

# Specification Section 15310 Automatic Sprinklers and Water-Based Fire Protection Systems

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This document has undergone the formal Review and Approval process, and its contents have been deemed unclassified/unlimited release.



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## Part 1 - General

### 1.01 Description of Work

#### A. Requirements

This specification, in conjunction with the contract documents and drawings, indicates the materials and operations required for the design and installation of fire protection systems. Requirements are included for the design and installation of fire protection systems, shop drawings, equipment, pipe, pipe fittings, valves, check valves, backflow prevention devices, alarm initiation and supervisory devices, fire department connections, sprinkler systems, operating instructions, identification, tests, and disinfection of piping.

#### B. Application of this Specification

This specification applies to all fire protection piping downstream of the flanged and spigot piece at the base of the sprinkler riser, unless otherwise noted on the contract drawings.

#### C. Variation, Clarification, or Conflict

Any variation, clarification, or apparent conflict from within this specification must be submitted to the Sandia Delegated Representative (SDR).

### 1.02 Quality Assurance

#### A. General

Where specific manufacturers or model numbers are mentioned in these specifications, proposed substitutions must be included in the submittal package furnished to the SDR for approval after contract award and before installation.

#### B. Warranty

All sprinkler system components furnished under this contract must be guaranteed against defective design, materials, and workmanship for the full warranty time, which is standard with the manufacturer or supplier. In no case can the warranty be less than one year from the date of system acceptance.

### 1.03 References

#### A. Sandia National Laboratories (SNL) Standard Specifications

Number	Title
01065	Environment, Safety, and Health (ES&H) for Construction Contracts
01300	Submittal Procedures
01700	Contract Closeout
02200	Earthwork
02665	Underground Water Lines for Domestic and Fire Protection Systems (DFPS)
07270	Firestopping
09900	Painting
15994	Mechanical Systems Demonstration

**B. American Public Health Association (APHA)**

- Standard Methods for the Examination of Water and Wastewater

**C. American Water Works Association Standard Specifications (AWWA)**

Number	Title
C500	Metal-Seated Gate Valves for Water Supply Service
C651	Disinfecting Water Mains
Manual M14	Recommended Practice for Backflow Prevention and Cross-Connection Control

**D. Factory Mutual (FM) Global**

- Approval Standards
- Data Sheets

**E. National Fire Protection Association (NFPA) Standards and Recommended Practices**

Number	Title
13	Standard for the Installation of Sprinkler Systems
14	Standard for the Installation of Standpipes and Hose Systems
15	Standard for Water Spray Fixed Systems for Fire Protection
16	Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems
20	Standard for the Installation of Stationary Pumps for Fire Protection Systems
25	Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems
70	National Electrical Code®
72	National Fire Alarm and Signaling Code
750	Standard on Water Mist Fire Protection Systems

**F. Underwriters' Laboratories Inc. (UL)**

- Fire Protection Equipment Directory

For interpretation of the above referenced documents and this standard, the "Authorities Having Jurisdiction" is the SNL Site Fire Marshal.

## **1.04 System Design**

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**A. Design**

1. The designer of the fire protection systems must meet one of these requirements:
  - a. A registered Professional Fire Protection Engineer in the State of New Mexico
  - b. Minimum National Institute for Certification in Engineering Technologies (NICET) Level III for wet-pipe or dry-pipe, Ordinary Hazard Group II sprinkler systems, regardless of size
  - c. Minimum NICET Level IV for all other types of systems, including rack storage systems and special hazard protection

2. Where NICET design is used, copies of the designer's certificates from NICET are submitted with the drawings for approval. The registered Professional Fire Protection Engineer stamps all other plans.
3. The Contractor is responsible for designing the fire protection system according to this specification, the documents referenced in section 1.03, and the contract documents. The Contractor coordinates the design and construction documents with all other disciplines (for example, architectural, civil, mechanical, electrical, and fire alarm).
4. The design of fire protection systems must be complete with all necessary components to ensure proper operation, including components that interface with the fire alarm system. System design must account for practical maintenance and aesthetic concerns, as well as meet the design requirements. Avoid inefficient designs, unnecessary materials, and special system modifications to meet design density (for example, reduced spacing the hydraulically remote areas).
5. The fire protection water supply lines, controlling devices, protective devices, alarm systems, supervisory devices, and related equipment must be compatible so all equipment functions together as specified.
6. The design must comply with all mandatory, advisory interpretations, and recommended applicable rules of the adopted editions of the codes and standards in section 1.03, "References," except where otherwise noted on the drawings or specified herein.
7. The Contractor must produce design drawings (design files) that indicate the extent and arrangement of the fire protection systems.
8. Unless indicated in the contract, "drawings" refers to the plotted hard copy document or print and the electronic computer-aided drafting design (CADD) file.

#### **B. Design Criteria**

Fire protection system design must be based on the following criteria:

1. The designated SNL Fire Protection Engineering representative decides whether to implement the light hazard occupancy rules.
2. Pipe schedule method is permitted only for additions or modifications (less than 3,000 feet<sup>2</sup>) to existing Ordinary Hazard Pipe Schedule systems, unless otherwise specified. All other designs must be hydraulically calculated.
3. The following table indicates the required sprinkler designs for various occupancies at SNL. These must be used unless otherwise specified on the SNL bid drawings.

**Table 1. Required Sprinkler Designs Based on Occupancy**

Occupancy	Sprinkler Density (gpm/ft <sup>2</sup> )	Area of Application ft <sup>2</sup>	Max. Area per Sprinkler ft <sup>2</sup>	Max. Area per Sprinkler Riser ft <sup>2</sup>	Hose Allowance (gpm)	Sprinkler Orifice, Temperature
Office or Assembly	0.15	1,500	130	52,000	500	½", ordinary temp.
Computer Rooms	0.20	3,000	130	52,000	500	½", ordinary temp.
Computer Tape Storage Rooms	0.28	3,000	100	40,000	500	½" or 17/32", ordinary temp.
Class B or C Labs	0.17	3,000	130	52,000	500	½", ordinary temp.
Class A Labs	0.25	3,000	100	52,000	500	½" or 17/32", ordinary temp.
Rack Storage – All Commodities <sup>1</sup>	Per NFPA 13, minimum density of 0.20 gpm/ft <sup>2</sup>	3,000	100	40,000	750 for Class IV or Group A	½", 17/32", or 0.64" extra large orifice (ELO)
Anechoic Chambers	Per FM Global Data Sheet 1-53 Anechoic Chambers					17/32" or 0.64" ELO, ordinary temp.
Clean Rooms	0.20	3,000	130	52,000	500	½", ordinary temp.
Accelerator Areas (Oil Filled)	0.30	5,000	100	40,000	500	17/32" or 0.64" ELO, high temp.
Cooling Towers <sup>2</sup> , Crossflow and Counterflow* Towers	.33	Under the fan decks, including fan openings, over fill areas, and motors	100	N/A	500	½" or 17/32"
	*.50 Counterflow*					
Hydraulic Oil Equipment, Pumps, and Hydraulic Lines Class IIIA or B	0.30	3,000 or entire area	100	40,000	750	17/32", ordinary or intermediate temp.



Occupancy	Sprinkler Density (gpm/ft <sup>2</sup> )	Area of Application ft <sup>2</sup>	Max. Area per Sprinkler ft <sup>2</sup>	Max. Area per Sprinkler Riser ft <sup>2</sup>	Hose Allowance (gpm)	Sprinkler Orifice, Temperature
Oil Pumping Stations, Oil Cellars, and Oil Storage	0.30	5,000 or entire area	100	40,000	750	17/32", ordinary or intermediate temp.
Standby Generators, Oil Fired Boilers, Steam Generators, Hydraulic Equipment, Reservoirs, Weld Shops, Compressors, Oxygen-Fuel Gas Systems	0.25	3,000 or entire area	100	40,000	750	17/32", intermediate temp.
Storage, Use, and Handling of Compressed and Liquefied Gases in Portable Cylinders	0.30	3,000 or entire area	100	40,000	750	17/32", intermediate temp.

1. Follow NFPA 13 for in-rack design parameters, except the minimum end-head pressure shall be 30 psi {2.0 bars}

2. Cooling towers with Factory Mutual (FM) approved fill **do not** require sprinkler protection. Interlock the system to shut down tower fans upon actuation.

4. Hydraulic design must be as follows:

- a. Maximum water-flow velocity must not exceed 20 feet per second (6 m/s) in any sprinkler system piping of hydraulically designed systems.
- b. Hydraulic design must be based on the water supply data provided by the SDR. The water supply data curve must be based on 85% of the available water supply as tested.
- c. All systems must be hydraulically calculated with a reduced pressure backflow preventer regardless of what backflow device is specified on the contract drawings.
- d. Hydraulic calculations must be performed using an SNL-approved (FireAcad, Hydraulic Analyzer of Sprinkler Systems [HASS<sup>®</sup>], HydraCalc, Hydronics, HyperCalc, THE, or Water) computer program. Hand calculations or calculations on spreadsheets will not be accepted. All calculation programs must use the Hazen-Williams calculation method.
- e. Hydraulic calculations must include the following adjusted C Factors when new or existing pipe for sprinkler systems and exterior piping systems is being used.

Interior Pipe Type	C Factor	Exterior Pipe Type	C Factor
New pipe, wet system	120	New steel pipe, unlined	120
20 years old, wet system	110	10 years old, unlined	110

Interior Pipe Type	C Factor	Exterior Pipe Type	C Factor
30 years old, wet system	100	15 years old, unlined	100
50 years old, wet system	90	20 years old, unlined	90
Galvanized piping	129	30 years old, unlined	80
		50 years old, unlined	70
		Bitumastic enamel lined	140
		Cement lined	140
		Cement asbestos	140
		PVC	150

- f. Extend all (regardless of job size, and including modifications, new installations, retrofits, and recalculations) hydraulic calculations back to the effective point of connection (ring-main) of the sprinkler lead-in to the fire water main supplying the building, unless indicated on the contract drawings.
5. The distance between sprinklers either on branch lines or between branch lines must not be less than 6'.
  6. Fire Hose Stations
    - a. Where host stations are called for on the contract drawings, they must be 2½" hose valves, with 2½" × 1½" National Standard Hose thread adapters, connected to the sprinkler system in accordance with NFPA 13, or as shown on the contract drawings.
    - b. The centerline of the hose valve must be installed between 4' and 5' above the finished floor.
    - c. Unless otherwise specified or shown on the drawings, no hose is required.
    - d. Where hose cabinets are required, they must be of the horizontal fold, hump type, with fully tempered glass doors.
    - e. Standpipes, where shown on the drawings, must be installed as Class 1 system per NFPA 14. Hydraulic calculations are required for all wet standpipes serving two or more hose stations.
  7. Seismic protection for automatic sprinkler systems is required for all new systems.
    - a. For modifications to existing systems, seismic protection is required, at a minimum, for the portion of the system being modified, the feed-main supplying the modification area, and the riser for that area.
    - b. Seismic separation joints are required in areas separating the modified area of the sprinkler system and the area that is not to be upgraded for seismic protection.
    - c. The installation guidelines for seismic protection in NFPA 13 must be used. Where an alternative method (other than NFPA 13) of providing seismic protection of a sprinkler system will be used, only UL-listed or FM-approved material is permitted. The alternative method must have a design based on a dynamic seismic analysis certified by a Professional Engineer (PE) registered in the State of New Mexico, and the registered PE stamps all drawings.
  8. Protection of Areas Subject to Freezing
    - a. Sprinkler piping that protects or passes through any unheated area in, under, or outside buildings exposed to freezing must be protected as shown on the plans or according to the

- methods specified in NFPA 13. Areas exposed to freezing are locations where the temperature may drop below 40°F (5°C) at any time during the year.
- b. Heating must be provided for sprinkler-protected areas in lieu of anti-freeze systems, except where otherwise noted on the drawings.
  - c. All anti-freeze systems require the installation of a reduced pressure backflow prevention (RPBFP) device. If an RPBFP is installed on the entire sprinkler system, no additional RPBFP is required for the anti-freeze system.
  - d. All dry-pipe systems, regardless of the volume, must deliver sustained water flow to the inspector's test connection within 60 seconds of the inspector's test valve being opened. All dry-pipe systems exceeding 500 gallons (1,890 L) must be given a UL-listed or FM-approved quick opening device; exceptions to NFPA 13 in this instance do not apply.
9. Manifolding of sprinkler risers to one single sprinkler lead-in is permitted only at the SNL Fire Protection Engineering representative's discretion.
10. Fire Department Connections
- a. Fire department connections must be located at the nearest point of fire department apparatus accessibility or at a location approved by the designated SNL Fire Protection Engineering representative.
  - b. Fire department connections must be installed at each new alarm check valve, dry-pipe valve, deluge valve, preaction valve, and standpipe system, unless the sprinkler system is supplied by a fire department connection in the yard main or as otherwise noted on the contract drawings.
  - c. When the sprinkler system hydraulic demand (not including exterior hose demand) exceeds 1,000 gallons per minute (gpm), a 6" 3-way fire department connection must be provided.
  - d. A single fire department connection must be provided to supply all fire protection systems for a building that has more than 5 sprinkler risers.
  - e. The check valve must be located where it is not subject to freezing temperatures and have handhole covers to provide adequate access for inspection and repair without removing the valve from the system.
  - f. The automatic ball drip (ABD) must be in the lowest section of pipe to provide proper drainage, and the discharge must be piped to drain. The ABD must be located where it is not subject to freezing temperatures. The ABD must close when the water flow through the valve is in the range of 4 to 10 gpm.
  - g. Use valve drains in place of ABD drains when the static head of water above the ABD will exceed 11'6" (5 pounds per square inch [psi]).
  - h. The fire department connection must be installed between 18" and 48" above grade.
  - i. Backflow prevention devices must be installed on all sprinkler systems.
    - A reduced-pressure backflow prevention (RPBFP) assembly or double-check backflow prevention (DCBFP) assembly must be installed on all new systems and where shown on the drawings for modifications to systems.
    - Backflow prevention devices are not required on dry-pipe, preaction, or deluge systems.

- When the sprinkler system requires a backflow prevention device, a line size bypass must be installed around the fire department check valve (see riser detail, which is available on the FMOC Standards Program web site, <http://www.sandia.gov/engstds/stdwgs.html>).
- Backflow prevention devices located outside buildings must be in heated enclosures and have adequate space for inspection, testing, and maintenance.
- Adequate drainage must be provided for RPBF and meet the following requirements:
  - Discharge must be piped full size (of the relief valve) and extended to a drain (see riser detail).
  - Discharge piping must be sloped 1/8" per foot and be Schedule 10.
  - French drains are not permitted.

#### 11. Utility Corridors or Chases

- a. Utility corridors must have two levels of sprinklers with the lower being intermediate-level heads. This is due to present and future obstructions.

#### 12. Elevator Shafts and Machine Rooms

- a. Sprinklers are required at the top and bottom of all elevator shafts and in the elevator equipment rooms. Sprinklers must be protected from freezing.
- b. Provide an outside screw and yoke (OS&Y) gate valve to shut off all sprinkler water flow into the elevator shaft and into the elevator machine room. Where possible, all piping should be run outside the elevator shaft and arranged so a single valve can shut off water to both locations.
- c. The valves must be identified clearly and at a readily accessible location, no more than 7'0" above the finished floor, or in an area approved by the SDR or a designated SNL Fire Protection Engineering representative.

#### 13. Sprinklers

- a. Sprinkler locations must be at least 6" from ceiling tile edges.
- b. Sprinklers must be installed throughout stairways and at each landing.
- c. Gas cabinets must be equipped with a 135-degree, 3/8"-orifice wax-coated sprinkler with a means to drain piping exterior to the gas cabinet.

#### 14. Sprinkler Riser Protection

- a. When the sprinkler riser is installed in a location other than an equipment room, an enclosure, as detailed in the SNL Standard Drawing FX5003STD, must be designed around the sprinkler riser and alarm valve and painted "caution" yellow.

#### 15. Drains

- a. Two-inch drains must be installed on all main risers and downstream of any interior sectional valves.
- b. Three-quarter-inch valve auxiliary drains with standard hose threads and caps must be installed at all low points in the system where more than 5 sprinklers are trapped. Where the capacity of trapped piping exceeds 20 gallons (75 L), the overflow must be piped to drain.

- c. Inspector's test connections must be installed on each sprinkler system as close as possible to the most hydraulically remote end of the system. The inspector's test valve must be located not more than 7' above the floor and be visible and easily accessible.
- d. In multilevel buildings where there are water-flow alarm devices for each floor or where there is more than one alarm device in a single sprinkler system, a separate inspector's test connection must be provided for each alarm device. For convenience, in multilevel buildings where more than one inspector's test connection is required, all the valves must be manifolded together at a single location on the grade floor, with a sight glass and a common drain line discharging outdoors.

## 1.05 Submittals

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### A. Providing Submittals

Provide submittals to the SDR as required by Specification Section 01300, *Submittal Procedures*.

### B. Design Submittal Package

As soon as practicable after award of contract and prior to fabrication, the Fire Protection System Contractor must give complete design submittals to the SDR for approval. Design submittals package must include the following:

1. Paper and electronic (if available) copies of manufacturers' catalog data, system and component operating instructions, and paper and electronic copies of hydraulic calculations and seismic calculations for the sprinkler system and underground piping shown on plot plans.
2. Paper copies and electronic copies of graphic design drawings (CADD files) showing any underground piping, building fire protection floor plans, riser diagram, and any other graphic drawings to delineate the design.
3. If welded joints are to be used in the sprinkler system installation, the Contractor must provide a paper and electronic (if available) copy of the welding procedure to be used, the quality assurance procedure, and the welder's qualifications.

### C. Acceptance of Submittal Package

Installation is not permitted to begin without Fire Protection Engineering acceptance of the completed shop drawings, calculations, and material submittals. This applies to all jobs, regardless of size or scope.

### D. Electronic Design Submittal

1. All manufacturers' catalog data, system and component operating instructions, design drawings, and calculations (hydraulic and seismic) for the fire protection system must be included in the deliverable file package as follows: The fire protection deliverable package, both CADD and non-CADD, must be delivered to SNL in hard copy (the SDR determines the quantity), in addition to one electronic copy. If an electronic copy is not included, the submittal will be rejected. Microsoft Word, Microsoft PowerPoint, Microsoft Project, and Microsoft Access (latest versions suitable for Microsoft Windows<sup>®</sup> 7 are required). In addition to electronic copies of the bond (paper) documentation, the Contractor will provide electronic copies of all engineered, calculated project software in the format originally generated (for example, FireAcad, HASS, Hydronics, or HyperCalc). If these software packages cannot be used, the Contractor must produce the documents in portable document format (PDF), or scanned image in \*.jpg or \*.bmp format. All files must be returned with the file name, description of content, software and software version requirements listed. All deliverable data, designs, records, graphics, and supporting tools are the

property of SNL, and SNL also has the right to provide any of this information to others as it deems appropriate.

2. All graphic design drawings must be plotted CADD files, and the CADD files must follow SNL file-naming conventions and use an SNL border title block.
3. Floor Plans
  - a. All fire protection floor plans must reference architectural floor plans.
  - b. Files must be completed at a one-to-one scale.
  - c. The Contractor must identify the location of the post indicator valve (PIV) and fire department connection that are attached to the building.
  - d. Each floor must be rendered in a single file (for example, Bentley MicroStation – Master Floor Plan, or AutoCAD® – Model File).
  - e. Orientation of North and key play breakout must match architectural construction of floor plans.
  - f. Unless otherwise specified, new floor plans and full-height cross sections must be plotted at 1/4" = 1'0".
4. Riser Diagram
  - a. Riser must be detailed in nature showing each fire protection component. At a minimum, each component must be labeled with description, size, and equipment part and manufacturer information.
  - b. Riser details must show at a minimum all components from the PIV and fire department connection up to the roof level, or top of the riser. Riser will be to scale, or dimensions must be shown indicating height and distances between components.
5. The Contractor will verify the location on the construction site plans of PIV, fire department connection, and hydrants that are not attached to the building.
6. All requirements listed under submittals apply whether Bentley MicroStation or AutoCAD is used.

#### **E. Bentley MicroStation V8 XM**

The Facilities Maintenance and Operations Center (FMOC) uses Bentley MicroStation V8 XM as its standard CADD software. It is anticipated that SNL will upgrade to V8i release in the summer of 2011. When upgrades occur, the Fire Protection Designer is required to use the new workspace and Bentley MicroStation software. To maximize efficiency, SNL will provide a custom Bentley MicroStation workspace environment, which includes toolboxes, tool frames, macros, MicroStation Development Language (MDL) application, user commands, help routines, and menu bars.

#### **F. AutoCAD 2000**

AutoCAD 2000 may be used instead of MicroStation if the following requirements are met:

1. The translated MicroStation architectural floor plan must be referenced into the AutoCAD model. Each AutoCAD model will show the Fire Protection Design for a given floor. The model must include all design information required by NFPA 13.

2. The SNL Fire Protection border files must be copied into all project sheets (layout tabs). Each layout tab must contain border, keyed notes, general notes, details, and title block information. Each layout tab must be labeled with the correct SNL plotted file name.
3. All data, designs, records, graphics, and supporting tools generated during project creation must be included in the deliverable file package.
4. Any fonts, line styles, or blocks used to generate these files that are not AutoCAD 2000 standard must be included in the deliverable package.
5. All Fire Protection Layers will follow CAD Layer Guidelines established by the American Institute of Architects.
6. A table listing all line, text, and block information must be created within each design file just outside the plotted area. Information must include layer names, color, pen width association, line style, description, text size, block names, and identification of frozen layers.
7. The SNL SDR must approve in writing any blocks used that do not match the SNL-provided symbols, which are located on the Fire Protection borders file. These symbols must be reflected in the files' border legend.

#### G. Graphic Design Presentation

1. Drawings must show all details required or recommended by NFPA 13 for "Working Plans" in addition to the following:
  - a. Name and room number must appear in each room.
  - b. Potential obstructions (columns, ductwork, and so forth) to the sprinkler layout must be shown.
  - c. Building column, grid lines, and grid labels must be shown.
  - d. New construction must be delineated clearly on the drawing. Use the SNL ballooning process.
  - e. All lines and details must be shown. Specifying "opposite hand" is not acceptable.
  - f. Pipe lengths must be shown, center to center of fittings.
  - g. Where more than one type of pipe is used, each piece of pipe must be identified on the drawing file.
  - h. No lettering will be smaller than 1/8" plotted height.
2. Files will be laid out and plotted to be identical (including sheet breakout, size, scale, orientation, key plan, column grids, room names and numbers, and project title) to the original building construction contract drawings.

#### H. As-Built Drawings

1. When installation is complete, the Contractor must revise all Fire Protection Design files, calculations, manuals, and operating instructions to agree with the construction as actually accomplished. The notation "As-Built" must be entered in the revision block, dated, and initialed. All as-built records must follow the requirements listed under section 1.05, "Submittals."
2. Fire Protection Design files must be requested from SNL prior to as-builts. As-builts must be reflected on the existing design file records.

3. The as-built files, whether on new or original contract, must show the entire sprinkler system and existing and new construction as it exists at the completion of the contract work. Delete all references to "new work," "existing," "Not in Contract (NIC)," and so forth.
4. As-builts must be submitted to the SNL SDR prior to the final acceptance testing. This delivery must include both electronic and hard copies.
5. Final hydraulic calculations must reflect the as-built condition. These calculations must be submitted before final acceptance testing by SNL.



## Part 2 - Products

### 2.01 Materials, General

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#### A. Materials and Equipment

Materials and equipment used in the installation of the sprinkler system must conform to NFPA 13. In addition, system equipment and components must be new and listed by the UL Fire Protection Equipment Directory or the FM Approval Guide, latest edition, and installed according to their listing or approval. The standard products and the latest design of the manufacturer must be used and installed per its listing, approval, or recommendations. All products listed or approved in prior editions of the UL Directory or FM Approval Guide are unacceptable if not listed or approved in the most recent edition of the directory or approval guide.

#### B. Same Manufacturer Requirement

Where two or more units of the same class of equipment are required, these units must be products of the same manufacturer. For example, couplings must be from one manufacturer. All materials must be installed according to their listing or approval and per the manufacturer's recommendations and specifications.

#### C. Required Devices

New dry-pipe, preaction, and deluge sprinkler systems must be provided with the following devices:

1. An FM-approved or UL-listed air dryer for the sprinkler control air supply for dry-pipe and preaction systems.
2. An FM-approved or UL-listed air dryer for the air supply to any pneumatic tubing used for heat detection (if used).
3. Where air compressors are used, the air compressor must come equipped with a minimum 10-gallon tank. Nitrogen bottles are permitted to supply nitrogen pressure to systems smaller than 125 gallons. If the system capacity is more than 125 gallons, air compressors must be used.

#### D. Tape

Corrosion-protection tape must be Scotchwrap 51™ manufactured by 3M or an approved equivalent.

### 2.02 Sprinklers

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#### A. Types

1. Unless otherwise specified, allowed per other sections of this document, or shown on the drawings, sprinklers must be standard response, ½"-orifice, automatic, closed-head sprinklers.
2. Higher-temperature-rated sprinklers must be installed where heads are exposed to high ambient temperature, exposed to direct sunlight, and beneath skylights or windows, and they must be installed in the vicinity of heating equipment or in attics. The sprinkler temperature chosen must be a minimum of 50°F above the maximum ambient temperature and no greater than 100°F above the ambient conditions, unless specifically directed by NFPA 13.
3. Rooms containing electrical equipment must be protected with sprinklers having the following minimum temperature ratings, but no less than 50°F above normal ambient room temperature:

Room Type	Rating
Transformer and switchgear rooms; elevator machine rooms	Intermediate Degree Rated
Computer rooms	Ordinary Degree Rated
Telephone equipment rooms	Ordinary Degree Rated
Top of elevator shafts	Intermediate Degree Rated

4. Sidewall sprinklers must be UL-listed or FM-approved for Ordinary Hazard Occupancy.
5. Extended coverage sprinklers are not allowed.
6. Only sprinklers with a "Belleville" seal can be used. No O-ring sealed sprinklers are allowed in "crush" or "radial" seal styles. Sprinklers must be of all-brass frame construction with a coated metal-to-metal seating mechanism.
7. Only sprinklers with integral shields listed by UL as "intermediate level" sprinklers or by FM as "racked storage" sprinklers are acceptable indoors where shields are required over ordinary sprinklers. Shop-made water shields are not allowed, nor are aftermarket attachments designed as water shields. "Heat-collection devices" for use with sprinklers are not allowed.
8. Sprinklers installed in storage racks must be equipped with a listed sprinkler head guard with an integral water shield to protect the in-rack sprinklers fusible element from water spray by a sprinkler above it.
9. All sprinklers subject to physical damage must be equipped with a listed sprinkler head guard. The SDR or a designated SNL Fire Protection Engineering representative will determine where physical damage is likely or possible.
10. Pendant sprinklers in a suspended ceiling must be installed by means of a UL-listed, FM-approved flexible system, or by return bends (refer to the FMOC Standards Program website, <http://www.sandia.gov/engstds/stddwgs.html>)

#### B. Protection against Freezing

1. Horizontal dry sidewall sprinklers must be used in lieu of anti-freeze loops for narrow, unheated areas adjacent to heated areas such as docks, covered loading platforms, vehicular air locks, elevator hoistways, and gas bottle or other storage sheds.
2. The depth of the protected space must not exceed 10' (3.05 m).
3. The dry sprinkler must extend a minimum of 12" (30 cm) into the heated space. For refrigerated spaces, the designated SNL Fire Protection Engineering representative specifies the length that dry sprinklers must extend into the heated space.

#### C. Position and Finish

1. Sprinklers installed on exposed piping must be manufacturer's standard-finish sprinklers. Sprinklers and escutcheons installed below dropped ceilings must have a finish matching the color of the ceiling tile. Only factory-applied finishes are acceptable. If the factory does not have a finish that matches the ceiling tile color, standard chrome-finish sprinklers are allowed.
2. In rooms where sprinkler heads penetrate a suspended ceiling, only semirecessed or recessed sprinklers are acceptable. Standard pendant sprinklers with "cup and skirt" escutcheons, one-piece escutcheons, or flush or concealed sprinklers are not allowed.

3. Exception: On existing installations only, where sprinkler head relocations or small modifications (fewer than 20 heads) are being made, the new sprinklers and escutcheons must match the existing sprinklers.
4. Only escutcheons, head guards, and water shields from the supplied sprinkler manufacturer can be used with the installed sprinkler. No aftermarket escutcheons, head guards, or water shields are allowed.
5. Head guards must be two-piece, universal attachments bolted in place on the sprinkler. "Snap-on" one-piece units are not allowed.

## 2.03 Pipe

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### A. Types

1. Unless otherwise specified, the minimum steel pipe wall thickness must be Schedule 10 for pipes 2½" or larger. Pipes smaller than 2½" must be Schedule 40. Threaded or cut groove steel pipe must be Schedule 40 for sizes less than 8 inches and a minimum of Schedule 30 for sizes 8" and larger for pressures up to 300 psi (2.1 megapascals [MPa]).
2. Mechanical rolled groove pipe or welded pipe must be a minimum of Schedule 10 for sizes 2½" to 5", 0.134" wall thickness for 6", and 0.188" wall thickness for 8" and 10" pipe for pressures up to 300 psi (2.1 MPa).
3. Steel pipe must be internally and externally galvanized in the following locations:
  - a. From drain line valves and inspector's test valves
  - b. Dry-pipe and preaction sprinkler systems
  - c. Where installed through an exterior wall or exposed to outdoor weather
  - d. Alarm check valve trim package, including the water motor alarm line and drain, pressure gauges, retarding chamber, testing bypass, and all necessary pipe, fittings, and accessories
  - e. Any piping leading to a pressure-operated water-flow indication device
4. Fire protection lead-in must terminate inside the building with a factory-manufactured flange and spigot piece. The spigot piece must be plumb with the flange installed level, and set no less than 4" and no greater than 8" above the finished floor. A temporary blank flange must be installed on top of the flange and spigot piece to prevent foreign matter entering the supply line.

## 2.04 Pipe Fittings

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### A. Types

1. Mechanical groove couplings are required on all 4" and larger pipe.
2. Plain-end pipe couplings must not be used in any new installation.
3. Galvanized pipe fittings must be installed where galvanized piping is specified.
4. Welded branch outlet fittings (for example, weld-o-lets, groove-o-lets, thread-o-lets) must be minimum Schedule 10 for pipe sizes 2½" or larger. Pipe sizes smaller than 2½" must be Schedule 40 standard wall pipe thickness. Welded outlets must be UL-listed or FM-approved, affixed with the UL or FM identification stamps, and pressure rated for 300 psi maximum.

5. Adjustable, two-piece drop nipples must not be used. All drop nipples must be one-piece, nonadjustable units with a minimum 1" inside diameter.

## **2.05 Pipe Hangers, Supports, and Seismic Bracing**

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### **A. Hanger Assembly Components**

The components of a hanger assembly that directly attach to the pipe or to the structure must be UL listed or FM approved and affixed with the UL or FM identification stamps.

### **B. C-Clamps and Beam Clamps**

C-clamps and beam clamps must have lock nuts and retaining straps, or clips, and pipe rings must be of the solid-band adjustable swivel type.

### **C. Rod-Ceiling Plates**

Provide rod-ceiling plates at finished ceilings for coach screw rods, expansion shields, and toggle hangers.

### **D. Purlin Clamp**

A purlin clamp with retaining strap must be used when fastening hangers to purlins. Other means of attaching hangers to purlins is permitted only at the discretion of the designated SNL Fire Protection Engineering representative.

### **E. Seismic Brace Members**

All seismic brace members must be continuous. Under no circumstances can members be spliced or offset.

### **F. Tension-Only Seismic Bracing**

Tension-only seismic bracing systems are not allowed.

## **2.06 Fire Protection Check Valves**

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### **A. Check Valves**

Check valves in sprinkler system must have handhole covers to provide adequate access to facilitate inspection and repair without removing the valve from the system, and must be listed for installation in the vertical or horizontal position. Wafer check valves are unacceptable. All check valves must have a working water pressure of 250 psi.

### **B. Alarm Check Valves**

Alarm check valves (wet-pipe, dry-pipe, deluge, preaction) must be provided on all sprinkler risers and have the following:

1. The alarm check valve (ACV) must be equipped with a removable handhole cover assembly, and must be listed for installation in the vertical or horizontal position.
2. The ACV must be equipped with gauge connections on the system side and supply side of the valve clapper.

3. ACV trim piping and fittings must be internally and externally galvanized.
4. Ported alarm connections on the ACV must be to a retard chamber to absorb variable pressure surges.
5. Wet-pipe systems must use a variable-pressure alarm check valve. Plain-type check valves are not allowed. Sprinkler alarm valve must be equipped with an external bypass to eliminate false water-flow alarms.
6. Dry-pipe valves must be a positive latching clapper, differential-type dry valve and the air pressure to water pressure area differential must be approximately 5 to 1.
7. Deluge valves must be externally resettable by hydraulic means, and must use a positive vent on the priming line to ensure that the deluge valve will not prematurely reset.

**C. Backflow Prevention Devices**

1. Backflow prevention assemblies must be approved by the Foundation for Cross-Connection Control and Hydraulic Research, University of Southern California (USC-FCCHR).
2. Repairs to backflow prevention devices must be made with original manufacturer's parts.

## **2.07 Fire Protection Interior Valves**

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**A. Each system must have interior control valves as follows:**

1. A control valve must be installed for isolation of each floor in multistory buildings.
2. Interstitial spaces, in-rack sprinkler systems, mezzanines, and so forth must have control valves for system isolation at the feed-main.
3. All inside control valves must be OS&Y. Butterfly valves are permitted only at the discretion of the designated SNL Fire Protection Engineering representative. Valves must be manufactured in accordance with AWWA Standard C500 and have a clear waterway equal to the full nominal diameter of the valve. Valves must be provided with a handwheel, with an arrow cast in the metal to indicate direction of opening.
4. Main and auxiliary drain valves must be globe valves.

## **2.08 Supervisory Devices**

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**A. Provide the following equipment:**

1. Electric valve supervision switches must be installed for all fire protection valves 2½" or larger. The devices must be electrical, single-pole, double-throw, with normally open contacts and include design that signals when the control valve is in a position other than normal.
2. For wet-pipe sprinkler systems, install a vane-type water-flow alarm initiating device, unless otherwise noted on the contract drawings.
3. All vane-type water-flow alarm initiation devices must be equipped with an adjustable delay of audible alarm initiation. Adjustment range must be from 0 to 120 seconds. Vane-type water-flow switch must be Potter Model VSR-F or an approved equal with a 250 psig pressure rating and designed for horizontal or vertical installation. Include two single-pole, double-throw, circuit switches for isolated alarm and auxiliary contacts, 7 A, 125 V ac and 0.25 A, 24 V dc, complete with tamper-proof cover.

4. Vane-type water-flow alarm initiation devices must be labeled as to the correct orientation of flow when mounted on system piping. When drilling of the system is necessary to mount the flow switch, the drilled-out disc (coupon) must be retrieved and attached to the mounting U-bolt of the flow switch.
5. Where pressure-operated water-flow alarm initiation devices are used, any valve installed upstream of the device on the alarm line must be electrically supervised using the Potter Model BVS or an approved equal. Pressure-operated alarm initiation devices must be an electrical-supervision type, water-flow switch with retard feature. The device must include single-pole, double-throw, normally open contacts and design that operates on rising pressure and signals water flow.
6. A vane-type water-flow alarm initiation device must be installed on the air gap drain for all reduced pressure backflow prevention devices.
7. Low-pressure supervision must be installed on all dry-pipe or preaction systems and be connected to the fire alarm system.
8. Any device to be installed in a hazardous location, as defined by NFPA 70, must be rated for the hazard classification.

## 2.09 Fire Department Connections

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Fire department connections must have a minimum of two 2½" inlets with National Standard Hose (NSH) threads, brass plugs, attached chains, and associated signage.

## Part 3 - Execution

### 3.01 Installation of the Fire Protection System

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#### A. Responsibilities

1. The Contractor is responsible for installing the fire protection system in accordance with this specification, the documents referenced in section 1.03, and the contract documents. The installation must reflect high-quality, professional work that properly accounts for practical maintenance concerns and aesthetics.
2. The installation must be performed by a licensed sprinkler contractor or licensed company regularly engaged in this type of work, and in accordance with requirements of the NFPA.
3. An individual with a minimum NICET Level II must supervise the installation.
4. Any deviations from the accepted contract documents must be submitted to the SNL Fire Protection Engineering department for review prior to installation.

#### B. Pipe and Fittings Aboveground

1. All interior piping must be accessible, and fittings must not be encased in a wall or partition without prior written acceptance of the Sandia Delegated Representative (SDR) and the designated SNL Fire Protection Engineering representative.
2. All sprinkler piping must be substantially supported from the building structure (for example, sprinkler lines under ducts must not be supported from ductwork supports but must be supported from the building structure).
3. Pipe interiors must be kept free of debris.
4. Flanged Fittings or Mechanical Groove Couplings
  - a. A temporary blank flange must be installed on top of the flange and spigot piece to prevent foreign matter from entering the supply line until final connection to the aboveground sprinkler system. A flanged tapered reducer must be installed at the flange and spigot piece when the riser is smaller than the underground supply line.
  - b. Flanged joints must be face matched. Raised-face flanges must not be mated to flat-face cast-iron flanges on valves or equipment. The raised face must be machined flush. All flange boltholes must straddle the horizontal and vertical centerlines unless otherwise noted. Bolting must comply with ANSI B31.1, *Power Piping*. Torque values and tightening sequence for bolts must be in accordance with the flange manufacturer's instructions.
  - c. Install insulating kits on flanges connecting dissimilar metals (such as steel to copper) to prevent electrolytic action.
  - d. Pipe must be installed straight and true with no greater deflection at mechanical groove pipe couplings than is recommended by the manufacturer.
  - e. Plain-end couplings are not permitted.
  - f. Only rigid-type mechanical couplings must be used, unless specifically directed by NFPA 13, such as for specific seismic locations. Only in areas identified by NFPA 13 where flexible-type mechanical couplings are specified are flexible couplings permitted. All other parts of the system must use rigid-type mechanical groove couplings.

5. Pipe Hangers and Anchors
  - a. Offsets in hanger rods are not permitted.
  - b. Concrete anchors must be installed by drilling and installing a UL-listed or FM-approved anchor. Explosive-driven fasteners are not permitted for installing anchors or hangers.
  - c. When fastening hangers or braces to bar joists, the fastener must be located within 4" of the panel point on the bar joist.
  - d. All piping 4" in diameter and larger must be supported from a minimum of two-bar joists when run parallel to a bar joist.
6. Welded joints are acceptable when shop fabricated in accordance with provisions of NFPA 13.
7. Teflon paste and tape must be used as pipe-joint compound at screwed joints. (Tape for screwed joints must be 3 mil and ½" wide.)
8. Bushings are not permitted.
9. Control valves must be installed in a vertical (stem up) or horizontal position and given identification signs describing the areas protected. Where the valve location is concealed above the ceiling, a sign below the ceiling must indicate the valve location and identify the protected area.
10. Wall, Ceiling, and Floor Penetrations
  - a. Where fire-rated barriers are penetrated, a UL-listed fire barrier system must be installed to retain the fire-resistance rating of the barrier. (Refer to SNL Standard Specification 07270, *Firestopping*.)
  - b. Escutcheons must be provided at wall, ceiling, and floor penetrations of piping in occupied areas.
11. Cutting structural members for the passage of sprinkler piping or for pipe-hanger fastenings is not permitted.
12. Joints
  - a. Joints must be left exposed until the SDR has witnessed the final inspection and testing.
  - b. Return bends or an approved flexible application (such as flex head or an approved equal) must be used for connecting pendant sprinklers to branch lines.

### 3.02 Sprinklers

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#### A. Pendant Sprinklers

Pendant sprinklers below the ceiling must be aligned and parallel to ceiling features and walls.

#### B. Piping

In areas without a suspended ceiling, install sprinkler piping as high as possible.

#### C. Abutting Sprinkler Systems

Where two sprinkler systems abut, the pendant sprinklers must be aligned in different directions to distinguish the boundaries of each sprinkler system.



#### D. Dry Pendant and Horizontal Dry Sidewall Sprinklers

Dry pendant and horizontal dry sidewall sprinklers can only be installed in the run side of a screwed tee fitting with the other end plugged.

### 3.03 Drains

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#### A. Retarding Chamber Drain Line

The retarding chamber drain line must be piped independently of the main drain line.

#### B. Discharge from Drain Valves

Discharge from drain valves must be piped to drain, and the discharge must be visible either by open-end or sight drain fitting.

#### C. Drains and Inspector's Test Connections

Drains and inspector's test connections through outside walls must be run through the walls as close as possible to the floor or grade line, terminating with a 45-degree galvanized elbow turned down to splash blocks.

### 3.04 Signage and Instructions

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#### A. Hydraulic Design Information

A sign with hydraulic design information must be typed in a minimum of 12-point font and not subject to fading (for example, permanent marker is not permitted).

#### B. Maintenance and Operating Instructions

The Contractor must furnish and place in a clear plastic envelope attached to each sprinkler alarm check valve riser: one complete set of manufacturer's maintenance and operating instructions, as well as a complete set of the approved as-built drawings and hydraulic calculations of the sprinkler system.

### 3.05 Flushing

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Before connecting sprinkler systems to the main supply, the Contractor must thoroughly flush out each sprinkler supply line in the presence of SNL Maintenance and the designated SNL Fire Protection Engineering representative. Discharge must be through an unrestricted opening not less than 4" in diameter and directed to a suitable location.

### 3.06 Testing

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#### A. Aboveground Tests

Prior to acceptance of the installation, the Contractor must, in the presence of the SDR, subject the system to the tests required by NFPA 13, for the completion of the Contractor's Material and Test Certificate.

1. Hydrostatic testing must be performed before any ceiling is installed below the sprinkler piping. Each water control valve must be fully opened and closed under water pressure to ensure proper operation.
2. Where sprinkler locations are roughed-in using plugged drop nipples projecting below the level of the finished ceiling, the hydrostatic testing must be performed twice.
  - a. After the system is completed using the plugged drops and before the ceiling panels are installed.
  - b. After the plugged drop nipples are cut to length for the finished ceiling or replaced with other drop nipples of the correct length and the sprinklers are installed.
3. Adding sodium silicate (also known as water glass) or related substances before hydrostatic testing to stop water leakage is not permitted.

### **3.07 Acceptance**

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#### **A. Request for Acceptance Testing**

A Request for Acceptance Testing (FRM.218) must be submitted to the SDR.

#### **B. Preacceptance Meeting**

The Preacceptance Meeting must be conducted and attended by the designated SNL Fire Protection Engineering representative, Fire Protection Maintenance, Construction Manager, Construction Inspector, and Sprinkler and Fire Alarm Contractors. This meeting includes review of specifications, acceptance checklists, and completion of identified deficiencies.

#### **C. Complete Operating Test**

A complete operating test of dry-pipe, preaction, deluge, water-spray, and foam water systems must be performed.

#### **D. Full Forward Flow Test**

When a backflow prevention device is installed, a full forward flow test (at system demand) must be performed as required by NFPA 13/25.

1. Backflow prevention assemblies must be tested by a Certified Backflow Control Assembly Tester who possesses a current certificate that confirms successful completion of an approved (SDR specified or USC-FCCCHR or Colorado Environmental Training Center, Golden, Colorado) training course.
2. Upon successful testing of the backflow preventer, a tag indicating test performed, tester's initials, and test date must be affixed to the assembly. Testing documentation must be submitted to the SDR.

#### **E. Testing of New and Modified Devices**

The Contractor must test all new alarm devices and modified alarm devices. Defective alarm devices must be replaced immediately.

#### F. Spare Heads and Wrenches

The Contractor must provide the required spare heads and wrenches to SNL maintenance at the time of acceptance.

#### G. Postacceptance Meeting

The Postacceptance Meeting must be conducted and attended by the designated SNL Fire Protection Engineering representative, Fire Protection Maintenance, Construction Manager, Construction Inspector, Sprinkler and Fire Alarm Contractors. This meeting includes review of the deficiencies associated with the acceptance testing. A completion date for addressing the deficiencies must be agreed upon.

### 3.08 Backflow Prevention

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#### A. Installation

Install the backflow prevention assembly at the service connection for the fire sprinkler system or as noted on the contract drawings.

#### B. Need for RPBFP or DCBFP

The contract drawings or the designated SNL Fire Protection Engineering representative must determine if an RPBFP or a DCBFP is to be installed on the sprinkler system.

#### C. Assemblies

Backflow prevention assemblies must be installed in accordance with AWWA Manual M14 requirements, or as directed by the SDR.

### 3.09 Painting and Labeling

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#### A. Painting

The Contractor must paint those portions of fire protection as required by SNL Specification 09900, *Painting*.

#### B. Labeling

Sprinkler system labeling (for PIVs, interior control valves, risers, inspector's test connections, drain valves, and so forth) must be in accordance with NFPA 13.

### 3.10 Disinfection

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#### A. Disinfection of Piping

Before it is placed in operation, piping installed under this contract must be disinfected per AWWA C651 by using one of the following methods.

#### B. Exception

Where nonpotable fire protection piping is added downstream of an approved backflow prevention device, disinfection is not required.

**C. Continuous Feed Method**

1. Place calcium hypochlorite in pipe sections when installing pipe, or inject liquid chlorine into the system via the injection port. Pipe is filled with water and the chlorine concentration must remain at 10 mg/L for a minimum of 24 hours. During this time, all valves in the new section will be cycled open and closed to allow for adequate disinfection. Valves connecting the new or repaired line with mains in active service must remain closed to prevent chlorine pollution.
2. Samples must be drawn at 1-, 4-, 8-, 12-, 16-, 20-, and 24-hour marks to determine the chlorine concentration. Acceptable tests are the N-diethyl-p-phenylenediamine (DPD) drop dilution method (AWWA C651, Appendix A) or the High-Range Test Kit. The tests must be performed by the Contractor and witnessed by the SDR. The results must be recorded for auditing purposes.

**D. Slug Method**

1. Similar to the continuous feed method. Follow AWWA C651. Chlorine concentration must be 100 mg/L for a minimum of 3 hours. During this time, all valves must be cycled open and closed to allow for adequate disinfection. Valves connecting new or repaired lines with mains in active service must remain closed to prevent chlorine pollution.
2. Samples must be drawn every 15 minutes to determine concentration. Acceptable tests are the DPD drop dilution method or the High-Range Test Kit. The tests must be conducted by the Contractor and witnessed by the SDR. The results must be recorded for auditing purposes.

**E. Repairing or Cutting into Existing Mains**

1. New interior piping surfaces must be swabbed with a 1% hypochlorite solution. The section being modified must be subjected to a high-chlorine disinfection process per AWWA C651. The concentration must be a minimum of 300 mg/L for 15 minutes.
2. Samples must be drawn before the chlorine is injected and every 5 minutes thereafter. The Contractor or SDR designee using the High-Range Test Kit must test chlorine concentration. The SDR must witness the test and results must be recorded.

**F. Flushing**

1. After the lines have been chlorinated using one of the above methods, it is necessary to flush the lines with water until the test sample indicates the water is suitable for drinking. The residual chlorine concentration in the water is to be between 0.2 and 2.0 mg/L, as measured using a Low-Range Test Kit. The SDR or other SDR designee must witness the test and record the results.
2. Heavily contaminated water must be disposed of or neutralized under the direction of SNL Pollution Prevention and Environmental Monitoring Department.

**G. Bacteriological Testing**

1. All new and modified water lines require testing for coliform organisms per AWWA C651. The testing must occur after successful chlorination and flushing of the lines. Samples must be taken from the new line in sodium thiosulfate-treated sterile bottles and analyzed as specified by APHA's Standard Methods for the Examination of Water and Wastewater. The SDR determines whether SNL Industrial Hygiene or an independent laboratory is to perform the analysis.
2. Results must be recorded with the original documentation of results attached. These results are used for auditing purposes.

3. Fire protection lines will not be accepted until a negative result is obtained from a bacteriological test. Lines will be chlorinated and flushed repeatedly, at no additional cost to SNL, until a negative result is obtained.