



Developments in protection of open-top combustible containers (OTCC)

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Open-Top Combustible Containers



Rack Storage



Palletized / Solid-Pile

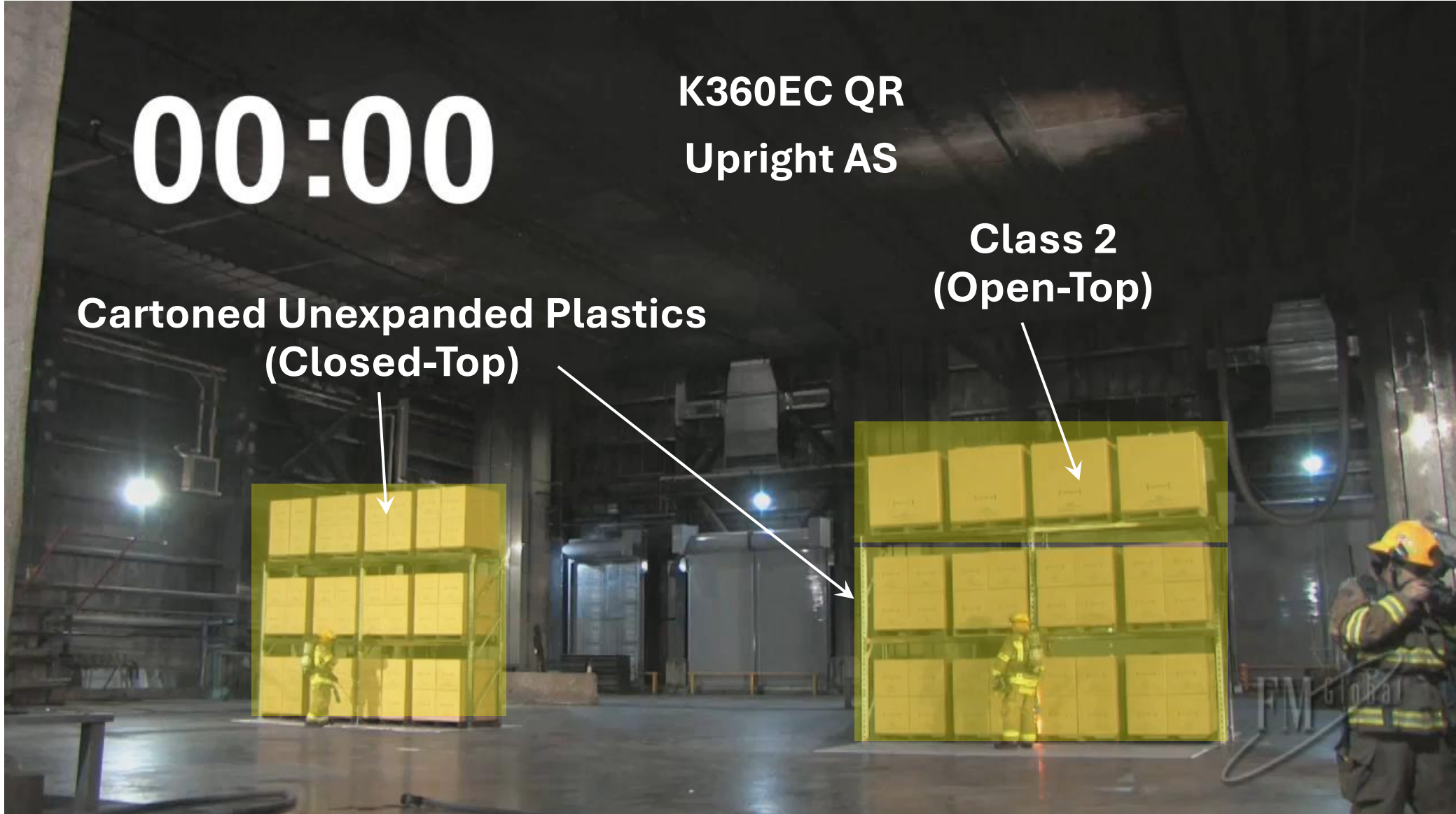


Top-Load ASRS



Mini-Load ASRS

Open-Top Combustible Containers



Open-Top Combustible Containers

Different materials, same result

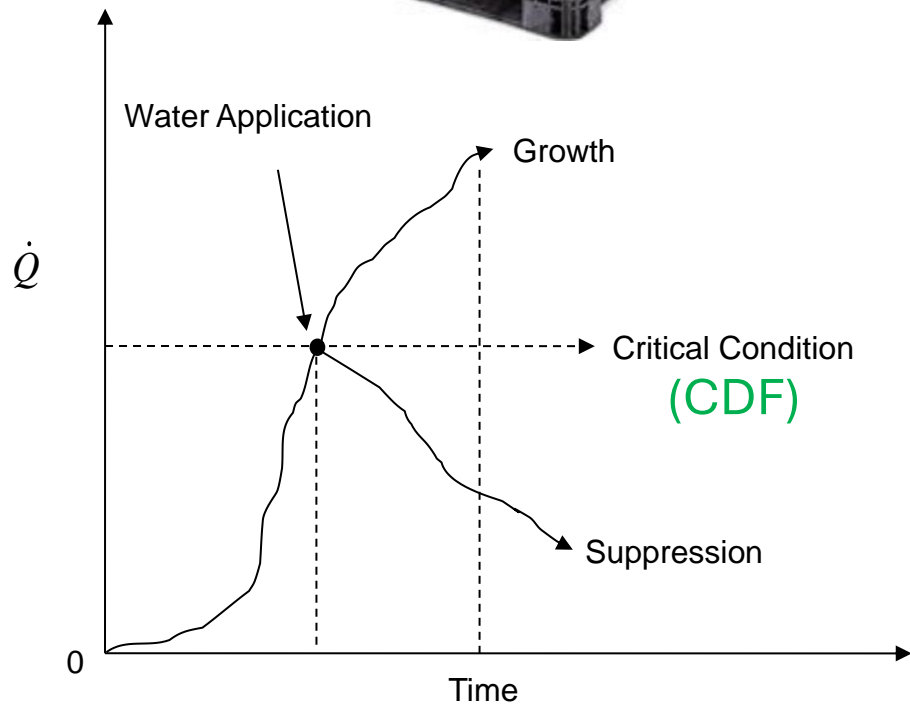


Delays water penetration

Evaluation of the Open-Top Container Hazard



Water Application Apparatus



Evaluation of the Open-Top Container Hazard

Class 2



Cartoned
Unexpanded Plastic



Uncartoned
Unexpanded Plastic



OTCC



Critical Delivered Flux



Class 3



Cartoned Expanded
Plastic

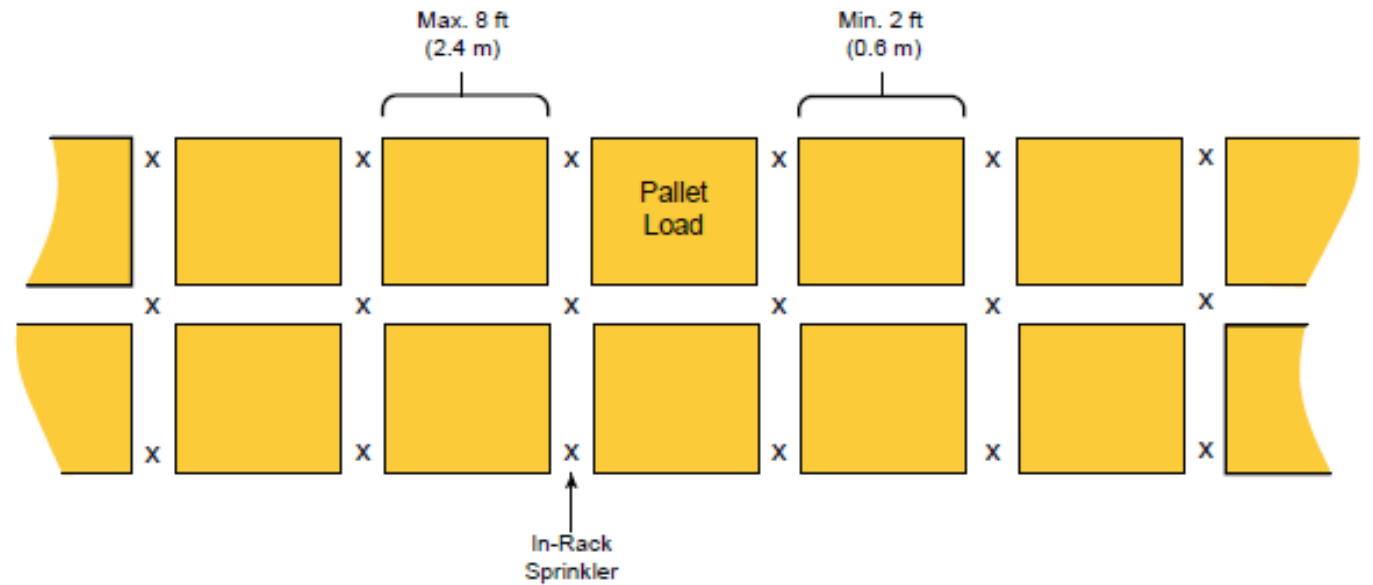


Uncartoned
Expanded Plastic

Current Protection Scheme



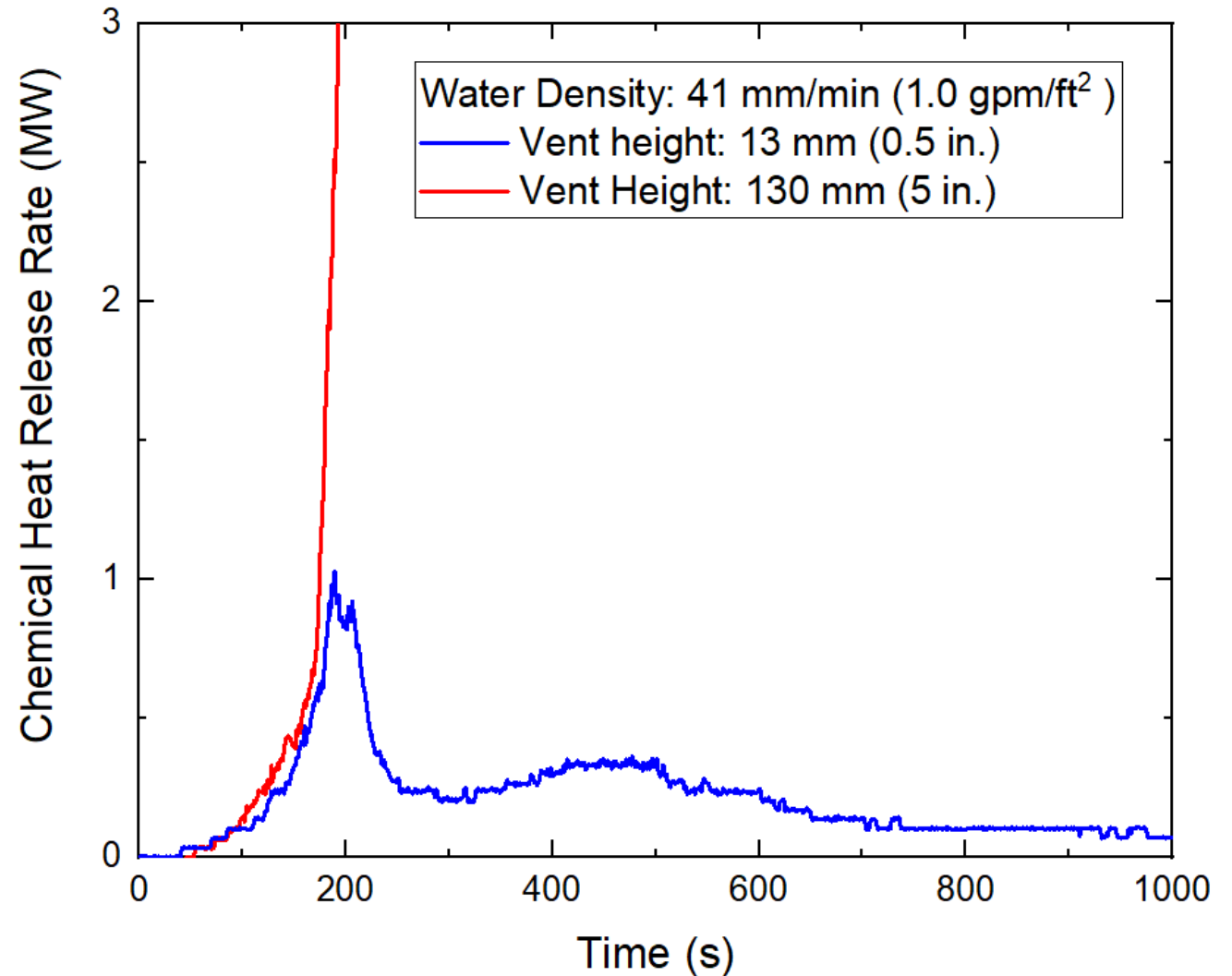
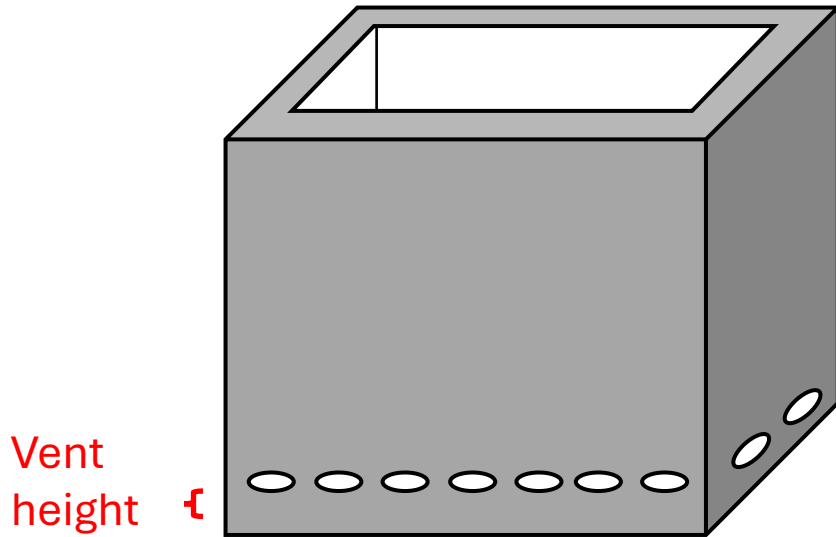
Layers of in-rack sprinklers every 3 m vertically



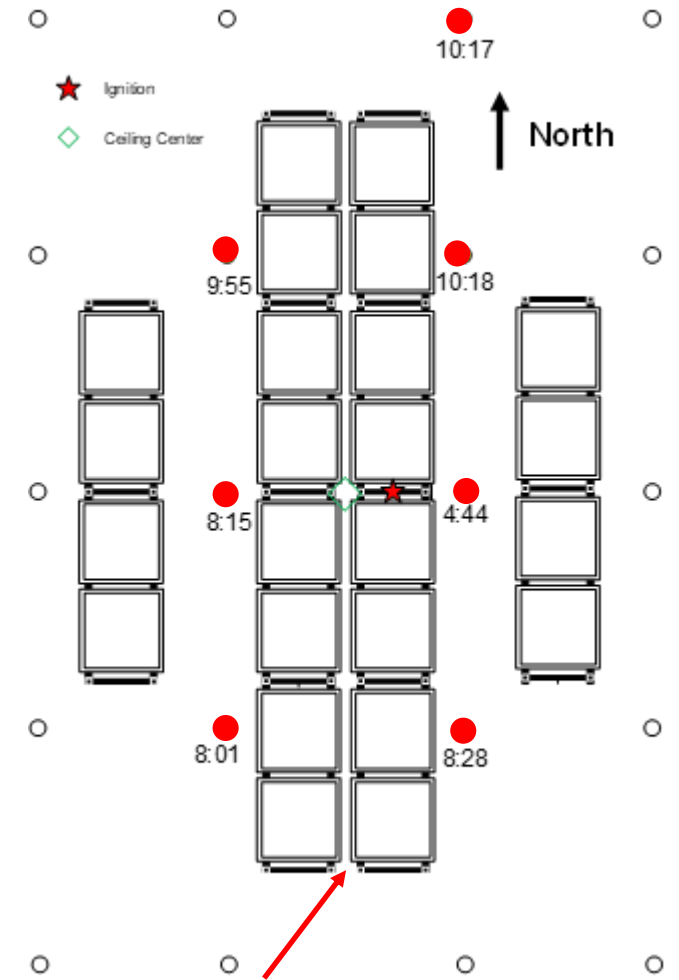
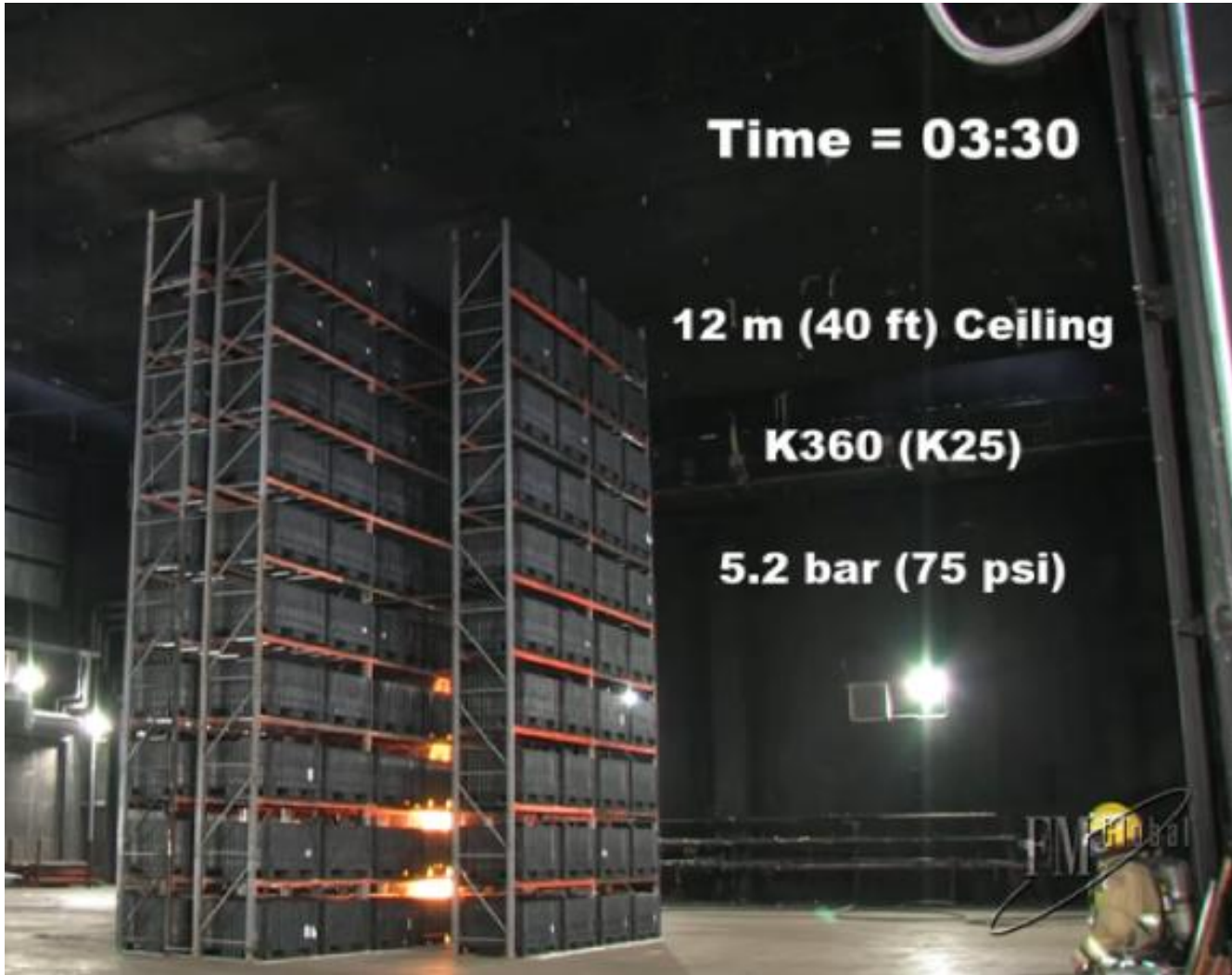
Vents on Side Walls

Vents on side wall reducing water collection provide significant fire protection benefits

Vent height, size, and location are critical

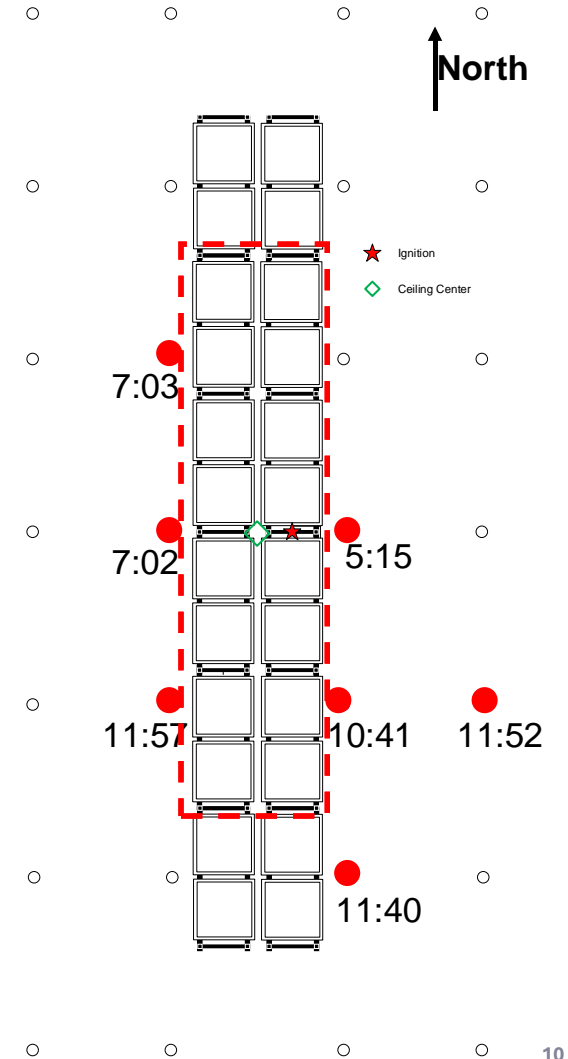
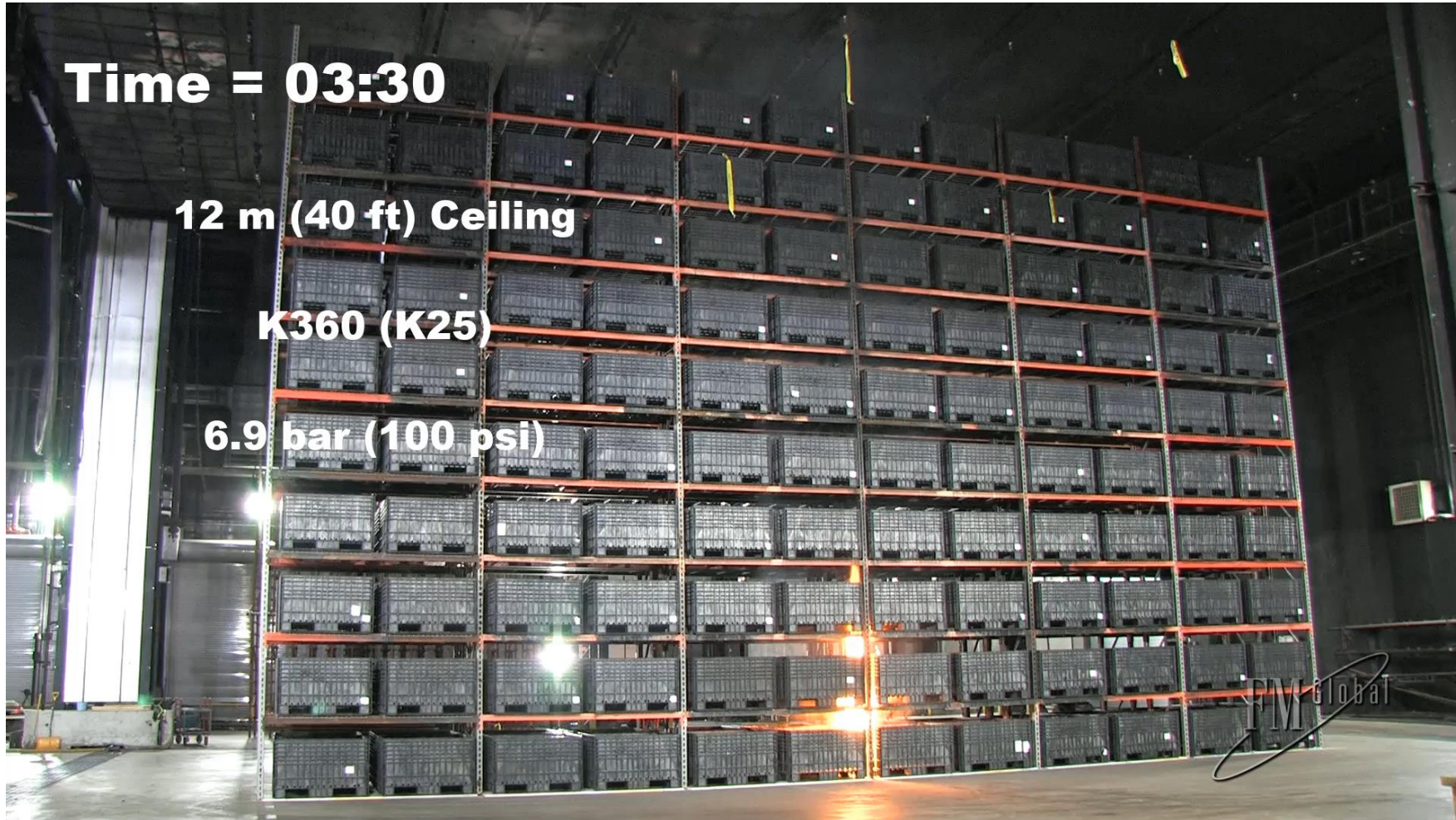


Large-Scale Test 1



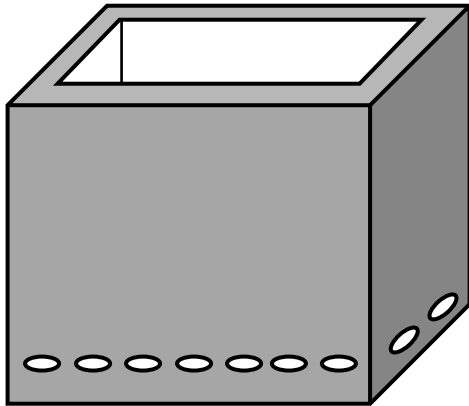
Fire reached both ends

Large-Scale Test 2

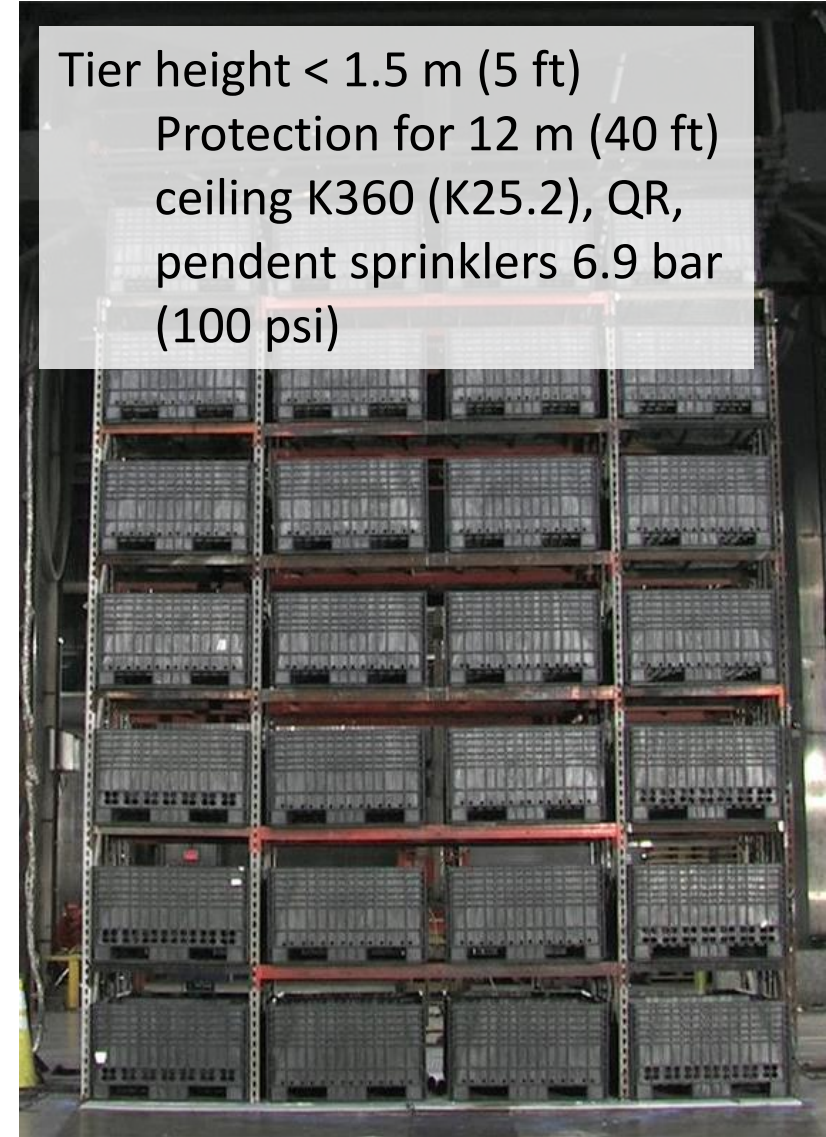
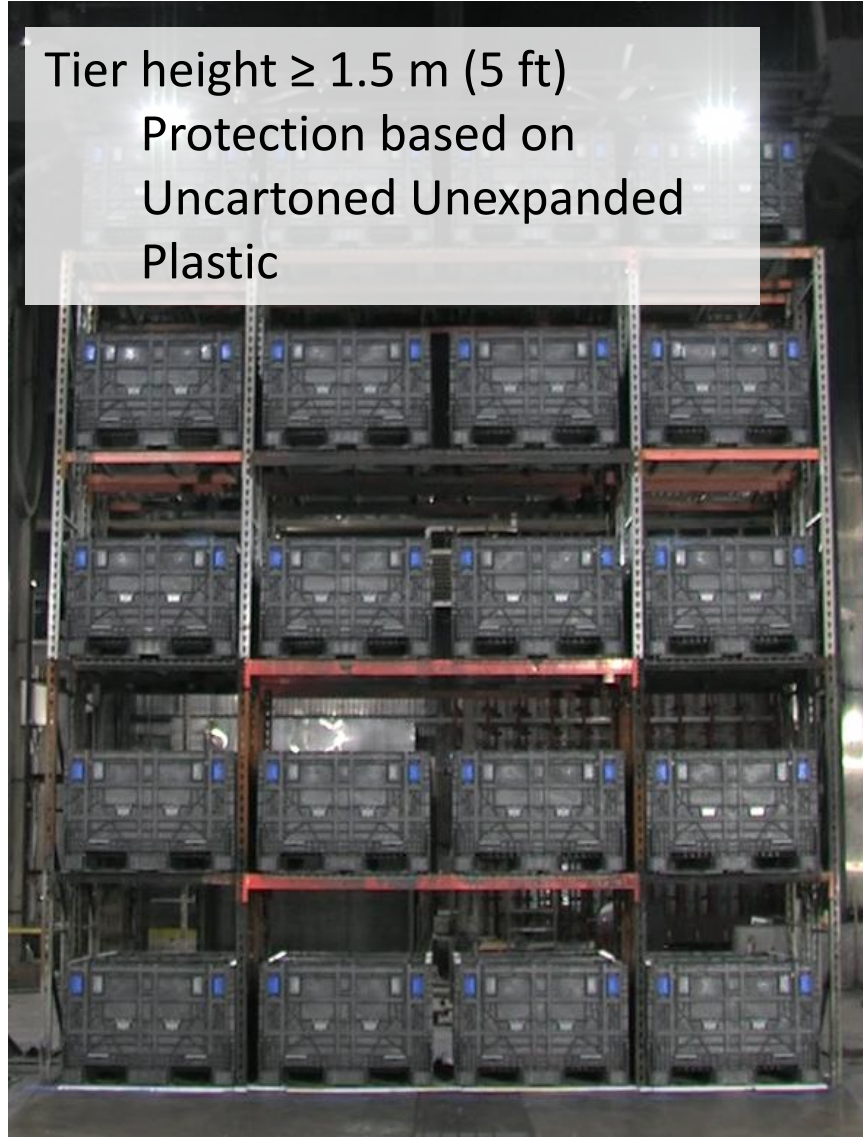


Conclusions – Rack Storage

Ceiling-only
sprinkler protection



Vented Open-top Containers



Solid-Piled or Palletized OTCC



In current guidance, there is no distinguishment between open- or closed-top containers

Solid-Piled OTCC

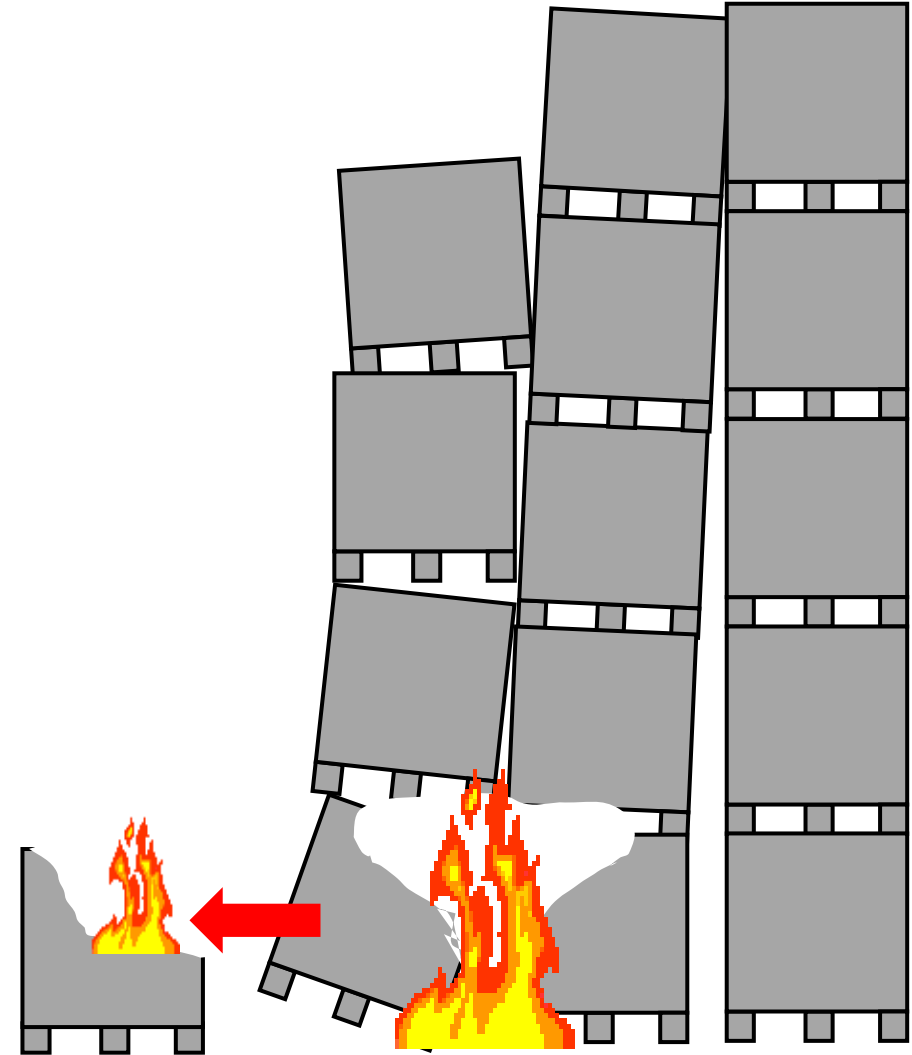
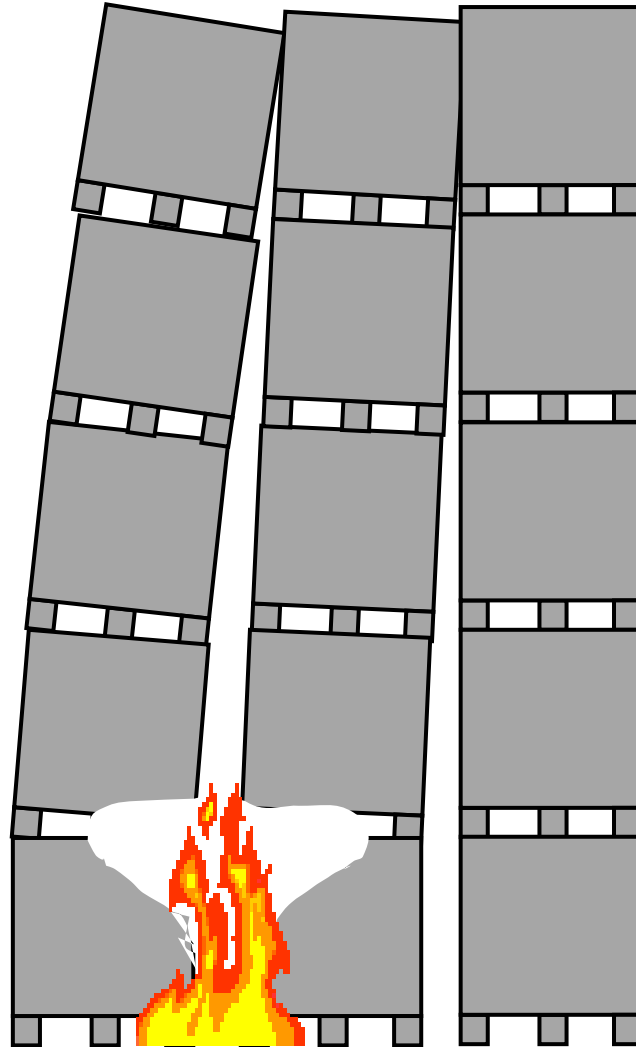
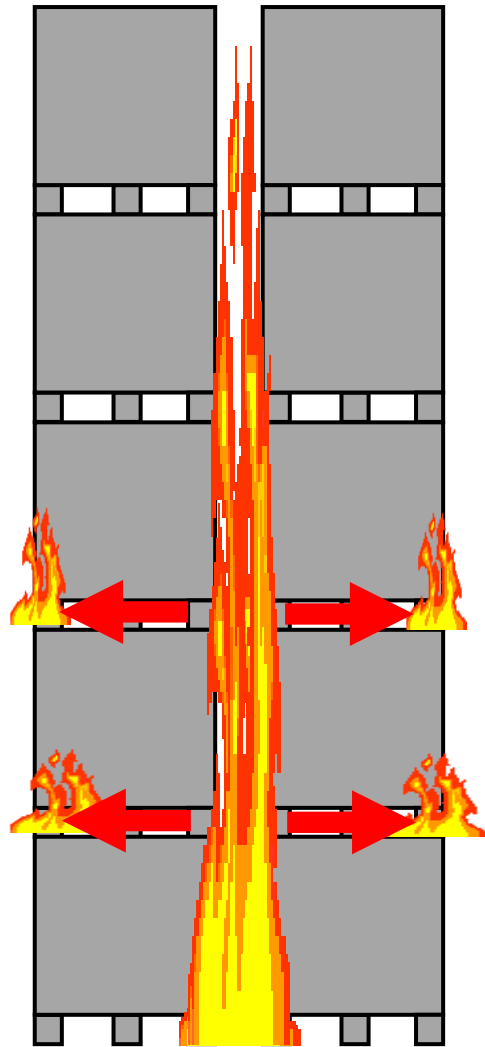


Collapse of piles ‘usually’ reduces the fire hazard

Reduced height of the burning commodity

Dispersed commodity allows better wetting by sprinkler discharge

Observations from Testing Palletized OTCC



Palletized OTCC

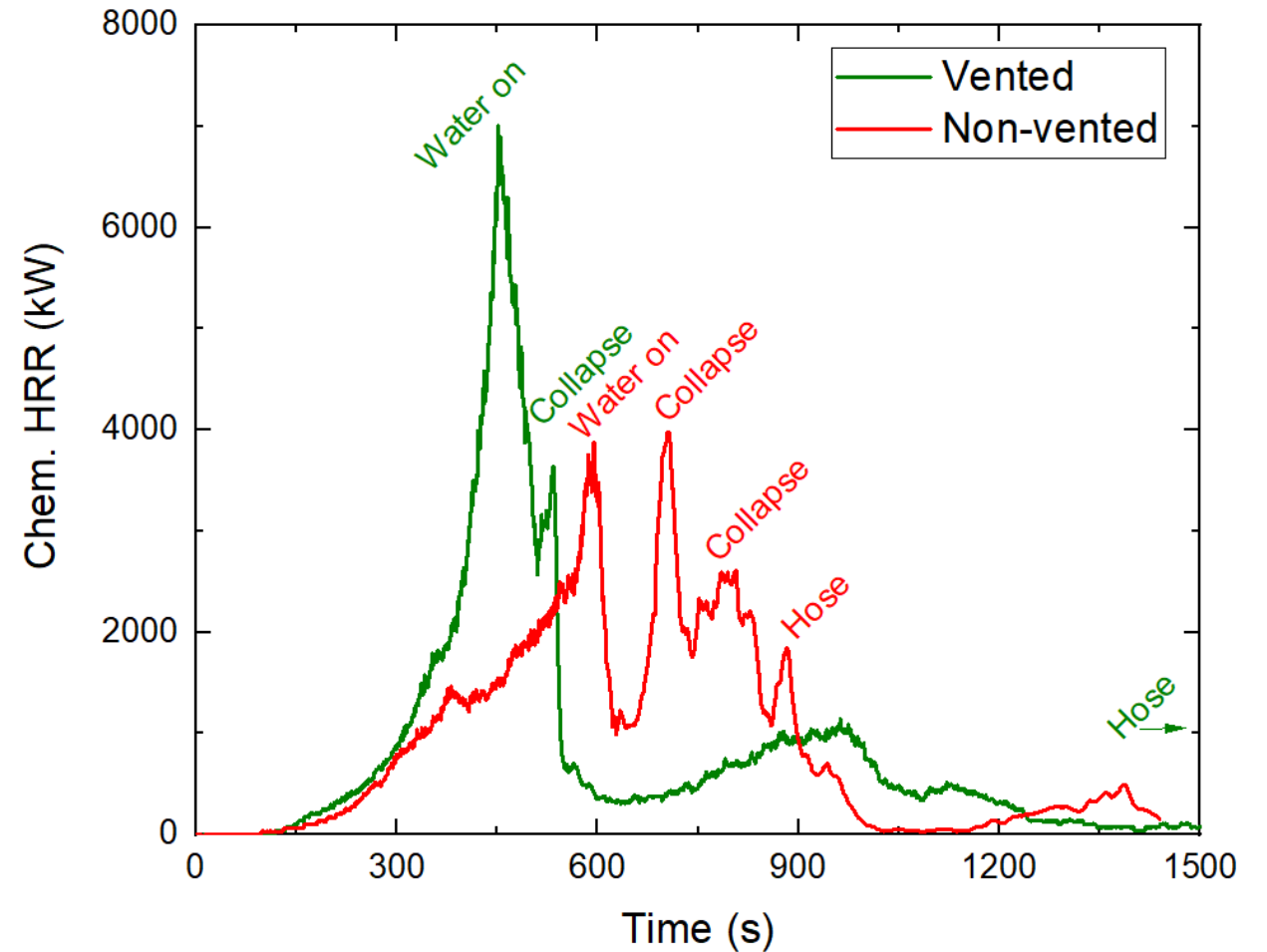
Benefits of using Vented OTCC:

- Minor collapses
- Better chance for ceiling sprinklers

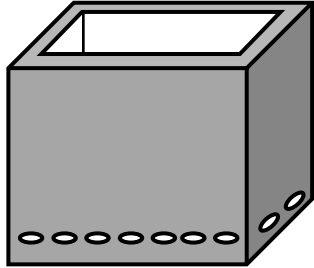
Vented



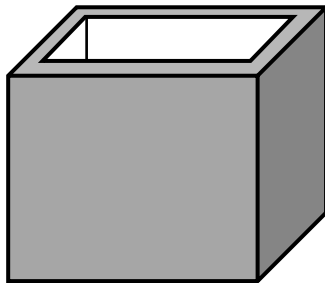
Non-vented



Hazard Evaluation of Palletized OTCC



Vented

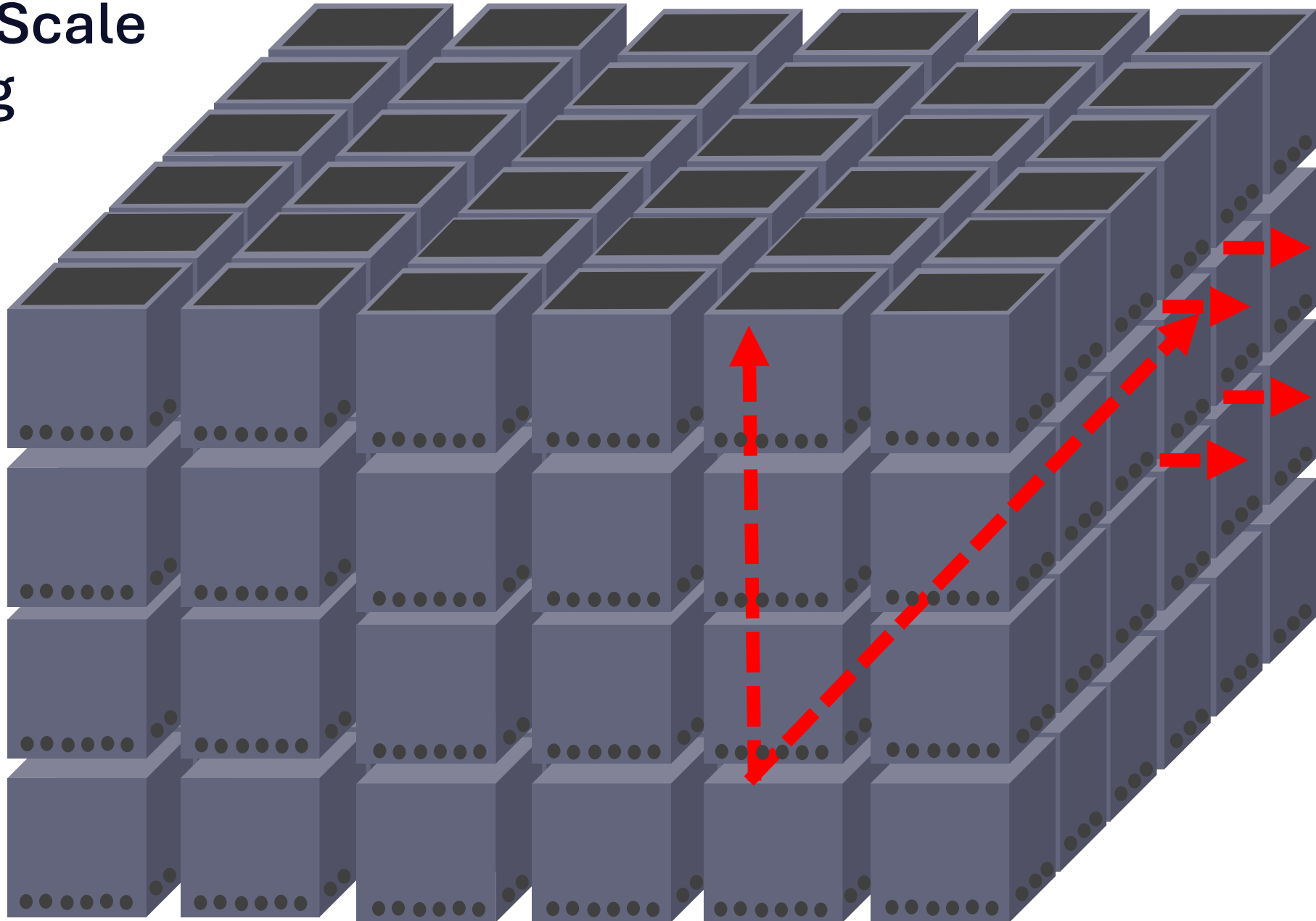


Non-vented



Supporting rack
minimizing impact
of collapse

Large-Scale Testing



Protection Scheme

- Adequate protection can be provided for palletized *vented* open-top combustible containers
- Number of sprinklers needs to be adjusted for the storage footprint, especially in the direction where containers are butted-up together

FM Approval Standard 4993

Vented Open-Top Combustible Containers (OTCCs)

Standards in progress

While FM Approvals has developed over 200 Approval Standards that specify the Approval criteria of various types of products and services, we're always working on developing more and improving the ones that we have. Below we outline the standards that are currently under development.

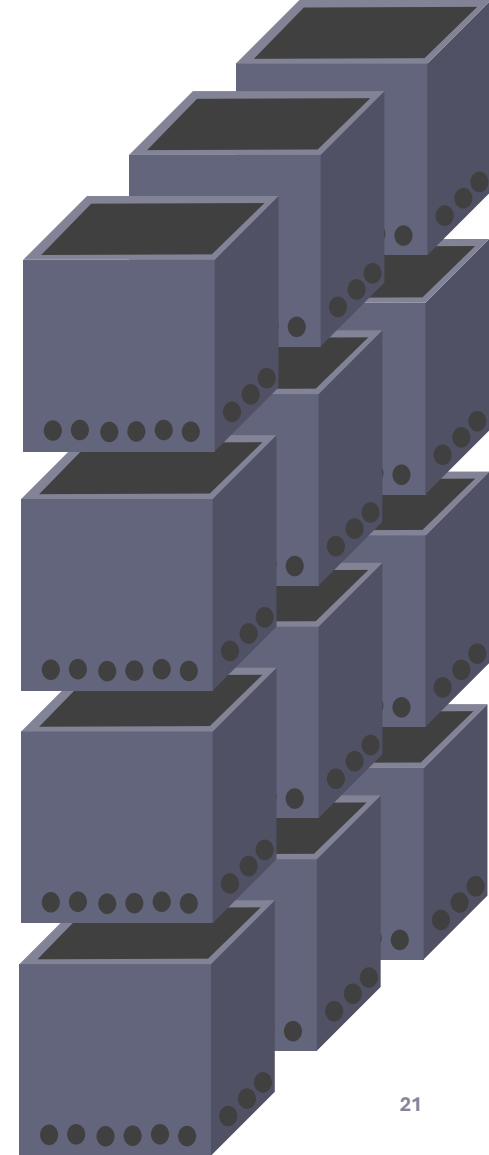
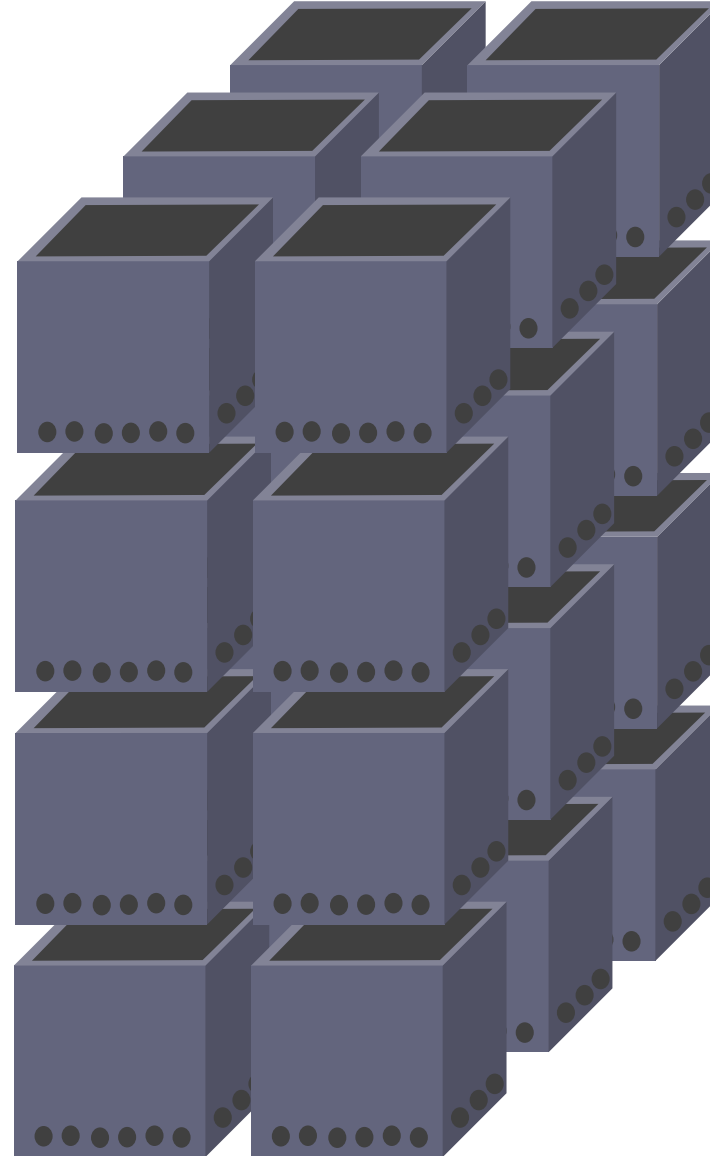
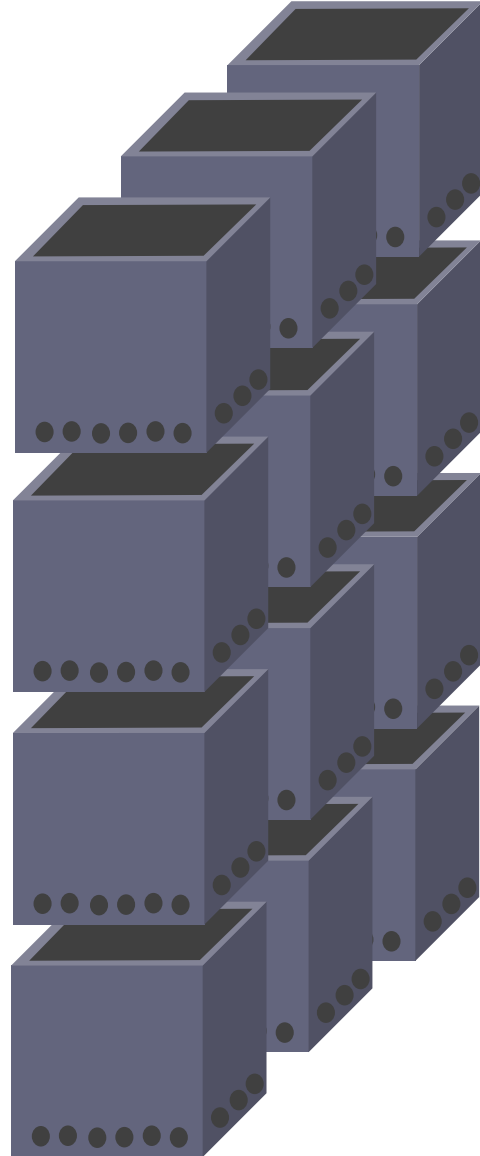
FM 4993, Open Top Storage Containers (Vented)

New Approval standard which will specify requirements for testing of open top storage containers that are vented.

Summary – Rack Storage & Palletized OTCC

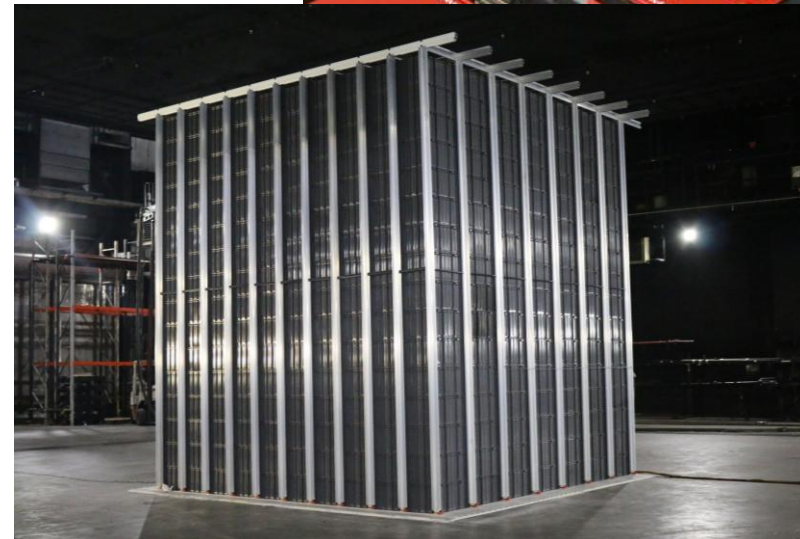
- Open-top containers present a fire hazard far greater than standard commodities
- Protection using ceiling sprinklers is possible for adequately vented open-top combustible containers
- FM Approval Standard in development

When are vented containers a challenge?



Top-Loading ASRS

- Containers stored in stacks
 - Open-top plastic with solid walls
 - Open-top plastic with non-solid walls
- Robots load and unload containers vertically
 - Aisles not required for material handling
 - Very limited access to storage area
- Storage height limited by robot capability (typically < 6 m)



Top-Loading ASRS

- Solid-Walled or Non-Solid Walled (Vented) Containers

Solid side walls help reduce speed of horizontal flame spread



Protection of Top-Loading ASRS

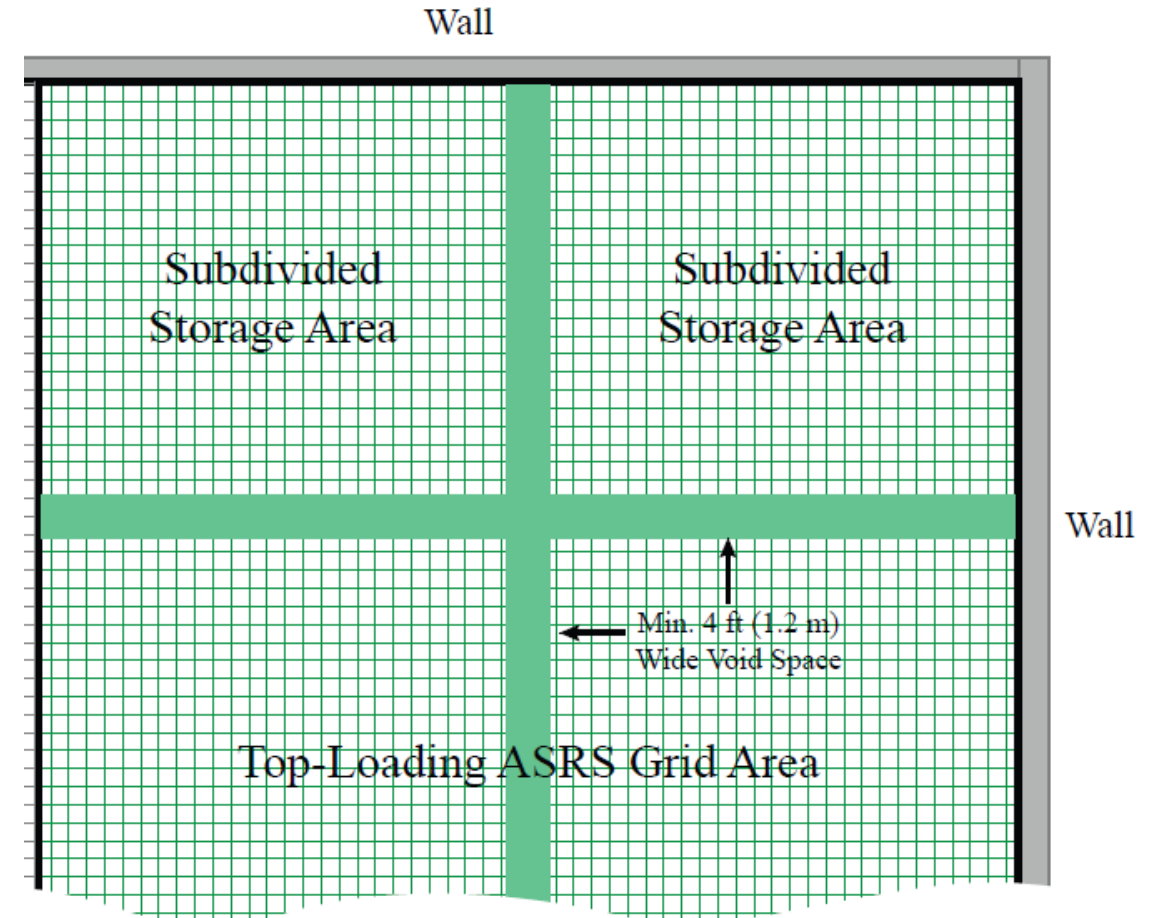
- Access to the seat of the fire and final extinguishment is a significant challenge
- Extinguishing sprinkler designs are available for **solid-walled** containers under 7.6 m and 9 m ceilings
- Non-solid wall (vented) containers require aisle spaces and...



Protection of Top-Loading ASRS

- Pre-incident plan with the fire department
- Perimeter mezzanines / platforms
- Vertical barriers
- Monitor nozzles
- Small hose station
- 4-hour water supply

For both *combustible* container types, significant damage and downtime is possible following a fire



What if we could reduce the hazard of the containers themselves?

Non-flame-propagating containers

- Prevent fire spread away from origin
- Limit damage to storage structure
- Reduce or eliminate smoke and water damage
- Minimise reliance on manual intervention
- Containers do not need to be noncombustible
- Fire retardants or composites are allowed



FM Approval Standard 4994

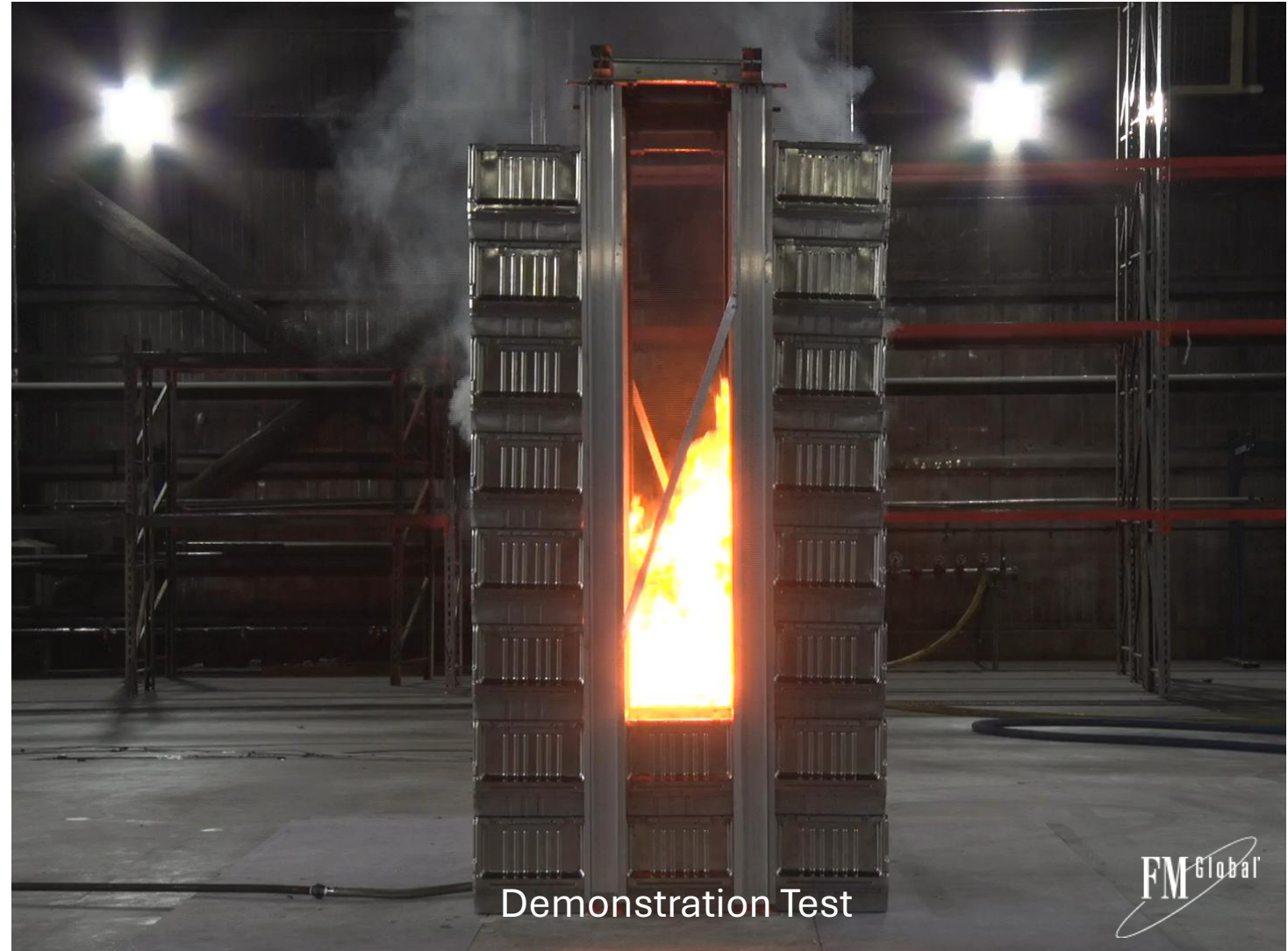
Non-Flame-Propagating Containers Used in Top-Loading Automatic Storage and Retrieval Systems

Exposure

- 75 kW/m² for 15 minutes
- Addresses storage of ordinary combustibles

Benefits

- No fire spread
- Minimal damage to storage structure



Protection of Top-Loading ASRS

Future TL-ASRS recommendations with FM Approved Non-Flame Propagating Containers:

- Concerns with manual fire extinguishment eliminated
- Sprinkler design for surrounding occupancy (no need to change an existing sprinkler system)
- Property damage significantly reduced
- Business interruption significantly reduced

Thank you. Any questions?

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