided in accordance with the growth potential of the building. A minimum of 2 spare initiating device circuit (IDC) zones and 1 notification appliance circuit (NAC) output or 10% of the functioning zones and outputs shall be provided.
  - d. Complete supervision of fire sprinkler systems shall include, but not be limited to, sprinkler control valves, room temperature switches (where required/specified), and air pressure supervision for dry pipe sprinkler systems in accordance with NFPA 13 and NFPA 72.
  - e. Fire alarm controls shall be housed in key-locked control cabinets. Locks furnished with this equipment shall be Corbin Cabinet Lock, Key Cat. No. 60.
  - f. Compatibility of the FACU and RFAR must be verified. Both shall be listed for their intended use.
  - g. Fire Alarm control panels, NAC extension panels, IDC, NAC and emergency control functions and interfaces (fan shutdown, door holders, etc.) shall be designed, installed and tested in accordance with NFPA 72 (most recent edition).
  - h. FACU Alarm zones shall be individually reported via RFAR alarm zones.
  - i. FACU common Supervisory output shall report via RFAR Supervisory Zones.
  - j. FACU common Trouble output shall report via RFAR FACU trouble indication.
2. FACU zoning criteria:

- a. There should be a one-for-one relationship between FACU zone numbers and RFAR zone numbers (i.e., FACU Zone 1 ⇔ RFAR Zone 1).
- b. The FACU zone assignment shall be coordinated with, and approved by, the Hanford Fire Marshal’s Office. Prescribed FACU zoning order is as follows:

Grouping	Device Function
First	Automatic sprinkler system water flow
Second	Other suppression systems (e.g., deluge, carbon dioxide, foam)
Third	Manual pull stations
Fourth	Fire detectors (e.g., smoke, thermal)
Spare Zone(s)	Spare zones, provided for future expansion
Last	Trouble/supervisory devices (work backwards from the last zone on panel)

- c. Fire alarm zones may be based on a logical division of the building into geographic areas. This zoning approach implies that different types of initiating devices may be included on a single zone if they indicate an alarm within the geographical zone. Zone water flow signal may be included if riser water flow switch is on a separate zone.
- d. The FACU shall be configured or programmed such that panel supervisory and trouble conditions shall report to the RFAR as an FACU trouble alarm.
- e. FACU point reporting (discreet device off-premise reporting via RFAR transceiver). FACU indications shall be received and displayed at HFD dispatch RFAR monitor.

3. Bypass switch criteria:

- a. FACUs should be provided with a "bell" bypass switch (occupancies not disrupted by sounding bells during testing need not have a bell bypass). The term "bell" is used to designate any notification appliance. The bell bypass switch shall initiate a FACU trouble condition when activated.
- b. Operation of any remote function (such as heating, ventilating, and air conditioning; elevator recall; or computer shutdown) in response to a fire alarm initiating device shall be processed by the FACU. The remote function initiation circuit shall include a function bypass switch that shall initiate a FACU trouble condition when activated.

*Exception: When a single device (e.g. duct smoke detector) is the only device required to initiate the remote function, then that device may be arranged to initiate the function directly if permitted by the device listing.*

- c. When a bypass switch (module) cannot be provided by the FACU manufacturer, the design shall include a supervised switch located in a

locked enclosure, in close proximity to the FACU. NFPA 72 (2013), Section 10.13, *Fire Alarm Signal Deactivation*, requires "bell" bypass switches to be key-operated or located within a locked cabinet or arranged to provide equivalent protection against unauthorized use.

4. Resolving Conflicts with Existing Facility FACU's and RFAR's. When problems are encountered in applying these design requirements to existing facilities, the following guidelines should be considered (in the design decision process):
  - a. When possible, modifications to existing systems should include matching the existing system(s) and/or zone(s) where the project contains only minor changes or when less than 25% of the inputs/outputs are changed.
  - b. If more than 25% of the inputs/outputs are being changed in the panel by a project, zones may need to be rearranged using the zoning order in this section. This should be determined on a case by case basis, with Hanford Fire Marshal concurrence.
  - c. An agreement in writing is required from the Hanford Fire Marshal's Office if the supervisory zones are to be installed as the first zone or zones in the panels, or where several FACU zones are combined into a single RFAR zone. This could be for either upgrading existing systems or for new system installation. If possible the combining of zones should be limited to trouble conditions for new systems and existing combinations of zones for existing systems.

### 3.3 Manual Fire Alarm Boxes

1. Manual fire alarm boxes (pull stations) shall be listed or approved, non-break glass, double action type. Manual fire alarm boxes shall not be self-restoring.
2. Manual fire alarm boxes (pull stations) shall be located in accordance with NFPA 101 and NFPA 72. In addition, pull stations should be installed at each designated stairwell in multi-story buildings. Buildings requiring protection shall have at least one pull station at each floor level. Additional manual fire alarm boxes shall be provided so that the travel distance to the nearest fire alarm box will not be in excess of 200 feet measured horizontally on the same floor.

### 3.4 Fire Detectors

1. The criteria for the location and installation of fire detectors shall be NFPA 72 and the detection manufacturer's installation instructions.
2. Detector (Heat and Smoke) coverage (total, partial, or non-required) shall be determined by the Hanford contractor's qualified fire protection engineer.
3. Detectors that activate a special extinguishing system shall be installed in accordance with the special suppression code requirement and FACU listing.
4. Photoelectric smoke detectors are generally the smoke detector of choice on the Hanford Site.

5. Photoelectric smoke detectors are preferred in areas where a fire is expected to produce high concentrations of smoke.
6. Ionization smoke detectors are preferred if the expected fire would more likely be a cleaner burning flame type fire.
7. Concealed detectors shall be provided with a remote alarm indicator light that will allow quick identification of the alarm source. The detection location and remote alarm light shall be labeled in accordance with NFPA 72.

### **3.5 Notification Appliances**

1. Notification signals for occupants to evacuate shall consist of audible and/or visible signals.
2. The ATP for a new or upgraded alarm system shall ensure signals can be heard under normal background conditions in spaces that may be occupied. This shall be the responsibility of the contractor/installer for the building involved.
3. Audible, visual, and combination audible/visual notification appliances shall be installed and operate in accordance with NFPA 72.

### **3.6 Cold Detectors**

1. Sprinkler system risers in mobile structures with aboveground crawlspaces shall be equipped with UL listed temperature detectors with the sensor placed on the piping within the crawlspace. The piping shall be wound with UL approved heat tape covered by a layer of insulation.

### **3.7 FACU/RFAR Power Supplies**

1. The primary power source shall be a dedicated branch circuit from the commercial light and power panel. The typical Fire Alarm Control Unit (FACU) AC power requirement is 120 VAC/20A/60 Hz. Other requirements for the primary power are;
  - a. The dedicated branch circuit and connections shall be mechanically protected (conduit).
  - b. Circuit disconnect means shall have a red marking.
  - c. Circuit disconnect means shall be accessible only to authorized personnel (breaker blocking device connected with the breaker in the ON position).
  - d. Circuit disconnect means shall be identified as “FIRE ALARM CIRCUIT”.
  - e. The location of the circuit disconnecting means shall be permanently identified at the FACU.
2. The secondary power supply shall be a configuration to have, as a minimum, two 12 volt “sealed lead-acid batteries” in series arrangement to add the voltage to 24

VDC. The capacity of the batteries is listed in amp hour (the electric charge transferred by a steady current of one ampere for one hour) and amp hour value is determined by each individual systems standby power calculation. The amount of battery standby needed is calculated based on the power requirements of the devices and equipment used. See typical battery calculation below.

a. Typical Battery calculation

Total amp hour load = (AX 24hrs+BX.083 hrs) X 1.2 where A=Total current required for Supervision (non-alarm) and B= Total current required during alarm mode.

### 3.8 Wiring

1. Fire protective signaling circuits on the Hanford Site are usually classified as nonpower-limited and shall be designed and installed in compliance with both the requirements of Part A (general) and Part B (nonpower-limited) of the NFPA 70, *National Electric Code*, Article 760, Fire Alarm Systems.
2. Wiring for fire protective signaling circuits shall comply with NFPA 70, NFPA 1221, and the following.
  - a. Splices in fire alarm wiring shall be made mechanically strong by use of pressure-type solderless connections. Connectors shall be installed according to the manufacturer's instructions and with the proper tool for the connector or terminal. Splices in wiring systems should be avoided.
  - b. Terminal ends of approved stranded conductors should be completed with crimp-on terminal lugs. Connections to terminal blocks are approved without the use of lugs.
  - c. Conductors for interior, nonpower-limited, and power-limited auxiliary fire alarm circuits shall be no smaller than No. 16 American Wire Gauge for single conductors and No. 18 American Wire Gauge for multi-conductor cables.
  - d. Single conductors size No. 14 American Wire Gauge and larger installed in nonpower-limited circuits shall have THHN/THWN insulation.
  - e. Conductors shall be color coded to distinguish initiating circuit conductors, annunciating circuit conductors, and power conductors from each other. Specific colors are at the option of the designer/installer. RFAR interface conductors shall be color coded in accordance with Figure 5.
3. Wiring shall be installed in intermediate metal conduit, rigid galvanized steel conduit, or electrical metallic tubing. Nonmetallic sheathed cable may be used without conduit in the concealed spaces in office buildings of 15,000 square feet or less. This installation must be made in accordance with NFPA 70.
4. Dedicated circuit breakers shall be provided for FACU and RFAR boxes. The FACU circuit breaker shall be different than the RFAR box circuit breaker. The breakers shall be painted red and fitted with a suitable guard requiring manual removal before the breakers can be operated. The breakers shall serve the fire

alarm equipment only and shall be clearly identified as fire alarm circuit control, FACU or RFAR.

5. The ground point for shielded conductors shall be in the FACU.
6. Junction box covers associated with fire alarm systems shall be identified by decals or red paint.
7. Relays, switches, push-buttons, terminals, terminal boards, etc., in the FACU shall be marked and identified, and properly coordinated with the nomenclature on the drawings.
8. Signaling conductors between the FACU and RFAR box shall be separated from other conductors to ensure that electromagnetic interference is eliminated.
9. Voltages above 50 volts are not permitted within the FACU except for the FACU power leads which shall be protected from personnel exposure.

### 3.9 Device and Wire Labels

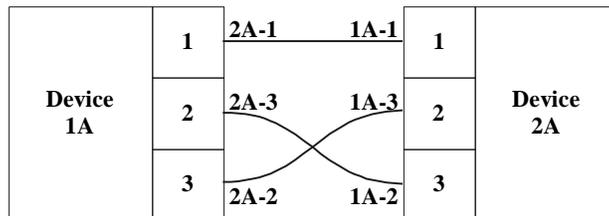
1. The following examples in Table 1 are given as guidance for labeling devices and wires. When modifying existing systems the existing labeling convention should be maintained. Some new or existing facilities may have more stringent labeling conventions.
2. When choosing the name for the wire to be labeled, consideration should be given to the function of the circuit. Some examples of common labels are given in Table 1.

**Table 1. Examples of Common Wire Labels**

TYPE OF CIRCUIT	ALPHANUMERIC IDENTIFIER
BELL/GONG/CHIME	G1A G1B
ZONE (MODULE TO FIELD DEVICE)	1A1 1A2
FACU TO RFAR TROUBLE CIRCUIT	TR TR
FACU TO RFAR ZONE CIRCUITS	Z1+ Z1-
FACU TO BATTERY	BAT+ BAT-
POWER PANEL TO FACU AND RFAR	H N

	G
RELAY	K
STROBE	S1A S1B

3. Device and Wire Labels Inside an Enclosure.
  - a. Generally, device-to-device conductors within a single enclosure are not required to be individually labeled. However, complexity of design may warrant labeling and shall be provided by the installer at the direction of the Hanford fire Marshal’s Office.
  - b. Devices within enclosures are assigned an alphanumeric identifier dependent on their location within the enclosure. If the device to be labeled is located in Row 1, Column A, then the device typically is labeled Device 1A. Device 1A is usually located in the upper left-hand corner of the enclosure.
  - c. When wiring from device to device inside the same enclosure the destination wiring method should be used. For example, near the terminal where the wire leaves the device, the wire should be labeled identifying its destination device and terminal. Similarly at the opposite end the wire will have a different label identifying the destination device and terminal, see Figure 1. Short jumpers between terminals on the same device do not require labels.



**Figure 1. Wire Labels Inside An Enclosure**

4. Device labeling and wire labeling between enclosures or field devices.
  - a. Field devices are assigned an alphanumeric identifier depending on the type of system involved. For conventional fire alarm systems the alphanumeric identifier is assigned based on the zone the device is connected to and its position in the circuit. For example, the first device in circuit of zone 72 should be labeled 72-1, etc. For addressable fire alarm systems the device is given an alphanumeric identifier corresponding to the device address assigned within the software of the microprocessor.
  - b. When wiring from one enclosure to another enclosure or field device, the same wire label should be maintained at both ends of the wire. The label

should be unique from any other label used in the installation (see Figure 2).

- c. The same wire label can be used more than once in zone and bell circuits. These circuits involve many devices connected in parallel to the same two wires. Each device is located in a separate enclosure (e.g., junction box) (see Figure 3).
- d. Devices with multiple terminals: When the terminals for the wires entering the device (e.g., detector, bell) are different than the terminals used for the wires leaving the device an extension should be added to the wire label identifying where the wire is to be landed (see Figure 4).

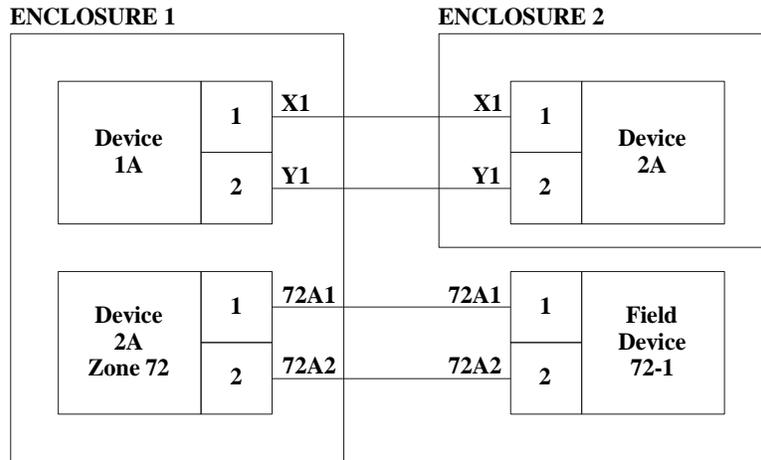


Figure 2. Wire Labels Between Two Enclosures.

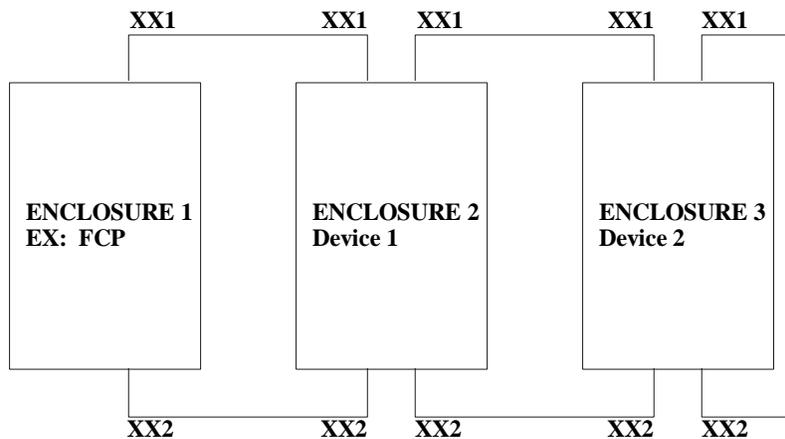
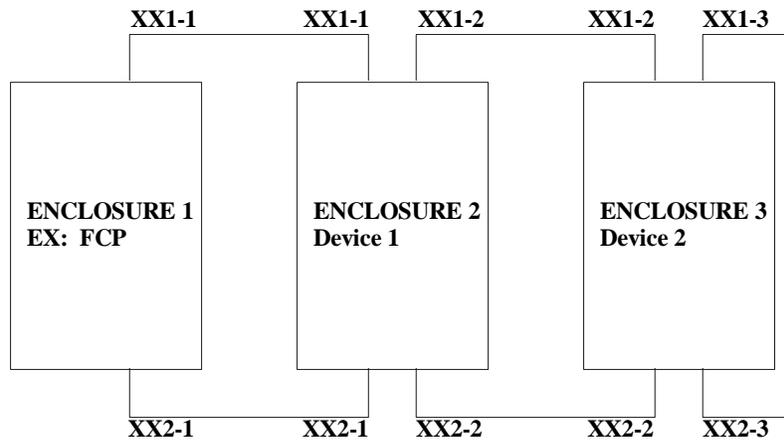


Figure 3. Wire Labels Between Zone and Bell Devices or Other Enclosures.

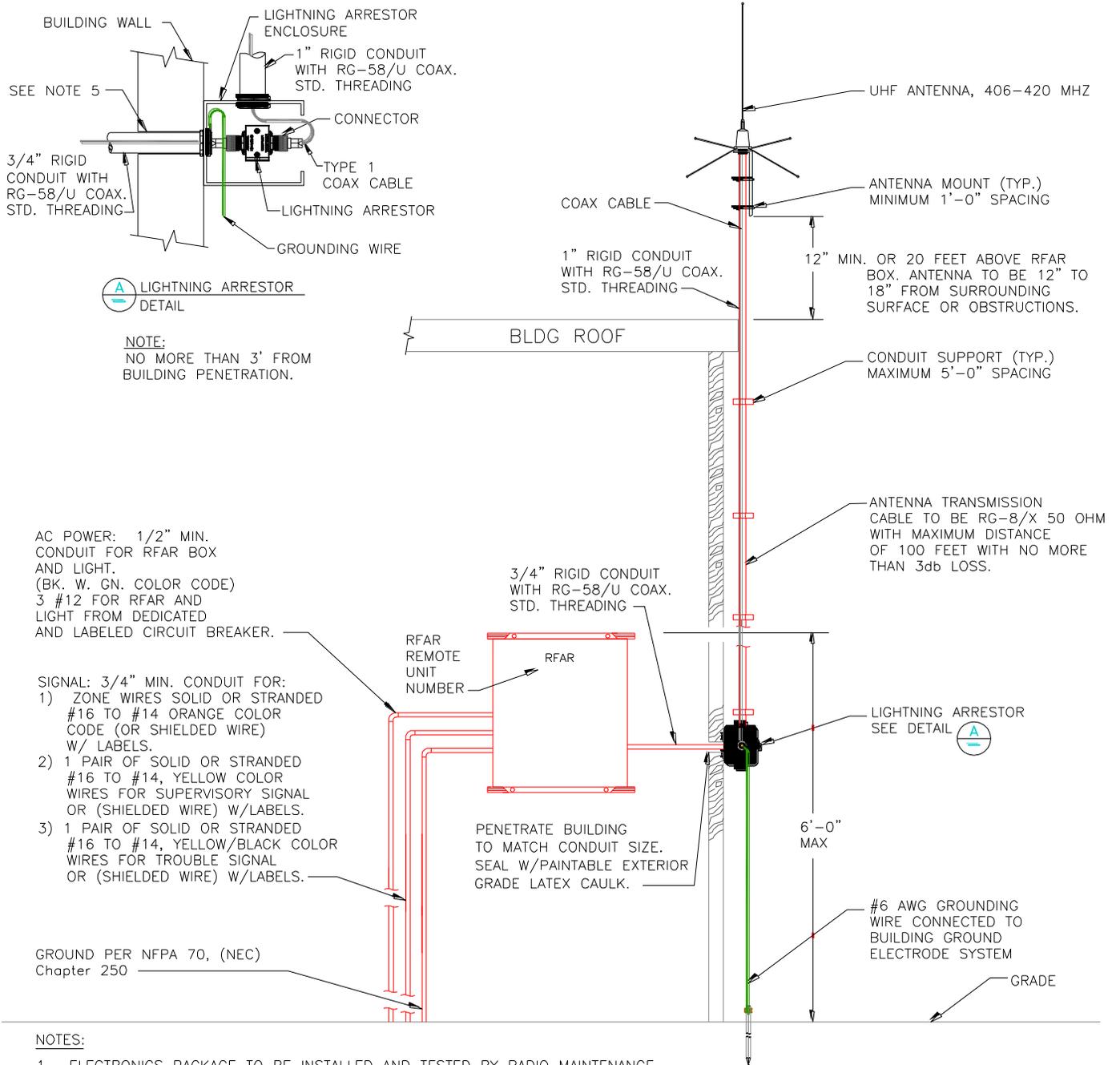


**Figure 4. Wire Labels Between Enclosures When Termination Points Are Critical.**

### 3.10 Radio Fire Alarm Reporting Boxes (RFAR)

1. The Proprietary Supervising Station (PSS) for the Hanford Site consists of RFAR boxes and RF transceivers. The boxes are manufactured by the Monaco Enterprises Inc. (MEI) and shall be procured for site projects through Radio Maintenance. RFAR boxes can be used as facility off premise reporting to HFD dispatch as zone to zone connection or point reporting. The zone to zone RFAR boxes can provide 8, 16, 24, 32, 40, and 48 zones for connection to a local FACU (see section 3.2.2).
2. RFAR box code numbers are assigned by the HFD.
3. RFAR boxes shall be grounded to one of the main building grounding electrodes (e.g., water pipe, building steel, grounding grid, etc.) with a No. 4 American Wire Gauge copper wire. If no suitable grounding electrode is available, a suitable alternative would be to connect the RFAR to a grid of two 2.4 m (8-ft) ground rods connected with No. 4 American Wire Gauge wire.
4. The installation of more than one FACU reporting to a single RFAR box shall be approved by the Hanford Fire Marshal's Office before the design is completed.
5. RFAR antennas shall be procured for site projects through Radio Maintenance. The location of the RFAR box and antenna on the outside of buildings shall be as directed by Radio Maintenance. The conduit for the RFAR antenna shall be 3/4-inch rigid conduit.
6. Conduit entry into the RFAR boxes shall be in the bottom of the RFAR box, within 2-1/2 inches from the back of the RFAR box. Conduit entries shall be made with watertight connectors.
7. Final wiring connections in RFAR enclosures shall be made only by Radio Maintenance or FSM.
8. RFAR box enclosures shall not be used as a junction box or wire pass through for power or signaling circuits not related to the fire alarm reporting system.
9. RFAR box installation details for indoor and outdoor installations, respectively, are shown below.

### TYPICAL RFAR BT-X REMOTE UNIT INSTALLATION (INDOOR LOCATION)



**A** LIGHTNING ARRESTOR  
DETAIL

**NOTE:**  
NO MORE THAN 3' FROM  
BUILDING PENETRATION.

AC POWER: 1/2" MIN.  
CONDUIT FOR RFAR BOX  
AND LIGHT.  
(BK. W. GN. COLOR CODE)  
3 #12 FOR RFAR AND  
LIGHT FROM DEDICATED  
AND LABELED CIRCUIT BREAKER.

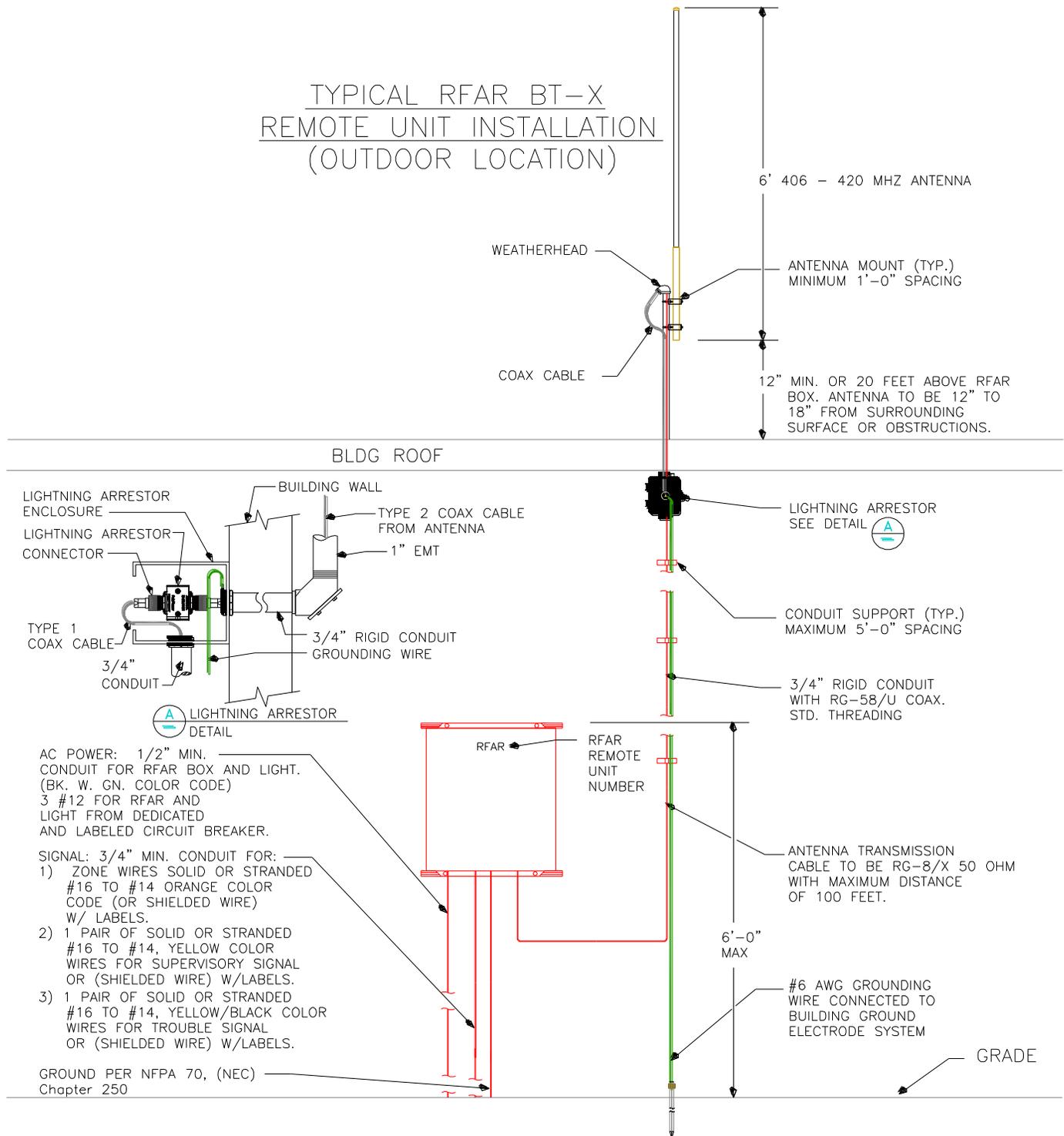
SIGNAL: 3/4" MIN. CONDUIT FOR:  
1) ZONE WIRES SOLID OR STRANDED  
#16 TO #14 ORANGE COLOR  
CODE (OR SHIELDED WIRE)  
W/ LABELS.  
2) 1 PAIR OF SOLID OR STRANDED  
#16 TO #14, YELLOW COLOR  
WIRES FOR SUPERVISORY SIGNAL  
OR (SHIELDED WIRE) W/LABELS.  
3) 1 PAIR OF SOLID OR STRANDED  
#16 TO #14, YELLOW/BLACK COLOR  
WIRES FOR TROUBLE SIGNAL  
OR (SHIELDED WIRE) W/LABELS.

GROUND PER NFPA 70, (NEC)  
Chapter 250

- NOTES:**
1. ELECTRONICS PACKAGE TO BE INSTALLED AND TESTED BY RADIO MAINTENANCE DURING THE OPERATIONAL TEST.
  2. ALL CONDUITS AND ENTRY WAYS TO BE PLUGGED AND SEALED.
  3. A LIGHTNING ARRESTOR MAY BE USED TO HELP PROTECT THE ELECTRONIC EQUIPMENT FROM DAMAGE BY DISCHARGING EXCESS VOLTAGES OF CURRENTS GENERATED BY LIGHTNING OR STATIC BUILDUP. HOWEVER, LIGHTNING ARRESTORS CANNOT PROTECT EQUIPMENT FROM DIRECT LIGHTNING STRIKES.
  4. DO NOT EXCEED BEND RADIUS OF CABLE.
  5. SEAL AROUND ALL PENETRATIONS TO EXTERIOR SIDING AND FASCIA WITH PAINTABLE EXTERIOR GRADE LATEX CAULK. USE ONLY GALVANIZED FASTENERS AND HARDWARE FOR EXTERIOR APPLICATIONS. TREAT ALL EXPOSED METAL WITH GALVANIZING PAINT BEFORE INSTALLATION.

TMM 09/23/14

TYPICAL RFAR BT-X  
REMOTE UNIT INSTALLATION  
(OUTDOOR LOCATION)



AC POWER: 1/2" MIN. CONDUIT FOR RFAR BOX AND LIGHT. (BK. W. GN. COLOR CODE)  
3 #12 FOR RFAR AND LIGHT FROM DEDICATED AND LABELED CIRCUIT BREAKER.

SIGNAL: 3/4" MIN. CONDUIT FOR:

- 1) ZONE WIRES SOLID OR STRANDED #16 TO #14 ORANGE COLOR CODE (OR SHIELDED WIRE) W/LABELS.
- 2) 1 PAIR OF SOLID OR STRANDED #16 TO #14, YELLOW COLOR WIRES FOR SUPERVISORY SIGNAL OR (SHIELDED WIRE) W/LABELS.
- 3) 1 PAIR OF SOLID OR STRANDED #16 TO #14, YELLOW/BLACK COLOR WIRES FOR TROUBLE SIGNAL OR (SHIELDED WIRE) W/LABELS.

GROUND PER NFPA 70, (NEC) Chapter 250

NOTES:

1. ELECTRONICS PACKAGE TO BE INSTALLED AND TESTED BY RADIO MAINTENANCE DURING THE OPERATIONAL TEST.
2. INSTALL ALL CONDUIT WITH WATER TIGHT FITTINGS AT THE BOTTOM WITHIN 2 1/2" FROM THE BACK OF THE RFAR BOX.
3. ALL CONDUITS AND ENTRY WAYS TO BE PLUGGED AND SEALED.
4. A LIGHTNING ARRESTOR MAY BE USED TO HELP PROTECT THE ELECTRONIC EQUIPMENT FROM DAMAGE BY DISCHARGING EXCESS VOLTAGES OF CURRENTS GENERATED BY LIGHTNING OR STATIC BUILDUP. HOWEVER, LIGHTNING ARRESTORS CANNOT PROTECT EQUIPMENT FROM DIRECT LIGHTNING STRIKES.

TMM 09/23/14

## 4.0 FIRE SUPPRESSION SYSTEMS AND WATER SUPPLIES

### 4.1 General

1. Fire suppression systems shall be designed and constructed in accordance with the following, as applicable:
  - a. DOE Orders and Directives, including, but not limited to:
    - CRD O 420.1B Change 1 (Supplemented, Rev. 0), "Facility Safety"
    - ENS-ENG-IP-05 R2, "ORP Fire Protection Program"
  - b. The latest edition of the NFPA, including, but not limited to:
    - NFPA 13, "Standard for the Installation of Sprinkler Systems"
    - NFPA 24, "Private Fire Service Mains and Their Appurtenances"
  - c. Other standards and requirements, including:
    - 29 CFR 1910, "Occupational Health and Safety Standards"
    - 29 CFR 1926, "Safety and Health Regulations for Construction"
    - DOE-STD-1066-99, "Fire Protection Design Criteria"
    - DOE-STD-1088-95, "Fire Protection for Relocatable Structures"
    - Underwriters Laboratory (UL) product and design directories (including the periodic supplements).
    - FM Global (FM) Approval Guide
    - WAC 173-303, "Dangerous Waste Regulations"
    - WAC 212-80, "Fire Sprinkler System" \*
    - WAC 246-290, "Public Water Supplies"
    - International Building Code (IBC)
  - d. The requirements in this document.
2. New installations and modifications or additions to existing systems shall be the manufacturer and type approved by the Hanford Fire Marshal's Office.
3. Shop drawings and submittals for automatic sprinkler system design and underground fire main design produced by an off-site contractor are required to be stamped and signed by the holder of a current State of Washington Fire Sprinkler Level 3 Certificate of Competency\*.
4. Off-site contractors performing installation of sprinkler system and underground fire mains shall be licensed fire protection contractors holding a State Level 3 (State Level U for underground only) license\* issued by the State of Washington.
5. "As built" drawings for sprinkler systems and underground fire mains as well as contractor's Materials and Test Certificates shall be stamped and signed by a State Level 3 or State Level U certified individual (respectively) indicating compliant installation.

(\* This WAC is invoked relative to the requirements for certification and licensure of those contracting on the Hanford Site to design and/or install Fire Sprinkler Systems including associated underground feed mains.)

6. Components/equipment installed in accordance with this design criteria, shall be listed for their intended use by UL, or approved by FM, where applicable. Trim valves and accessories of alarm check valves, dry pipe valves, deluge valves, etc., must be approved or listed for intended use as part of the approved trim package as supplied by the manufacturer.
7. Fire suppression systems must be designed to provide an actuation alarm through an approved fire alarm system to the HFD as described in section 3.0 above.
8. Fire suppression system design drawings and equipment/hardware submittals must be approved by a qualified fire protection engineer representing the responsible Hanford Contractor.
9. Drawings and submittals for water system additions and modifications shall be approved by a designated representative of the Hanford Fire Marshal's Office prior to installation.
10. As-built drawings must be approved and issued prior to acceptance of the system from the contractor.

#### **4.2 Underground water lines minimum depth of earth cover**

1. Water mains used for fire protection water supplies shall have a minimum earth cover above top of pipe of 42 inches.
2. Underground water distribution mains shall be a minimum of 12 inches unless otherwise approved by the Hanford Fire Marshal's Office.

#### **4.3 Water Flow Test Data**

1. Water flow test data is required for conceptual design reports and definitive design. This data shall be included in the report or the design package that will have fire suppression systems installed.
2. Water flow test data shall be requested from the HFD.

#### **4.4 Sprinkler System Design**

1. As a minimum, sprinkler systems shall be designed to NFPA 13 Ordinary Hazard Group 1 occupancy classification. The discharge density may be higher depending on the degree of hazard. When determining the occupancy classification, give consideration to expected future uses of the facility.
2. Sprinkler systems having air or other gases in the piping (dry pipe, pre-action, or deluge) shall be designed using internally and externally galvanized piping.
3. Sprinkler system water supply piping installed in unheated areas (e.g., crawl spaces) shall be provided with approved freeze protection.
4. Sprinkler piping shall be schedule 40. Fittings shall be as permitted by NFPA 13 and shall be listed for use intended.

*Exception: Rolled grooved fittings shall not be used in a sprinkler system when the system is supplied directly from the discharge of a fire pump within the fire pump room. Use treaded, cut grooved, or welded/flanged fittings in such situations.*

## 4.5 Hydraulic Design

1. Hydraulically designed sprinkler systems shall have a flow and pressure factor that is a minimum of 10 percent below the water supply curve.
2. Hydraulically calculated systems shall include a basic 250-gpm outside hose stream allowance and any additional hose stream allowances and other water demands that may be part of the requirements, such as in-rack sprinkler demand or other process demand.

## 4.6 Water Flow Alarm Gongs

### 4.6.1 Mechanical Water Motor Gong

1. The use of water motor alarm gongs shall be in accordance with NFPA 13.
2. Drain pipe should be appropriately routed from the water motor gong terminating with a 45 degree elbow turned down. Provide a splash block where necessary to prevent erosion.

### 4.6.2 Electrical Water Flow Alarm

1. Water flow alarm pressure switches are required for dry pipe systems and preferred for wet pipe systems having alarm check valves.
2. Wet sprinkler systems designed without alarm check valves and mechanical water motor alarm gongs shall be equipped with electric non-silenceable water flow alarm bells. This bell shall be continuous ringing, mounted on the building exterior, 24 Vdc, and powered from the fire alarm control panel. The first pole of the flow alarm pressure switch shall be connected to the FACU. The water flow bell shall be activated by the second pole of the water flow alarm pressure switch.

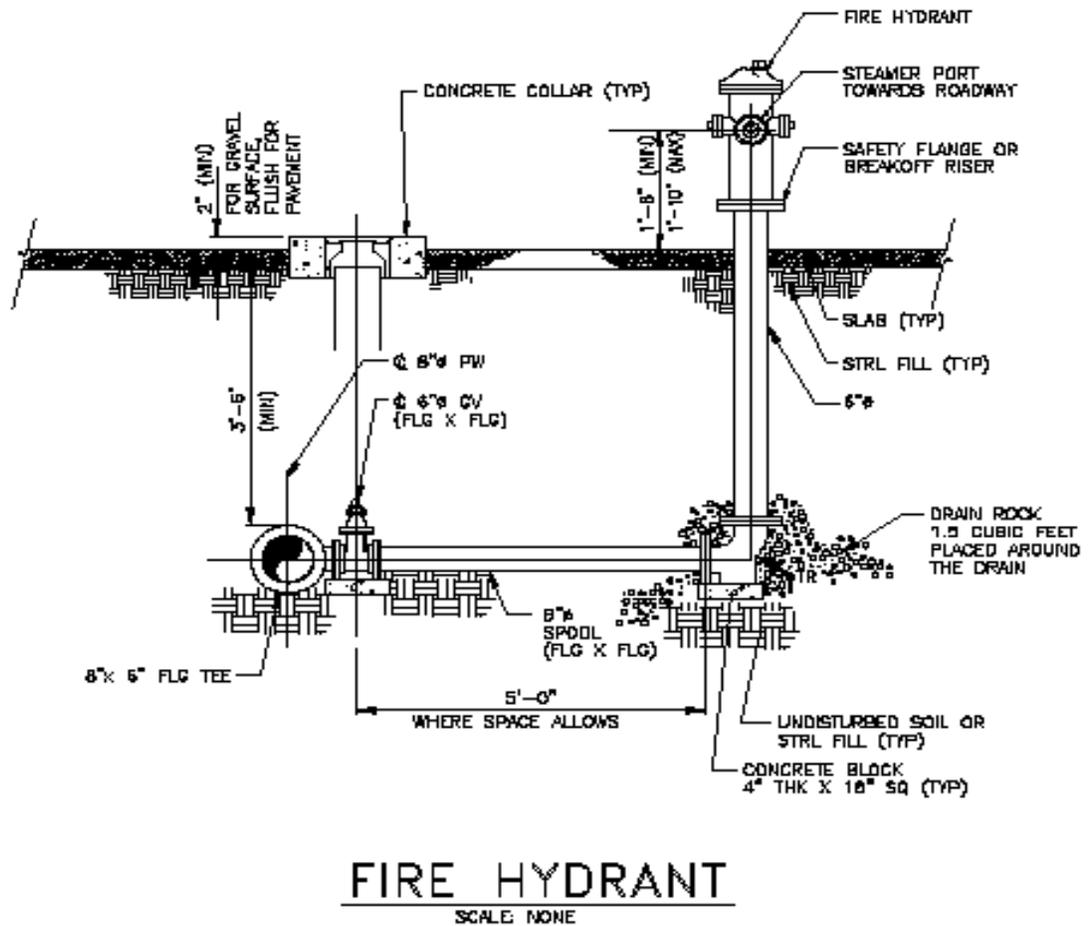
## 4.7 Halon

New Halon systems shall not be installed.

## 4.8 Fire Hydrants

Fire hydrants shall be dry barrel compliant with AWWA C502, with compression type main valve that opens against pressure. Inlet valve shall have a minimum 5" opening. Hydrants shall have one 4 ½ inch pumper connection and two 2 ½ inch hose connections each with caps and chains. Connection threads shall be in accordance with NFPA 1963, National Hose threads. Hydrant operating nut and cap nuts shall be National Standard Pentagon and open in a counter-clockwise direction. Stem seals shall be O-ring type. Hydrant shall be Clow Medallion, M & H Model 929, or equal approved by Fire System Maintenance and shall be painted chrome yellow. A typical Hanford hydrant detail is shown below.

Baseline flow data shall be established and documented for all new hydrants. Contact the HFD for support in conducting flow tests.



#### 4.9 Backflow Preventers

Contact the MSA Water Purveyor to determine if a backflow prevention device is required to be installed in the water supply line feeding the sprinkler system. If a backflow preventer is required in the water supply line to the sprinkler system, it shall be a make and model approved for use by the State of Washington Department of Health. Further, it shall be a model from a manufacturer specified below. Others, not listed below, may be installed if approved, in advance, by Hanford Fire System Maintenance.

##### Reduced Pressure Type

- Wilkins<sup>®</sup>
- Watts<sup>®</sup>

##### Double Check Type

- Watts<sup>®</sup>
- Ames<sup>®</sup>
- Wilkins<sup>®</sup>

A factory test certification shall be provided with all backflow prevention assemblies and

assemblies shall be forward flow tested after installation to ensure proper operation and there are no obstructions.

#### **4.10 Portable Fire Extinguishers**

The selection of portable fire extinguishers for a given situation shall be determined by company Fire Protection Engineers (FPE) utilizing the applicable requirements specified in NFPA 10.

The following factors shall be considered:

- Type of fire most likely to occur
- Size of fire most likely to occur
- Hazards in the area where the fire is most likely to occur
- Energized electrical equipment in the vicinity of the fire
- Ambient temperature conditions

### **5.0 OTHER**

#### **5.1 General Design & Drawing Requirements**

1. Drawings shall show, in graphic and quantitative form, the extent, location, relationship, and dimensions of the work to be done in sufficient detail to demonstrate that the design requirements have been met and to facilitate construction of the work.
2. Drawings shall be produced by AutoCAD (latest edition) format. Drawing files shall be on CD/DVD, uncompressed. If nonstandard fonts are used, the font file must be supplied with the drawing file
3. Identify conduit and conductor sizes, and number of conductors in each conduit on the floor plan drawings. Provide each conductor and device with a unique alphanumeric identifier.
4. Interconnecting wiring in the FACU and RFAR panels between modules, and connecting wiring to the field device terminals on point-to-point wiring diagrams shall be shown on drawings.
5. FACU jumper cuts, switch positions, or other "programming" features shall be annotated on the drawing.
6. Attachment designs: Hanger and support details, fastener types, sizes, material to be fastened to and embedment depth shall be shown on the drawing.
7. Power supply, HVAC and miscellaneous control circuit diagrams shall be shown on drawings as applicable.
8. Drawings shall be prepared using Hanford Title Blocks. Generally, the standard size sheet used is 28 inches by 40 inches, size F.
9. Fire protection systems shall include the following documentation, which shall be delivered to the facility system/design engineer upon acceptance of the

system.

- An owner manual and manufacturer’s published instructions covering all system equipment.
- Record drawings.
- For software-based systems, a record copy of the facility-specific software.