



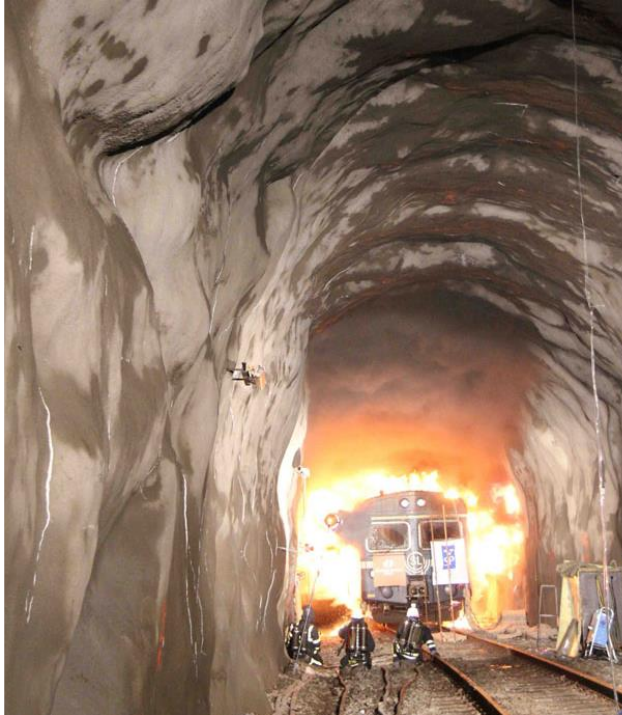
# FIRST RESPONDERS AND NEC – CHANGES AND CHALLENGES IN UNDERGROUND ENVIRONMENT

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Safety and Transport - Fire Research



# These are the new NEC problems we need to deal with

## ❑ Liquefied gas vehicles (LPG, DME, LNG)

- ✓ jet fires
- ✓ BLEVE with fireballs
- ✓ gas cloud explosion



## ❑ Compressed gas vehicles (CNG, BNG, H<sub>2</sub>):

- ✓ jet fires
- ✓ Gas tank rupture with fireballs
- ✓ gas cloud explosion



## ❑ Electric battery vehicles (Li-ion):

- ✓ Normal fires with small jet flames
- ✓ Gas cloud explosion



# Examples with gas containers



Jet fire – famous buss fire  
incident here in the Netherland



BLEVE and fire ball  
(*Superheat temperature*)

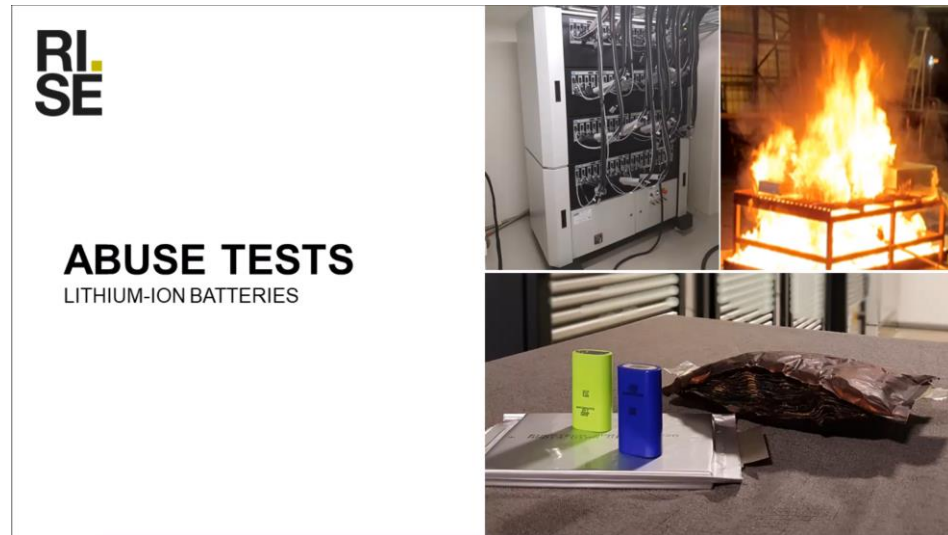
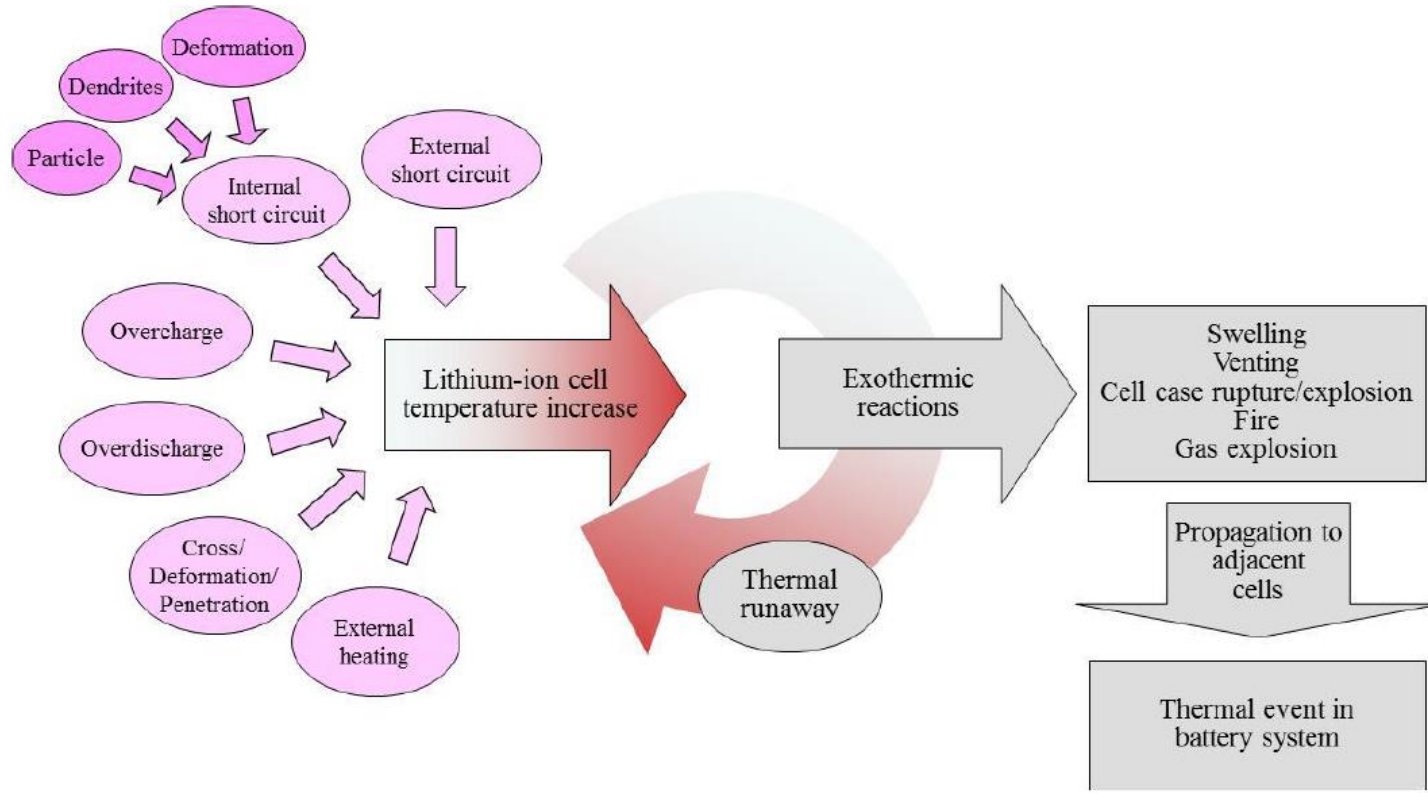


# Example of risk for vapour cloud explosion



Photo:aftonbladet

# The battery problems





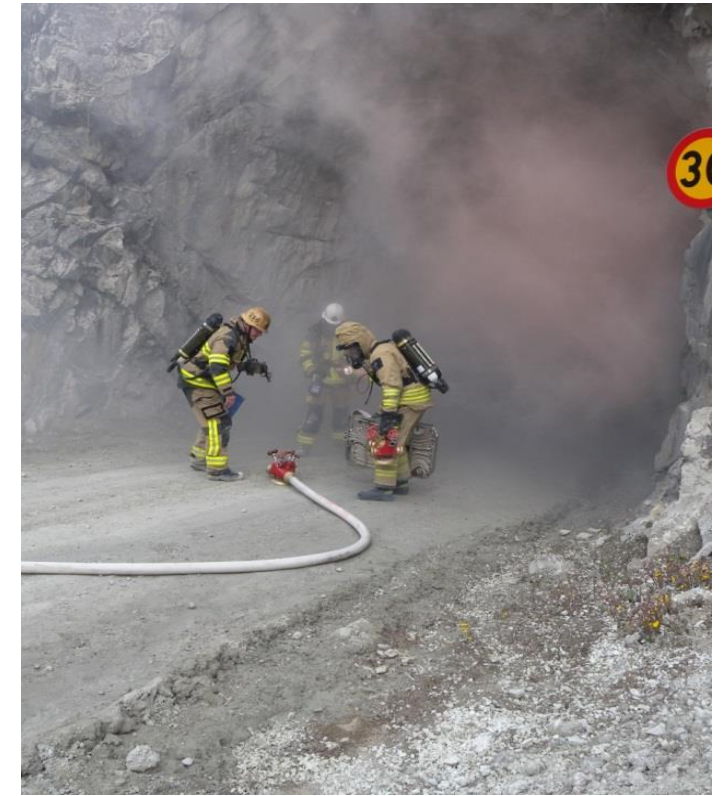
# There are good news ...

- HRR appears not to change much compared to conventional vehicles
- There are safe solutions available and we can predict outcome
- Tunnels will not collapse
- Mitigation systems can help
- There are no risks for flashover situations
- Authorities – begin to understand the complexity
- First responders seeks information



# but there are bad news also

- Increased transportation with NEC related products
- Problems to identify vehicles
- Forseen discussion on increased water demand
- There are no established new tactics for tunnels
- New problems after fires
- Underground car parks will become a major problem
- There are still many uncertainties
- and misconceptions grow



# Challenges for first responders

- Timeline differs from conventional fuels
- Leads to uncertainty during a rescue operation
- Cooling of gastanks uncertain
- Cooling battery and risk for re-ignition
- Hydrogenfluoride HF (protection)
- If gas related – no entry
- General knowledge about the risks limited

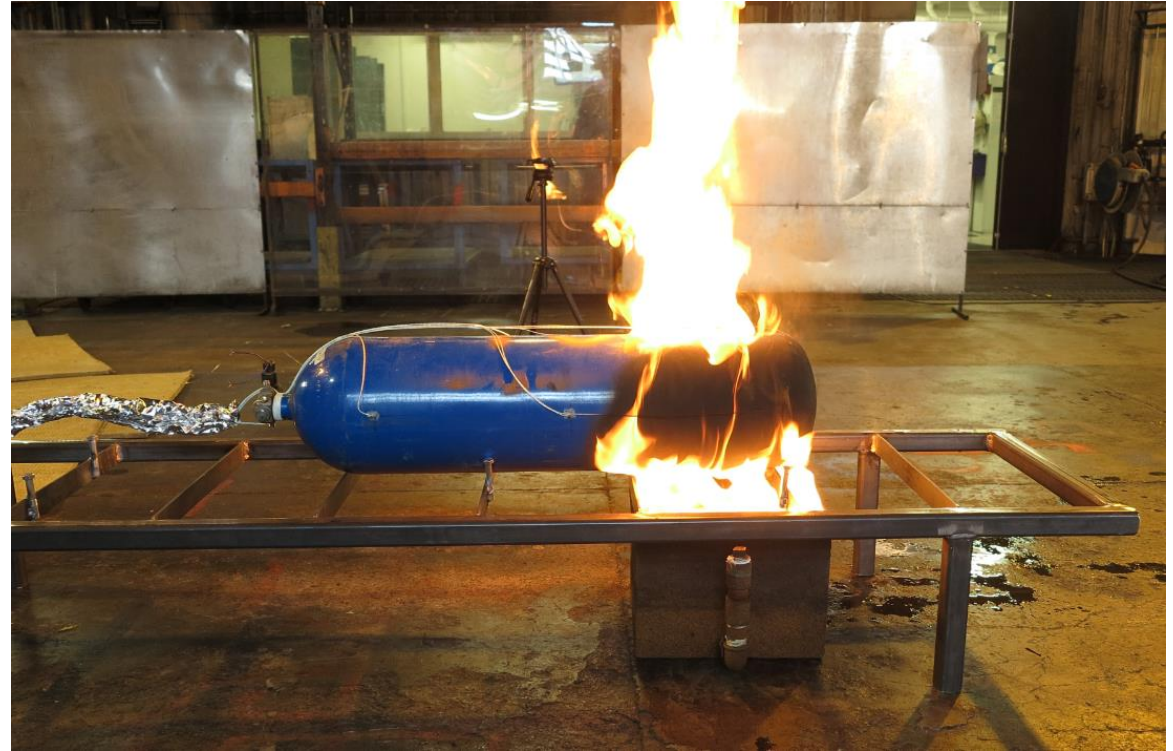




# RISE perform new research to obtain public data



Composite tanks



steeltank

# Test with a CNG composite tank (empty) – fullscale tests planned



# Summary

- We will be able to solve most of the problems but we need time
- We need to educate and communicate better with authorities and first responders
- We need to revise design fires (10-20 years with mixed traffic)
- Arguments for FFFS may be reconsidered
- Road tunnels robust against introduced new explosion risks
- Battery fires can be dealt with in most cases
- Researchers and first responders needs to work more closely in the future



# Finally examples of related research at RISE



Risks associated with alternative fuels in road tunnels and underground garages

Jonatan Gehandler, Peter Karlsson, Lotta Vylund

SP Technical Research Institute of Sweden



SP Report 2017:14



SAFETY AND TRANSPORT



Study of fire and explosion hazards of alternative fuel vehicles in tunnels

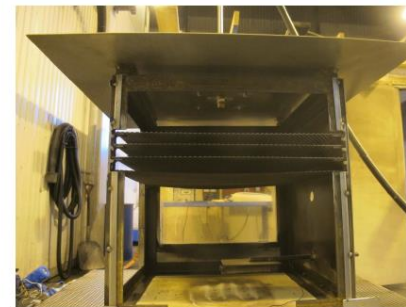
Ying Zhen Li

RISE report 2018:20

Aforsk Project 16-649  
BrandForsk Project 400-161



SAFETY AND TRANSPORT  
SAFETY



Lion Fire: Extinguishment and mitigation of fires in Li-ion batteries at sea

Petra Andersson, Magnus Arvidson, Franz Evegren, Mourhaf Jandali, Fredrik Larsson, Max Rosengren

RISE Report 2018:77



SAFETY & TRANSPORT  
FIRE RESEARCH



Fire Safety of Lithium-Ion Batteries in Road Vehicles

Roeland Bisschop, Ola Willstrand, Francine Amon, Max Rosengren

RISE Report 2019:

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Thanks

