Local Application
Water Mist for
Land-Based Risks

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AquaMist ULF

tyco Fire Protection Products
Agenda

Local Application
- Definition
- Examples of protected risks

Fire Test Protocol Overview
- Marine
- Land
- Key differences

Development Programme at CNPP
- Pool Fires
- Spray Fires
- Burning Leak Fires
- Cable Fires

Correct Design Procedure
Local Application
A local application system is one where a fixed supply of extinguishing media is discharged into a defined area that, has either no enclosure surrounding it, or is only partially enclosed.
Examples

• Class B Fuel Risks, e.g.
  • Transformers
  • Generators
  • Industrial Machinery
## Machinery Protection Schemes:

<table>
<thead>
<tr>
<th>Approach</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Flooding</td>
<td>More robust to obstruction. Potentially cost effective in rooms with multiple hazards.</td>
<td>Cost increases with room volume Room volume/height may exceed approval limitations. Room integrity requirements. Collateral damage and Business Interruption.</td>
</tr>
<tr>
<td>Local Application</td>
<td>Economic. Robust to room integrity. Limited collateral damage.</td>
<td>Limitation on highly obstructed equipment.</td>
</tr>
</tbody>
</table>

Local application eliminates the limitations of room sizes for total flooding systems
# Machinery Local Protection Options: Water Mist, Spray, CO2

<table>
<thead>
<tr>
<th>Agent</th>
<th>Standards</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO₂</td>
<td>NFPA12</td>
<td>Economic</td>
<td>H&amp;S Issues Reduced Cooling Effect</td>
</tr>
<tr>
<td>Water Spray</td>
<td>FM</td>
<td>Prescriptive Economic</td>
<td>Thermal Shock Flood Risk High Water Consumption</td>
</tr>
<tr>
<td>Water Mist</td>
<td>IMO 1387 / FM5560 / TD2 (CNPP)</td>
<td>High Cooling Effect Low Water Consumption</td>
<td>Installation cost</td>
</tr>
</tbody>
</table>

Market is increasingly demanding Water Mist Local Application solutions – this presentation is to ensure we make the CORRECT one
Marine

- IMO 1387 (formally IMO913)
Land

- FM 5560 Appendix I
- BS 8489 Part 4 (based on FM protocol)
- CNPP TD2
Fire Test Overview
IMO 1387 Fire Test

- Marine Fire Test Protocol
- Enclosure 100m²
- At least 5m ceiling height
- Ten test configurations (5 at maximum height / 5 at 1 m)
- **ALL tests are SPRAY fires**
- Approval Criteria
  - Extinguishment within 5 minutes with no re-ignition

<table>
<thead>
<tr>
<th>Spray Nozzle</th>
<th>120°-125° Spray Angle</th>
<th>80° Spray Angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal Oil Pressure</td>
<td>8 Bar</td>
<td>8.5 Bar</td>
</tr>
<tr>
<td>Oil Flow</td>
<td>0.16kg/s</td>
<td>0.03kg/s</td>
</tr>
<tr>
<td>Oil Temperature</td>
<td>20 °C</td>
<td>20 °C</td>
</tr>
<tr>
<td>Nominal Heat Release</td>
<td>6MW</td>
<td>1MW</td>
</tr>
</tbody>
</table>
IMO 1387 – Restrictions

• LIMITED PROTECTION
  ▪ Spray fires ONLY
  ▪ No pool fires, no concealed fires

• PRIMARY PROTECTION ONLY
  ▪ Requires secondary (flooding) protection system

• 20 minute MINIMUM discharge time

• Mandatory Interlocks
  ▪ Electrical Shutdown
  ▪ Fuel Shutdown
  ▪ Lubrication shutdown
  ▪ Ventilation shutdown
  ▪ Containment of flammable liquid releases
FM 5560 Appendix I Fire Test

• Land Fire Test Protocol
• Enclosure > 500m³ volume
• At least 5m ceiling height
• 23 test configurations consisting of:
  ▪ Square Pool Fires (4 off including min/max nozzle height)
  ▪ Channel Pool Fires (4 off including min/max nozzle height)
  ▪ Spray Fires (4 off including min/max nozzle height)
  ▪ Combined Pool & Spray Fires (5 off arrangements, max nozzle height)
  ▪ Obstructured Pool Fire (2 off – min/max nozzle height)
  ▪ Offset Pool Fire (2 off – min/max nozzle height)
  ▪ Combined Pool & Spray Fires w/ External Ignition Source (2 off – min/max nozzle height)
• Approval Criteria - Extinguishment
FM 5560 Appendix I – Restrictions

• 10 minute MINIMUM discharge time

• Mandatory Interlocks
  ▪ Electrical Shutdown
  ▪ Fuel Shutdown
  ▪ Lubrication shutdown
  ▪ Ventilation shutdown
  ▪ Containment of flammable liquid releases
CNPP TD2 Fire Test

- Land Fire Test Protocol
- Based on actual machine mock-up
- 7 test configurations consisting of:
  - Pool Fires (2 off)
  - Large Burning Spray Fire
  - Small Burning Spray Fire
  - Small Burning Fuel Leak Fire
  - Large Burning Fuel Leak that could turn into Pool Fire
  - Cable Tray Fire
- Approval Criteria - Extinguishment
CNPP TDS – Restrictions

• 10 minute MINIMUM discharge time

• Mandatory Interlocks
  ▪ Electrical Shutdown
  ▪ Fuel Shutdown
  ▪ Lubrication shutdown
  ▪ Ventilation shutdown
  ▪ Containment of flammable liquid releases
Machinery Fire Scenario

TD2 (CNPP)

IMO1387
Spray Fires:
• Exposed
• Obstructed

Pool Fires:
• Exposed
• Obstructed

Electrical Fires

IMO1387 partially covers potential fire events which suffices for Marine application but not for land base

FM5560 and TD2 (CNPP) cover all potential fire events which suffices land base
Overview of Tyco Tests
Development Programme at CNPP

// Process at CNPP

• Completed 58 fire tests
• Tested various configurations
  • Low Pressure (ULF)
  • High Pressure (FOG)
  • Both solutions as approved to IMO 1387
• New solution
• Changed angles, spacing, height, distance, k-factor, pressure
Development Program at CNPP

// Generator mockup
- 5m x 2m x 2m
- Instrumentation: thermocouples, heat flux gauges, pressure sensors, flow meter, cameras

// Fuel package
- Diesel fuel

// Fire scenarios
- Pool fires (1.1 - 3 MW)
- Spray fires (0.5 - 3 MW)
- Leakage fires (0.4 - 2.4 MW)

<table>
<thead>
<tr>
<th>Main physic-chemical characteristics of the oil</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Flash Point (°C)</td>
<td>65-75</td>
</tr>
<tr>
<td>Auto-ignition temperature (°C)</td>
<td>270-330</td>
</tr>
<tr>
<td>LII (% vol)</td>
<td>0.5-0.6</td>
</tr>
<tr>
<td>PCI (MJ/kg)</td>
<td>42.2</td>
</tr>
</tbody>
</table>
Pool Fire Tests

Tray Positions (in red)
Spray Fire Tests

Spray Location (indicated by red arrow)
Burning Leak Fire Tests

Two diesel injection points (green arrows)
Cable Fire Tests`

Cable trays (in red). Set-up partially obstructed
Technical Solution – Why it works

// Mixture of large and small water droplets
  • Due to deflector design and increased k-factor over IMO1387
  • Combination of droplets are necessary
    • Smaller droplets cool the surroundings and displace oxygen
    • Larger droplets penetrate the fire plume

// Droplet momentum
  • High velocity to infiltrate the fire plume

// Addition of foam
  • Prevents re-ignition
  • Helps extinguish obstructed areas

// IMO 1387 approved solutions FAILED this test and therefore are not appropriate for this application
CORRECT DESIGN PROCEDURE

- IMO 1387 solutions shall NOT be used for LAND based applications
  - Limitations and restrictions must be clearly documented
  - Secondary Protection System Required

- FM5560/ TD2 solutions SUITABLE for LAND based applications
  - More nozzles/greater flow
  - Foam Additive
  - Will always we more expense than IMO 1387 solution
Thank You