COMBINATION STANDPIPE/SPRINKLER RISERS

Maurice Pilette
Christian Dubay

Editor’s Note: This supplement provides information related to the application of combination standpipe/sprinkler risers and is limited to combination standpipe/sprinkler systems as addressed by NFPA 14, Standard for the Installation of Standpipe and Hose Systems, and NFPA 13, Standard for the Installation of Sprinkler Systems. Guidelines in the application of combination standpipe/sprinkler systems relative to the overall design, water supply, piping, valves, and installation requirements, as determined by NFPA 14 and NFPA 13, are also covered.

OVERVIEW

The primary use of a combination standpipe/sprinkler system piping arrangement is to reduce the use and installation of multiple risers within a building when a sprinkler system and standpipes are required. This arrangement combines the method of the water supply delivery for both the sprinkler system and fire department use to a given location or floor of a building. Combination standpipe/sprinkler systems include control valves, check valves, and flow alarm devices as part of the overall installation requirements. When these devices are installed, coordination with the fire alarm system designer should be completed as part of an overall system design for the building.

System Design

The designer should review the applicable regulatory codes and consult with the authority having jurisdiction (AHJ) and building owner prior to designing a combination standpipe/sprinkler system, and then determine if a combination system is appropriate for a given application or building project. The designer should consider, but not be limited to, the following issues:

- Hazard and risk assessment
- Water supply, municipal or private
- Fire pumps and storage tanks
- Piping system installation restrictions

Maurice Pilette, P.E., Registered Fire Protection Engineer, has 25 years of professional practice, is a member of several NFPA committees, and was the past Chair of the Standpipe committee.

• Listed and/or approved equipment and devices
• Appropriate use and limitations of pressure regulating devices, if applicable
• Testing, inspection, and maintenance feasibility
• Fire department instructions on the use of the equipment
• Equipment and devices, functions integrated with other building fire safety systems
• Overall cost impact

Application
Careful consideration should be given if the combination standpipe/sprinkler system is going to be a system other than a wet-type system. NFPA 14 does not restrict or provide guidelines for the design or installation of a combination system design as an automatic dry pipe, pre-action, or semi-automatic system. A system design other than a wet-type application is considered unique and must be appropriately analyzed for its intended use and application. The use of a dry pipe system can add significant complications and restrictions where interconnected with the sprinkler system. A once common restriction is the prohibition of NFPA 13 against gridded dry sprinkler systems, and in some cases a combined standpipe/sprinkler system can result in a gridded dry sprinkler system due to the cross or interconnection piping. Once the final design applicability parameters, including equipment and performance expectations, have been determined, the criteria of the various flow rates required by NFPA 14 and NFPA 13 and piping installation requirements are expected to be incorporated in the final design.

System Definitions
The main goals for installing a combination standpipe/sprinkler system are to protect life and property and to provide reliable, effective performance for fire fighter safety. Designers, building owners, and others involved in the design process should evaluate each building’s unique design, any new fire protection requirements, and the available equipment technology to determine if a combination system is a good fit for a project, based on the issues of design, installation, testing and maintenance, and cost.

The use of a standpipe and hose system that also provides the necessary water supply for an automatic sprinkler system to a portion of a building is commonly referred to as a combination or combined system. Combination risers are generally restricted to Class I and Class III standpipes, as defined by NFPA 14.

Class I System. A system that provides 2½ in. (65 mm) hose connections to supply water for use by fire departments and those trained in handling heavy fire streams. [14:3.3.15.1]

Class III System. A system that provides 1½ in. (40 mm) hose stations to supply water for use by trained personnel and 2½ in. (65 mm) hose connections to supply a larger volume of water for use by fire departments and those trained in handling heavy fire streams. [14:3.3.15.3]

NFPA 14 defines a standpipe system as follows.

Standpipe System. An arrangement of piping, valves, hose connections, and allied equipment installed in a building or structure, with the hose connections located in such a manner that water can be discharged in streams or spray patterns through attached hose and nozzles, for the purpose of extinguishing a fire, thereby protecting a building or structure and its contents in addition to protecting the occupants. [14:3.3.12]

Standpipe System. This arrangement is accomplished by means of connections to water supply systems or by means of pumps, tanks, and other equipment necessary to provide an adequate supply of water to the hose connections. [14:A.3.3.12]

Additionally, NFPA 14 specifically defines a combined system as follows.

Combined System. A standpipe system having piping that supplies both hose connections and automatic sprinklers. [14:3.3.12.2]

GENERAL INSTALLATION REQUIREMENTS
Role of AHJ and Local Codes
Neither NFPA 13 nor NFPA 14 mandates that combination standpipe/sprinkler systems be installed in buildings that require both standpipes and sprinkler systems. Both standards only establish the design and installation requirements for each respective system. The decision to use a combination standpipe/sprinkler system within a building is generally left up to the discretion of the designer. In some cases, local, state, or a model code may require the use of a combination system in certain buildings, and additional requirements may be mandatory based on those local regulations. The designer must design the combination system in accordance with the requirements of NFPA 14, NFPA 13, and with any additional requirements mandated by the AHJ.

An example of an AHJ requirement that would exceed the requirements established by NFPA 14 and NFPA 13 is a jurisdiction that requires that all floors of a high-rise building be served by a minimum of two combination standpipe/sprinkler systems and that the sprinkler system be cross connected (looped) between a minimum of two
risers or multiple risers as a backup for the sprinkler system water supply to a given floor of a building should one riser be impaired for any reason. Neither NFPA 14 nor NFPA 13 requires the interconnection of risers. However, if it is required as part of the local jurisdiction or design specification requirements, then NFPA 14 and NFPA 13 provide requirements for cross connection of combination system risers.

Where automatic sprinkler systems are cross connected with two or more risers, careful consideration needs to be given to the method of sizing the sprinkler piping. At the discretion of the AHJ or the designer, the hydraulic calculations can be restricted using only one of the combination standpipe/sprinkler risers or the required flow can be split using multiple risers.

One of the reasons that the designer may elect to split the flow between multiple risers is that this approach allows the reduction of sprinkler pipe sizing to the sprinkler system on a given floor. However, should a riser be impaired, the required hydraulic flow rate may not be achieved through a single riser. The AHJ may see it differently and would not necessarily permit the split of flow using multiple risers and might require that the hydraulic calculations use only one combination standpipe/sprinkler riser. This method would provide the hydraulic flow rate per the design should the other riser be impaired. The method of not splitting the hydraulic flows of multiple risers defeats any financial savings that may be achieved by reducing pipe sizing to the sprinkler system, but provides additional reliability since each floor or area will be served by multiple risers each capable of meeting the required hydraulic flow rates.

Use of NFPA 13 or NFPA 14

The designer and the AHJ should understand the criteria for combination systems established by NFPA 14 and NFPA 13. As previously discussed, combination standpipe/sprinkler systems as defined by NFPA 14 are generally limited to Class I and/or Class III standpipes, which require 2 1/2 in. hose valve connections for fire department use and permit the interconnection of the sprinkler system to the standpipe system. Not to be confused with standpipes for fire department use, NFPA 13 establishes requirements for the installation of 1 1/2 in. hose valves and hose stations where required for occupant use, which are connected to the sprinkler system when standpipes are not part of the design or installation requirements. The designs for pipe sizing, type and style of various hose valves, and connections to various portions of the systems are significantly different in scope and application. Effectively, the system is either a standpipe riser with 2 1/2 in. hose valves for fire department use with a sprinkler system attached (NFPA 14 and NFPA 13) or a sprinkler riser restricted to a sprinkler system only with 1 1/2 in. hose valves or hose stations for occupant use (NFPA 13 only).

PIPING AND VALVE INSTALLATION REQUIREMENTS

Pipe Installation

NFPA 14 and NFPA 13 have established similar piping installation requirements for combination standpipe/sprinkler systems. Both 6.3.5 of NFPA 14 and 8.17.5.2.2(1) of NFPA 13 state that “each connection from a standpipe that is part of a combined system to a sprinkler system shall have an individual control valve and check valve of the same size as the connection.” Both standards recognize and have correlated the installation requirements for combination standpipe/sprinkler system piping interconnection. Exhibit S4.1 and Exhibit S4.2 show two typical designs for a combination standpipe/sprinkler system where the sprinkler system pressures exceed 175 psi (12.1 bar).

NFPA 13 does have an additional requirement in the design of combination standpipe/sprinkler systems where the sprinkler system pressures exceed 175 psi, and pressure-reducing valves are required per 8.15.1.2 of NFPA 13. NFPA 14 does not address the NFPA 13 requirement relative to the use of sprinkler system pressure-reducing valves; it requires only that a combination system be provided with a control valve and a check valve. The designer should consider the use of pressure-reducing valves that have been listed as a “combination indicating control valve, pressure-reducing valve and check valve.” If the designer uses valves that are not listed as described above, there would be multiple redundancies in control valve and check valve arrangements required by each standard. The AHJ should be consulted prior to the acceptance of an arrangement that does not meet the requirements of NFPA 14 and NFPA 13. NFPA 14 and NFPA 13 provide identical annex figures to address the interconnection requirements between a sprinkler system and a standpipe system. Exhibit S4.3 and Exhibit S4.4 illustrate these requirements. Additionally, Exhibit S4.5 and Exhibit S4.6 illustrate fire hose valves with floor control at main floor and mid-landing locations, respectively.

Valve Installation

NFPA 14 has the following additional requirements relative to the installation of control valves and check valves.

Where sprinkler system piping supplied by a combined system is supplied by more than one standpipe (“loop” or “dual feed” design), a sign shall be located at each dual or multiple feed connection to the combination sys-
EXHIBIT S4.1 Typical Design for Combination System with System Pressures over 175 psi.

An indicating control valve, check valve, pressure gauge, pressure reducing valve, flow switch, test-drain valve, and pressure reducing fire hose valve are illustrated. The system is designed to indicate that in order to isolate the sprinkler system served by the control valve, an additional control valve or valves at other standpipes shall be shut off. [14:6.3.8.3]

The sign also shall identify the location of the additional control valves. [14:6.3.8.3.1]

Exhibit S4.7 illustrates an interconnection (loop or dual feed) design.

Additionally, NFPA 13 provides the following requirements where a sprinkler system is served from multiple directions or risers.

1. Shut down the sprinkler system for repairs
2. Remove that portion of the sprinkler system connected to the standpipe risers, as required for building area renovations
3. Shut off or limit sprinkler water flow after a fire incident while retaining a necessary unimpaired water supply available for fire department operations at the 2½ in. fire hose valve connection

These requirements ensure that where a combined standpipe/sprinkler system is installed and is interconnected, signs be provided so that when the sprinkler system is to be isolated for maintenance or repair it is clear that the system is supplied from multiple directions. These signs are intended to reduce the potential of disassembly of a pressure-charged sprinkler system and to facilitate rapid shutdown in the event of system damage.

Additionally, the requirements for sprinkler system control valves to permit the shutdown of the sprinkler system for any reason without impairment to the 2½ in. fire department hose valve are intended to ensure that, when at all possible, the standpipe system remain in service. Examples of when a sprinkler system shutdown may be necessary include needing to do the following:
The requirement for a check valve to be included as part of the connection to the sprinkler system is to permit the standpipe riser to be drained and refilled in a limited amount of time should repair be necessary to any portion of the standpipe riser, fire department hose valves, pipe, and fittings, etc. The check valve arrangements shown in Exhibit S4.3 and Exhibit S4.4 permit the standpipe system to be drained while allowing the sprinkler pipe to remain water filled. In general, the check valve between the two systems maintains the water volume supplied within the sprinkler piping, thereby limiting the drain and refill time of the overall combination standpipe/sprinkler system. In addition, when combination risers are cross connected (loop or dual feed), the check valves will limit the flow to the appropriate floor where sprinklers have activated and limit circulation of water throughout multiple levels of the building.

**SYSTEM PIPE SIZING**

**System Pipe Sizing — Fully Sprinklered Buildings**

When sizing the water flow demands for a combination standpipe/sprinkler system, the designer must establish
how the requirements of NFPA 14 and NFPA 13 are to be applied. Where a building requires a standpipe system and a sprinkler system, and the designer plans to utilize the standpipe riser as the water supply for the sprinkler system, then the requirements of 7.10.1.3 in NFPA 14 apply and the requirements of 11.1.5.6 in NFPA 13 apply, since the arrangement will be a combined sprinkler/standpipe system.

**Combined Systems. [14:7.10.1.3]**

For a building protected throughout by an approved automatic sprinkler system, the system demand established by Section 7.7 and 7.10.1 also shall be permitted to serve the sprinkler system. [14:7.10.1.3.1]
A separate sprinkler demand shall not be required. [14:7.10.1.3.1.2]

For a combined system in a building equipped with partial automatic sprinkler protection, the flow rate required by 7.10.1 shall be increased by an amount equal to the hydraulically calculated sprinkler demand or 150 gpm (568 L/min) for light hazard occupancies, or by 500 gpm (1893 L/min) for ordinary hazard occupancies, whichever is less. [14:7.10.1.3.2]

When hose valves for fire department use are attached to wet pipe sprinkler system risers in accordance with 8.17.5.2, the following shall apply:

1. The water supply shall not be required to be added to standpipe demand as determined from NFPA 14, Standard for the Installation of Standpipe and Hose Systems.

2. Where the combined sprinkler system demand and hose stream allowance of Table 11.2.3.1.2 exceeds the requirements of NFPA 14, Standard for the Installation of Standpipe and Hose Systems, this higher demand shall be used.

3. For partially sprinklered buildings, the sprinkler demand, not including hose stream allowance, as indicated in Figure 11.2.3.1.1 shall be added to the requirements given in NFPA 14, Standard for the Installation of Standpipe and Hose Systems. [13:11.1.5.6]

For fully sprinklered buildings, if hose valves or stations are provided on a combination sprinkler riser and standpipe for fire department use in accordance with NFPA 14, Standard for the Installation of Standpipe and Hose Systems, the hydraulic calculation for the sprinkler system is not required to include the standpipe allowance and should be limited to 50 gpm at each hose valve to a maximum of 100 gpm. [13:A.11.1.5.6]

For fully sprinklered buildings, both NFPA 14 and NFPA 13 establish the same requirements in 7.10.1.3.1.1 of NFPA 14 and 11.1.5.6(1) and (2) in NFPA 13. In this case, the system demand requirements from NFPA 14 are compared to the sprinkler system and hose stream requirements of NFPA 13, and the final system demand is the larger of the two values. It should also be noted that where the standpipe demand exceeds the sprinkler and hose stream demands of NFPA 13, 7.10.1.3.1.2 in NFPA 14 specifically states that a separate sprinkler system demand is not required to be added to the standpipe demand, which is already in excess of the required sprinkler and hose demand. (See Exhibit S4.8.)

One common area of confusion involves a fully sprinklered building that does not require a standpipe system but the designer and/or AHJ determine that 2½ in. valves for fire department use should be attached to the sprinkler system. The main difference here is that the sprinkler system will be supplying 2½ in. valves for fire department use, but the system will not be a combined standpipe/sprinkler system. Where this is the case, 8.17.5.1.4 in NFPA 13 applies, and only the inside hose stream requirements from Table 11.2.3.1.2 in NFPA 13 would apply. The requirements of NFPA 14 would not be applicable to this specific arrangement.

**System Pipe Sizing — Partially Sprinklered Buildings**

Determining the combination standpipe/sprinkler system demand in a building protected by a partial automatic sprin-
kler system results in a potential conflict between the requirements of each document. This situation is addressed in 7.10.1.3.2 of NFPA 14 and 11.1.5.6(3) of NFPA 13 in a slightly different way, which can result in differing requirements.

For a combined system in a building equipped with partial automatic sprinkler protection, the flow rate required by 7.10.1 shall be increased by an amount equal to the hydraulically calculated sprinkler demand or 150 gpm (568 L/min) for light hazard occupancies, or by 500 gpm (1893 L/min) for ordinary hazard occupancies, whichever is less. [14:7.10.1.3.2]

For partially sprinklered buildings, the sprinkler demand, not including hose stream allowance, as indicated in Figure 11.2.3.1.1 shall be added to the requirements given in NFPA 14, Standard for the Installation of Standpipe and Hose Systems. [13:11.1.5.6(3)]

Paragraph 7.10.1.3.2 of NFPA 14 requires that standpipe demand from NFPA 14 be increased by the hydraulically calculated sprinkler demand or the specific allowances from 7.10.1.3.2, whichever is less, while 11.1.5.6 of NFPA 13 requires that the sprinkler demand and hose stream required by NFPA 13 be added to the required standpipe demand from NFPA 14. Where the required sprinkler and hose stream demand of NFPA 13 is less than 150 gpm (568 L/min) for light hazard occupancies or is less than 500 gpm (1893 L/min) for ordinary hazard occupancies, then the requirements of NFPA 13 and NFPA 14 are the same and the required sprinkler and hose stream would be added to the NFPA 14 required demand.

However, where the required sprinkler and hose stream demand of NFPA 13 exceeds the limits established in 7.10.1.3.2 of NFPA 14, the requirements of NFPA 13 and NFPA 14 would be different and would result in NFPA 13 requiring a higher flow and NFPA 14 requiring a lower flow. Where both documents are applicable to a partially sprinklered building, this conflict can be avoided by providing the high flow required by NFPA 13. The final design flow would then exceed the minimum requirements of NFPA 14 while meeting the minimum requirements of NFPA 13. (See Exhibit S4.9.)

An example of a combination standpipe/sprinkler riser with partial sprinkler protection in a building would be automatic sprinkler protection for a light hazard occupancy located on the fifth floor of a six-story unsprinklered building. The combination riser would initially be sized for the standpipe flow rate demand of 500 gpm (1893 L/min), which would include 250 gpm (946 L/min) for each remote fire department hose valve on the riser. The added NFPA 14 sprinkler flow rate of 150 gpm (568 L/min) results in a total combined flow of 650 gpm (2460 L/min), and this total flow rate establishes the initial system demand for
the combined standpipe/sprinkler system. At this point the required sprinkler and hose demand for the sprinklered area of the building would be determined and added at the appropriate point(s) of connection to the standpipe system. This demand would then be compared to the demand established by NFPA 14, and the more demanding arrangement should be selected to ensure both the requirements of NFPA 13 and NFPA 14 are met. If there are additional standpipe
risers, those additional standpipe flow rates would be added to the rest of the system piping at the various points of connection. (See Exhibit S4.10.)

**SUMMARY**

The evaluation of a unique building design, new fire protection material, and equipment technology make combination standpipe/sprinkler systems an ongoing challenge impacting design, installation, testing, maintenance, and cost of a combination system, particularly in high-rise buildings. However, the most important challenge to any design is to satisfy the intended purpose of the system and provide reliable, effective performance for fire fighter safety, as well as to protect life and property. In the end, careful planning and design analysis can ensure that the requirements of NFPA 14 and NFPA 13 can be met when providing a combined system.

**REFERENCES CITED**

National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.
