Water Spray Systems: NFPA 15
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NFPA 25
Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems

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Objectives

- Identify the difference in system components required for water spray fixed systems
- Identify three different types of spray nozzles
- Identify factors affecting nozzle selection
- Identify reasons for corrosion protection
Water Spray Nozzles
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Water Spray Nozzles
Listed Nozzle Selection

- K factor
- Spray patterns depend on
  - Pressure
  - Distance
  - Orientation angle
- Uniform water distribution
Special Coatings for Corrosion Protection

- Listed corrosion-resistant spray nozzles for intended application
  - Manufacturer applied
  - Chemical resistant characteristics
  - Moisture resistant
  - Other corrosive atmospheres
Strainers

- Listed Pipeline Strainers
- Remove >3.2 mm solids
- Flushing connection
- Individual strainers remove solids from nozzles served
Requirements for Live Un-insulated Electrical Components

- Maintain minimum clearances
- Clearances depend on
  - Nominal voltage,
  - Maximum voltage,
  - Design BIL voltage
Table 6.1.2.2 Electrical Clearance from Water Spray Equipment to Live Uninsulated Electrical Components

<table>
<thead>
<tr>
<th>Nominal System Voltage (kV)</th>
<th>Maximum System Voltage (kV)</th>
<th>Design BIL (kV)</th>
<th>Minimum* Clearance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>in.</td>
</tr>
<tr>
<td>To 18.8</td>
<td>14.5</td>
<td>110</td>
<td>7</td>
</tr>
<tr>
<td>25.0</td>
<td>24.3</td>
<td>150</td>
<td>10</td>
</tr>
<tr>
<td>34.5</td>
<td>36.5</td>
<td>200</td>
<td>13</td>
</tr>
<tr>
<td>46.0</td>
<td>48.8</td>
<td>250</td>
<td>17</td>
</tr>
<tr>
<td>69.0</td>
<td>72.5</td>
<td>350</td>
<td>25</td>
</tr>
<tr>
<td>115.0</td>
<td>121.0</td>
<td>550</td>
<td>42</td>
</tr>
<tr>
<td>138.0</td>
<td>145.0</td>
<td>650</td>
<td>50</td>
</tr>
<tr>
<td>161.0</td>
<td>169.0</td>
<td>750</td>
<td>58</td>
</tr>
<tr>
<td>230.0</td>
<td>242.0</td>
<td>900</td>
<td>76</td>
</tr>
<tr>
<td>345.0</td>
<td>362.0</td>
<td>1050</td>
<td>84</td>
</tr>
<tr>
<td>500.0</td>
<td>550.0</td>
<td>1500</td>
<td>124</td>
</tr>
<tr>
<td>1800</td>
<td>144</td>
<td>3658</td>
<td>3658</td>
</tr>
</tbody>
</table>

Note: BIL values are expressed as kilovolts (kV), the number being the crest value of the full wave impulse test that the electrical equipment is designed to withstand. For BIL values that are not listed in the table, clearances can be found by interpolation.

*For voltages up to 161 kV, the clearances are taken from NFPA 70, National Electrical Code. For voltages 230 kV and above, the clearances are taken from Table 124 of ANSI C2, National Electrical Safety Code.
High Voltage Transformer
Selection Criteria for Water Spray Nozzles

- Discharge characteristics
- Physical character of hazard
- Ambient conditions
- Material burning
- Design objectives of system
Positioning Factors for Water Spray Nozzles

- Shape and size of protected area
- Nozzle design and spray pattern
- Wind and fire draft effects
- Water wastage
- Nozzle orientation
- Mechanical damage
Factors for Location of System Actuation Valves

- Radiant heat from exposing fire
- Explosion potential
- Drainage facilities (e.g. dikes, trenches)
- Freeze potential/mechanical damage
- Accessibility
- System discharge time
Explosion Protection

Vessel coverage

Riser located behind and supported by column

Blast wall

System actuation valve

PIV
### Maximum Pipe Stand Heights

<table>
<thead>
<tr>
<th>Diameter of Pipe</th>
<th>1½ in.</th>
<th>2 in.</th>
<th>2½ in.</th>
<th>3 in.</th>
<th>4 in.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1½ in.</td>
<td>10 ft</td>
<td>14 ft</td>
<td>18 ft</td>
<td>28 ft</td>
<td>30 ft</td>
</tr>
<tr>
<td>2 in.</td>
<td>8 ft</td>
<td>12 ft</td>
<td>16 ft</td>
<td>26 ft</td>
<td>30 ft</td>
</tr>
<tr>
<td>2½ in.</td>
<td>6 ft</td>
<td>10 ft</td>
<td>14 ft</td>
<td>24 ft</td>
<td>30 ft</td>
</tr>
<tr>
<td>3 in.</td>
<td>—</td>
<td>8 ft</td>
<td>12 ft</td>
<td>22 ft</td>
<td>30 ft</td>
</tr>
<tr>
<td>&gt;3 in.</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>10 ft</td>
</tr>
</tbody>
</table>
Detectors Special Situations

- Open–sided buildings - Follow indoor spacing rules
- Under open grates - Follow outdoor spacing rules.
- Two or more systems – each system spaced independently
- Flammable gas – where leakage is most likely
Nozzle spray patterns must meet or overlap.
Spacing vertical or horizontal < 3m (unless listed for greater spacing).
One system per fire area.
If multiple systems must meet five criteria.
One or multiple systems cannot exceed available water supply.
Design Approaches

- Water demand selected using
  - 7.2 – Extinguishment
  - 7.3 – Control of burning
  - 7.4 – Exposure protection
  - 7.5 – Prevention of fire
Design Objective - Extinguishment

- Complete extinguishment and prevent flashback

- Five extinguishment methods:
  - Surface cooling
  - Smother with steam
  - Emulsification
  - Dilution
  - Other factors
Design Objective - Extinguishment

- Density range of 6.1 to 20.4 (L/min)/m² for
  - Cable trays and cable runs
  - Belt conveyors including
    - Drive unit
    - Conveyor belt
Design Approach?
Design Objective - Control of Burning

- Control fire spread until one of the following occurs:
  - Fuel consumed
  - Fuel shut down
  - Fire extinguished by FD/others

- Minimum application rate is 20.4 (L/min)/m²
Design Objective - Control of Burning

- Minimum application rate is 20.4 \((L/min)/m^2\) for devices handling flammable liquids or gases:
  - Pumps
  - Compressors
  - Related equipment
Design Objective - Control of Burning

- Minimum application rate is 12.2 (L/min)/m² for:
  - Combustible liquid pool fires
  - Flammable liquid pool fires
Design Objective - Exposure Protection

- Operate as long as expected exposure fire
- Protect the following
  - Vessel
  - Structures and equipment
  - Transformers
- Application rate is dependent on item and orientation
Design Approach?
- Designed for hazards such as:
  - Flammable vapors
  - Gases
  - Hazardous materials
Design Objective - Prevention of Fire

- Depends on duration of release
- Operate long enough to:
  - Dissolve
  - Dilute
  - Disperse
  - Or cool
• Minimum application rate based on:
  – Field experience, or
  – Actual fire test data
Six Design Factors

The six factors are:
1. The shape and size of the protected area
2. The nozzle design and water spray pattern
3. Ambient conditions – effect of wind and fire draft on small and large droplets
4. Potential water wastage (miss target surface)
5. Effects of nozzle orientation on coverage
6. The potential for mechanical damage
Nozzle Placement for a Horizontal Tank?

The manufacturers selected nozzles for this tank have the following characteristics:

- Maximum spray cone diameter of 2439 mm (8-feet)
- Maximum nozzle spacing = 2137 mm (7-feet)
- When placed 610 mm (2-feet) to 914 mm (3-feet) from the protected surface
System Acceptance – Response Time

- The system actuation valve shall operate within 40 seconds, based on the following test conditions;
  - Heat detector exposed to a heat source
  - Pilot sprinkler line test valve opened
For systems with open nozzles, spray patterns shall be observed to verify:

- Spray patterns are not impeded
- Nozzles are positioned properly
- Spray patterns are not obstructed
System Acceptance – Discharge Tests
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Discharge Tests
System Acceptance – Discharge Tests
References

- Design of Special Hazards and Fire Alarm Systems - 2\textsuperscript{nd} Edition-Gagnon
- Fire Protection Systems-2\textsuperscript{nd} Edition-Jones
- Fire Protection Handbook-20\textsuperscript{th} Edition-NFPA
- NFPA 15
Questions?