SAFE TRANSPORT OF AFV´S FROM AN OPERATORS PERSPECTIVE

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What is the Owners perspective?

- Profit
- Business opportunities
- Decarbonization
- Safety?

Our main policy:

Zero harm to personnel and assets

Decarbonization - one of the greatest challenges for the industry

- **No safety culture in decarbonization?**
- **Decarbonization first, safety second?**

DNV Maritime Forecast 2022

Imature Safety regulations – a safety challenge:

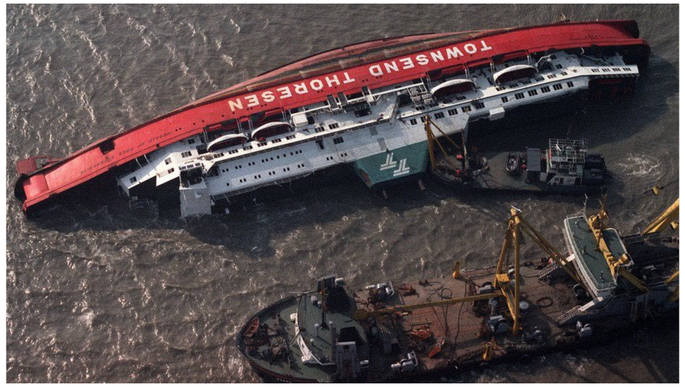
“Introduction of new marine fuels, the toxicity of methanol and ammonia, and the extreme flammability of hydrogen, bring new sets of safety challenges originating from the physical properties of each fuel”

- **Same applies for AFV´s**

Allianz – A burning issue: Fires on board

“*Existing counter-measure systems may not respond effectively in the event of an EV blaze”*

Highly regulated industry



HERALD OF FREE ENTERPRISE
1987

SCANDINAVIAN STAR
1990

ESTONIA
1994

Stability/freeboard issues

the greatest risks for a RoRo ship – until now?

It is fair to ask the question:

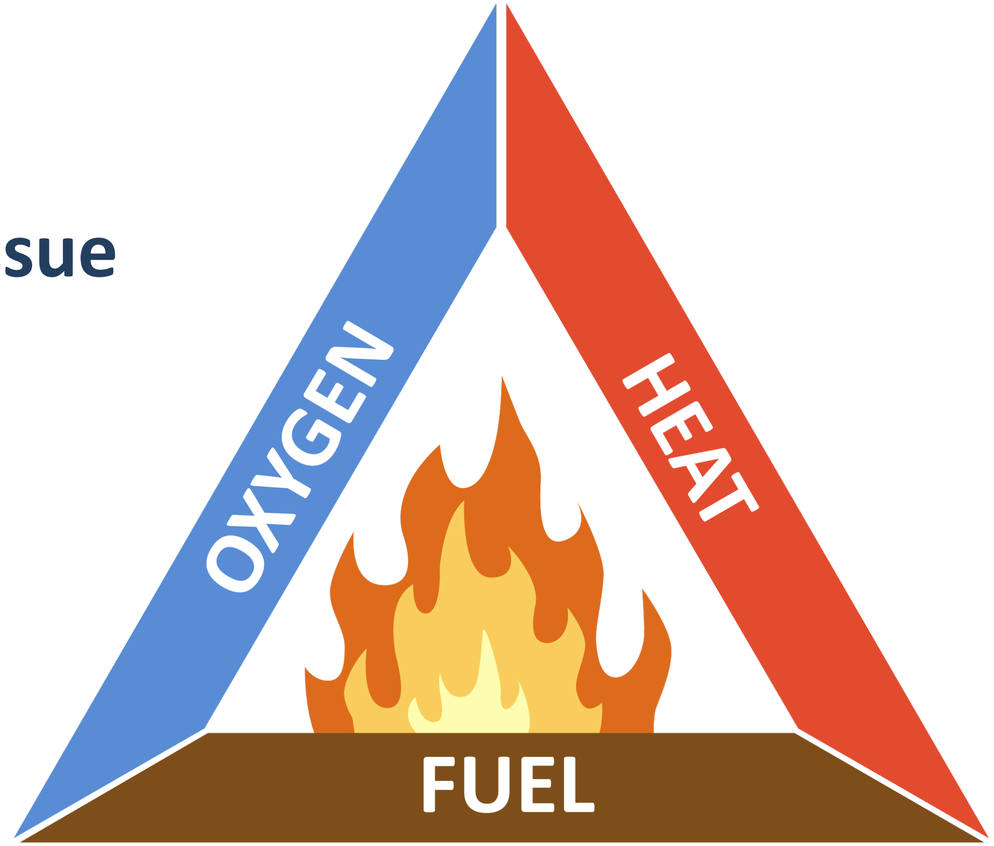
Has fire become the largest safety issue onboard RoRo/Pax due to the EV´s?

- Battery fires are different to “conventional” fires. Uncontrolled, violent chemical reactions releasing tremendous amounts of energy and heat dives through the battery in a domino effect way. The only way to stop the thermal runway seems to be to fully submerge the vehicle for a long time.

It is fair to ask the question:

Has fire become the largest safety issue onboard RoRo/Pax due to the EV´s?

- Traditional fire triangle not applicable
- Controlling fires in EV’s is all about stopping the thermal runways in the batteries, and is different from a normal burning process.

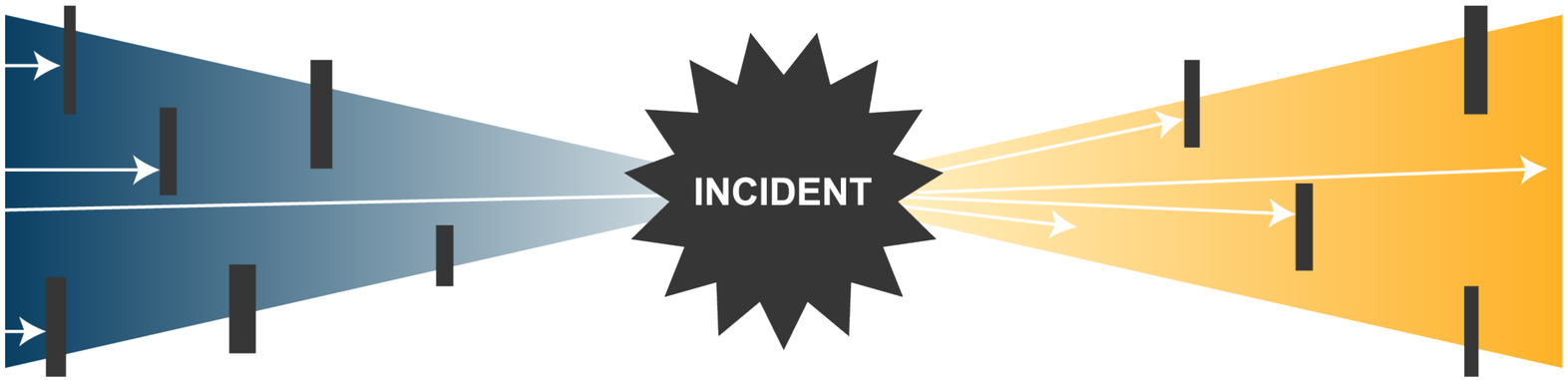


Control measures

acceptable

Recovery measures

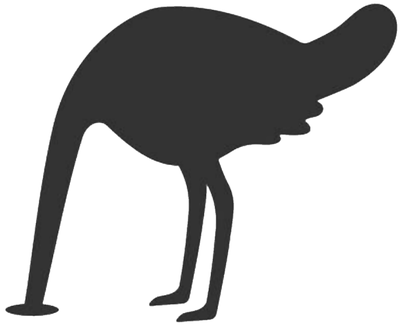
not acceptable



Barriers to ***prevent incident***

Barriers to ***reduce the consequence***

What to do?



- Ask ourselves: What is an acceptable risk?
- Which measures do we need to take in order to reduce possible harm to passengers, crew and assets, to a tolerated level.
- Existing counter-measure not sufficient!

Clearly need for new equipment and methods

Idea from the fishing Industry where we have used Brine as natural liquid freezing method in some of our fishing vessels.

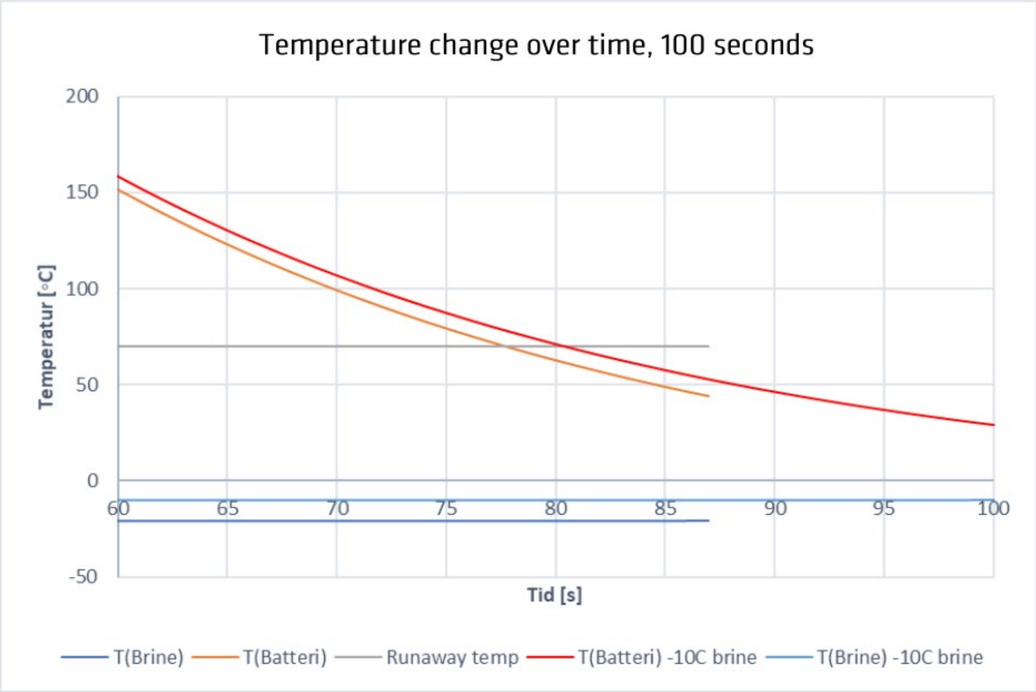
- **Brine as cooling agent**
- **Brine is a natural product**
  - Solution of salt (NaCl) in water (H20)
  - Lowest obtainable freezing point of brine is -21,1 degrees Celcius
  - Salt as heat transfer material
- **Salt** is a crystalline mineral with a high melting point. Melting point of 800, degrees where it turns into liquid, boiling point of 1465 degrees, turning in to vapor. Salt has as such the ability to absorb a huge amount of energy before it undergoes a fase change.

Theoretical study of Brine as cooler

The brine cooler clearly appears to have a huge cooling effect of thermal runaways, which should stop or limit ongoing thermal runaways.

It takes a little less than 80 sec. to cool the battery below 70°C, which is the critical temperature limit. The brine will still be below 0°C, and therefor will still have a cooling effect, during ongoing thermal runaways.

In this scenario, heat generation is not included, but the temperature of the thermal runaway is set to 1500°C. This is characterized as worst case scenario, and therefor must be counted for as coverage of all internal thermal processes.



Testing

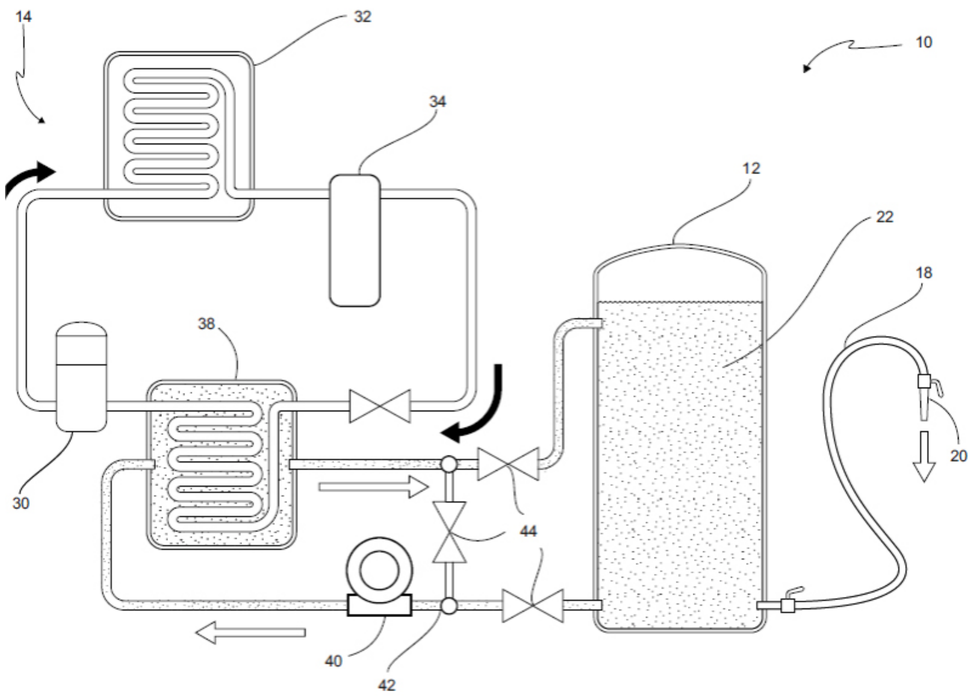
Film clip

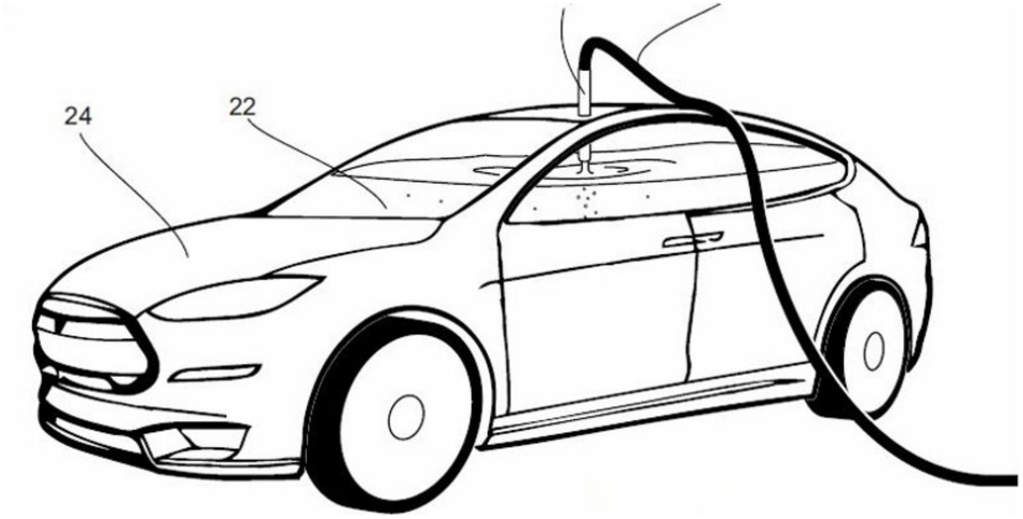
Test results and lessons learned

- 13 minutes to cool down to 70 degrees
- Brine mixture during test was not perfect. Perfect mixture would lead to even better results
- Theory confirmed
- No undesired reaction from the battery during cooling

Next steps

- **Pilot project onboard MV Norröna**
- **Brine system tank, cooling system, piping**
- **The injection system –**
  Injection method to transfer brine into the vehicle, preferrably a Roof rail system for safe access.





Thanks