Flammable and Combustible Liquid Storage Challenges

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- One of world's largest business property insurers
- Clients: 1 of every 3 FORTUNE 1000 companies
- 176 years in business; Mutually owned
- Employ 1,800 engineers; No actuaries

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Scientifically focused.
 Believe losses are preventable, not inevitable.

We don't manufacture or sell fire sprinklers

 Pioneered every major development in sprinkler technology since the 1950s

Overview

- Big Picture
- Liquids
- Containers
- Liquids + Containers



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Big Picture

Approaching the Problem

- Understand the Liquids
 - Basic hazard = large pool fire
 - Need to understand protection for liquid pool fire
- Understand the Containers
 - Impact how much liquid can be released
 - Expected to fail in fire = all fail
 - Expected to resist failure in fire = one container



Liquids

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Liquids: What Do They Mean?

- Flammable Liquids
 - Expected to burn
- Combustible Liquids
 - Expected to burn less or not at all....
 - What does it mean to "burn less severely"?
 - "I have put a torch in the oil and clearly it would take some extreme event to make it burn."

Liquids: Fire Testing Shows

- Low flash point liquids (Flammable)
 - Ignite easily
 - Create challenging fire
- High flash point liquids (Combustible)
 - Harder to ignite with a torch
 - Easily ignite with a packaging fire
 - Create challenging fire



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Ignitable Liquid = Liquid That Burns

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Liquids: Fire Testing

High Flash Point Liquid - Closed cup flash point > 93°C (200°F) -16 mm/min (0.4 gpm/ft²) for 9.1 m (30 ft) roof -33 mm/min (0.8 gpm/ft²) for 14 m (45 ft) roof Very High Flash Point Liquid - Closed cup flash point > 260°C (500°F) Local area ignition - No spreading pool fire - Small Bottles = Big fire



Containers

Containers: IBC

Intermediate Bulk Container

Capacity 450 – 3,000 L (119 – 793 gal.)

Variety of Construction Materials

- Metallic
- Plastic
- CompositeCorrugated





Containers: Failure Modes

- Compatibility Issues at Increased
 Temperatures
 - Oil-filled
 - Soluble with HDPE
 - Large rips form
 - Water-filled
 - Pinhole leaks
 - Average time to failure 4 times greater



Containers: Approval Standard

Class 6020: Intermediate Bulk Containers

- Small scale compatibility testing
 - Screening
- Large scale testing
 - 2x2x2 array in a 9.1 m (30 ft) roof
 - Oil filled IBCs exposed to oil pool fire
 - K160 / 74°C / upright / SR / 24 mm/min
 - No breach for at least 45 minutes

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Liquids + Containers

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Containers: IBC Storage





Palletized Storage

Rack Storage

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Liquids + Containers

Protection Needed for Non-Approved IBCs

- Rack Storage
 - High flash point liquids
 - Alcohol
- Palletized Storage
 - Single IBCs
 - Composite IBCs
 - Empty IBCs



Rack Storage of Oil and Alcohol

In-rack Sprinklers with Barriers Effective

 Stop IBC failure
 Control "local" pool fire

 No Way to Avoid Large Pool Fire

 Need ceiling sprinklers for controlling pool fire

Palletized: Composite IBCs

Single-IBC Sufficient to Ignite a Pool
Single-IBC and Pool Fire can be Protected

Multiple-IBCs Require Additional Protection

 Suppress pool fire, not fire in the flue space
 Not sufficient to prevent additional IBC breaches
 Empty IBC fire is BAD

Palletized: Empty IBCs

Greater Hazard than Pool or Single-IBC
Plastic Pallet IBCs

K200 (K14.0) and 33 mm/min (0.8 gpm/ft²)

Wood Pallet IBCs

K200 (K14.0) and 24 mm/min (0.6 gpm/ft²)

Public Report will be Available – FPRF/PIRG

New Guidance – DS 7-29

Protection Options for:

 Oil and alcohol in composite IBCs in racks
 VHFP liquids in composite IBCs
 VHFP liquids in bag-in-box IBCs
 Propylene glycol in composite IBC
 Silicone emulsions in IBCs
 Empty IBCs

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Questions

Flammable & Combustible Liquids in Non-Listed Nonmetallic IBCs, David Nugent