

CONSTRUCTION STANDARD SPECIFICATION

SECTION 15310

AUTOMATIC SPRINKLERS AND WATER BASED FIRE PROTECTION SYSTEMS

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CONSTRUCTION STANDARD SPECIFICATION

SECTION 15310

AUTOMATIC SPRINKLER AND WATER BASED FIRE PROTECTION SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

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 disinfecting of piping.

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

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

1.02 REFERENCES

A. Sandia National Laboratories (SNL) Standard Specifications

01065	ES&H for Construction & Maintenance Contracts
01330	Submittal Procedures
02200	Earthwork
02665	Underground Water Lines for Domestic and Fire Protection Systems
07270	Firestop and Smokestop Systems
09900	Painting
15050	General Material & Work Requirements – Mechanical
15994	Mechanical Systems Demonstration

B. American Public Health Association (APHA)

Standard Methods for the Examination of Water and Wastewater

American Water Works Association Standard Specifications (AWWA)

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

C. Factory Mutual Research Corporation (FM)

Approval Guide

National Fire Protection Association (NFPA) Standards and Recommended Practices

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 Foam-Water Sprinkler & Foam-Water Spray Systems
20	Standard for the Installation Centrifugal Fire Pumps
25	Standard for Inspection, Testing and Maintenance of Water-Based Fire Protection Systems
70	National Electrical Code®
72	National Fire Alarm Code®
750	Standard for Water Mist Fire Protection Systems

For interpretation of the above NFPA Standards, the "Authorities Having Jurisdiction" referred to in the Standards shall be the Sandia Delegated Representative (SDR).

Underwriters' Laboratories, Inc. (UL)

Fire Protection Equipment Directory

1.03 SYSTEM DESCRIPTION

A. Design

1. The designer of the fire protection systems shall meet one of the requirements below.
 - 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 special hazard protection.
 - d. Where NICET design is used, copies of the designer's certificates from NICET shall be submitted along with the drawings for approval. The registered Professional Engineer shall stamp all other plans.

- e. The contractor is responsible for the design and installation of the fire protection system in accordance with these specifications and the contract drawings. The contractor shall coordinate with architectural, civil, mechanical, and electrical, design and construction documents, to ascertain the required information, to effect a properly designed fire protection system for the building construction and occupancy classification.
2. The design of fire protection systems shall be complete with all necessary accessories for proper operation and shall include seismic support details.
 3. The fire protection water supply lines, controlling devices, protective devices, alarm systems, supervisory devices, and related equipment shall be compatible so that all equipment will function together as specified.
 4. The design shall comply with all mandatory, advisory interpretations, and recommended applicable rules of the latest editions of the referenced codes and standards in Section 1.03, "References," except where otherwise noted on the drawings or specified herein.
 5. The contractor shall produce design drawings (design files) that indicate the extent and arrangement of the fire protection systems.
 6. Unless indicated in the contract, drawing(s) refers to the plotted hard copy document or print and the electronic computer aided drafting design (CADD) file.
- B. Design Criteria
1. Light hazard occupancy rules are prohibited.
 2. Pipe schedule method shall be permitted only for additions or modifications (less than 3000 -feet² (278.71-m²) to existing Ordinary Hazard Pipe Schedule systems. All other designs shall be hydraulically calculated.
 3. Hydraulic calculation methods shall be used as a minimum for Ordinary Hazard, Group 2, wet-pipe systems, unless otherwise specified. The minimum operating area allowed shall be either 3,000 feet² (278.71-m²) or the entire area for smaller systems.

The following table indicates the required sprinkler designs for various occupancies at SNL. These shall be used unless otherwise specified on the SNL Bid Drawings.

Table 1.04B. Sprinkler Densities for all new/renovated installations shall be as follows:

Occupancy	Sprinkler Density (gpm/ft ²)	Area of Application (ft ² / m ²)	Max. Area per Sprinkler (ft ² / m ²)	Max. Area per Sprinkler Riser (ft ² / m ²)	Hose Allowance (gpm)	Sprinkler Orifice, Temperature
Office or Assembly	0.17	3,000 / 278.71	130 / 12	52,000	500	½-in., 155°F QR
Computer Rooms	0.20	3,000 / 278.71	130 / 12	52,000	500	½-in., 155°F QR
Computer Tape Storage Rooms	0.28	3,000 / 278.71	100 / 9.3	40,000	500	½-in. or 17/32-in., 155°F QR
Class B or C Labs	0.17	3,000 / 278.71	130 / 12	52,000	500	½-in. 155°F QR
Class A Labs	0.25	3,000 / 278.71	100 / 9.3	52,000	500	½-in. or 17/32-in., 155°F QR
Rack Storage – All Commodities ¹	Per NFPA 13, minimum density of 0.20 gpm/ft ²	3,000 / 278.71	100 / 9.3	40,000/ 3716.12	750 for Class IV or Group A	½-in., 17/32-in. or 0.64-in. ELO
Anechoic Chambers	Per IR Information Manual IM Section 17.16.					17/32 or 0.64-in. ELO, 165°F
Clean Rooms	0.20	3,000 / 278.71	130 / 12	52,000	500	½-in. 155°F QR
Accelerator Areas (Oil Filled)	0.30	5,000 / 464.52	100 / 9.3	40,000 / 3716.12	500	17/32-in., or 0.64-in. ELO 286°F QR
Cooling Towers ² , Crossflow & Counterflow* Towers	.33	Under the fan decks, including fan openings, over fill areas, and motors.	100 / 9.3	N/A	500	½-in. or 17/32-in.
	.50 Counterflow					
Hydraulic oil equipment, pumps, hydraulic lines, etc. Class IIIA or B	0.30	3,000 / 278.71 or the entire area.	100 / 9.3	40,000 / 3716.12	750	17/32-in., 165°F or 212°F

Occupancy	Sprinkler Density (gpm/ft ²)	Area of Application (ft ² / m ²)	Max. Area per Sprinkler (ft ² / m ²)	Max. Area per Sprinkler Riser (ft ² / m ²)	Hose Allowance (gpm)	Sprinkler Orifice, Temperature
Oil Pumping stations, Oil Cellars, Oil Storage, etc.	0.30	5,000 / 464.52 or entire area.	100 / 9.3	40,000 / 3716.12	750	17/32-in., 165°F or 212°F
Standby Generators, Oil Fired Boilers, Steam Generators, Hydraulic Equipment, Reservoirs, Weld Shops, Compressors, Oxygen-Fuel Gas Systems.	0.25	3,000 / 278.71 or the entire area.	100 / 9.3	40,000 / 3716.12	750	17/32-in., 212°F
Storage, Use, and Handling of compressed and Liquefied Gases in Portable Cylinders	0.30	3,000 / 278.71 or the entire area.	100 / 9.3	40,000 / 3716.12	750	17/32-in., 212°F

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

²Factory Mutual (FM) Approved Cooling towers do NOT require sprinkler protection. Interlock the system to shut down tower fans upon actuation.

4. Hydraulic design shall be as follows:

- a. The design area shall be the hydraulically most demanding "rectangular area" having a dimension parallel to the branch lines equal to 1.4 times the square root of the area of sprinkler operation.
- b. Gridded or looped piping systems shall not be used for dry pipe or preaction systems.
- c. Where the design area includes a corridor or tunnel protected by a single row of sprinklers, the maximum number of sprinklers that need be calculated is 7, when openings into the corridor are unprotected by fire rated construction. When openings into the corridor are protected, the maximum number of sprinklers that need to be calculated is 5.
- d. Maximum waterflow velocity shall not exceed 20-feet per second (6-m/s) in any sprinkler system piping of hydraulically designed systems.
- e. Where inside hose stations are installed the hose allowance shall be 50 GPM (3.2 l/s) for each hose station up to a maximum of 2 hose stations (100 GPM (6.4 l/s)). The inside hose allowance shall be added to the sprinkler requirements at the point(s) where the hose station(s) connect(s) to the sprinkler system.

- f. The water allowance for outside hose shall be added to the sprinkler and inside hose requirement at the connection to the water mains or a yard hydrant, whichever is closer to the system riser. A minimum hose allowance of 500 GPM (32 l/s) is required for combined inside and outside hose. Reference Table 1.04B for all other hose demand requirements.
- g. Hydraulic design shall be based upon the water supply data shown on information supplied by the SDR. The water supply data curve shall be based upon 85% of the available water supply as tested.
- h. Hydraulic calculations shall be performed using an SNL approved (FireAcad, HAAS, HydraCalc, Hydronics, HyperCalc, THE, Water, etc.) computer program. Hand calculations or calculations on spreadsheets will not be accepted. All calculation programs shall use the Hazen-Williams calculation method.
- i. Hydraulic calculations shall include the following adjusted C Factors when using new or existing pipe for sprinkler systems and exterior piping systems.

<u>Interior Pipe Type</u>	<u>C Factor</u>	<u>Exterior Pipe Type</u>	<u>C Factor</u>
New Pipe, Wet System	120	New Steel Pipe, Unlined	120
20 years old, Wet System	110	10 years old, unlined	110
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	140
		Lined	
		Cement Lined	140
		Cement Asbestos	140
		PVC	150

- j. Extend all (regardless of job size, and including modifications, new installations, retrofits, recalculations, etc.) 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 shall not be less than 6 feet distance apart.
 6. Seismic protection for automatic sprinkler systems is required for all new systems. Modifications to existing systems shall require seismic protection when indicated on the contract drawings.
 - a. For modifications to existing systems, seismic protection will be required for only that portion of the system being modified, the feedmain 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 that area which is not to be upgraded for seismic protection.

- c. The installation guidelines for seismic protection in NFPA 13 shall be used. Where an alternative method (other than NFPA 13) of providing seismic protection of a sprinkler system is to be used, only UL Listed or FM Approved material shall be permitted. The alternative method shall have a design based on a dynamic seismic analysis certified by a registered Professional Engineer in the State of New Mexico and the registered PE shall stamp all drawings.
 - d. All seismic calculations shall be completed using the "Seismic Bracing Calculation" form located in Appendix A of this document.
 - e. Seismic protection is not required in mobile offices or trailers.
- C. Standpipes, where shown on the drawings, shall be installed as Class 1 system per NFPA 14. Hydraulic calculations are required for all wet standpipes serving two or more hose stations.
- D. Protection of Areas Subject to Freezing
- 1. All anti-freeze systems require the installation of a reduced pressure backflow prevention (RPBFP) device. If a RPBFP is installed on the entire sprinkler system, then no additional RPBFP is required for the anti-freeze system.
 - 2. Gridded or looped dry pipe or preaction systems are not allowed. The design for these systems shall be of the conventional tree design.
 - 3. All dry-pipe systems, regardless of the volume, are required to deliver sustained waterflow to the inspector's test connection within 60 seconds of the opening of the inspector's test valve. All dry pipe systems in excess of 500 gallons (1890-L) shall be provided with a UL listed or FM approved quick opening device, exceptions to NFPA 13 in this instance do not apply.
- E. Manifolding of sprinkler risers to one single sprinkler lead-in shall not be permitted.
- F. Fire department connections shall be as follows:
- 1. Install fire department connections, where show on the drawings. Install underground piping, if required, in accordance with standard specification 02665, "Underground Water Lines for Domestic and Fire Protection Systems."
 - 2. When the sprinkler system hydraulic demand (not including exterior hose demand) exceeds 1000 gpm, a 6-inch 3-way fire department connection shall be provided.
 - 3. A single fire department connection shall be provided to supply all fire protection systems for a building that has greater than 5 sprinkler risers.
- G. Exposure protection design shall be as follows.
- 1. A minimum of 3 gpm (11.4-L/Min) per linear feet (0.3-M) using ½-inch orifice sprinklers spaced a maximum of 10 feet apart horizontally apart shall be calculated. Sprinklers shall be high-temperature rated.
 - 2. The vertical distance protected by a single line of sprinklers shall not exceed 15 feet. A single line of sprinklers may protect a single-story building that has a 20 feet maximum

height. All heights exceeding this will require more than one row of sprinklers vertically.

3. Hydraulic calculations shall include all of the sprinklers facing the exposure, on every row.

H. Elevator Shafts And Machine Rooms

1. Sprinklers are required at the tops of all elevator shafts and in the elevator equipment rooms. Sprinklers shall be protected from freezing.
2. Provide an OS&Y gate valve to shut off all sprinkler water flow into the elevator shaft and into the elevator machine room. Where possible, piping should be arranged such that a single valve can shut off water to both locations.
3. The valve(s) shall be at a readily accessible location, no more than 7' 0" (2-m) above finished floor, inside a clearly marked wall cabinet.

1.04 SUBMITTALS

- A. Provide as required by Specification Section 01330, "Submittal Procedures", to the SDR.
- B. As soon as practicable after award of contract and prior to fabrication, Fire Protection System Contractor shall submit to the SDR for approval, complete design submittals. Design submittals package shall include:
 1. Paper copies and electronic (if available) of manufacturers' catalog data, system and component operating instructions, and paper and electronic copies of hydraulic calculations, and seismic calculations, etc. 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 clearly delineate the design.
 3. If welded joints are to be used in the sprinkler system installation, then the Contractor shall provide a paper copy and electronic (if available) of the welding procedure to be used, the quality assurance procedure and the welder's qualifications.
- C. No installation will be permitted prior to SNL approval of the complete shop drawings, calculations, and materials submittal. 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 shall be included in the deliverable file package as follows. The fire protection deliverable package, both CADD and non-CADD shall be delivered to Sandia in printed format (hard copy), quantity to be determined by SDR, in addition to one electronic copy. Microsoft Word, Microsoft PowerPoint, Microsoft Project, and Microsoft Access are the required software (latest versions suitable for Windows/NT) to be used. 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 (i.e., FireAcad, HASS, Hydronics, HyperCalc, etc.). Where these software packages cannot be used, the contractor shall produce the documents in portable document file (PDF) format, or scanned image in *.jpg or *.bmp format. All files will be returned with the file name, description/content, software and software version requirements listed. All deliverable data, designs, records, graphics, and supporting tools are the property of SNL. SNL also has the right to provide any of this information to others, as it deems appropriate.

2. All graphic design drawings will be plotted CADD files. CADD files will follow SNL File Naming conventions, and utilize a SNL border title block.
3. Floor Plans
 - a. All fire protection floor plans will reference architectural floor plans.
 - b. Files will be completed at a one-to-one scale.
 - c. The contractor will identify location of post indicator valve (PIV) and Fire Department Connection that are attached to the building.
 - d. Each floor will be a single file (i.e., MicroStation – Master Floor Plan, or AutoCAD – Model File).
 - e. Orientation of North, key play breakout will match architectural construction of floor plans.
 - f. Unless otherwise specified, new floor plans and full height cross sections shall be plotted at $\frac{1}{4}''=1' 0''$.
4. Riser Diagram
 - a. Riser will be detailed in nature showing each fire protection component. Each component will be labeled, at a minimum with description, size, and equipment part and manufacturer information.
 - b. Riser details will 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 shall be shown indicating height and distances between components.
5. Site Plans: The contractor will verify 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 regardless of use of MicroStation or AutoCAD.
- E. MicroStation SE: SNL Facilities maintains MicroStation SE for Windows/NT, release 05.07.01.14 (vector), as its standard CADD software. It is anticipated that Bentley will be releasing the new version of MicroStation V8 in the spring of 2001. When this occurs, SNL will upgrade the required CADD Standards Workspace to work with the V8 release. When these and future upgrades occur, it is required that the Fire Protection Designer utilize the new workspace and MicroStation software. To maximize efficiency, SNL will provide a custom MicroStation SE workspace environment, which includes toolboxes, tool

frames, macros, MicroStation Development Language (MDL) application, user commands, help routines, and menu bars to help in the production of facilities CADD files.

- F. AutoCAD 2000 may be used in lieu of MicroStation SE under the condition that the following requirements will be met:
1. The translated MicroStation architectural floor plan must be referenced into AutoCAD model. Each AutoCAD model will show the Fire Protection Design for a given floor. The model will include all required design information from NFPA 13.
 2. The SNL Fire Protection border files must be copied into all project sheets (layout tabs). Each layout tab will contain border, keyed notes, general notes, details, and title block information. Each layout tab will be identified (labeled) with correct SNL plotted file name.
 3. All data, designs, records, graphics and supporting tools generated during project creation shall 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 submitted as part of the deliverable package.
 5. All Fire Protection Layers will follow CAD Layer Guidelines, 2nd edition or newer, established by the American Institute of Architects.
 6. A table, listing all line, text, block information will be created within each design file just outside of the plotted area. Information to include: layer names, color, pen width association, line style, description, text size, block names and identification of frozen layers.
 7. Any blocks used that do not match the SNL provided symbols, located on the Fire Protection Borders File, must have written prior approval from the SNL SDR and be reflected in the files border legend.
- G. Graphic Design Presentation
1. Drawings shall show all details required or recommended by NFPA 13, for "Working Plans" in addition to the following:
 - a. Name and room number shall appear in each room.
 - b. Potential obstructions (i.e., columns, ductwork, etc.) to the sprinkler layout shall be shown.
 - c. Building column, grid lines and grid labels.
 - d. New construction shall be clearly delineated on the drawing. Use SNL ballooning process.
 - e. All lines and details shall be shown. Specifying "opposite hand" is not acceptable.
 - f. Pipe lengths shall be shown, center to center of fittings.

- g. Where more than one type of pipe is used, each piece of pipe shall be identified as to type 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, (i.e., 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. Upon completion of the installation, the Contractor shall revise all Fire Protection Design files, calculations, manuals, operating instructions to agree with the construction as actually accomplished. The notation "As-Built" shall be entered in the revision block, dated and initialed. All as-built records will follow the requirements listed under 1.05 Submittals.
 - 2. Fire Protection Design files must be requested from SNL prior to as-builts. As-builts will be reflected on the existing design file records.
 - 3. The as-built files, whether on new or original contract shall show the entire sprinkler system, existing and new construction, as it exists at the completion of the contract work. Delete all references to "new work," "existing," "NIC," etc.
 - 4. As-built submittals shall be submitted to the SNL SDR prior to the final acceptance testing. This delivery shall include BOTH electronic and hard copies.
 - 5. Final hydraulic calculations shall reflect the "As-Built" condition. These calculations must be submitted before final acceptance testing by SNL.

1.05 QUALITY ASSURANCE

- A. General: Where specific manufacturers or model numbers are mentioned in these specifications, proposed substitutions shall be included in the submittal package furnished to the Sandia Delegated Representative (SDR) for approval after contract award and before installation.
- B. Warranty: All sprinkler system components furnished under this contract shall be guaranteed against defective design, materials, and workmanship for the full warranty time, which is standard with the manufacturer and/or supplier. Refer to contract requirements. In no case shall the warranty be less than one year from the date of system acceptance.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

- A. Materials and equipment used in the installation of the sprinkler system shall be new and listed by the UL Fire Protection Equipment Directory or the FM Approval Guide, latest edition. The standard products and the latest design of the manufacturer shall be used, and installed per their listing, approval, or manufacturer recommendations. All products listed or approved by prior editions of the UL Directory of FM Approval Guide will not be

acceptable, if not listed or approved in the most recent edition of the directory or approval guide.

- B. Where two or more units of the same class of equipment are required, these units shall be products of the same manufacturer (e.g., couplings shall be from one manufacturer.) All materials shall be installed per their listing or approval and per the manufacturer's recommendations and specifications.
- C. New dry-pipe, preaction and deluge sprinkler systems shall be provided with the following devices:
 - 1. A FM approved or UL listed air dryer for the sprinkler control air supply for dry-pipe and preaction systems.
 - 2. A 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 will come equipped with a minimum 10-gallon tank. Nitrogen bottles are permitted to supply nitrogen pressure to systems smaller than 125 gallons in size. Where the system capacity is larger than 125 gallons, air compressors shall be used.
- D. Tape for screwed joints shall be minimum, 3 mil., 1/2-inch wide.
- E. Corrosion protection tape shall be Scotchwrap 51, manufactured by 3M Company or approved equivalent.

2.02 SPRINKLERS

- A. Types:
 - 1. Unless otherwise specified, allowed per other sections of this document, or shown on the drawings, sprinklers shall be nominal, 1/2-inch orifice, automatic, closed-head sprinklers rated at 155° F (68° C) Quick Response, frangible bulb type fusible element.
 - 2. Higher temperature rated sprinklers shall be installed where heads are exposed to high ambient temperature, exposed to the direct rays of the sun, beneath skylights or windows and installed in the vicinity of heating equipment, or in attics. The sprinkler temperature chosen shall 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 shall be protected with sprinklers having the following minimum temperature ratings, but no less than 50° F above normal ambient room temperature:

Transformer and switchgear rooms; Elevator machine rooms	212° F (100° C)
Computer rooms	155° F (68° C) QR
Telephone equipment rooms	155° F (68° C) QR
Top of elevator shafts	212° F (100° C)

4. On-Off sprinklers are not allowed. FM approved or UL listed on-off sprinkler systems, like the Viking FireCycle (or approved equal), are allowed.
5. Quick Response (QR) sprinklers, where specified on the drawings, shall have a Response Time Index (RTI) of 50 or less in English units and 28 or less in metric units.
6. Sidewall sprinklers shall be Underwriters' Laboratories listed or Factory Mutual approved for Ordinary Hazard Occupancy.
7. Extended coverage sprinklers are not allowed.
8. Only sprinklers with a "Belleville" type seal shall be used. No O-Ring sealed sprinklers shall be allowed either in "crush" seals or "radial" seal styles. Sprinklers shall be of all brass frame construction with a coated metal to metal seating mechanism.
9. Only Sprinklers with integral shields listed by UL as "intermediate level" sprinklers or by FM as "racked storage" sprinklers are acceptable indoor where shields are required over ordinary sprinklers. Shop-made water shields are not allowed, nor are after market attachments designed as water shields. "Heat collection devices" for use with sprinklers shall not be allowed.
10. Sprinklers installed in storage racks shall 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. Roof sprinklers subject to mechanical damage shall be equipped with a listed sprinkler head guard.

B. Protection Against Freezing

1. Horizontal dry sidewall sprinklers shall be used in lieu of antifreeze 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 shall not exceed 10 feet. (3.05-m.)
3. The dry sprinkler shall extend a minimum of 12 inches (30-cm) into the heated space. For refrigerated spaces, the length dry sprinklers shall extend into the heated space shall be as specified by the SDR.

C. Position and Finish

1. Sprinklers installed on exposed piping shall be manufacturer's standard finish pendent sprinklers. Sprinklers and escutcheons installed below dropped ceilings shall have a finish matching the color of the ceiling tile. Only factory applied finishes shall be acceptable. If the factory has a finish that cannot match the ceiling tile color, standard finish sprinklers are allowed.
2. In rooms where sprinkler heads penetrate a suspended ceiling, only quick response, semi-recessed 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 (less than 20 heads) take place, the new sprinklers and escutcheons shall match the existing sprinklers.
4. Escutcheons, head guards, and water shields from the supplied sprinkler manufacturer shall be used solely with the installed sprinkler. No after market escutcheons, head guards, or water shields are allowed.
5. Head guards shall be two-piece, universal attachments, bolted in place on the sprinkler. "Snap-on" one-piece units are not allowed.

2.03 PIPE

- A. Pipe for installation above ground shall conform to the requirements of NFPA 13. Pipe shall be listed by UL and be FM approved, and installed per its listing and approval and meet the following requirements:
 1. Unless otherwise specified, the minimum steel pipe wall thickness shall be Schedule 10 for pipe sizes 2½ inches or larger. Pipe sizes smaller than 2½ inches shall be Schedule 40. Threaded or cut groove steel pipe shall be Schedule 40 for sizes less than 8 inches and a minimum of Schedule 30 in sizes 8 inches and larger for pressures up to 300 psi (2.1-MPa.)
 2. Mechanical rolled groove pipe or welded pipe shall be a minimum of Schedule 10 for sizes 2½ inches up to 5 inches, 0.134-inch wall thickness for 6 inches, and 0.188-inch wall thickness for 8- and 10-inch pipe for pressures up to 300-psi (2.1-MPa.)
 3. Steel pipe, installed for the water motor alarm line, piping from drain line valves and inspector's test valves, dry pipe and preaction sprinkler system piping, and where pipe is exposed to outdoor weather, etc., shall be internally and externally galvanized. Galvanized fittings are required where galvanized piping is used. Any piping leading to a pressure-operated waterflow indication device shall also be galvanized. The starting point is on the alarm connection to the alarm check valve.

2.04 PIPE FITTINGS

- A. Pipe fittings for installation above ground shall conform to the requirements of NFPA 13 and shall be FM approved or UL listed.

1. Mechanical groove couplings are required on all 4 inches and larger pipe.
2. Plain-end pipe couplings shall not be used in any new installation.
3. Galvanized pipe fittings shall be installed where galvanized piping is specified.
4. Welded branch outlet fittings (weld-o-lets, groove-o-lets, thread-o-lets, etc) shall be minimum Schedule 10 for pipe sizes 2½ inches or larger. Pipe sizes smaller than 2½ inches shall be Schedule 40 standard wall pipe thickness. Welded outlets shall 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 shall not be used. All drop nipples shall be one-piece, non-adjustable units with a minimum 1-inch diameter.

2.05 PIPE HANGERS, SUPPORTS AND SEISMIC BRACING

- A. Pipe hangers, and hangar assemblies shall be UL listed or FM approved.
- B. C-clamps and beam clamps shall have lock nuts and retaining straps, or clips, and pipe rings shall be of the solid-band adjustable swivel type.
- C. Provide rod ceiling plates at finished ceilings for coach screw rods, expansion shields, and toggle hangers.
- D. All seismic bracing devices and flexible couplings shall be specifically UL listed or FM approved and installed per their listing or approval.
- E. When fastening hangars to purlins, bolt-through fastening methods shall be used. Beam clamps with restraining straps shall not be used in any circumstance.
- F. All seismic brace members shall be continuous. Under no circumstances shall members be spliced or off-set.
- G. Tension-only seismic bracing systems shall meet the following.
 1. The tension-only system shall be UL listed or FM approved for seismic service, and installed in accordance with listing limitations and installation instructions.
 2. A means to prevent vertical motion due to seismic forces shall be installed at the brace location.
 3. Two tension only braces shall be installed in opposing directions at each brace location.

2.06 FIRE PROTECTION CHECK VALVES

- A. Check valves in sprinkler system shall be UL listed or FM approved, have hand hole covers to provide adequate access to facilitate inspection and repair, without the removal of the valve from the system, and shall be listed for installation in the vertical or horizontal position. Wafer check valves are unacceptable. All check valves shall have a working water pressure of 250 PSI.

- B. Alarm check valves (wet pipe, dry pipe, deluge, preaction, etc.) shall be provided on all sprinkler risers and have the following.
1. The alarm check valve (ACV) shall be equipped with a removable hand hole cover assembly, and shall be listed for installation in the vertical or horizontal position.
 2. The ACV shall be equipped with gauge connections on the system side and supply side of the valve clapper.
 3. ACV trim piping and fittings shall be internally and externally galvanized.
 4. Ported alarm connections on the ACV shall be to a retard chamber to absorb variable pressure surges.
 5. Only "Flange x Flange" ACV devices shall be installed.
 6. Wet-pipe systems shall use a variable-pressure alarm check valve. Plain-type check valves are not allowed. Sprinkler alarm valve shall be equipped with an external bypass to eliminate false water flow alarms.
 7. Dry-pipe valves shall be a positive latching clapper, differential type dry valve and air pressure to water pressure area differential shall be approximately 5 to 1.
 8. Deluge valves shall be externally re-settable by hydraulic means, and shall employ a positive vent on the priming line to ensure that the deluge valve will not prematurely reset.
- C. Backflow prevention devices shall be installed on all sprinkler systems at SNL as follows, please see section 3.12 for further guidance.
1. A reduced pressure backflow prevention assembly (RPBFP) shall be installed to prevent cross-connection contamination between potable water systems and any fire sprinkler system, at the service connection for the fire sprinkler system.
 2. On Dry-Pipe and Preaction systems where galvanized piping and fittings are used backflow prevention devices are not required.

2.07 FIRE PROTECTION INTERIOR CONTROL VALVES

- A. Each system shall have interior control valves as follows:
1. A control valve shall be installed for isolation of each floor of multi-story buildings.
 2. Interstitial spaces, in-rack sprinkler systems, mezzanines, etc, shall have control valves for system isolation at the feed-main.
 3. All control valves 2½ inches or larger shall be provided with an electric valve supervision device, connected to the Site Fire Alarms.
 4. All inside control valves shall be OS&Y. Butterfly valves are not permitted, unless directed by SNL on the drawings. Valves shall be manufactured in accordance with AWWA Standard C500, and have a clear waterway equal to the full nominal diameter

of the valve. Valves shall be provided with a handwheel, with arrow cast in metal to indicate direction of opening.

2.08 SUPERVISORY DEVICES

- A. When specified on the contract drawings, supervisory devices shall be compatible with the site fire alarm system.
- B. Provide the equipment listed below.
 - 1. Electric valve supervision switches shall be installed for all internal (inside) and external (outside) fire protection valves 2½ inches or larger. The devices shall be electrical; single-pole, double-throw; with normally closed contacts and include design that signals controlled valve is in other than fully open position.
 - 2. For wet pipe sprinkler systems, install vane-type waterflow alarm initiation devices with 250 psig (1725 kPa) 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 tamperproof cover that sends signal if removed.
 - 3. All vane type waterflow alarm initiation devices shall be equipped with an adjustable delay of audible alarm initiation. Adjustment range shall be from 0 to 120 seconds. Vane type waterflow switch shall be Potter Model VSR-F or approved equal.
 - 4. Waterflow vane-type alarm initiation devices shall be labeled as to the correct orientation of flow when mounted on system piping. When drilling of the system riser is necessary to mount flow switch, the drilled out disc (coupon) shall be retrieved and attached to the mounting u-bolt of the flow switch.
 - 5. Where pressure operated waterflow alarm initiation devices are used, any valve installed upstream of the device on the alarm line shall be electrically supervised, using the Potter Model BVS or approved equal. Pressure operated alarm initiation devices shall be an electrical-supervision type, water-flow switch with retard feature. The device shall include single-pole, double-throw, normally closed contacts and design that operates on rising pressure and signals water flow

EXCEPTION: Where the waterflow alarm initiation device is used only for the purpose of an outside electric bell in lieu of the water motor gong device.

- 6. A vane-type waterflow alarm initiation device shall be installed on the air gap drain for all reduced pressure backflow prevention devices.
- 7. Low-pressure supervision shall be installed on all dry pipe or preaction systems and be connected into the SNL Site Fire Alarm.
- 8. Any device that is to be installed in a hazardous location defined by NFPA 70 shall be rated for occupancy.

2.09 FIRE DEPARTMENT CONNECTIONS

- A. Fire department connections shall have a minimum of two 2½-inch inlets with National Standard Hose (NSH) threads, internal double clapper check valve, brass plugs, and attached chains.
- B. Fire department connections shall be installed at each new alarm check valve, dry pipe valve, deluge and preaction valve and standpipe, unless the sprinkler system is supplied by a fire department connection in the yard main, or as otherwise noted in NFPA 13.
- C. The completed installations shall include a metal sign or escutcheon plate, with raised lettering, marked "FIRE DEPARTMENT CONNECTION STANDPIPE-AUTO. SPKR," "AUTOMATIC SPKR," or "STANDPIPE," as appropriate. Additional signs for systems such as foam water sprinkler systems or other alternative designed systems, as required by other NFPA Standards, shall also be provided by the Contractor where required.
- D. When the sprinkler system hydraulic demand (not including exterior hose demand) exceeds 1000 gpm, a 6-inch 3-way fire department connection shall be provided.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Responsibilities

1. The Contractor is responsible for the installation of the automatic sprinkler system in accordance with these specifications and the contract drawings. The Contractor shall coordinate with architectural, mechanical, and electrical, design and construction documents, to ascertain the required information, to effect a properly designed and installed sprinkler system for the building construction and occupancy classification.
2. The installation of the automatic sprinkler system shall be complete with all necessary accessories for proper operation and shall be accomplished by a licensed sprinkler contractor or licensed company regularly engaged in this type of work, and in accordance with requirements of the National Fire Protection Association Standards (NFPA).
3. An individual with a minimum NICET Level II shall supervise the installation.
4. The fire protection system installation shall be coordinated with the other trades (mechanical, electrical and structural, etc.).
5. The installation shall comply with all mandatory, advisory interpretations, and recommended applicable rules of the latest editions of the standards listed in Section 1.03 of this document, except where otherwise noted on the drawings or specified herein.

B. Contamination and Obstruction Prevention. Pipe interiors shall be kept free of debris.

C. Pipe and Fittings Above Ground

1. Pipe, fittings, and hangers shall be installed where shown on the drawings and in accordance with the requirements of NFPA 13.

2. Overhead sprinkler piping, drain and test piping, fire department connection piping, etc. installed through exterior walls shall be galvanized. All sprinkler piping shall be substantially supported from building structure and only UL listed or FM approved type hangers shall be used. Sprinkler lines under ducts shall not be supported from ductwork but shall be supported from building structure (with trapeze hangers where necessary), or from steel angles supporting ductwork in accordance with NFPA 13.
3. Flanged Fittings or Mechanical Groove Couplings
 - a. Flanged fittings or mechanical groove couplings shall be used at the base of risers, in the risers of multiple-story sprinkler systems at each floor-system connection, and in feed mains. Flanged fitting shall be used for alarm valve assemblies.
 - b. A flanged tapered reducer shall be installed at the flange and spigot piece when riser is smaller than the underground supply line.
 - c. Pipe shall be installed straight and true with no greater deflection at mechanical groove pipe couplings than is recommended by the manufacturer.
 - d. Plain end couplings are not acceptable.
 - e. Only rigid-type mechanical couplings shall be used, unless specifically directed by NFPA 13 such as for specific seismic locations. Only in those areas identified by NFPA 13 where flexible type mechanical couplings are specified will the use of flexible couplings be permitted. All other parts of the system shall use rigid-type mechanical groove couplings.
4. Pipe Hangers and Anchors
 - a. Offsets in hanger rods will not be permitted.
 - b. Concrete anchors shall be installed by drilling and installing a UL listed or FM approved anchor. Explosive driven fasteners as a method of installing anchors or hangers shall not be permitted.
 - c. Supports, hangers, braces, etc., shall be attached to the building primary structural members only.
 - d. When fastening hangars or braces to bar joists, the fastener shall be located within 4 inches of the panel point on the bar joist.
 - e. All piping larger than 4 inches in diameter shall be supported from a minimum of two-bar joists when run parallel to a bar joist.
5. Welded joints: Welded joints are acceptable when shop fabricated in conformance to provisions of NFPA 13.
6. Screwed joints: Teflon paste and tape shall be used as pipe-joint compound at screwed joints.
7. Bushings: Bushings are not permitted.

8. Control valves: Control valves shall be provided with identification signs describing the areas protected. Where the valve location is concealed above the ceiling, a sign below the ceiling shall indicate the valve location, and identify the protected area.
9. A guardrail of 1½-inch black steel pipe shall be fabricated as detailed on the drawings and installed around the sprinkler riser and alarm valve and painted "caution yellow".
10. Wall, Ceiling, and Floor Penetrations

- a. Pipe sleeves shall be installed and properly secured in place at all points where sprinkler piping passes through concrete or masonry construction. Sleeves through all walls and floors shall provide adequate clearance for slight movement of the piping. The guidance in NFPA 13 guidance for seismic areas shall be followed.
- b. Sleeves for pipes passing through floors of concrete or waterproof construction shall project 3 to 6 inches (7.6 to 15.2 cm) above floors to prevent leakage. Sleeves through walls shall be cut flush with each surface unless otherwise specified. Sleeves shall be caulked to make penetration watertight.
- c. Unless otherwise specified, sleeves shall be of Schedule 40 steel and a minimum of two pipe sizes larger in diameter than the passing pipe.
- d. Holes through walls, floors, and ceilings of other than concrete or masonry construction shall be large enough to accommodate pipe expansion. Holes through existing concrete floors and walls shall be core drilled to provide clean, neat holes. Spaces between pipe and sleeve or pipe and opening for floors and exterior walls shall be filled with a non-hardening sealant material and made watertight.

Where fire rated barriers are penetrated, a UL listed fire barrier system shall be installed to retain the fire resistance rating of the barrier (Refer to SNL Standard Specification 07270).

- e. Escutcheons shall be provided at wall, ceiling and floor penetrations of piping in occupied areas.
11. The cutting of structural members for the passage of sprinkler piping or for pipe-hanger fastenings is not permitted.

12. Joints

- a. Joints shall be made in accordance with the requirements of NFPA 13.
- b. Joints shall be left exposed until final inspection and testing have been witnessed by the SDR.
- c. Swing joints are preferred for connecting pendent sprinklers to branch lines.

13. Dielectric unions shall be used to connect dissimilar metals (such as steel to copper) to prevent electrolytic action.

D. Flange Joints, General

1. Flanged joints shall be face matched. Raised face flanges shall not be mated to flat-face cast-iron flanges on valves or equipment. The raised face shall be machined flush.

All flange bolt holes shall straddle the horizontal and vertical centerlines unless otherwise noted. Bolting shall comply with ANSI B31.1, Power Piping. Torque values and tightening sequence for bolts shall be in accordance with flange manufacturer's instructions.

2. Install insulating kits on flanges connecting dissimilar metals (such as steel to copper) to prevent electrolytic action.
3. The following procedure shall be followed when making final assembly of a bolted flange joint.
 - a. Install the gasket on the gasket-seating surface and bring the cover flange in contact with the gasket.
 - b. Install all bolts, ensuring that they are free of dirt and grit, and are well lubricated.
 - c. Run-up all nuts finger tight.
 - d. Develop the required torque in each bolt in a minimum of four steps. A fairly even compressive force will be exerted on the gasket by:
 - (1) The first sequence shall set the bolts at 30 percent of the required torque. Damage to the gasket can result beyond this amount for the first sequence.
 - (2) The second sequence shall set the bolts at 60 percent of the required torque.
 - (3) The third sequence shall set the bolts at 90 percent of the required torque.
 - (4) The fourth sequence shall set the bolts at 100 percent of the required torque. A final tightening shall be performed in a clockwise bolt-to-bolt sequence to ensure that all bolts have been evenly stressed.

3.02 SPRINKLER SYSTEM ALARM CHECK VALVES

- A. Alarm Check Valves (ACV) shall be provided with internally and externally galvanized trim piping and fittings, pressure gages, a retarding chamber, water motor gong, alarm switch, testing bypass, and all necessary pipe, fittings and accessories.
- B. The retarding chamber drain line shall be piped independently of the main drain line.
- C. The drain line from the water motor gong shall be piped to discharge through the wall as close to the grade line as possible.
- D. Piping between the ACV and a pressure actuated alarm initiating device shall be galvanized piping not less than 3/8 inch nominal pipe size.
- E. Piping supplying the retard chamber, water motor gong, and water motor gong drain shall be galvanized. Galvanized fittings are to be used where galvanized piping is required.

3.03 SPRINKLERS

- A. Pendent sprinklers below ceiling shall be aligned, and parallel to ceiling features, walls, etc. In areas without a suspended ceiling, install sprinkler piping as high as possible, using necessary fittings and auxiliary drains to maintain maximum clear headroom.
- B. Where two sprinkler systems abut, the pendent sprinklers shall be aligned in different directions to distinguish the boundaries of each sprinkler system.
- C. Sprinklers under open grating shall be intermediate levels.
- D. Sprinklers shall not be installed closer than 6 feet apart.
- E. Dry pendent and horizontal dry sidewall sprinklers shall only be installed in screwed tee fittings.
- F. Ceiling Areas: Where suspended ceilings are installed, the sprinkler Contractor shall install pendent sprinklers as shown on the reflected ceiling plans. Where these plans do not specify the location of the pendent sprinklers, the Contractor shall obtain the original reflected ceiling plans; and design sprinkler locations at least 6 inches from ceiling tile edges, 2 feet 6 inches from HVAC supply and return louvers, dimension the locations, follow a repetitive pattern, and locate sprinklers along straight lines to the extent possible. Swing joints shall feed pendent sprinklers from 1-inch outlet tees in branch lines.
- G. Stairs: Sprinklers shall be installed throughout stairways, and at every landing.

3.04 ELEVATOR SHAFTS AND MACHINE ROOMS

- A. Sprinklers at the tops of all elevator shafts and in the elevator equipment rooms shall be protected from freezing.
- B. Provide an OS&Y gate valve to shut off all sprinkler water flow into the elevator shaft and into the elevator machine room. Where possible, piping should be arranged such that a single valve can shut off water to both locations, and shall be at a readily accessible location, no more than 7'0" (2-m) above finished floor, inside a clearly marked wall cabinet.

3.05 DRAINS

- A. Two-inch drains shall be installed on all main risers and downstream of any interior sectional valves, and shall be piped to drain.
- B. A pressure gage cock and approved gage shall be installed downstream of interior sectional valves of 4 inches size and larger. 3/4-inch valve auxiliary drains with standard hose threads and caps shall be installed at all low points in the system, where more than five sprinklers are trapped. Where the capacity of trapped piping exceeds 20 gallons (75-1), the overflow shall be piped to drain.
- C. Inspector's test connections shall be installed on each sprinkler system as near the most hydraulically remote end of the system as possible. The orifice shall be sized to discharge a flow equivalent to the smallest orifice sprinkler in the system. The inspector's test valve shall be located not more than seven feet above the floor in a visible, easily accessible location. For antifreeze systems, a plugged outlet shall replace the orifice.

- D. In multi-level buildings where waterflow alarm devices are provided for each floor or where more than one alarm device is provided in a single sprinkler system, a separate inspector's test connection shall be provided for each alarm device. For convenience, in multi-level buildings where more than one inspector's test connection is required, all the valves shall be manifolded together at a single location on the grade floor, with a sight glass and a common drain line discharging outdoors.
- E. Drains shall be piped to discharge to drain, and the discharge shall be visible either by open-end or sight drain fitting.
- F. Drains and inspector's test connections through outside walls shall be run through the walls as close to the floor or grade line as possible, terminating with a 45 degree galvanized elbow turned down to splash blocks.
- G. Concrete splash blocks, 18" x 18" x 4" (45 cm x 45 cm x 10 cm) minimum in size, shall be installed under each drain or test outlet. The top of the block shall be 1 inch (2.54-cm) above grade, with a slope of 1/2 inch per foot (4 cm/m) away from the building wall.

3.06 FIRE DEPARTMENT CONNECTIONS

- A. The check valve and normally open automatic ball drip (ABD) shall be located at points where they will not be subject to freezing temperatures, and the discharge from the ball drip shall be piped to drain. The ball drip shall close when the flow of water through the valve is in the range of 4 through 10 gpm (0.25 to 0.6 l/s). All ball drips shall be rated at 175 psi (1.2 MPa). Use valve- drains in place of automatic ball drip drains when the static head of water above the ABD will exceed 11'6" (3.5 m) (5 psi) (34 kPa). Check valves shall be UL listed or FM approved and shall have bodies with the UL or FM stamp.
- B. The fire department connection shall be installed between 18 inches and 36 inches (0.46 to 0.91 m) above grade.

3.07 FIRE HOSE STATIONS

- A. Where hose stations are called for on the contract drawings, they shall be 2½-inch hose valves, with 2½" x 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 shall be installed between 4 feet and 5 feet (1.22 and 1.52-m) above finished floor.
- C. Unless otherwise specified or shown on the drawings, no hose is required.
- D. Where hose cabinets are required, they shall be of the horizontal fold, hump type, with full tempered glass doors.

3.08 IDENTIFICATION

- A. Control, drain, test, and alarm valves and zone waterflow switches shall be provided with identification signs of the standard design adopted by the automatic-sprinkler industry, or their equivalent.

- B. A hydraulic data information nameplate shall be secured to the riser with chain, directly above the controlling alarm check valve and shall include the following design data.
 - 1. Building designation
 - 2. Location of remote area
 - 3. Design density
 - 4. Area of application
 - 5. System demand (gpm (l/s) and psi (kPa) at base of riser)
 - 6. Data shall be permanently engraved on the nameplate as follows:
 - 7. Material shall be durable plastic or aluminum. Minimum height of lettering is 1/8".
- C. The Contractor shall furnish and place in a clear, plastic envelope attached to each sprinkler alarm check valve riser: one complete set of typed or printed maintenance and operating instructions, a set of prints of the as-built working drawings and hydraulic calculations of the sprinkler system.
- D. Contractor shall supply each riser with a cabinet containing maintenance and repair equipment (spare heads, wrench, etc.)
- E. Each Contractor shall affix an identification tag on each system riser indicating:
 - Name of the Contractor
 - Business Address of the Installing Contractor
 - Phone Number
 - 24-hour emergency contact phone number.

3.09 FLUSHING

- A. Before connecting sprinkler systems to the main supply, each sprinkler supply line shall be flushed out thoroughly by the Sprinkler Contractor in the presence of the SDR, through an unrestricted opening not less than 4 inches in diameter. Minimum flowing quantities are specified in NFPA 13.
- B. Failure to comply with this requirement shall necessitate flushing of the entire sprinkler system by the Contractor at no additional cost to SNL.
- C. A 4-inch temporary pipe or two 2½-inch fire hoses shall be provided by the Contractor to discharge water to a suitable location, as designated by the SDR.

3.10 TESTING

- A. Aboveground Tests: Prior to acceptance of the installation, the Contractor shall, 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. In addition complete operating test of dry pipe, preaction, deluge, water-spray and foam water systems shall be performed in the presence of the SDR.

1. Hydrostatic testing shall be performed before any ceiling is installed below the sprinkler piping. Each water control valve shall 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 shall be performed two times.
 - a. First, after the system is completed using the plugged drops, and before the ceiling panels are installed.
 - b. Second, 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 installed.
 3. The addition of sodium silicate (also known as water-glass) and related substances before hydrostatic testing, to stop water leakage, is not permitted.
 4. Pipe interiors shall be kept free of debris.
- B. Alarm Testing: Contractor shall be responsible for testing new alarms and modified alarms installed under this contract. Defective alarms shall be replaced immediately.

3.11 PROTECTION AGAINST FREEZING

- A. Sprinkler piping passing through any unheated spaces in, under, or outside buildings exposed to freezing, shall be protected as shown on the plans or in accordance with the methods specified in NFPA 13. Exposed to freezing is defined as any location where the temperature may drop below (40°F) 5°C at any time during the year.
- B. Heating shall be provided for sprinkler protected spaces in lieu of providing anti-freeze systems except where otherwise noted on the drawings or specified herein.

3.12 PROTECTION FOR BACKFLOW PREVENTION

- A. A reduced pressure backflow prevention assembly (RPBFP) shall be installed on all new systems and where shown on the drawings for modifications to systems to prevent cross-connection contamination between potable water systems and any fire sprinkler system. Install the RPBFP at the service connection for the fire sprinkler system or as noted on the contract drawings.
- B. RPBFP assemblies shall be either FM approved or UL listed and be approved by the Foundation for Cross-Connection Control and Hydraulic Research, University of Southern California (USC-FCCCHR) and the International Association of Plumbing and Mechanical Officials (IAPMO).
- C. Backflow prevention assemblies used or installed under this contract shall be tested by a "Certified Backflow Control Assembly Tester" who possesses a current (within three (3) years from date of issuance) certificate that confirms successful completion of an approved (SDR specified or USC-FCCCHR or Colorado Environmental Training Center, Golden, Colorado) training course.
- D. RPBFP assemblies shall be installed in accordance with AWWA Manual M14 requirements, or as directed by the SDR.

- E. If RPBF devices will be installed outside the building they must be in heated enclosures and with adequate space for inspection, tests and maintenance.
- F. Adequate drainage shall be provided for RPBF and meet the following.
 - 1. Discharge shall be piped full size (of the relief valve) and extended to a drain.
 - 2. Discharge piping shall be sloped 1/8" per foot and be Schedule 40, galvanized.
 - 3. French Drains are not allowed.
- G. The Contractor shall perform an operational test on any new or relocated backflow prevention assemblies used or installed under this contract. Passing backflow preventors shall be labeled with a tag indicating: test performed, tester's initials and date. Testing documentation shall be submitted to the Sandia Delegated Representative (SDR).
- H. Repairs to RPBFs shall be made with original manufacturer's parts.

3.13 PAINTING AND LABELING

- A. Contractor shall paint those portions of fire protection as required by Sandia National Laboratories (SNL) Painting Specification 09900. Labeling shall be as follows:
 - 1. Sprinkler system (e.g., inspectors tests, drain valves) shall be labeled with all information required by NFPA Standard 13.
 - 2. Labeling shall be accomplished with the use of permanently marked weatherproof metal or rigid plastic identification signs. The signs shall be secured with corrosion-resistant wire, chain, or other approved means. These signs shall be provided by the manufacturer, manufacturer's representative, or installer of the sprinkler system.
 - 3. Sprinkler riser shall be labeled with building and sprinkler system riser numbers. Labeling shall be accomplished with the use of "Brady" or approved equal self-sticking labels. The color and size shall contrast the surface that it is applied to. The labels shall be provided and applied by SNL Fire Protection Systems Maintenance Organization.

3.14 DISINFECTION

- A. Piping installed under this contract shall be disinfected per AWWA C651 before it is placed in operation, by using one of the following methods.

EXCEPTION: Where non-potable fire protection piping is added downstream of a RPBF, disinfection is not required.
- B. 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 chlorine concentration shall remain at 10 mg/l for a minimum of 24 hours. During this time, all valves in 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 shall remain closed to prevent chlorine pollution.

2. Samples shall 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 shall be done by the contractor and witnessed by the SDR. The results shall be recorded for auditing purposes.

C. Slug Method:

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

D. Repairing or Cutting into Existing Mains:

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

E. Flushing:

1. After the lines have been chlorinated using one of the above methods, it becomes necessary to flush the lines with water until test sample indicates that 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 test shall be witnessed by SDR or other SDR designee and the results recorded.
2. Heavily contaminated water shall be disposed of or neutralized under the direction of SNL Pollution Prevention and Environmental Monitoring Department.

F. Bacteriological Testing:

1. All new and modified water lines require testing for coliform organisms per AWWA C651. The testing shall occur after successful chlorination and flushing of the lines. Samples shall 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. Analysis, at the discretion of the SDR representative shall be performed by SNL Industrial Hygiene or an independent laboratory.

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2. Results shall be recorded with the original documentation of results attached. These will be used for auditing purposes.
3. Fire protection lines will not be accepted until a negative bacteriological test is performed. Lines will be chlorinated and flushed repeatedly, at no additional cost to SNL, until such a negative test is accomplished.

END OF SECTION

Appendix A

Seismic Bracing Calculations

Sheet _____ of _____

Project: _____
 SNL Bldg: _____
 Location: _____

Contractor: _____
 Address: _____

 Telephone: _____
 Fax: _____

Brace Information

Length of brace: _____
 Diameter of brace: _____
 Type of brace: _____
 Angle of brace: _____
 Least radius of gyration *: _____
 L/R value *: _____
 Maximum horizontal load: _____

Seismic Brace Attachments

Structure attachment fitting or tension-only bracing system:
 Make: _____ Model: _____
 Listed load rating: _____ Adjusted load rating: _____
 Sway bracing (pipe attachment) fitting:
 Make: _____ Model: _____
 Listed load rating: _____ Adjusted load rating: _____

Seismic Brace Assembly Detail

(Provide detail on plans)

Fastener Information

Orientation of connecting surface: _____

 Fastener _____
 Type: _____
 Diameter: _____
 Length (in wood) _____
 Maximum load: _____

Brace identification no.
 (to be used on plans): _____

Lateral brace Longitudinal brace

Sprinkler System Load Calculation

Diameter	Type	Length (ft.)	Total (ft.)	½ Weight per ft.	½ Total Weight
				Lb./ft	Lb.
				Lb./ft	Lb.
				Lb./ft	Lb.
				Lb./ft	Lb.
				Lb./ft	Lb.
				Lb./ft	Lb.
* Excludes tension-only bracing systems				Total ½ weight of water-filled pipe	Lb.