Local Application Water Mist for Land-Based Risks

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Agenda

Local Application

- Definition
- Examples of protected risks

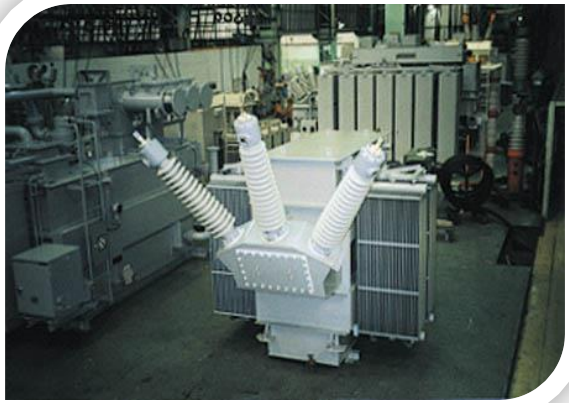
Fire Test Protocol Overview

- Marine
- Land
- Key differences

Development Programme at CNPP

- Pool Fires
- Spray Fires
- Burning Leak Fires
- Cable Fires

Correct Design Procedure



Local Application

Definition

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:

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

Local application eliminates the limitations of room sizes for total flooding systems

Machinery Local Protection Options: Water Mist, Spray, CO2

Agent	Standards	Advantages	Disadvantages
CO_2	NFPA12	Economic	H&S Issues Reduced Cooling Effect
Water Spray	FM	Prescriptive Economic	Thermal Shock Flood Risk High Water Consumption
Water Mist	IMO 1387 / FM5560 / TD2 (CNPP)	High Cooling Effect Low Water Consumption	Installation cost

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

Fire Test Protocols

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
- Enclosure100m^2
- 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

Spray Nozzle	120 º-125 º Spray Angle	80 º Spray Angle
Nominal Oil Pressure	8 Bar	8.5 Bar
Oil Flow	0.16kg/s	0.03kg/s
Oil Temperature	20 ºC	20 ºC
Nominal Heat Release	6MW	1MW

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> 500m^3 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

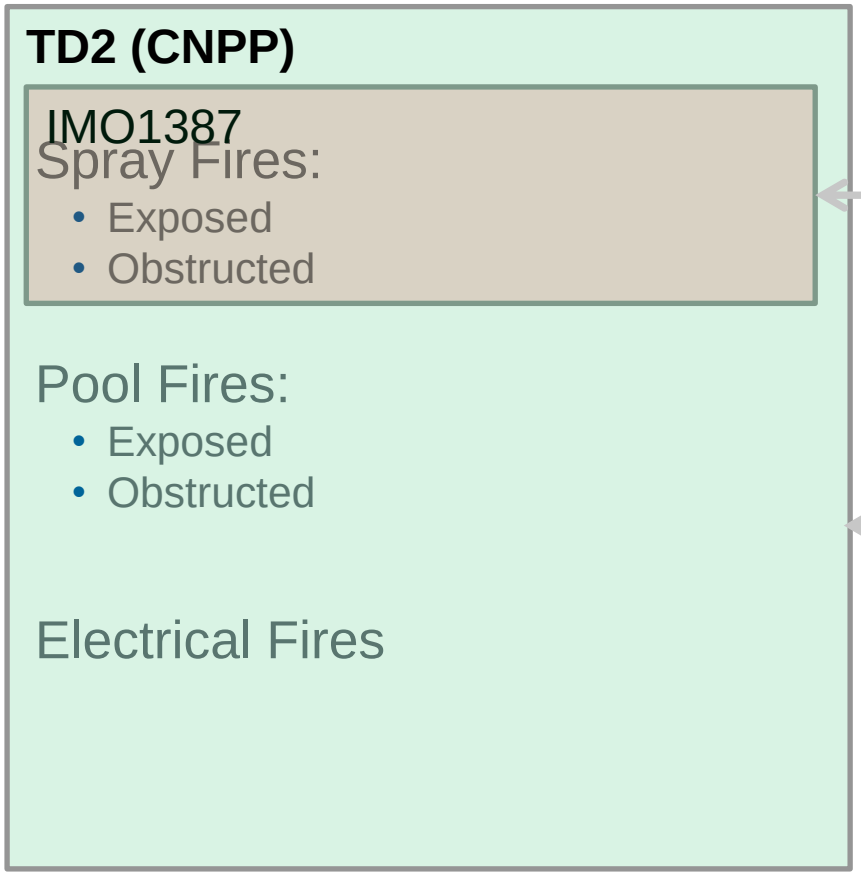
CNPP TD2 Fire Test

- 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 Burining 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



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

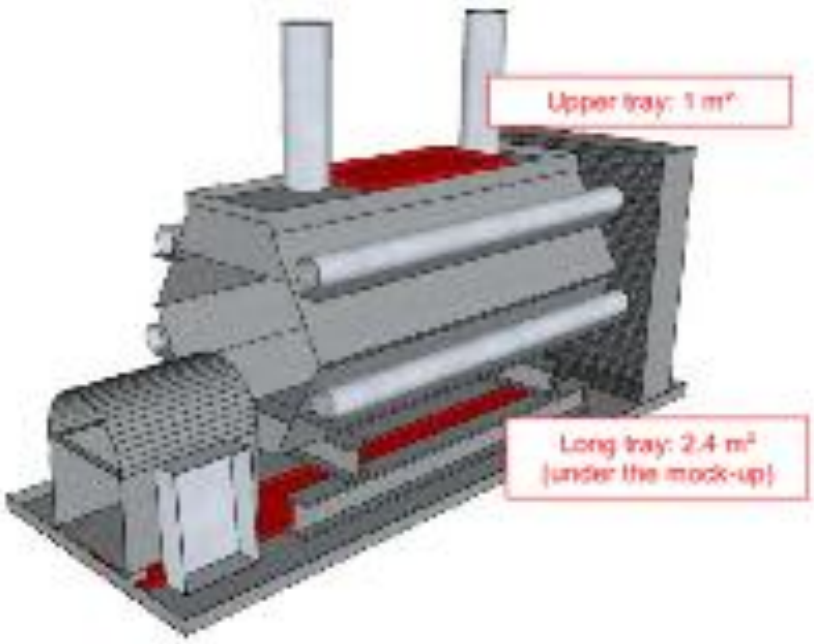
- Diesel fuel

Main physic-chemical characteristics of the oil	
Flash Point (°C)	65-75
Auto-ignition temperature (°C)	270-330
LII (% vol)	0,5-0.6
PCI (MJ/kg)	42.2

Fire scenarios

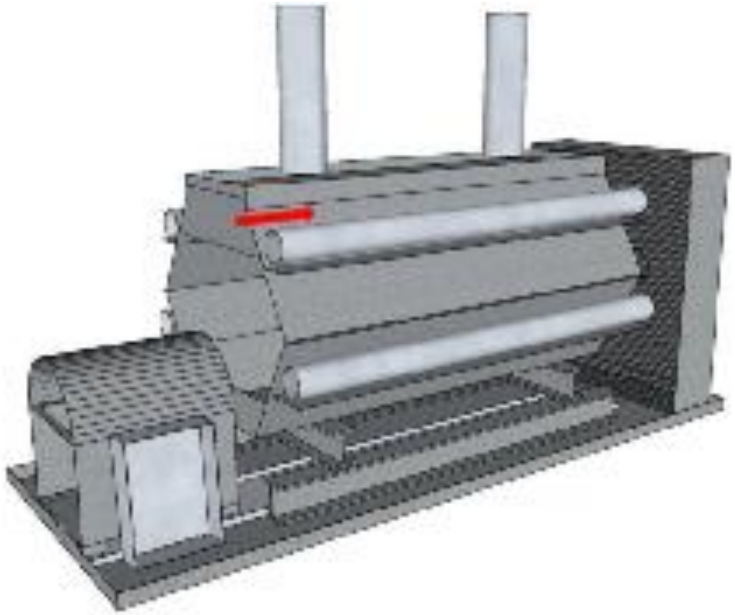
- Pool fires (1.1 - 3 MW)
- Spray fires (0.5 - 3 MW)
- Leakage fires (0.4 - 2.4 MW)

Pool Fire Tests



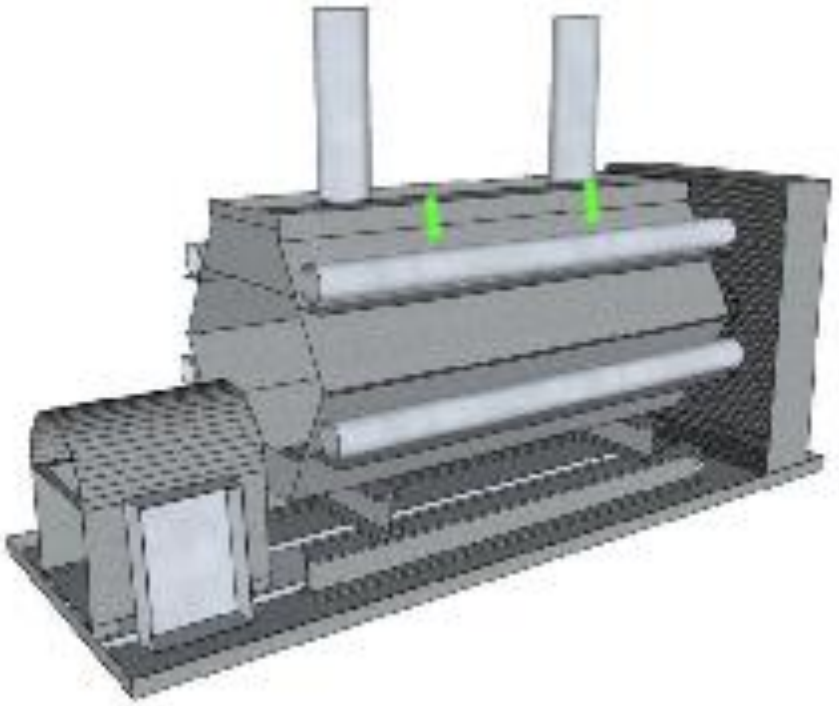
Tray Positions (in red)

Spray Fire Tests



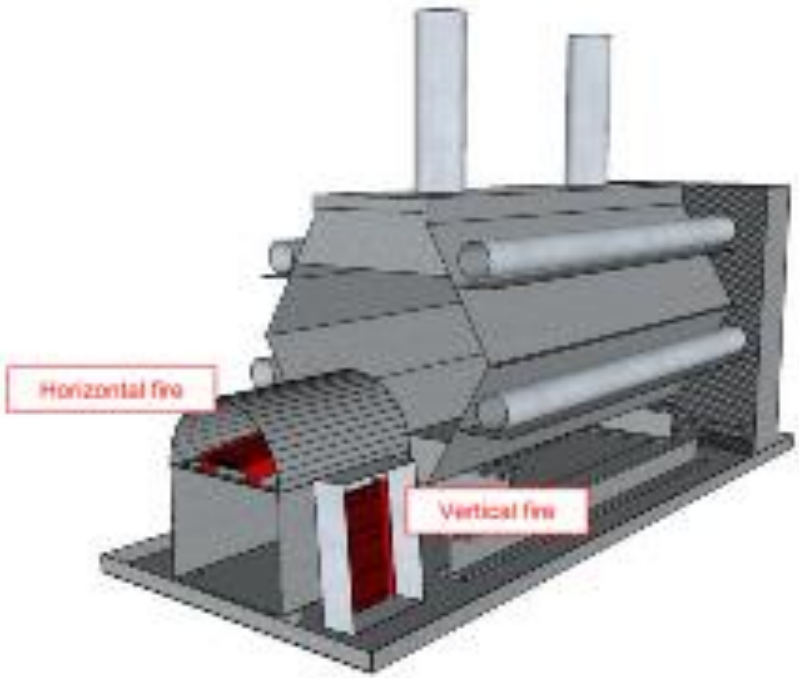
Spray Location (indicated by red arrow)

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
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