Fire Flows in Public Water Systems

How Much is Enough?

NY Section of the American Water Works Annual Conference April 26, 2017

Paul J. Paparella, PE,PP
Fire Flow
Why Does it Matter?
You Can’t Fight Fire With Fire

You Can Fight it with Water
What is the Obligation of a Public Community Water System to Provide Fire Protection?

1. Policy
2. Regulation
3. Codes and Standards
REGULATION

NYCRR
Title 10 Department of Health

Part 5, Subpart 5-1
Public Water Systems
5-1.33 Water supply emergency plans

- b) The water supply emergency plan shall include:

- (10) The development of criteria and procedures for determining and the subsequent reporting of the system's capacity and ability to meet peak water demands and **fire-flow conditions** concurrently.
5-1.22 Approval of plans and completed works

- **Recommended Standards for Water Works**,..... shall, in their entirety, be the basis on which all plans and specifications for public water systems will be approved.

“10 States Standards”
8.2.3 Fire protection

When fire protection is to be provided, system design should be such that fire flows and facilities are in accordance with the requirements of the State Insurance Services Office.
7.0.1 Sizing (of finished water storage facilities)

Storage facilities should have sufficient capacity, as determined from engineering studies, to meet domestic demands, and where fire protection is provided, fire flow demands.
16 NYCRR Part 503

Minimum working pressure (the pressure under all conditions except fire flows) in all portions of the water corporation's distribution system should not be less than 35 pounds per square inch (psi).
Each water corporation which provides public fire protection shall have a program to inspect and test each hydrant a minimum of once every three years with a minimum of one-third of the hydrants being inspected and tested annually.
AWWA Manual of Practice

Distribution System Requirements for Fire Protection
“Most municipalities are willing to incur the higher cost for distribution system sizing because of the reduction in loss that is possible by using the water system for fire protection."
“The key question for water utilities is how large must distribution system components be to provide sufficient water for fire protection.”
How Do We Calculate Required Fire Flow?

Let Us Count the Ways
Fire Flow Calculation Methods
As Found in AWWA M31

1. Insurance Services Office (ISO)
2. Iowa State University (ISU)
3. National Fire Academy (NFA)
4. Illinois Institute of Technology Research Institute (IITRI)
How Do We Calculate Required Fire Flow?

Let Us Count the Ways
2.1.1 ISO Method
2.1.2 International Fire Code (IFC) and NFPA 1 Methods
2.1.3 NFPA 1142 Method
2.1.4 IWUIC Method
2.1.5 Ontario Building Code Method
2.1.6 FIERAsystem Water Requirements Model
2.1.7 New Zealand SFPE Method TP 2004/1 and TP 2005/2
2.1.8 New Zealand Fire Engineering Design Guide Method (FEDG)
2.1.9 SNZ PAS 4509 Methods
2.1.10 French D9 Technical Document Method
2.1.11 UK National Guidance Document on the Provision of Water for Firefighting Method
2.1.12 Iowa State University Method (ISU)
2.1.13 Särqvist, Thomas, and Baldwin Methods
2.1.14 Illinois Institute of Technology Method (IIT)
2.1.15 National Fire Academy Method (NFA)
2.1.16 3D Firefighting Method
2.1.17 Other Water Supply Literature
Other International Approaches
Other Reviews of Fire Flow Methodologies
Comparison of Methods
Non Sprinklered Single Family Home

<table>
<thead>
<tr>
<th></th>
<th>ISO</th>
<th>ISU</th>
<th>NFA</th>
<th>IITRI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1500 SF</td>
<td>750</td>
<td>200</td>
<td>500</td>
<td>1,000</td>
</tr>
<tr>
<td>3500 SF</td>
<td>750</td>
<td>3,500</td>
<td>1,200</td>
<td>2,800</td>
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</tbody>
</table>

Gallons/minute
## Comparison of Methods

### Non Sprinklered Commercial Building

<table>
<thead>
<tr>
<th>ISO</th>
<th>ISU</th>
<th>NFA</th>
<th>IITRI</th>
</tr>
</thead>
<tbody>
<tr>
<td>10,000 SF</td>
<td>3,000</td>
<td>2,000</td>
<td>3,500</td>
</tr>
<tr>
<td>50,000 SF</td>
<td>7,500</td>
<td>10,000</td>
<td>17,000</td>
</tr>
</tbody>
</table>

Gallons/minute
GUIDE FOR DETERMINATION
OF NEEDED FIRE FLOW

$NFF_i = (C_i)(O_i)[1.0 + (X + P)_i]$
\[ NFF_i = (C_i)(O_i)[1.0 + (X + P)_i] \]

- **C**: type of construction and effective area
- **O**: type of occupancy
- **X**: exposure hazard of adjacent buildings
- **P**: communication hazard with adjacent buildings
### Guide for Determination of Needed Fire Flow

For 1- and 2-family dwellings not exceeding 2 stories in height

<table>
<thead>
<tr>
<th>Distance between Buildings (ft)</th>
<th>NFF (GPM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 30</td>
<td>500</td>
</tr>
<tr>
<td>21 to 30</td>
<td>750</td>
</tr>
<tr>
<td>11 to 20</td>
<td>1,000</td>
</tr>
<tr>
<td>0 to 10</td>
<td>1,500</td>
</tr>
</tbody>
</table>
Community-Wide Assessments of Needed Fire Flow

ISO's Public Protection Classification (PPC™) Program

To help establish appropriate fire insurance premiums for residential and commercial properties, insurance companies need reliable, up-to-date information about a community’s fire-protection services. ISO provides that information through the Public Protection Classification (PPC™) program.
## Community-Wide Assessments of Needed Fire Flow

### Needed and Available Flows

<table>
<thead>
<tr>
<th>TEST NO.</th>
<th>TYPE DIST.</th>
<th>TEST LOCATION</th>
<th>SERVICE</th>
<th>FLOW - GPM (Q-C260.83/C(d^2+3.5))</th>
<th>PRESSURE PSI</th>
<th>FLOW - AT 20 PSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>FD51</td>
<td></td>
<td>2029 Georgetown Rd</td>
<td>Fire Department Supply</td>
<td>800</td>
<td>2000</td>
<td>800 (0 &lt; 1250 gpm)</td>
</tr>
<tr>
<td>FD52</td>
<td></td>
<td>207 Georgetown Rd</td>
<td>Fire Department Supply</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>FD53</td>
<td></td>
<td>RTE 1</td>
<td>Fire Department Supply</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>FD54</td>
<td></td>
<td>County Rd 1525 (ski resort access)</td>
<td>Fire Department Supply</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>FD55</td>
<td></td>
<td>125 Aspen Lane</td>
<td>Fire Department Supply</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>FD56</td>
<td></td>
<td>Denton's Point Rd</td>
<td>Fire Department Supply</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>FD57</td>
<td></td>
<td>South Cross Rd</td>
<td>Fire Department Supply</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**Flow Summary:**
- **Total Flow:**
  - **INDIVIDUAL HYDRANTS:**
    - Total Flow: 800 gpm
  - **TOTAL:**
    - Static: 2000 psi
    - Residual: 800 psi
  - **FLOW - AT 20 PSI:**
    - Needed: 800 gpm
    - Available: 0 gpm
- **Remarks:**
  - CTR (Commercial TR)
How Much is Too Much?

12,000 GPM
Maximum per ISO Standard

3,500 GPM
Maximum Normally Expected from Public Water System
Required Fire Flow:
It’s More than Just the Flow Rate

Flow Rate \times \text{Duration} = \text{Volume}
## Fire Flow Duration

<table>
<thead>
<tr>
<th>Flow Rate Required</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>2500 GPM or Less</td>
<td>2 hours</td>
</tr>
<tr>
<td>3000 to 3500 GPM</td>
<td>3 hours</td>
</tr>
</tbody>
</table>
Flow Requirements for Buildings with Fire Sprinklers
ISO and AWWA Guidance for Sprinklered Buildings

1. Commercial Occupancies
   NFPA 13
   Standard for Installation of Sprinkler Systems

2. Residential Occupancies
   NFPA 13R
   Standard for the Installation of Sprinkler Systems in Residential Occupancies up to and including Four Stories in Height

3. One and Two Family Dwellings
   NFPA 13D
   Installation of Sprinkler Systems for One- and Two-Family Dwellings and Manufactured Homes
NY Fire Codes – Residential Sprinklers

Adopted 2015 International Residential Code.

Townhomes, one family, and two family dwellings having a height of three+ stories above grade must have sprinklers.

Local jurisdictions may not adopt sprinkler ordinances.
ISO and AWWA Guidance for Sprinklered Buildings

Demand at the base of the automatic sprinkler riser (typically 250 to 1,500 GPM)

+ 

Hose stream demand (100 to 1000 GPM)

Minimum of 500 GPM
## NFPA 13
### Pipe Schedule Design Method

<table>
<thead>
<tr>
<th>Occupancy</th>
<th>Flow (GPM)</th>
<th>Duration (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light Hazard</td>
<td>500-750</td>
<td>30-60</td>
</tr>
<tr>
<td>Ordinary Hazard</td>
<td>850-1500</td>
<td>60-90</td>
</tr>
</tbody>
</table>

**NFPA® 13**

Standard for the Installation of Sprinkler Systems

2016 Edition
ISO and AWWA Guidance for Sprinklered Buildings

Demand at the base of the automatic sprinkler riser

- 1,000 GPM minimum
- 2 hour duration

Residential Occupancies

NFPA 13R
Standard for the Installation of Sprinkler Systems in Residential Occupancies up to and including Four Stories in Height
ISO and AWWA Guidance for Sprinklered Buildings

Demand at the base of the automatic sprinkler riser
or
500 GPM at 20 psi for a duration of 1 hour,
whichever is greater.

3
One and Two Family Dwellings

NFPA 13D
Installation of Sprinkler Systems for One- and Two-Family Dwellings and Manufactured Homes
Volume Comparison
Single Family Home

120,000 Gallons
Volume Required
1000 GPM x 2 Hrs

30,000 Gallons
Volume Required
500 GPM x 1 hr

Non Sprinklered

Sprinklered
Pressure Requirements for Fire Fighting
Pressure Requirements
Drawing from Hydrants

20 psi
minimum residual
Fire Sprinkler System Pressure Requirements

- At least 7 psi residual at the sprinkler head
- At base of riser: different in every case
Thank You

And be Careful Where you Park

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How Much is Enough?

This presentation represents the results of general research by the author. It is not intended to be and shall not be construed as engineering advice. Any design of water improvements for a particular system must be performed by an experienced licensed professional engineer taking into account many factors in addition to required fire flows. Those factors are specific to the conditions applicable to each particular water system including, without limitation, peak flow and storage characteristics, specific locations and elevations within the water system and the nature of construction and use of buildings for which water flows are being analyzed. General parameters set forth in this presentation are not sufficient to base engineering conclusions upon. The author and Mott MacDonald disclaim any responsibility for use made by readers or audiences to whom this material has been presented. All such persons are encouraged to seek independent advice from experienced professionals before making any decision relative to water system design or required flow rates.