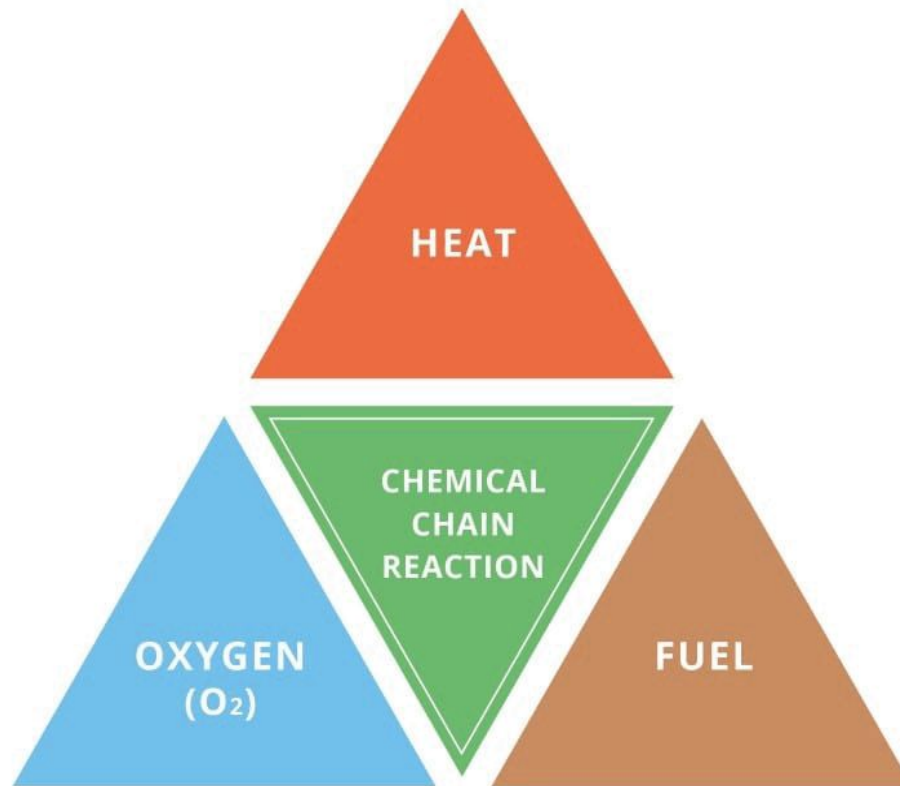


# Containership fires and the difficulties of fighting fires at sea

Dr Nick Carey

# Fire tetrahedron



# Lithium batteries include:

- Fuel,
- an oxidant,
- can generate heat
- So with a chain reaction - they provide everything required!

# Self-heating

A number of materials are capable of self-heating in specific circumstances, for example:

- Drying Oils (i.e. linseed etc. which have carbon-carbon double bonds and harden via oxidation)
- Vegetable oils in a matrix (cotton fabric etc.) if pre-heated
- Coal
- Carbon powder or charcoal in large quantities

# Linseed oil – self heating



Image courtesy of Jamie Novak

# Cotton contaminated with vegetable oil











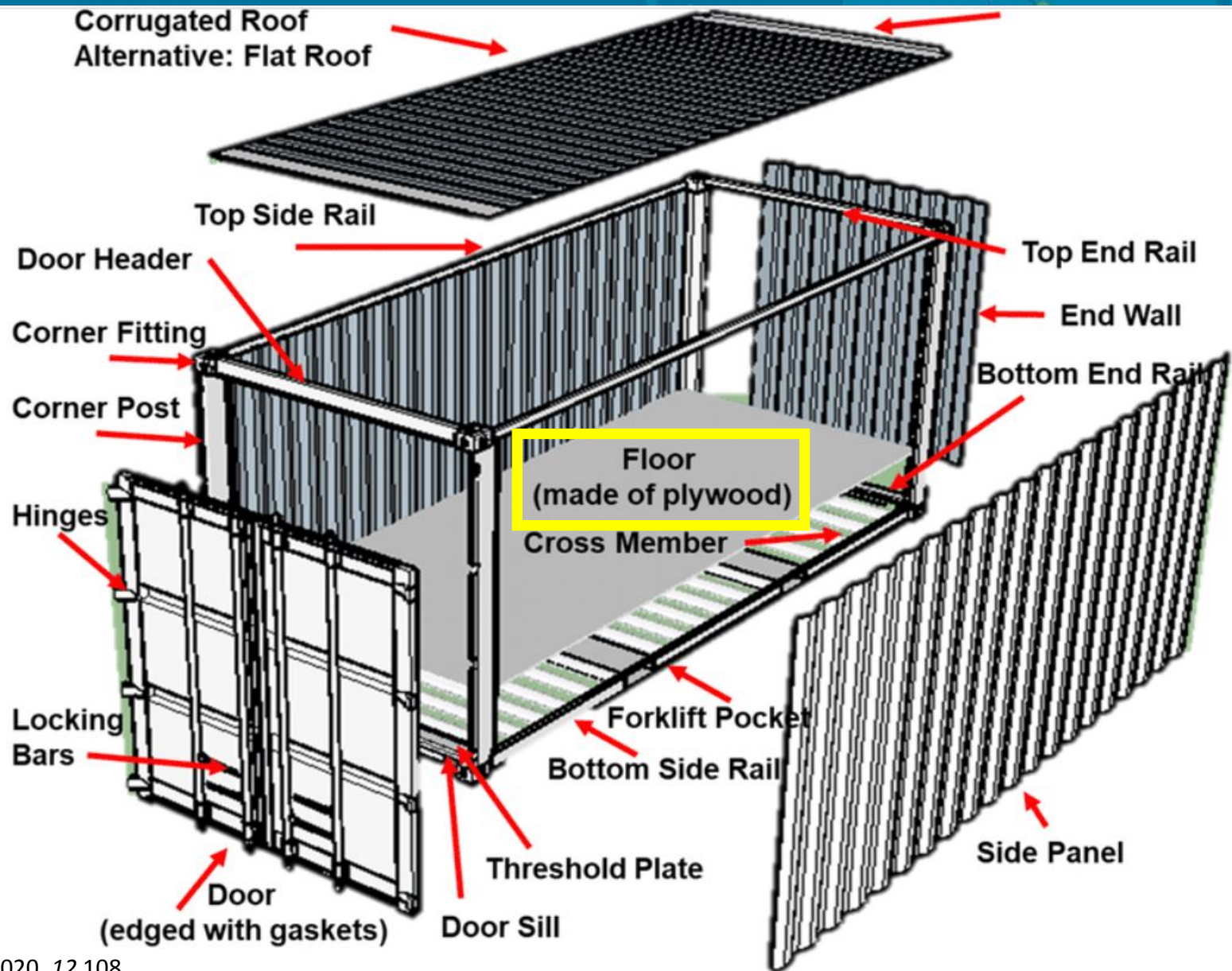
# Exothermic reactions

The material is unable to lose heat quicker than it is generated i.e. large volumes of material

The exothermic reaction times of materials are related to the volume i.e. the slower the reaction the larger a mass of material is required for ignition

A high ambient temperature or pre-heating – can initiate the exothermic reaction

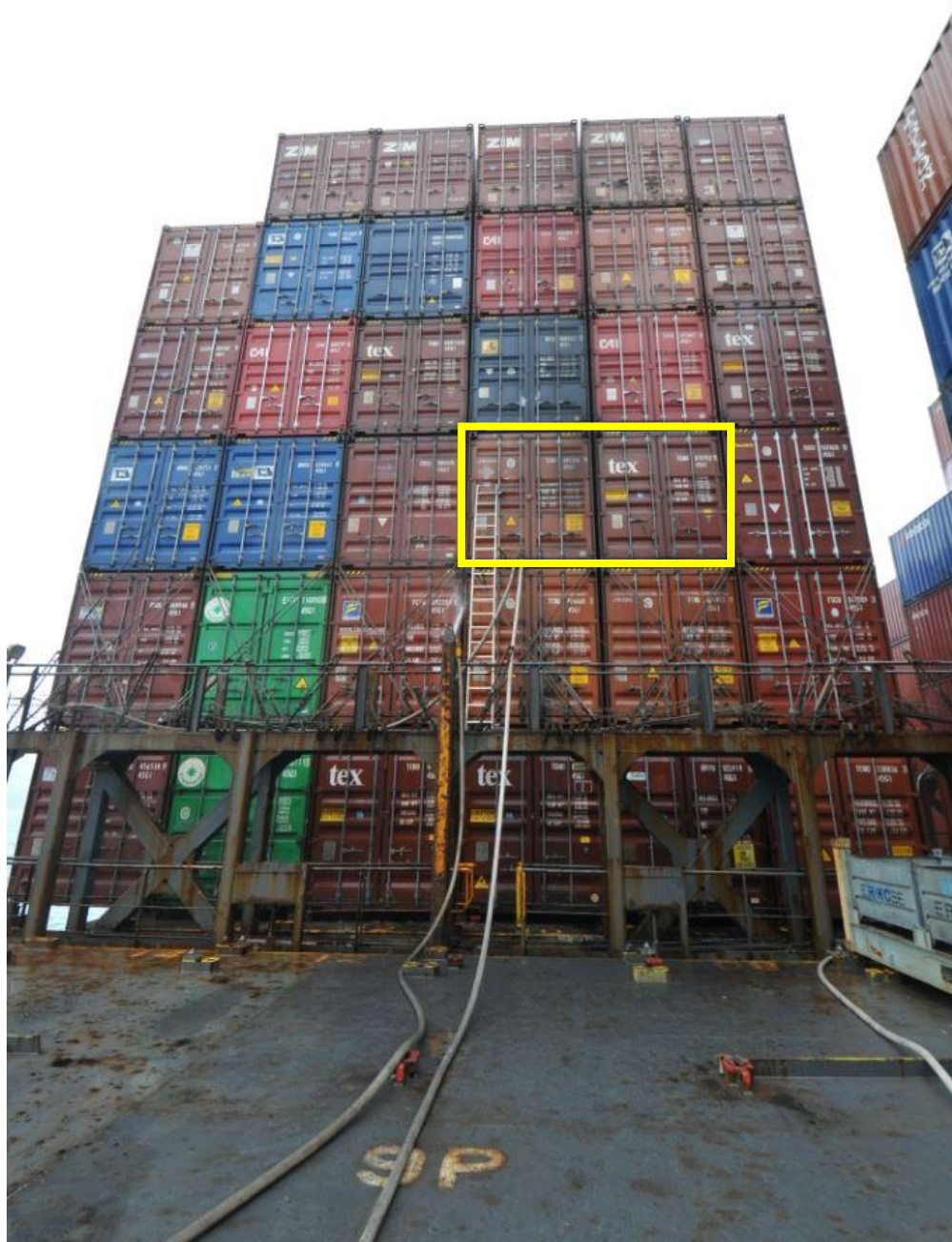
# Container design



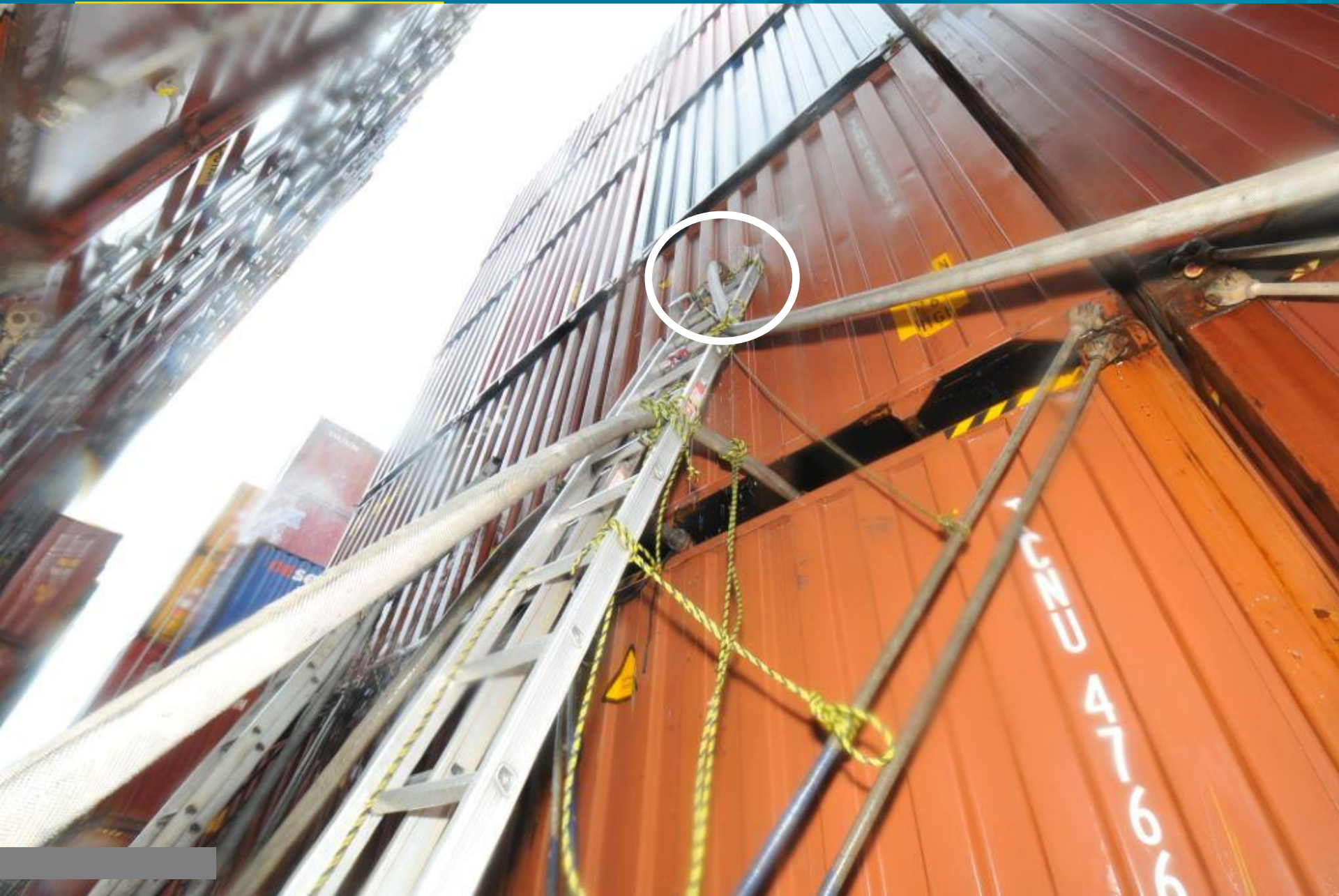
# Case study













# Dedicated firefighting nozzle



Burning  
material  
falling  
through  
the  
plywood  
floor





# Ignition of released carbon powder















869146 5  
45G1

32.500 KG  
71.650 LB  
3.900 KG  
8.600 LB

28.600 KG  
63.050 LB  
76.4 CUM.  
2.700 CU.FT.









# IMDG special provision 925

- ***Non Dangerous Goods (DG) if:***
  - *“it passes the tests for self-heating substances as reflected in the Manual of Tests and Criteria (see 33.3.1.3.3), and is accompanied by a certificate from a laboratory accredited by the competent authority, stating that the product to be loaded has been correctly sampled by trained staff from that laboratory and that the sample was correctly tested and has passed the test.”*



# Firefighting innovations – cutting/abrasive nozzles (Cobra etc.)



Source: Cobra website



# Some final thoughts.....

- Should DG and non-DG cargo cost the same to ship?
- Design change for container floors?
- Inert gas-filled containers?
- Verification of self-heating testing laboratories
- Flooding the container with water may not extinguish the fire!

[nick.carey@hawkins.biz](mailto:nick.carey@hawkins.biz)