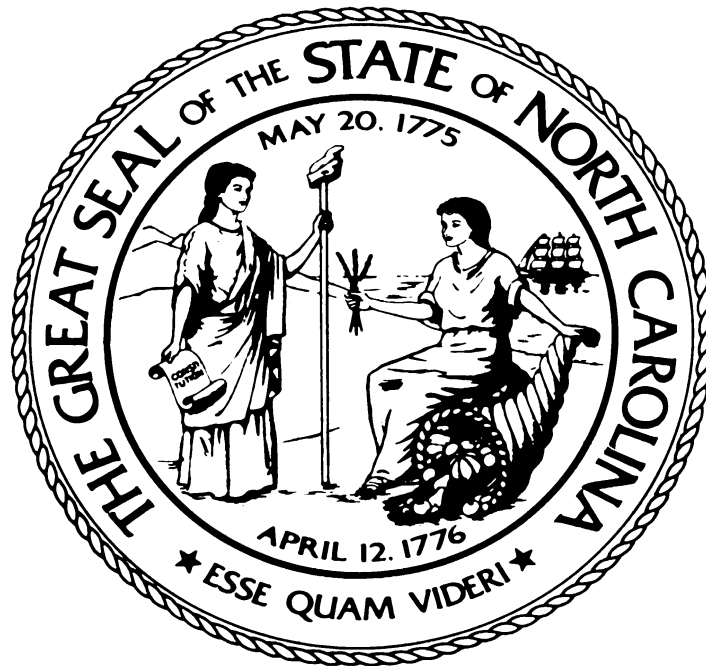


STATE OF NORTH CAROLINA
DEPARTMENT OF ADMINISTRATION
STATE CONSTRUCTION OFFICE



WATER BASED
FIRE PROTECTION SYSTEMS
GUIDELINES AND POLICIES

2014

Revised March 27, 2014

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APPLICABILITY

- A. The **WATER BASED FIRE PROTECTION SYSTEMS GUIDELINES AND POLICIES** applies to all projects in which the State Construction Office (SCO) is the designated Authority Having Jurisdiction (AHJ). This includes all State properties as defined in NC GS 425. Note that this does not include community college work. As defined by NC GS 58-31-40, the AHJ for Community College projects over 20,000 square feet is the North Carolina Department of Insurance. The local plan review and inspection department is the AHJ on community college projects under 20,000 square feet.

PURPOSE

- A. The following guidelines and policies are established to aid the design engineer during bid document preparation. This guideline is not intended to repeat requirements from governing NFPA standards and is not intended to be included in the design engineer's specification by reproduction. Rather it is a source of additional requirements, procedures, and clarifications to the design engineer that are to be incorporated in their preliminary design of the fire sprinkler system. Variances of these guidelines and policies shall be discussed with the State Construction Office prior to submitting design to alleviate possible extra work on the designer's part. This office will not entertain a request for deviation from an applicable NFPA requirement.

ADMINISTRATION

- A. NC Statutes allow sprinkler contractors with a minimum NICET III certification to provide sprinkler designs. A design engineer will typically be contracted to provide a preliminary design within the construction documents that will contain sufficient detail to identify the scope of the work and allow for competitive bidding. The design engineer's responsibilities include but are not limited to:
1. Evaluate the broad range of hazards and fire protection schemes required to develop a workable, integrated fire sprinkler solution.
 2. Provide design documents as outlined in this guideline.
 3. Review shop drawings and submittals to ensure conformance with design documents and applicable codes and standards.
 4. Monitor the installation of fire protection systems and participate in their acceptance and commissioning.
- B. The current edition of NFPA 13, 14, 20, and 24 as referenced by the NC Building Code is the minimum acceptable. The design to be used by the fire sprinkler contractor shall be clearly stated in the contract documents.
- C. This document provides rules and procedures that may not be contained in reference NFPA requirements and provides guidance and commentary on Fire Protection Systems subject areas that are frequently points of confusion, contention, or misapplication.

- D. The local fire code official or fire marshal referred to in this document is the Agency's Fire Protection Specialist and/or the local fire code official that will operate the fire apparatus. Although not the AHJ for State Properties, the technical input from these departments is appropriate and should be obtained for issues relating to on-site response.

SCO FIRE SPRINKLER GUIDELINES AND POLICIES

A. Construction Documents:

1. Fire Protection drawings and specifications prepared by the design engineer and included in the bid documents constitute a 'preliminary design' and shall be sealed by the design engineer of record registered in the State of North Carolina. This 'preliminary' design is a basis for bidding and may be referenced to herein as 'construction documents'. A basic understanding of hazard and occupancy classifications; and a working knowledge of fire protection codes and standards is expected from the design engineer of record.
2. Contract Documents shall comply as applicable with NFPA 13, NFPA 14, NFPA 20, NFPA 24, NC Fire Code, NC Building Code, and this guideline. Items to be included but not limited to on Construction Documents are as follows:
 - a) Provide Sprinkler Design Data Summary to include:
 - (1) Project name and address
 - (2) Total building height
 - (3) Type of system
 - (4) Hazard classification
 - (5) Design area
 - (6) Design Density
 - (7) Hose allowance
 - (8) Water supply information
 - b) Identify use of all rooms and areas.
 - c) Symbols and legend.
 - d) Location of alarm valve, check valves, riser check, control valves, etc.
 - e) Electrical equipment locations with schedule listing electrical requirements.
 - f) Piping schematic indicating all tamper/flow switches, valves, etc.
 - g) Main and auxiliary drain locations.
 - h) Fire Department Connection location, type and size.

- i) The plans shall include a general piping layout. The plans need to be of sufficient scale to be clear and concise. (Minimum Scale 1/8"=1'-0").
3. The fire protection work outlined in the contract documents shall not be included on the sheets of other disciplines and shall identify that the fire sprinkler contractor scope of work begins 12" above the finished floor.
4. Details such as piping sizes and head locations are not required to be part of the Construction Documents. Such layouts when provided shall be denoted as being provided for general coordination and information only.
5. Each building story must be a separate sprinkler zone with a dedicated cutoff valve, tamper switch, water flow switch and inspector's test valve; typically referred to as a floor control assembly piped to discharge to exterior. Multiple riser designs requiring the operation of more than one shutoff valve to isolate a portion of the system are not permitted.
6. The Design Team should solicit input from local fire officials or the fire marshal when developing fire protection plans for State-owned facilities.
7. Instructions for sealing penetrations through rated assemblies (such as UL details) shall be on the contract document. The fire sprinkler plans shall identify rated walls consistent with the architectural plans.
8. Working drawings, also referred to as shop drawings, prepared by a licensed fire sprinkler contractor with a minimum NICET III certification shall be complete and submitted and reviewed per the below procedure. A licensed Professional Engineer may also provide sprinkler shop drawings.

B. Review and Approval of Shop Drawings and Hydraulic Calculations:

The following procedure for review and approval of working shop drawings is applicable and should be included in the construction documents as necessary to ensure the fire sprinkler contractor understands their responsibility.

Fire Sprinkler Contractor: The Fire Sprinkler Contractor shall submit working shop drawings, hydraulic calculations, and product data to the design engineer of record – *number of copies as determined by the design engineer*. Shop drawings shall include and be in accordance with working plan requirements of chapter 22 of NFPA 13. Product data shall include and identify all material, equipment, and accessory selections to be installed. A copy of the water flow test shall be included. The hydraulic calculations and shop drawings shall be signed by the fire sprinkler designer and include the NC Fire Sprinkler Contractor (FS) license number. The construction documents are a performance design. The fire sprinkler contractor, as the designer and contractor, shall provide all necessary materials and labor for a system fully compliant with all applicable NFPA requirements and the construction documents. Any discrepancies shall be brought to the attention of the specifying engineer (PE).

Project Engineer: The specifying engineer (PE) has primary responsibility for review and approval of fire suppression system shop drawings and hydraulic calculations. Specifying Engineer review shall determine compliance with applicable codes and standards and the project contract documentation.

After completing this review, the Specifying Engineer sends one (1) copy with a signed cover letter, including printed reviewer name, summarizing the outcome to the State Construction Office for approval. If comments by the design engineer are limited, the engineer may, at their discretion, forward the shop drawings to this office in parallel with comment resolution by the fire sprinkler contractor. All comments made by the designer shall be forwarded to this office with the review package including comments from previous review iterations, if any.

For mail by US Postal Service:
Assistant Director
Design Review
State Construction Office
1307 Mail Service Center
Raleigh, NC 27699-1307

For mail by UPS, FedEx, etc.
Assistant Director
Design Review
State Construction Office
301 N. Wilmington Street, Suite 450
Raleigh, NC 27601

Once all comments are resolved and approved by SCO, an approval letter releasing this part of project to enter into construction will be sent to the Specifying Engineer. No other reviews are required after the receipt of this approval letter.

C. Water Supply Test Requirements:

1. Water flow and pressure test data within 12 months shall be included with the construction documents to determine if a fire pump may be required. This shall include static pressure, residual pressure, residual flow, date of test, and elevation and location of hydrants used for the test. The water flow test required shall be performed as indicated in NFPA 13 which uses two hydrants; a pressure hydrant and a flow hydrant. The two hydrants shall be as close to the point of connection as possible. If a fire pump is installed the fire pump test can be used instead of a hydrant flow test as basis of design.
2. An updated water flow and pressure test is to be obtained by the fire sprinkler contractor to be used for the working plan design and calculations. A copy of the flow test and test hydrant locations shall be submitted with the shop drawing package.
3. A safety factor to account for fluctuations in water supply, the design calculations shall be based on an available water supply of 10 psi less static pressure, 10 psi less residual pressure and 10% less residual flow than measured.
4. A backflow preventer shall be provided for the fire protection system. If a RPDA type assembly is provided they should be located in a heated enclosure outside of the occupied building. The heated enclosure shall have a low temperature heat detector connected to building fire alarm system. If an exterior heated enclosure is not possible for the site, the RPDA can be installed inside of the building provided it is installed in a room with the floor level of the room above grade with room containing at least 1 exterior wall. An opening in the exterior wall or the mechanical room door with a minimum free area to drain the relief valve to exterior shall be provided. A gravity backdraft damper is recommended in relief opening to limit heat loss in fire protection room. At least 1 floor drain 4" in size shall be provided at backflow preventer. Relief valve of RPDA shall be piped to exterior.

D. Partial Renovation Projects:

For modification of existing sprinkler systems the following applies:

1. If the modification does not change the design density and does not add sprinkler coverage area to the existing system, then the existing system may be reworked without hydraulic calculations and without a new water supply test. Shop drawings will still be required to be submitted and approved in accordance with procedure when more than 10 sprinkler heads are affected.
2. If the hazard classification changes or if the area of sprinkler coverage increases, a new water supply test will be required and hydraulic calculations performed and submitted for approval with the shop drawings. Water supply test information from the existing hydraulic nameplate or from the most recent available hydrant may be used for the construction document submittal; a new water flow test will be required for the working drawing submittal.

E. Sprinkler Coverage:

1. Exemptions in the NC Fire Code from 903.3.1.1.1. Note that use of these exemptions does not nullify any credits or exemptions based on a fully sprinklered building. Depending on the hazard of the space, the SCO may require a non-water based fire suppression system to be used. Machine room-less elevator controller closets are an example where this exemption is likely to be granted.
 - a) Any room where the application of water, or flame and water, constitutes a serious life or fire hazard.
 - b) Any room or space where sprinklers are considered undesirable because of the nature of the contents, when approved by the fire code official.
 - c) Generator and transformer rooms separated from the remainder of the building by walls and floor/ceiling or roof/ceiling assemblies having a fire-resistance rating of not less than 2 hours.
 - d) Rooms or areas that are of noncombustible construction with wholly noncombustible contents.
 - e) Fire service access elevator machine rooms and machinery spaces. *(This is a new type of elevator applicable to high rises)*

F. Minimum Design Requirements:

1. In accordance with NFPA 13, including occupancy hazard. Design engineer should consider an increase the designated hazard level for unusual or abnormal fuel loading.
2. Residence Halls:
 - a) NFPA 13 shall be the basis of design. The use of NFPA 13R is only for privately funded residential projects as allowed by guidelines found on the SCO website.
 - b) CPVC piping may be used in residential applications subject to listing requirements found in manufacturer literature. In general, piping shall be concealed and protected by 3/8" minimum gypsum board or ceiling tile weighing 0.35 lb/sq. ft. minimum.

3. In Institutional Group I occupants the fire sprinkler zones shall match the fire alarm zones. The designer shall coordinate with owner during the design phase to discuss egress paths, zone locations and “defend in place” strategies.

G. Seismic Requirements:

1. Reference the building code summary for the facility seismic design category. A common omission for a new sprinkler system in an existing building is the lack of a seismic design category. The project must obtain a seismic design category in accordance with the NC Building Code.
2. For seismic design categories A and B, the fire sprinkler drawings should state that “Hanging, bracing, and restraint of fire sprinkler piping shall be in accordance with chapter 9.1 and 9.2 of NFPA13.
3. For seismic category C, the fire sprinkler drawings shall state that “Seismic requirements apply to this project. Hanging, bracing, and restraint of fire sprinkler piping shall be in accordance with section 9.3 of NFPA13. Shop drawings must include details and signify approximate locations of all seismic bracing. Calculations and layout of restraints shall be submitted to this office for approval with shop drawings.
4. For seismic category D (rare in North Carolina), additional seismic analysis is required which shall be by a professional qualified to perform seismic design in accordance with ASCE-7. Calculations and layout of restraints shall be submitted to this office for approval with shop drawings.

H. Materials:

1. All sprinkler materials and components must be third party listed for sprinkler systems and installed in accordance with their listing. Piping, hanger material, and components that don't affect system performance such as drain valves are generally exempted from this requirement.
2. Piping: The construction document specifications should contain piping and fitting requirements that comply with NFPA 13. SCO guidelines include:
 - a) Black steel piping should be listed as sprinkler piping and include an FM approved MIC inhibiting coating.
 - b) Underground Pipe 3” and larger should be ductile iron with standard cement mortar lining and elastomeric gasket joints.
 - c) Above ground 2-1/2” and larger should be schedule 10 black steel pipe welded or roll grooved for mechanical fittings.
 - d) Above ground 2” and smaller should be schedule 40 black steel pipe threaded, welded, or roll grooved for mechanical fittings.
 - e) CPVC piping may be used in residence halls subject to limitations of the manufacturer listing. Penetrations of rated walls will require details applicable to plastic piping.

3. Sprinkler heads in rooms containing a shower or swimming pool shall have a corrosion resistant coating.
4. Sprinkler heads in janitor's closets should be provided with approved head guard.
5. Sprinkler heads in dormitory closets shall be provided with approved head guard.
6. Provide a requirement/detail for return bends for sprinkler connections, even with potable water connections. Include a detail on the contract documents.
7. Clearly indicate if flexible hose connectors are allowed. Be extra careful with product specification and **supervision** of the work execution when allowing installation of the flexible connection at sprinkler heads. SCO has experienced many faulty installations of such products on various projects (flexible piping are being crimped, very long taps with two or more sections of hose joined together, numerous bends and turns on a single tap, and others). If allowed, they must meet all of the following:
 - a) FM 1637 or UL 2443 listed.
 - b) Specification for Flexible Connections shall include statement for the product to be mounted in **strict** accordance with manufacturer written installation instructions.
 - c) Number and radius bends shall be as allowed by the manufacturer. There shall be no twists or kinks. In addition
 - (1) Only UL listed **and** FM approved 304 stainless steel, corrugated hose **with fully braided cover** shall be used
 - (2) Hose assembly shall be limited to 5-feet.
 - (3) Head shall be permanently attached to the ceiling using tamper resistant screws
 - (4) Connections shall be seismically qualified where applicable
 - (5) The hydraulic calculations shall be based on actual pressure loss published by the manufacturer.
 - (6) Have 1" true bore internal corrugated hose diameter.
 - (7) Takeoffs shall be from the top of the pipe.
8. Floor control valves shall be in accessible and visible location.

I. Dry and Preaction Systems:

1. Wet pipe systems are preferred. Small unheated areas may be protected by systems utilizing listed heat tracing. Heat tracing used for branch lines shall be specifically listed for branch lines. All heat tracing shall be supervised.
2. The use of air in dry systems inevitably contains residual water from testing the system and water from condensation collecting in the system. This leads to greater corrosion problems than experienced with wet pipe systems and even freezing problems. Consider moisture and corrosion concerns and systems that will address this and employ one of the options below:

- a) A combination air compressor with dryer that is FM or UL approved for sprinkler systems is recommended for base bid.
 - b) Use nitrogen instead of compressed air. Nitrogen is preferable to air in dry systems subject to condensation.
 - c) Black steel piping is recommended.
3. An isolation valve and tamper switch with drain downstream of preaction valve is recommended to allow piping system to be temporarily turned off to allow forward flow testing of preaction valve. If this valve is not in place the entire piping system will be filled with water for annual testing.

J. Standpipes:

1. Class III standpipes and hose connections are required where dictated by the NC Fire Code.
2. Roofs – Section 905.4 of The NC Fire Protection Code requires that each required standpipe be extended to the roof if there is no stair access and if the roof is less than 4:12 slope, or be extended to the highest stair landing if there is stairwell access to the roof and if the roof is less than 4:12 slope. This can result in more roof top standpipe connections than needed. This section of the code is to support fire-fighting efforts. If the local fire-fighting authority does not need them all, it is acceptable to defer to their direction on this provided the design engineer obtains a letter indicating the concurrence of the local fire fighting authority.
3. Note that NFPA14 allows Class I standpipe systems to be any type described in NFPA14 Section 5.2 in buildings not classified as high-rise buildings. This includes a Manual Wet system which does not require the pressure in the system to be 100 psig until the fire apparatus is hooked up and pressurizes the system. Therefore a Manual Wet Standpipe is allowed in a non-high rise building. 100 psig at the top of the remote standpipe is only applicable to high rise buildings. This may alleviate the need for a fire pump.

K. Elevator Hoistways and Machine Rooms:

1. Traction Elevators
 - a) Traditional (with machine room on top)
 - (1) Sprinkler heads are exempted from the elevator shaft by NFPA 13 paragraph 8.15.5.5 when the hoistway is non-combustible and the car enclosure materials meets the requirements of ASME A17.1 (limited combustibility).
 - (2) A sprinkler head in the machine room, if installed, requires special arrangements to shut down power prior to discharge of water. Because it is generally agreed that the additional costs and potential danger of this sprinkler outweigh the benefits gained, the SCO will allow the elimination of this head based on 903.3.1.1.1 of the NC Building Code with the installation of an approved automatic fire detection system meeting requirements specified therein.

b) Machine room less

- (1) Sprinkler heads are exempted from the elevator shaft by NFPA 13 paragraph 8.15.5.5 when the hoistway is non-combustible and the car enclosure materials meet the requirements of ASME A17.1 (limited combustibility).
- (2) These elevators have no machine room and utilize a controller located in a closet adjacent to the shaft. The closet should be dedicated to the controller with permanent signage prohibiting storage. Because it is generally agreed that the additional costs and potential danger of this sprinkler outweigh the benefits gained, the SCO will allow the elimination of this head based on 903.3.1.1.1 of the NC Building Code with the installation of an approved automatic fire detection system meeting requirements specified therein.

2. Hydraulic Elevators

- a) Sprinklers may be omitted from the top of the elevator shaft by NFPA 13 paragraph 8.15.5.5 when the hoistway is non-combustible and the car enclosure materials meet the requirements of ASME A17.1 (limited combustibility).
- b) NFPA 13 and ASME A17.1 require a sprinkler head in the elevator pit within 2 feet of the pit floor where combustible hydraulic fluids are used. Although NFPA 13 specifically states that this sprinkler head activation need not be delayed until elevator power is shutdown, the Department of Labor currently requires this.

3. Power Shutdown

Wherever a sprinkler head is located in an elevator shaft or machine room/control closet, means shall be provided to shutdown elevator power prior to the application of water. The SCO standard method of accomplishing this is:

- Use of an intermediate temperature sprinkler head with a smoke and heat detector adjacent. The smoke detector actuates first and initiates elevator recall. The heat detector with a lower actuation temperature than the sprinkler head, operates a shunt trip breaker provided by the electrical contractor to interrupt power to the elevator.

L. Fire Protection Site Plan:

1. Note that this information may be provided on the civil utility plans. It is a frequent source of comments on construction documents. The fire protection engineer will receive the comments where these items are not properly coordinated.
2. Site plan shall show fire water connection to main. Indicate the location of the Back Flow Preventer (BFP), Post Indicator Valve (PIV), Fire Department Connection (FDC), fire pump test header (if applicable), exterior sprinkler alarm, and adjacent Fire Hydrants (FH). Indicate test hydrant and flow hydrant with flow data on plans.

3. Contract documents for proposed fire apparatus access, location of fire lanes and construction documents and hydraulic calculations for fire hydrant systems should be submitted to the local AHJ for review and approval prior to construction.
4. Unless approved by the local fire marshal, no portion of the facility or building shall be more than 400 feet [600 ft. for sprinklered buildings] from a hydrant on a fire apparatus access road, as measured by an approved route around the exterior of the facility or building. Site plans shall clearly showing apparatus access routes to all buildings on the site within 150 feet of all portions of the first floor.
5. A detail shall be provided showing restraint of underground joints. Either thrust blocks or restrained joints in accordance with chapter 10 of NFPA 13 are acceptable.
6. Fire protection main piping shall enter the building as close to the exterior as possible. The fire protection main piping shall not be routed through the building. This would include but is not limited to running the fire protection main piping under the slab, through crawl spaces or above the ceiling. In the event that this is technically infeasible a water flow switch and control valve shall be installed where the fire protection main enters the building.
7. The FDC shall be within 100' of a fire hydrant. FDC shall be readily accessible and not located on loading docks or under a building overhang, behind fence or inside enclosed mechanical yard.

M. Fire Pumps:

1. Perform a preliminary hydraulic calculation to determine whether a fire pump is needed.
2. Fire pumps shall be located in dedicated rooms that are 1 hour rated (2 hour rated in high rises). Boilers and other mechanical equipment not related to the fire pump shall not share the room. Domestic water distribution equipment is allowed in the fire pump room.
3. Provide pumps schematic, plan layout and isometric riser and electrical service as required. Electric fire pumps shall have a backup energy source.
4. A recirculating line with a flow meter shall be installed to permit pump testing without discharging.
5. A pump bypass with a normally open valve shall be provided.
6. A suction control valve shall be installed if the incoming water pressure is exceptionally low or where required by the local municipality.
7. If the pump must be sized such that the city pressure plus the churn pressure exceeds 175 psig, account for this with either suitably rated components or suitably located PRV with relief valve.
8. The final NFPA 20 test shall be performed by flowing water through test header not flow meter.

N. Testing:

1. Contractors Material and Test Certificate Forms from the NFPA standards must be used to document testing completed. Waterflow detection devices shall be tested and documented on these forms as well. These tests include:
 - a) Underground pipe flushing and hydrostatic test per NFPA 24.
 - b) Hydrostatic pipe testing per NFPA 13.
 - c) Air pressure test of dry systems per NFPA 13
 - d) Operating test for dry pipe systems per NFPA 13.
 - e) Hydrostatic test and operating test per NFPA 14.
 - f) Fire/Booster Pump Acceptance Test (Performance Test): The fire pump must have a field acceptance test in accordance with NFPA 20. This test shall include a member of the design team, the pump manufacturer, the engine manufacturer (if provided), controller manufacturer, and transfer switch manufacturer (if provided). SCO shall witness a test of the fire pump. It is up to the engineer of record if he wants SCO to witness the official NFPA 20 test or perform secondary test. NFPA 20 requires that the AHJ be given advance notice of the test date, time, and location. Minimum one week advance notice is required.

O. Closeout:

1. The Specifications shall require the following: The fire sprinkler contractor shall have for review all pertinent NFPA paperwork properly filled out on NFPA forms as applicable (NFPA 13, 14, 20, 24). The shop drawing approval letter from this office shall be available. A set of as-built fire sprinkler shop drawings and hydraulic calculations shall be placed in a white PVC tube marked 'Fire Sprinkler Shop Drawings' and securely fixed in the fire sprinkler riser room.
2. A second set of 'as built' shop drawings shall be provided to the owner.
3. A copy of the shop drawings and calculations shall be provided in PDF format on CD.