NATIONAL FIRE SPRINKLER ASSOCIATION, INC.

Tuesday e-Tech Alert
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Number 82

Best Questions of April 2007

We have selected the following questions as the "best of April 2007" answered by the engineering staff as part of the NFSA "Engineer of the Day" member assistance program:

Question 1 – Intent of Earthquake Bracing

I have three questions relating to sway bracing using the 2002 edition of NFPA 13.

1). Is the purpose of sway bracing to prevent the lateral and longitudinal movement of overhead/horizontal piping only?
2). Should the sway bracing for the riser be attached to the wall or the roof system?
3). Are all sway braces intended to deal with vertical motion from an earthquake?

Answer: The answer to the first question is "no". Lateral and longitudinal bracing are required not only for horizontal piping such as mains and large branch lines, but also on vertical piping such as risers. This is evident in Section 9.3.5.5, which specifically addresses sway bracing for risers.

With regard to the second question, while the figures in the annex of NFPA 13 demonstrate a preference for the top of the riser to be braced to the roof structure, it is acceptable to attach the sway bracing required at the top of the riser to either the roof structure or the top of the wall. Sway braces that are listed to attach to the wall are often those that look like a "V" in the plan view, allowing them to act as both longitudinal and lateral braces. These should be attached below the flexible couple at the top of the riser, which will allow them to move properly with the building. This is consistent with the requirement of 9.3.2.3(7) for flexible couplings above and below intermediate points of support for a riser. A four-way brace that is installed attached to the roof structure will typically be the same type of bracing that is used on the mains of the system, but located very near the riser to pick up that load. This type of brace would be attached above the flexible coupling, again so that the attachment is not stressed if the roof/ceiling moves relative to the tops of the walls.

Your third question asks about vertical earthquake loads. In general, upward vertical loads are assumed to be offset by gravity and downward loads assumed to be addressed sufficiently by safety factors in system hangers. Section 9.3.5.7 addresses the net vertical seismic forces from strong horizontal loads. It states, "Where the horizontal force factors used exceed 0.5 Wp and the brace angle is less than 45 degrees from vertical or where the horizontal force factor exceeds 1.0 Wp and the brace angle is less than 60 degrees from vertical, the braces shall be arranged to resist the net vertical reaction produced by the horizontal load." This indicates that only when the horizontal forces are large is the system intended to be specially braced for the seismic net vertical reaction. It should be noted that this section was mis-titled in the 2002 edition of NFPA 13 but has been corrected for the 2007 edition as "Net Vertical Reaction Forces." In addition, it

should be noted that the standard does not specifically cover how the vertical reaction should be addressed. It is common to use items such as "surge clips" on hangers or to run the rod to the top of pipes to limit the amount of possible movement.

Question 2 - Drooping Insulation Obstructing Sprinklers

A new school is being built with sprinklers above the ceiling protecting the combustible roof assembly. The insulation between the joists is fiberglass batts with no backing. There lies the problem - the insulation is falling out of the space and could either impede the operation of a sprinkler or impede the flow of heat. As an AHJ, what section in NFPA 13 can I use to require a correction? I am aware of fire code and building code issues that will assist and will use them. I would also like to be able to reference NFPA 13.

Answer: The rules for keeping sprinklers clear of obstructions are scattered throughout Chapter 8 of NFPA 13 (2002 edition) depending on the type of sprinkler. If the sprinklers in question are standard spray upright sprinklers, the rules are in section 8.6.5. If the sprinklers in question are extended coverage sprinklers, then the rules are in section 8.8.5. If the building is still under construction, these sections can be cited. Once the building has been approved and occupied, NFPA 13 no longer has jurisdiction but NFPA 25 can be used to ensure that the sprinkler system is maintained in an operational condition. In fact, Section 18.1 of NFPA 13 mandates that NFPA 25 be followed for the correct maintenance of a sprinkler system. Section 5.2.1.2 of NFPA 25 (2002 edition) states the situation much more clearly than anything in NFPA 13: “Unacceptable obstructions to spray patterns shall be corrected.” In the 2007 edition this will be modified to read: “The minimum clearance required by the installation standard shall be maintained below all sprinklers. Stock, furnishings or equipment closer to the sprinkler than the clearance rules allow shall be corrected.” This revised wording will still address the situation at hand. In general, however, building codes require all products and materials to be installed correctly, so the building code would be the proper vehicle to require that batt insulation be properly secured.

Question 3 - Sprinkler Closet Dimensions

Can you tell me what the minimum inside dimensions for a 6-inch sprinkler riser closet should be? The architect is asking if a 30-inch wide 7-inch deep closet with double doors to the outside will work. I can't find any design standards.

Answer: There is no standard for this situation, since every installation is different depending on the equipment being installed on the riser. For example, a Reliable Model E wet alarm valve can be anywhere from 29 inches wide to 12 inches wide depending on the trim arrangement. A six inch Model D dry-pipe valve takes up 37 inches for the valve and trim. In addition to being concerned about the size of the valves and equipment in the space, you also need to be concerned about having enough room for someone to access the equipment and turn a wrench or use other appropriate tools. A foot or two around all equipment is a reasonable minimum for workers to use to physically install the equipment. While a smaller closet may save money due to reduced floor area, it will increase the cost of system installation and long-term maintenance.

Question 4 – Four-way Bracing at Tops of Riser Nipples

Section 9.3.5.5.1 of NFPA 13 (2007 edition) states: “Tops of risers exceeding three feet in length shall be provided with a 4-way brace.” Per Section 3.5.5: the definition of “riser” is: “The vertical supply pipe in a sprinkler system.” If I have ten branch lines 8 feet apart and each line is fed from

a three foot six inch riser nipple, are they required to be seismically braced? If so, am I still required to place redundant bracing on the main?

Answer: You have asked if riser nipples that are 3 feet or longer need to have a four-way brace at the top of them. The answer is "no." The intent of the Committee is to brace the mains of the system to maintain rigidity to the ceiling/roof assembly. The riser nipple, although connected to the main, is generally considered to be part of the branch line piping. The Committee sometimes uses the term "riser" but intends "system riser", such as for the four-way brace requirement. The four-way brace is required for risers on mains where there is a change in elevation of 3 feet or more. Requiring a four-way brace at the top of a riser nipple would conflict with concepts laid out in the Hanging and Bracing chapter. First, the branch lines of a system only require lateral bracing when they are 2-1/2 inches or larger in diameter. Even then, however, longitudinal bracing is not required for branch lines. Also, note that the Committee uses similar language with the hanging rules, addressing support of "risers" in Section 9.2.5. Yet these requirements are not applied to riser nipples.

It should be noted that once the riser nipple is 3 feet long, it is required to have a flexible coupling in it per Section 9.3.2.3(1)(b). If the riser nipple is 7 feet or longer, it would be required to have two flexible couplings, both at the top and bottom. These requirements do need to be applied to riser nipples in earthquake areas as clearly noted in the flexible coupling criteria of Section 9.3.2.3(1).

Question 5 – 1-1/2-in Hose Connections in Valve Cabinets

I am working on a six story hospital building with three full stairways with standpipes and one partial stairway with standpipe. The building is fully sprinklered. There are several locations specified by the engineering consultant for valves in cabinets, due to horizontal egress issues. Am I allowed to supply these 1-1/2-inch valves with the floor sprinkler piping, or must I supply these from a dedicated run of piping from the standpipe? One way would allow use of the 1-1/2-inch valves while turning off the sprinkler supply for the floor. The other way would shut off the supply to the 1-1/2-inch valves when you shut off the supply to the sprinklers on the floor.

Answer: You have asked if 1-1/2-inch hose valves in cabinets can be taken from the sprinkler system, or whether they must be separately supplied from dedicated piping. Since you have indicated these valves are required due to egress issues, it would indicate that they are being supplied as part of a Class II or III (combined Class I and II service) standpipe system. NFPA 14 requires (Section 7.3.3.1 in the 2007 edition) that Class II hose stations be provided such that all portions of each floor level are within 130 ft of a hose station provided with 1-1/2 in. hose or 120 ft of a hose station provided with 1-1/4 in. hose. Distances are measured along a path of travel originating at the hose connection. The 2-1/2-inch Class I hose connections, however, are provided only at main floor landings in exit stairways, which explains why additional 1-1/2-inch stations are planned.

The 1-1/2-inch Class II standpipe hose stations are not the same as the 1-1/2-inch hose connections to sprinkler systems allowed by NFPA 13 for storage occupancies. They have different flow and pressure requirements, and in fact are separately listed by Underwriters Laboratories. The inlet for the standpipe hose stations are 1-1/2-inch in diameter, while those for sprinkler system hose connections are 1-inch. Although the piping serving a standpipe hose station can be taken from a combined riser, it cannot be taken from sprinkler system piping.

It should be noted that NFPA 14 (Section 7.3.4.1 in the 2007 edition) permits the elimination of the Class II hose stations, subject to the approval of the authority having jurisdiction, in fully sprinklered buildings, provided that each Class I connection is equipped with a 2-1/2 x 1-1/2 inch reducer and cap attached with a chain. As such, the authority having jurisdiction is in a position to waive the Class II hose stations in a fully sprinklered building, or to substitute the use of 1-1/2-inch hose connections from the sprinkler system. There is precedent for this equivalency in documents such as the NFPA 101 Life Safety Code, which allows either type of hose connection to serve 1-1/2-inch hose lines provided for the protection of stages (Section 12.4.5.12.2 in the 2006 edition).

Question 6 - Replacement of Dry Pipe Schedule System

An existing dry pipe system for an ordinary hazard Group 2 occupancy needs to be replaced because of deterioration. The original system was installed as a pipe schedule system. We are planning to remove all of the piping and sprinklers and replace with a galvanized pipe sprinkler system at the same location. Can we use the use the pipe schedule with a dry system in accordance with the 2002 edition of NFPA 13? Our jurisdiction adopts the International Fire Code.

Answer: You have asked if the 2002 edition of NFPA 13 permits an existing pipe schedule dry pipe sprinkler system to be replaced with a new galvanized dry pipe sprinkler system using the same pipe schedule. Assuming the size of the system exceeds 5,000 ft^2, the answer is "no", unless it can be shown that the flows required by Table 11.2.2.1 are available at a minimum residual pressure of 50 psi at the highest sprinkler. Although Section 11.2.2.3 makes an exception for "additions or modifications to existing pipe schedule systems", it is not the intent of NFPA 13 to allow a replacement system to be considered a modification of the existing system.

Obviously, the option exists for changes to the system to be made piecemeal, as "repairs" to the system piping. However, this would require the approval of the authority having jurisdiction, specifically the code enforcement official for the jurisdiction. As an example, consider the 2003 edition of the International Building Code. Although Section 105.2 appears to exclude the need for a permit for work on mechanical systems such as "replacement of any part which does not alter its approval or make it unsafe", Section 105.2.2 more specifically addresses "Repairs" and states: "Application or notice to the building official is not required for ordinary repairs to structures…such repairs shall not include…addition to, alteration of, replacement or relocation of any standpipe, water supply, sewer, drainage, drain leader, gas, soil, waste vent or similar piping, electric wiring or mechanical or other work affecting public health or general safety." Since sprinkler piping can be considered similar to standpipe piping and obviously affects public safety, it is clearly the intent of the Code in this example that a permit be issued for repairs to sprinkler systems. The code official would then decide whether the changes in piping were in fact repairs or whether the work constituted a replacement system that would be required to meet the requirements of the NFPA 13 standard referenced by the building code.

Question 7- NFPA 13R Areas of Protection

I'm hoping to get a few answers regarding 13R (2002 edition) issues.

1. A common lounge / cooking area to a dormitory floor is approximately 870 sq ft and is a compartmented area. Do I understand Section 6.7.2.2 correctly that demand for this area is limited to the total number of sprinklers needed to cover the room and that the 4-sprinkler minimum does not apply?

2. The entry foyer into the building has 12-ft ceilings. Does 6.7.2.3 prohibit residential sprinklers from being used and therefore 6.6.7.2.1 requires quick response sprinklers?
3. The first floor of this building has a poured concrete deck at a 10 ft elevation. During construction a wooden ceiling (plywood) was constructed at approx 8 ft 6 inches. During a renovation project, suspended (steel track) ceilings were installed at 7 ft 6 inches and the wooden ceiling was left in place. Does Section 6.8.5 exclude the space above the wooden ceiling and below the concrete deck from sprinkler coverage?

Answer: The answer to your questions first depends on whether the Authority Having Jurisdiction considers the lounge/kitchen and entry foyer areas to be inside the dwelling unit or outside the dwelling unit. There are many dormitories and fraternity houses where these common spaces still meet the definition of being inside the dwelling unit since the spaces are similar to the spaces in a single-family dwelling and can be protected with residential sprinklers using a four-sprinkler design. If the kitchen is more like a commercial kitchen that is set up for cooking large batches of food for groups, then the space is probably outside the dwelling unit, and other parts of the building like the entry foyer might be treated likewise. But if the kitchen has appliances similar to a single-family dwelling and will be used for preparing similar size meals, then it might be considered part of the dwelling unit.

If you decide that the lounge/kitchen is outside the dwelling unit, then you need to make a choice between using section 6.7.2.1 or section 6.7.2.2. In order to use section 6.7.2.2, the rooms need to be divided into compartments not exceeding 500 sq ft. If rooms are bigger than 500 sq ft, then you are forced to use section 6.7.2.1 and use quick response sprinklers in accordance with NFPA 13. Note that you only go to NFPA 13 for information on the four specific items listed – there is no intent to apply all aspects of NFPA 13.

You are correct that section 6.7.2.3 prohibits the use of residential sprinklers where ceiling heights are greater than 10 ft in areas outside the dwelling unit. However, this restriction was eliminated in the 2007 edition of the standard. Residential sprinklers will work as well as other sprinklers in such spaces. If you are in a jurisdiction where the AHJ is going to hold you to the 2002 edition, quick response sprinklers will be required in accordance with NFPA 13.

With regard to the final question, Section 6.8.5 permits sprinklers to be omitted from all concealed spaces in the building, wherever they may be and however they are constructed. This is a departure from NFPA 13, but is permitted by NFPA 13R in order to promote sprinkler protection for life safety purposes.

Question 8 – Sprinklers in Rooftop Air Handling Units

There is an Air Handling Unit (AHU) on the roof of a new 5-story hospital. The AHU has a small walkway for maintenance, etc. The AHU is separated from the elevator penthouse by fire rated walls, and sits on top of a crawl space which is on top of the roof. Are sprinklers required in the AHU or parts of the AHU? If only in parts, which parts?

Answer: In general, sprinklers are not required inside of mechanical equipment, especially when that equipment is on the roof of a building. It is considered outside the envelope of protection contemplated by NFPA 13. The exception to this rule is for water cooling towers, which are required to be sprinklered under a separate standard -NFPA 214. Unlike NFPA 214, NFPA 90A addresses air handling units for HVAC systems and does not specifically require sprinklers in air handling units.

Question 9 – Accumulated Standpipe Flows for Large Buildings

I have a question regarding the amount of water we need to calculate for a Class I standpipe. The 2003 edition of NFPA 14, Section 7.10.1.1.3, sets the maximum accumulated flow for standpipes in a fully sprinklered building at 1000 gpm (500 for the most remote and 250 for each additional up to a maximum of 1000). Section 7.10.1.1.4.1 states when the floor area exceeds 80,000 sq. ft. the second most remote standpipe shall also be designed for 500 gpm. Does the requirements of 7.10.1.1.4.1 change the total accumulated flow requirement for the standpipes in a building with more than 80,000 sq. ft. per floor to 1250 gpm?

Answer: The 1000 gpm maximum flow for standpipe systems in sprinklered buildings applies regardless of whether or not the building is greater than 80,000 sq ft. If the building is less than 80,000 sq ft, then the 1000 gpm will be delivered through three standpipes (500 + 250 + 250). If the building is greater than 80,000 sq ft, then the 1000 gpm will be provided through two standpipes (500 + 500). Admittedly the language of NFPA 14 is unclear on this subject and NFSA will be submitting a proposal to revise it in the future.

Question 10 – Defining "Center of Tile"

Is there an accepted industry standard on the tolerances associated with "center of tile" specifications for placing sprinklers within suspended ceilings?

Answer: No. The NFSA Engineering and Standards Committee discussed this issue at its March 2000 meeting, and concluded that "center of tile" means centered in both directions, not just one. However, the discussion did not lead to a definitive tolerance. The main problem is that the pattern of the tile can affects the intent of the architect as well as the degree to which a small deviation from true center is acceptable. If the tile is 2 x 4 (2 ft x 4 ft), but the embossed pattern makes it look 2 x 2 or 1 x 1, then the architect really might want the quarter-point of the tile, not the center. However, if the tile is 2 x 2 or 1 x 1 and the architect specifies "center of tile" he should be given the center of the tile.

It is well established that the Authority Having Jurisdiction controls allowable tolerances in NFPA standards. Since NFPA 13 does not address aesthetics, this type of tolerance would need to be in accordance with project specifications as interpreted by a "reasonable man." The acceptable distance of a sprinkler from true center will vary based on the pattern of the tile and other factors that may be relative to the specific ceiling.

Question 11 - Swimming Pool Overhead Protection

Does an indoor swimming pool without seating area for a crowd and with supplies and water pump in separate rooms need to be sprinklered overhead? If not, does the walkway around the area need to be protected, even if it is only 4 ft wide?

Answer: Yes, an indoor swimming pool needs to be protected, regardless of other items that may or may not be in the room. Frequently, indoor pools can be covered and can support significant weight as an assembly space (remember the scene in *It's a Wonderful Life* when they dance on top of the pool?) A pool that is no longer in use and is drained sometimes becomes a repository for miscellaneous storage.

Question 12 – Alternate Schedule Pipe Used as Earthquake Bracing

I'm trying to do some seismic bracing calculations and trying to determine the maximum horizontal loads for sway braces with l/r=200. I'm using 1-1/4-inch Schedule 30 pipe. Table 9.3.5.8.9(b) in the 2002 edition of NFPA 13 gives values for all three different angle ranges for Schedule 40 pipe. My question is how do I adjust these values for Schedule 30 pipe?

Answer: You have asked how to adapt Table 9.3.5.8.9(b) values from the 2002 edition of NFPA 13 for the use of 1-1/4-inch Schedule 30 steel pipe rather than Schedule 40 pipe. When these tables were first developed, Schedule 10 values were included alongside those for Schedule 40 braces. You can refer to the 1991 or 1994 edition of the standard for the Schedule 10 values. (They also appeared in the 1987 and 1989 editions but were mislabeled, reversed with the Schedule 40 values). Schedule 30 pipe has never been addressed, but the deviations for Schedule 30 compared to Schedule 40 will be on about the same scale as those between Schedule 10 and Schedule 40 except in the opposite direction. Because Schedule 30 pipe is not commonly used in fire sprinkler applications, there is no reference to the Schedule 30 dimensions for smaller pipe sizes in our commonly referenced ASTM pipe standards.

There are two aspects to the table, maximum length and maximum loads. Maximum length is based on slenderness ratio l/r where r is the least radius of gyration. The table shows the formula for determining least radius of gyration r based on the pipe inner and outer radii. Schedule 30 pipe would have the same outer radius but a smaller inner radius (make sure you don't use the diameter values), so the least radius of gyration will be less than that of Schedule 40 pipe. The maximum length for l/r = 200 will therefore be slightly smaller than for Schedule 40. Maximum loads, however, as explained in the *NFPA Sprinkler Handbook* commentary (see page 389 in the 2002 edition) are calculated based on Euler's formula for buckling of long columns, where the maximum axial load is calculated as $P=AE\pi^2 / (l/r)^2$.

Note that the commentary contains a typo. As shown above, the denominator of the equation should be the slenderness ratio squared. Although the values for modulus of elasticity E should be the same for the two schedules of pipe, the cross-sectional area of the Schedule 30 will be larger based on the thicker wall, leading to a higher allowable axial load. The axial load values are then reduced for the ranges of angles from vertical given in the table. Continuing with the procedure shown in the *Sprinkler Handbook* commentary, the three sets of loads are found by multiplying the allowable axial load by factors of 0.5, 0.707, and 0.867.

It should be noted that, for the 2007 edition of the standard, the loads in the table were further reduced to approximately 70 percent of their former values so that 40 percent could be added back in to account for the differences in stress vs. strength design when applying the simplified approach to determining earthquake loads. However, this is not relevant if you are not planning to use the simplified approach of the 2007 edition of the standard.

Upcoming NFSA "Technical Tuesday" Online Seminar – May 8th

Topic: Changes to the Residential Sprinkler Standards
Instructor: Kenneth E, Isman, P.E., NFSA Vice President of Engineering
Date: May 8, 2007

This seminar will discuss the major changes in the 2007 editions of NFPA 13R and NFPA 13D. Included in the discussion for this seminar will be a complete analysis of how to handle obstructions to residential sprinklers and the use of residential sprinklers under ceiling configurations that were not contemplated during the listing process.

Information and registration for this seminar is available at www.nfsa.org or by calling Dawn Fitzmaurice at 845-878-4200 ext. 133 or email: dawn@nfsa.org.

Upcoming NFSA "Business Thursday" Online Seminar – May 17th

Topic: Construction Defect Laws
Instructor: Buddy Dewar, NFSA Director of Regional Operations
Date: May 17, 2007

The cost of correcting construction defects can be quite expensive but often pails to the cost of litigation that may or may not accompany the conflict. Often fire sprinkler contractors are faced with litigation to correct construction defects caused by other trades. And this litigation often leads to negative insurance claim history that surface during renewal periods. This seminar reviews legislation that has passed many state Legislatures and details language necessary for inclusion in legislation to help protect the contractor. A sample draft law will be provided.

Information and registration for this seminar is available at www.nfsa.org or by calling Dawn Fitzmaurice at 845-878-4200 ext. 133 or email: dawn@nfsa.org.

Additional NFSA Training Opportunities

Two-Week Technician Training Seminar

September 24- October 5 *Kansas City, MO*

This seminar, the last available for 2007, also serves as a starting point for the NFSA's two-year Certificate Program for Fire Sprinkler Technicians. For more information, contact Nicole Sprague at 845-878-4200 ext. 149 or email: Sprague@nfsa.org.

3-day Advanced Technician Training Classes

July 24-26	*Chicago, IL*
September 5-7	*St Louis, MO*

For more information, contact Nicole Sprague at 845-878-4200 ext. 149 or email: Sprague@nfsa.org.

NICET Inspector Certification Review Classes

May 22-24	*Anchorage, AK*
June 19-21	*Wilmington, DE*
August 14-16	*San Antonio, TX*
November 6-8	*Providence, RI*

For more information, contact Nicole Sprague at 845-878-4200 ext. 149 or email: Sprague@nfsa.org.

In-Class Training Seminars

NFSA also offers in-class training on a variety of subjects at locations across the country. Here are some upcoming seminars:

May 2 Foam Water Systems (1/2 day) (AM)////Las Vegas, NV
May 2 Advanced Pump Layout Procedures (1/2 day)(PM)////Las Vegas, NV
May 8 Inspection, Testing & Maintenance////Colorado Springs, CO
May 9 Residential Sprinklers Homes to High-Rise////Colorado Springs, CO
May 10 Underground Piping (1/2 day) (AM)////Colorado Springs, CO
May 10 Standpipe Systems (1/2 day) (PM)////Colorado Springs, CO
May 15-16 Two-day NFPA 13 Overview & Intro to Plan Review////Richmond, CA
May 17 Inspection, Testing & Maintenance////Richmond, CA
May 29 Introduction to Sprinkler Systems (1/2 day)(AM)////Southfield, MI
May 29 NFPA 13 2002 Update (1/2 day)(PM)////Southfield, MI
May 30 Sprinkler Protection for General Storage////Southfield, MI
May 31 Sprinkler Protection for Rack Storage////Southfield, MI
May 29-30 Two-day NFPA 13 Overview & Intro to Plan Review////Rogers, AR
May 31 Hydraulics for Fire Protection////Rogers, AR
June 5-6 Two-day NFPA 13 Overview & Intro to Plan Review////Anchorage, AK
June 7 Inspection, Testing & Maintenance////Anchorage, AK
June 5-6 Two-day NFPA 13 Overview & Intro to Plan Review////Willoughby, OH
June 7 Underground Piping (1/2 day) (AM)////Willoughby, OH
June 7 Advanced Pump Layout Procedures (1/2 day)(PM)////Willoughby, OH
June 5 Hydraulics for Fire Protection////Albany, NY
June 6 NFPA 13 2002 Update////Albany, NY
June 7 Pumps for Fire Protection////Albany, NY
June 12-13 Two-day NFPA 13 Overview & Intro to Plan Review////Holland, MI
June 14 Hydraulics for Fire Protection////Holland, MI
July 31 Introduction to Sprinkler Systems (1/2 day)(AM)////Pataskala, OH
July 31 Underground Piping (1/2 day) (PM)////Pataskala, OH
Aug 1 Pumps for Fire Protection////Pataskala, OH
Aug 2 Sprinkler Protection for Rack Storage////Pataskala, OH

For more information or to register, visit www.nfsa.org or call Michael Repko at 845-878-4207 or email: seminars@nfsa.org.