PART 1 - INTRODUCTION

1.1 PURPOSE

This section contains design criteria for building fire suppression systems. See Yale Fire Protection Specification, Section 15 31 00 for system installation specification details.

PART 2 - GENERAL DESIGN REQUIREMENTS

2.1 SPRINKLER AND STANDPIPE SYSTEM DESIGN AND PERFORMANCE REQUIREMENTS

A. General

If not specifically covered in the building design program or mandated by the building code, the architect will decide during the early design stage what types of fire extinguishers, sprinklers, and standpipe systems to include. Also, the insurers will review an early printing of the contract documents. Therefore, schedule a meeting, through the Yale University Facilities group, with the University Fire Marshal and with the municipal Fire Marshal having jurisdiction to discuss the project and its fire protection requirements.

B. Design Considerations

1. Fire Protection designs must account for end-user needs and the actual conditions encountered in the field during construction. Coordinate equipment locations with existing and new architectural, structural, and mechanical work.

2. Construction drawings must reflect, as closely as possible, actual equipment locations and piping routes.

    - Where possible, surface mount fire suppression system equipment (for example, panelboards, starters, contactors, and control panels) in dedicated electrical rooms so that exposed conduits can be run to the equipment, facilitating future changes. Where dedicated electrical rooms are not available, locate such equipment in mechanical rooms or electrical closets.
    - Install a fire alarm annunciator panel at the designated Fire Department building access area.
    - Follow NFPA and BOCA requirements for earthquake protection and seismic bracing.
    - Where possible, all fire sprinkler piping must be concealed or directed.

C. Combined Systems

The standpipe system and the sprinkler risers can be combined when the system is hydraulically calculated.

D. Hydraulic Design Versus Pipe Schedule

1. Design all sprinkler systems based on the hydraulic design as stated above and NFPA 13. Design systems to include inside and outside hose streams as listed in NFPA.
2. Use a pipe schedule only when adding to an existing system that was installed based on a pipe schedule and when adding less than 10 sprinkler heads. If 10 or more sprinkler heads are to be added, then base the entire system for the floor on hydraulic design.
3. If additional sprinkler heads are to be installed on a hydraulically designed system, the addition must be hydraulically designed.

E. Hydraulically Calculated Fire Protection Systems

Sprinkler systems must be hydraulically designed for each hazard group density in a project based on NFPA requirements, the proposed campus wide high-pressure fire main system, Yale Fire Marshal requirements, and municipal requirements.

F. Water Supplies

Obtain fire pump and hydrant flow test data from the Yale University Fire Marshal to determine the water supply available and its pressure at the project location. Obtain data on the campus high-pressure fire mains and fire pumps from the Yale University Fire Marshal.

G. Piping Mains

The fire main minimum piping size must be:

1. 10" underground or 8" above ground. (If a building has a fire main loop and it is connected at both ends, a 6" main may be used.)
2. 6" loop within a building
3. 8" feeder for a building from the express main
4. 10" express mains for more than one building

H. Multiple Water Feeds to a Single Area

Fire mains on each floor must have only one control valve per section. If more than one supply is needed on a floor, split the system with a separate supply for each section of the building, No area may have more than one supply (for example, no cross-connection of mains).

I. Factors Influencing the Water Demand for Sprinklers

The water demand required for sprinkler protection depends upon occupancy, discharge density, design area, type of sprinkler system (wet or dry), type of construction, and other building features.

J. Water Demand for Sprinklers

Use Table 1 to determine the water demand required for sprinklers.

Table 1. Water Demands for Sprinklered Facilities

Occupancy Classification	Sprinkler		Design Area Sq Ft[1]	Hose Gal/Min
Light Hazard	0.10		1500	100
Ordinary Hazard Group 1	0.14		2000	250
Ordinary Hazard Group 2	0.19		2000	250

1 For dry pipe and preaction systems, increase design area by 30 percent.

K. Design Densities

Design densities in Table 1 are minimum densities. Each sprinkler in the design area must discharge at least the flow rate required to produce the stipulated density.

L. Design Area

The design areas shown in Table 1 are the most hydraulically-remote areas.

M. Water Demand for Hose Streams

Hose streams are needed concurrently with sprinkler discharge to achieve final extinguishment or to wet down adjacent structures. Use Table 1 to determine the hose stream demand for sprinklered occupancies.

N. Total Water Demand for Sprinklered Occupancies

The total water demand for sprinklered occupancies is equal to the sum of the domestic demand plus the sprinkler system(s) water demand and the hose stream(s) demand. The total demand must be available at the sprinkler system connection to the underground main, and at the pressure necessary to produce the required sprinkler density over the required, most hydraulically-remote area of sprinkler operation.

O. System Types

1. All systems must be wet pipe, except in areas subject to temperatures below 40°F, which must have a dry pipe system installed.
2. Install dry pipe systems in all areas subject to temperatures below 40°F, such as attics and unheated areas.
3. Use a pre-action system only in areas where water damage by accidental activation or damage to a sprinkler head is of most concern.

P. Occupancy Classifications

1. Light Hazard

- Dwelling units
- Chapels
- Classrooms
- Libraries, except stack areas
- Offices
- Data processing or computer rooms
- Theaters and auditoriums, except stages and prosceniums

2. Ordinary Hazard I

- Dining hall kitchens
- Attics and basements used for storage
- Ordinary Hazard II
- All laboratory units
- Library stack areas
- Mechanical rooms
- Custodial rooms
- Stages

3. Ordinary Hazard II

- All laboratory units
- Library stack areas
- Mechanical rooms
- Custodial rooms
- Stages

Q. Protection of Domestic Water Supplies

Install a reduced-pressure back-flow preventer (RPBFP) on all fire sprinkler or standpipe systems, as required by the regional water authority, but not on the Yale University high-pressure fire main since it already has at least one RPBFP. Include any pressure reduction in the system hydraulic calculations. Install the back-flow preventer inside the building, with control valves before and after the unit. Pipe the drain to a proper drain location, such as outside, to a sump pit, or to a floor drain that is in good condition. Verify the condition of all drains before any piping is done. Install the back-flow preventer after the fire pump, per NFPA 20.

R. Main Drain Capacity Pipe all main drains from the sprinkler system and standpipe system to a proper drain location that can handle both water supply testing and draining of the systems. Proper drains are from alarm check valves, dry pipe valves, pre-action valves, deluge valves, riser valves, and sectional drain connections, including drain lines at floor control valves. These drains must be piped outside the building or to a sump pit that can handle a flow of 250 GPM for at least 3 minutes. Size the main drain per NFPA 13.

S. Valves—Above Ground and Within Buildings All control valves must be butterfly valves. Each valve must have a built-in tamper switch and two sets of contacts. Connect the tamper switch to the building fire alarm system as a separate point or zone and as a supervisory alarm (trouble), but not on the same point or zone of any alarm-causing device. All valves must be left hand to open (counter-clockwise).

T. Valves—Underground All curb boxes, post indicator valves (PIVs), and other control valves must be left hand to open (counter-clockwise). All PIVs must include a tamper switch with two sets of contacts.

U. Roof Manifolds

Provide roof manifolds, as required, to test the standpipe system for proper flow and pressure at the top of the most remote riser. Provide all manifolds subject to freezing with a butterfly valve that includes:

1. a tamper switch
2. an auxiliary drain with valve
3. a hose connection and cap above the control valve

V. Pipe Identification

1. Provide color-coded pipe identification markers. Pipe markers must be snap-on laminated plastic with an acrylic coating applied after architectural painting.
2. Provide an arrow marker with each pipe content marker to indicate direction of flow. If flow can be in either direction, use a double-headed arrow marker.
3. Label mains as follows:

   - At points of entry and exit from the mechanical room
   - At points of entry and exit from the building
   - Next to valves
   - On risers
   - At tee fittings
   - At least once in each room
   - At intervals not longer than 20 ft

4. Label piping with SETON pipe marking system as per NFPA13.

Table 2. Pipe Marker Identification

Service	Legend	Background Color
Sprinkler	Sprinkler	Red
Combined Sprinkler - Standpipe	Sprinkler - Fire	Red
Fire	Fire	Red

5. Provide valve tags on fire protection valves and valve charts. Valve tags must list the building and valve number. The chart must be wall-mounted, and its location coordinated with the University Fire Marshal.

6. Piping over electrical switchgear requires special consideration. Piping should be routed clear of such gear if possible. Contact the electrical designer for approval if it is not possible to reroute the piping. See Section 00700: General Design Conditions for drip tray below piping requirements.

7. All standpipes, must be 6" ID, except in the residential colleges where by hydraulic calculation they can be 4"ID.

8. Siamese connectors must use threads designated by the Yale University Fire Marshal.

9. Provide fire plugs with threaded connections per Yale Fire Marshal.

10. Provide NIC portable fire extinguishers. Yale University will specify the size. Portable fire extinguishers are usually mounted in recessed cabinets with doors, and are usually located in egress areas in or near egress stairwells. The Yale University Fire Marshal will determine additional locations. Extinguishers must be mounted with the top a maximum of 60 inches above floor.

2.2 SUBMITTALS

Designer submittals must include the following:

A. Preliminary calculations to determine water flow requirements and the need for a fire pump

B. Fire pump selection and pump curve

C. List of fire protection equipment, including the manufacturers' name and model or catalog number

D. Owner's certificate (as outlined in NFPA 13, Chapter 4)

2.3 PRODUCT STANDARDS

Products must conform to the following standards:

A. Color banding must meet the latest ANSI and OSHA requirements.

B. Use only Underwriters Laboratories- or Factory Mutual-listed items.

2.4 MANUFACTURERS

See Yale Fire Protection Specification, Section 15 31 00.

2.5 MATERIALS

See Yale Fire Protection Specification, Section 15 31 00.

2.6 INSTALLTION GUIDELINES

See Yale design standard for Fire Protection Specialties, Section 15 31 00.

2.7 QUALITY CONTROL

Contractor directions must include the following:

A. Arrange for the testing of completed units of work in successive stages in each area. Do not proceed with the next system and area until the test results for the work completed previously is verified to be in compliance with the design requirements.

B. Provide a contractor's material and test certificate for below- and above-ground piping.

C. Provide the services of a factory-authorized service representative to supervise the field assembly of components and the installation of the fire pump, including piping and electrical connections. Report the results in writing.

D. If incorporating commissioning into this portion of the project, verify that:

1. Specification insertions to this section have been made that reference commissioning procedures and the commissioning specification section.
2. This section does not conflict with commissioning procedures for testing and training.

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