NFSA The Voice of the Fire Sprinkler Industry TechNotes

Editor-Victoria B. Valentine, P.E. Issue # 351 June 14, 2016

Best of May 2016

Following are a dozen questions answered by the engineering staff as part of the NFSA's Expert of the Day (EOD) member assistance program being brought forward as the "Best of May 2016." If you have a question for the NFSA EOD (and you are an NFSA member), send your question to eod@nfsa.org and the EOD will get back to you.

It should be noted that the following are the opinions of the NFSA Engineering Department staff, generated as members of the relevant NFPA technical committees and through our general experience in writing and interpreting codes and standards. They have not been processed as formal interpretations in accordance with the NFPA Regulations Governing Committee Projects and should therefore not be considered, nor relied upon, as the official positions of the NFPA or its Committees. Unless otherwise noted the most recent published edition of the standard referenced was used.

Question 1 – Different Requirements in Different Standards

How should apparently contradictory information between standards be resolved? For example, there appears to be a contradiction in the requirements for sprinklers in rooms containing diesel driven fire pumps in **NFPA 20 (2016) 4.13.1.3** and **NFPA 13 (2016) 22.29.1.7**.

> **4.13.1.3 Fire Pump Buildings or Rooms with Diesel Engines.** Fire pump buildings or rooms enclosing diesel engine pump drivers and day tanks shall be protected with an automatic sprinkler system installed in accordance with NFPA 13 as an Extra Hazard Group 2 occupancy.

> **22.29.1.7 Fire Pumps.** Rooms housing diesel-driven fire pumps should be protected by automatic sprinkler, water spray, foamwater sprinkler, or compressed air foam systems. If sprinkler and water spray protection systems are provided, they should be designed for a density of 0.25 gpm/ft2 (10.2 mm/min) over the fire area. For automatic foam-water sprinkler systems, a density of 0.16 gpm/ft2 (6.5 mm/min) should be provided. [**851**:7.14]

Answer: The answer to this question is that there is no contradiction; the technical committee responsible for **NFPA 851**, *Recommended Practice for Fire Protection for Hydroelectric Generating Plants,* has elected to specify design densities rather than defer to the general

sprinkler, water spray, and foam standards which defer to **NFPA 20**. The requirements contained in **NFPA 13 22.29.1.7** have been extracted from **NFPA 851** and *only* apply in cases where it (or its successor **NFPA 850**) has been specified as a governing document.

NFPA 13 Chapter 22 is intended to bring other standards and recommended practices that may apply sprinkler installation requirements differing from **NFPA 13** to the user's attention when they are in force. In those cases, the reference standard takes precedence over **NFPA 13** as per **22.1.1.2**.

> **22.1.1.2** Where the requirements of the reference standard differ from the requirements of this standard, the reference standard shall take precedence.

It should be noted that, prior to the 2016 edition, **NFPA 20** did not specify Extra Hazard Group 2 protection. It was left to the design professional to determine the appropriate hazard classification for fire pump buildings or rooms enclosing diesel engine pump drivers and day tanks according to **NFPA 13**.

It should also be noted that **NFPA 851** was withdrawn in the Fall 2014 revision cycle. **NFPA 851** material has been incorporated into **NFPA 850**.

Question 2 – Small Rooms and Design Area Size

A project in a 3-story hotel being protected with a **NFPA 13R (2013) wet pipe** sprinkler system. There is an Ordinary Hazard Group 1 (OH1) compartment outside of the dwelling units protected with Quick Response (QR) sprinklers at 130 square-foot spacing. This compartment is greater than 500 square-feet but less than 900 square-feet.

7.2.2 refers to **NFPA 13** for design and discharge calculations (The size of the compartment precludes applying the exception in **7.2.2.1** and **7.2.4** for outside corridors.)

> **7.2.2** The design discharge and design area criteria for areas protected by quick-response sprinklers shall comply with NFPA 13 except as allowed by 7.2.2.1 and 7.2.4.
>
> **7.2.2.1** For compartments 500 ft2 (46 m2) or less that meet all of the following conditions and are protected with quick-response sprinklers, the design area shall be permitted to be limited to the number of sprinklers in the compartment but shall not exceed four sprinklers:
> ....

Applying **NFPA 13 (2013) 11.2.3.2 Density/Area Method**, a density of 0.15 gpm/square-foot over a 1500 square-foot base design area is required. The compartment has ceiling less than 10 feet in height with no ceiling pockets which qualifies it for the 40 percent QR Reduction as per **11.2.3.2.3.1** resulting in a minimum design area of 900 square-feet.

11.2.3.2.3.1 Where listed quick-response sprinklers, including extended coverage quick-response sprinklers, are used throughout a system or portion of a system having the same hydraulic design basis, the system area of operation shall be permitted to be reduced without revising the density as indicated in Figure 11.2.3.2.3.1 when all of the following conditions are satisfied:

(1) Wet pipe system
(2) Light hazard or ordinary hazard occupancy
(3) 20 ft (6.1 m) maximum ceiling height
(4) There are no unprotected ceiling pockets as allowed by 8.6.7 and 8.8.7 exceeding 32 ft2 (3 m2)

Is it necessary to include sprinklers outside of the compartment to make up the remainder of the design area?

Answer: The answer to this question is “yes, if the density/area method is used". When using the density/area method, the existence of walls is essentially ignored to it would be necessary to pick up sprinklers on the adjoining area to complete the required 900 square-feet. Alternatively, the "phantom flow" rules could be applied to pick up sprinklers within a potentially smaller area as detailed in **23.4.4.1.1.4*** with the remainder of the required minimum flow added at the cross main as detailed in **23.4.4.1.1.5**. An article discussing "phantom flow" was published in **NFSA**'s *SQ*, #184, May/June 2014.

23.4.4.1.1.4* Where the available floor area for a specific area/density design criteria, including any extension of area as required by 11.1.2 and Section 12.3, is less than the required minimum design area, the design area shall be permitted to only include those sprinklers within the available design area.

23.4.4.1.1.5 Where the total design discharge from these operating sprinklers is less than the minimum required discharge determined by multiplying the required design density times the required minimum design area, an additional flow shall be added at the point of connection of the branch line to the cross main furthest from the source to increase the overall demand, not including hose stream allowance, to the minimum required discharge as determined above.

Another potential alternative is to use **11.2.3.3 Room Design Method** if the compartment meets the separation requirements of that section.

11.2.3.3.3 To utilize the room design method, all rooms shall be enclosed with walls having a fire-resistance rating equal to the water supply duration indicated in Table 11.2.3.1.2.

11.2.3.3.5 Minimum protection of openings shall be as follows:
....
(3) Ordinary and extra hazard — Automatic or self-closing doors with appropriate fire resistance ratings for the enclosure.

Question 3 – Tire Storage on a Grated Floor Mezzanine

A building at an auto dealership has a 7-foot high double-row tire rack installed on top of a storage mezzanine. The mezzanine deck is grated metal at 9 feet above the main floor level. The storage below the deck is bin box and drawer storage protected as Ordinary Hazard Group 1 (OH1).

How should this tire storage arrangement be evaluated for height of storage?

Answer: The answer to this question is not well defined in **NFPA 13** but, due to the open grate floor of the mezzanine, there is good cause to evaluate the height of tire storage as all the way from the lower floor level to top of the tires stored on top of the mezzanine deck and treat this situation as high pile storage under **Chapter 18**. The subject of mezzanine protection was discussed in more depth in an article in **NFSA**'s *SQ*, #146, January/February 2008.

Question 4 – Riser Protection in Unsprinklered Areas

A retrofit is being conducted in an unoccupied Group F (Factory) occupancy. It is proposed that sprinklers will not be installed in the office portion of the building which is separated from the Group F area. The riser for the system protecting the sprinklered portion of the building will be located in the unsprinklered area.

Does **NFPA 13** require the riser to be enclosed in fire resistance-rated construction?

Answer: It would depend on whether compromising the riser in the unprotected office area would compromise the sprinklered Group F area. If the separation between the sprinklered and unsprinklered portions of the existing building is truly a "fire wall" as per the building code, then it would be regarded as separate buildings. **NFPA 13 (2016) 8.2.6.2** permits the riser to be located in a separate building if acceptable to the AHJ. (Similar language appears in recent previous editions.)

FIRE WALL. A fire-resistance-rated wall having protected openings, which restricts the spread of fire and extends continuously from the foundation to or through the roof, with sufficient structural stability under fire conditions to allow collapse of construction on either side without collapse of the wall. (**IBC**)

8.2.6.2 When acceptable to the authority having jurisdiction, detached structures shall be permitted to be supplied by the fire sprinkler system of an adjacent building.

If not separated by a fire wall, the sprinkler system in the Group F area would have to be regarded as a Limited Area System as per **4.2**.

4.2 Limited Area Systems.
4.2.1 When partial sprinkler systems are installed, the requirements of this standard shall be used insofar as they are applicable.
4.2.2 The authority having jurisdiction shall be consulted in each case.

If this is the case, it would be reasonable to require that the riser and associated supply and distribution piping in the partially protected building must be protected in accordance with **8.16.4.3*** to ensure that a failure of the unprotected riser would not compromise the sprinkler system.

8.16.4.3* Protection of Piping in Hazardous Areas.
8.16.4.3.1 Private service main aboveground piping shall not pass through hazardous areas and shall be located so that it is protected from mechanical and fire damage.
....

If the newly protected Group F area will be regarded as a separate building, then the same concerns would apply as for the sprinklered building. If any "trade ups" have been taken through the building code regarding the separation between the areas based on one of them being fully sprinklered, then the unprotected riser in the unsprinklered area would have to be protected since it is critical to the sprinkler protection in the Group F area.

A similar question about protection of sprinkler piping was addressed in **NFSA** *Tuesday e-Tech Alert*, #67, October 3, 2006.

Question 5 – Building Area Increase with NFPA 13R System

Does the 200% area increase from the IBC apply when a NFPA 13R system is installed?

Answer: The answer is "no". The 300% for single story and 200% area increases are only permitted when NFPA 13 systems are installed. The reason is the difference between the protection criteria of the two standards. NFPA 13R is primarily life safety whereas NFPA 13 is a system offering life safety and property protection, hence, the increase in the size of the property (area).

Question 6 – Miscellaneous Storage Areas and Distances

NFPA 13 (2016) 3.9.1.18 provides the definition of Miscellaneous Storage which raises two related questions:

Does the 1,000 square foot maximum area per pile or area include aisles within the area of miscellaneous storage?

Answer: Yes. When defining areas of miscellaneous storage, the aisle space is counted as well as the area taken up by the rack structures themselves.

Does the 25-foot minimum distance between other storage areas apply to separate storage racks?

Answer: No. It is permissible to have up to 1,000 square feet of miscellaneous storage either low-piled or on racks up to 12 feet. This area would incorporate the aisles between racks. Once the maximum area of 1,000 square feet of storage on racks (including aisles) is reached, a minimum of 25 feet separating this miscellaneous storage from any type of storage (whether it be another area of miscellaneous storage or high-piled storage) is required.

Question 7 – Buildings Connected by a Skybridge

A project consists of two fully sprinklered buildings connected by a skybridge with no fire separation between the two buildings. One of the buildings is required to have a standpipe system due the height above fire department access. The second building does not require a standpipe due to its height above fire department access.

Does the shorter building require standpipes by virtue of being connected to the taller building by the skybridge?

Answer: This depends on the building code. If these buildings are considered two separate buildings under the building code and all provisions of the code such as opening protection are adhered to, then the shorter building should not be required to be provided with standpipes. However, if the skybridge is considered as a required means of egress from the taller building, then a standpipe may be required.

As it was indicated that the skybridge is not provided with fire separation, a dialogue should be opened with the project engineer/architect and the AHJ to confirm the specific requirements for this project and its standpipe system(s).

Question 8 – Back-to-back Sidewall Sprinklers

A proposed sprinkler layout for a parking garage utilizes quick response (QR) sidewall sprinklers installed back-to-back with a concrete beam separating pairs of sidewall sprinklers. The AHJ is questioning this arrangement and feels that the beams separating the sidewall sprinklers create an obstruction leaving the floor immediately under the beams unprotected.

Does this arrangement, back-to-back sidewall sprinklers separated by a beam, meet the requirements of **NFPA 13**?

Answer: Yes, the arrangement described appears to be in compliance with the requirements of **NFPA 13** based on the following sections of the 2016 edition:

> **8.7.3.1.4** Sidewall spray sprinklers shall not be installed back-to back without being separated by a continuous lintel or soffit.

> **8.7.3.1.4.1** The maximum width of the lintel or soffit shall not exceed 16 in. (400 mm).

The arrangement described meets these requirements assuming the width of the beam does not exceed 16 inches; sidewall sprinklers are installed back-to-back and separated by a beam which acts as a lintel. If the width of the beam does exceed 16 inches, then pendent sprinklers must be installed under it.

The 16-inch maximum width comes from section **8.7.4.1.3.2** which states that when a sidewall sprinkler is installed in the face of a soffit, additional sprinklers are not required below a soffit that is 8 inches or less in width. For back-to-back sprinklers, the allowable soffit width is doubled to 16 inches (8 inches per sprinkler).

In must be noted the 2013 and earlier editions of **NFPA 13** in section **8.7.4.1.3.2** stated that the sidewall sprinkler was required to be installed within 4 inches of the bottom of the soffit . This requirement was removed from the 2016 edition with the following substantiation:

> *"When the 8-inch rule was originally accepted, the idea was not to get direct water spray from the sprinkler back behind the soffit. The idea was to define a small area where direct water spray would not be necessary and a curtain of water would drop straight down from the soffit preventing fire spread beyond the 8-inch width space. There are times when the sprinkler cannot be located within 4 inches of the bottom of a soffit and there is no need to put a pendent sprinkler under such a skinny object."*

As this committee substantiation makes clear, the committee allows each sidewall sprinkler to have up to an 8 inch "dry area" behind it. As there are two back-to-back sprinklers, each is allowed an 8 inch dry area for a total of 16 inches. Although the area directly under the beam might not be directly in the spray pattern of the sidewall sprinklers, this is permitted by the standard and would not be considered "unprotected".

> **8.7.4.1.3.2*** Where soffits used for the installation of sidewall sprinklers are less than or equal to 8 in. (200 mm) in width or projection from the wall, additional sprinklers shall not be required below the soffit when the sidewall sprinkler is installed on the soffit.

The other issues that should be included in this decision are that parking garages are typically considered ordinary hazard spaces so the sidewall sprinkler must be listed for ordinary hazard and the ceiling must be of flat smooth construction in order to use sidewall sprinklers in this application.

Question 9 – Using the ESFR Shift Rule without Structural Obstructions

An ESFR system has branch lines that are spaced 8 feet apart. The sprinklers on the branch lines are at spaced at 11 feet on-center for a resulting area of operation of 88 square-feet per sprinkler. The maximum permissible spacing between branch lines for ESFR sprinklers per **NFPA 13 (2016) 8.12.3.1(2)** is 10 feet.

> **8.12.3.1 Maximum Distance Between Sprinklers.** The maximum distance between sprinklers shall be in accordance with the following:
> ....
> **(2)** Unless the requirements of 8.12.3.1(3) or 8.12.3.1(4) are met, where the storage height exceeds 25 ft (7.6 m) and ceiling height exceeds 30 ft (9.1 m), the distance between sprinklers shall be limited to not more than 10 ft (3.0 between sprinklers.
> ....

It appears that the "ESFR shift rule", **8.12.2.2.3** and **8.12.3.1(3)**, has been applied to extend the spacing of *all* sprinklers on *all* the branch lines to 11 feet.

> **8.12.3.1 Maximum Distance Between Sprinklers.** The maximum distance between sprinklers shall be in accordance with the following:
> ....
> (3)*Regardless of the storage or ceiling height arrangement, deviations from the maximum sprinkler spacing shall be permitted to eliminate obstructions created by structural elements (such as trusses, bar joists, and wind bracing) by moving a sprinkler along the branch line a maximum of 1 ft (300 mm) from its allowable spacing, provided coverage for that sprinkler does not exceed 110 ft2 (10.2 m2) where all of the following conditions are met:
> (a) The average actual floor area protected by the moved sprinkler and the adjacent sprinklers shall not exceed 100 ft2 (9.3 m2).
> (b) Adjacent branch lines shall maintain the same pattern.
> (c) In no case shall the distance between sprinklers exceed 12 ft (3.7 m).
> ....
> **8.12.2.2.3*** Deviations from the maximum sprinkler spacing shall be permitted to eliminate obstructions created by structural elements (such as trusses, bar joists, and wind bracing) by moving a sprinkler along the branch line a maximum of 1 ft (300 mm) from its allowable spacing, ...

Is the intent of **8.12.2.2.3** to only permit *one row of sprinklers* to be shifted up to one foot along the branch lines or to move *a single branch line* up to one foot above the maximum permissible spacing and only in the case of structural obstructions?

Answer: Yes, the intent of the rule is to allow only a single row of sprinklers *or* a single branch line to be shifted up to one foot beyond its normally permissible spacing and *only in order to avoid conflicts with structural obstructions*. It can be argued that the "Shift Rule" can be applied

multiple times in the same ESFR system but this typically limits its use to a maximum of every other row or branch and it can still *only* be used in the event of structural obstructions -- it is not permissible to apply the rule to increase the maximum permitted space between sprinklers for reasons that are not related to the structural components of the building.

Question 10 – Sprinklers Placed Beneath Wide Obstructions

NFPA 13 (2016) 8.5.5.3.1.1 directs the location of sprinklers placed below wide obstructions.

> **8.5.5.3.1.1** Sprinklers shall be located below the obstruction and not more than 3 in. (75 mm) from the outside edge of the obstruction.

What is the intent of this section?

Answer: The intent is that sprinklers may be placed below the level of the obstruction anywhere within the outline of the obstruction *plus 3 inches beyond the obstruction* as it would appear in the plan view. The language is ambiguous and can be read to imply that the sprinkler(s) must be within 3 inches of the outside edge *even if it is placed under the obstruction*. The actual intent is to permit the sprinkler(s) to be placed within 3 inches *adjacent* to the obstruction as well as anywhere under it. This allowance is the result of fire testing demonstrating that sufficient heat will be trapped and directed across the sprinkler(s) as long as it is directly under or very nearly under the obstruction.

Horizontally, the sprinkler(s) must be located either (1) anywhere directly below the obstruction as it would appear in plan view or (2) not directly below the obstruction but within 3 inches of the obstruction's outside edge as it would appear in plan view. If the second option is chosen then the sprinkler(s) is not shielded from sprinklers above so an intermediate level rack type sprinkler must be used as per **8.5.5.3.1.2** to reduce the possibility of cold soldering.

> **8.5.5.3.1.2** Where sprinklers are located adjacent to the obstruction, they shall be of the intermediate level rack type.

Vertically, the sprinkler(s) must be located within 12 inches below the bottom of the obstruction as per **8.5.5.3.1.3** regardless of where they are placed horizontally.

> **8.5.5.3.1.3** The deflector of automatic sprinklers installed under fixed obstructions shall be positioned no more than 12 in. (300 mm) below the bottom of the obstruction.

Question 11 – Single Interlock Design Area Increase

NFPA 13 (2016) 11.2.3.2.5 and **12.5** details design area increases for dry pipe and preaction systems. Single interlock preaction systems are exempt from the 30% design area increase in **Section 11** but not in **Section 12**.

> **11.2.3.2.5* Dry Pipe and Double Interlock Preaction Systems.** For dry pipe systems and double interlock preaction systems, the area of sprinkler operation shall be increased by 30 percent without revising the density.

> **12.5 Dry Pipe and Preaction Systems.** For dry pipe systems and preaction systems, the area of sprinkler operation shall be increased by 30 percent without revising the density.

Why are the storage rules more stringent?

Answer: In storage situations, the assumption is not made that the detection system would react before the sprinkler system. This could potentially lead to a delay in water delivery so the single interlock preaction exception is not allowed. This is discussed in more detail in an article in **NFSA**'s SQ, #167, July/August 2011.

Question 12 – Which Direction is Parallel / Perpendicular to a Roof Slope?

NFPA 13 (2007) Table 8.6.2.2.1(a) contains entries which list the maximum permissible spacing for sprinklers under steeply sloped roofs (4 in 12 or steeper). The maximum sprinkler spacing is dependent on whether the distance is measured parallel or perpendicular to the slope.

Which direction is considered parallel to the slope?

Answer: The answer to this question is that the direction "parallel" to the slope is the direction moving directly up or down the slope. The direction moving across the slope is "perpendicular". In other terms, a pipe running *perpendicular* to the slope does not change elevation. A pipe running *parallel* to the slope changes elevation.