



Safety consideration for LNG storage on board of inland ships
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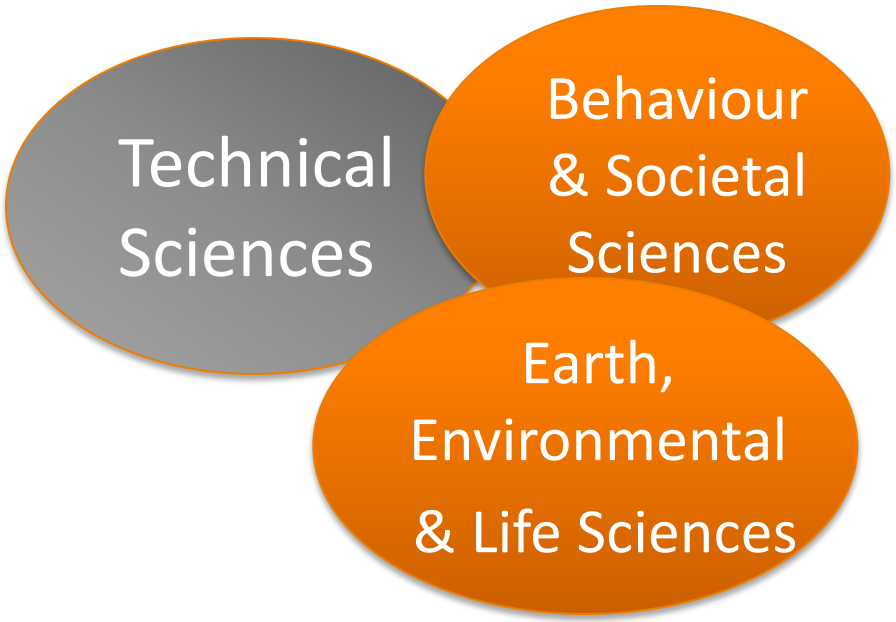
TNO innovation for life

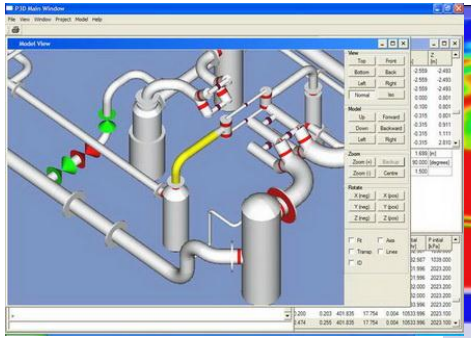
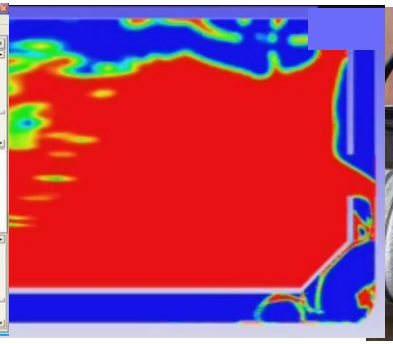
Introduction – TNO in short

- TNO = Netherlands Organisation for Applied Scientific Research
- Independent contract research organisation
- 4300 persons
- 3 clusters of expertise
- Turnover M€ 560



Introduction – TNO: LNG relevant expertise

- Ship structural integrity (advanced models & testing)
- Explosion prevention and protection
- Material and coating performance at cryogenic conditions
- LNG (multi-phase) flow behaviour
- Dynamic heat transfer, and process modelling
- Industrial and external safety







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Developments in LNG as fuel in Dutch inland shipping

- LNG is only option to comply with CCR3/4 with an ROI
  - As LNG is cheaper dan diesel EN509
  - Economic drivers (and less emissions is nice too)

- But…. Not allowed by Directive 2006/87/EG

Exemption procedure:

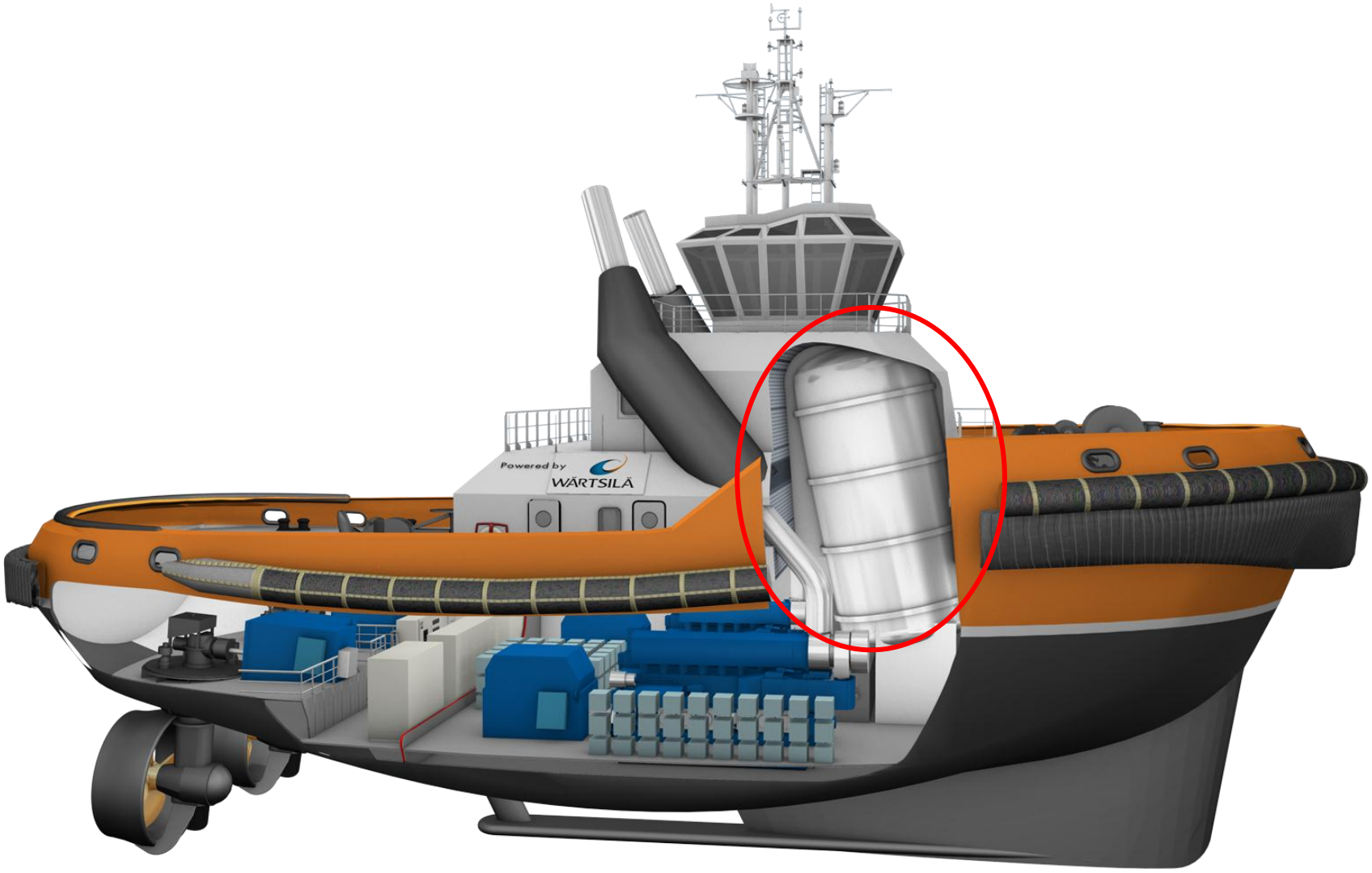
- With recommendation from CCR/AND
- For ships with new technologies
- As safe as “normal” ships
- For restricted period of time

Safe storage & transfer is a prerequisite for success

Safety of storage systems




TBS
TBS
TARBIT
BIT VIKING
SKÁRHAMN



Source: Wärtsilä Corporation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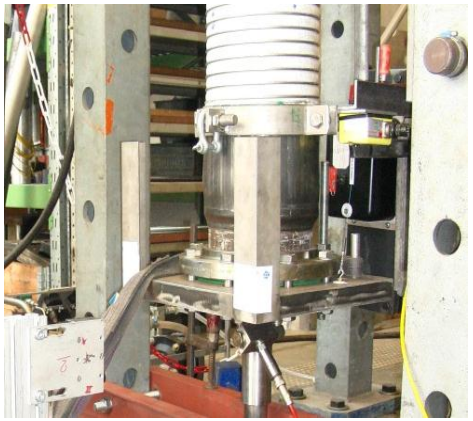
Minimum performance requirements











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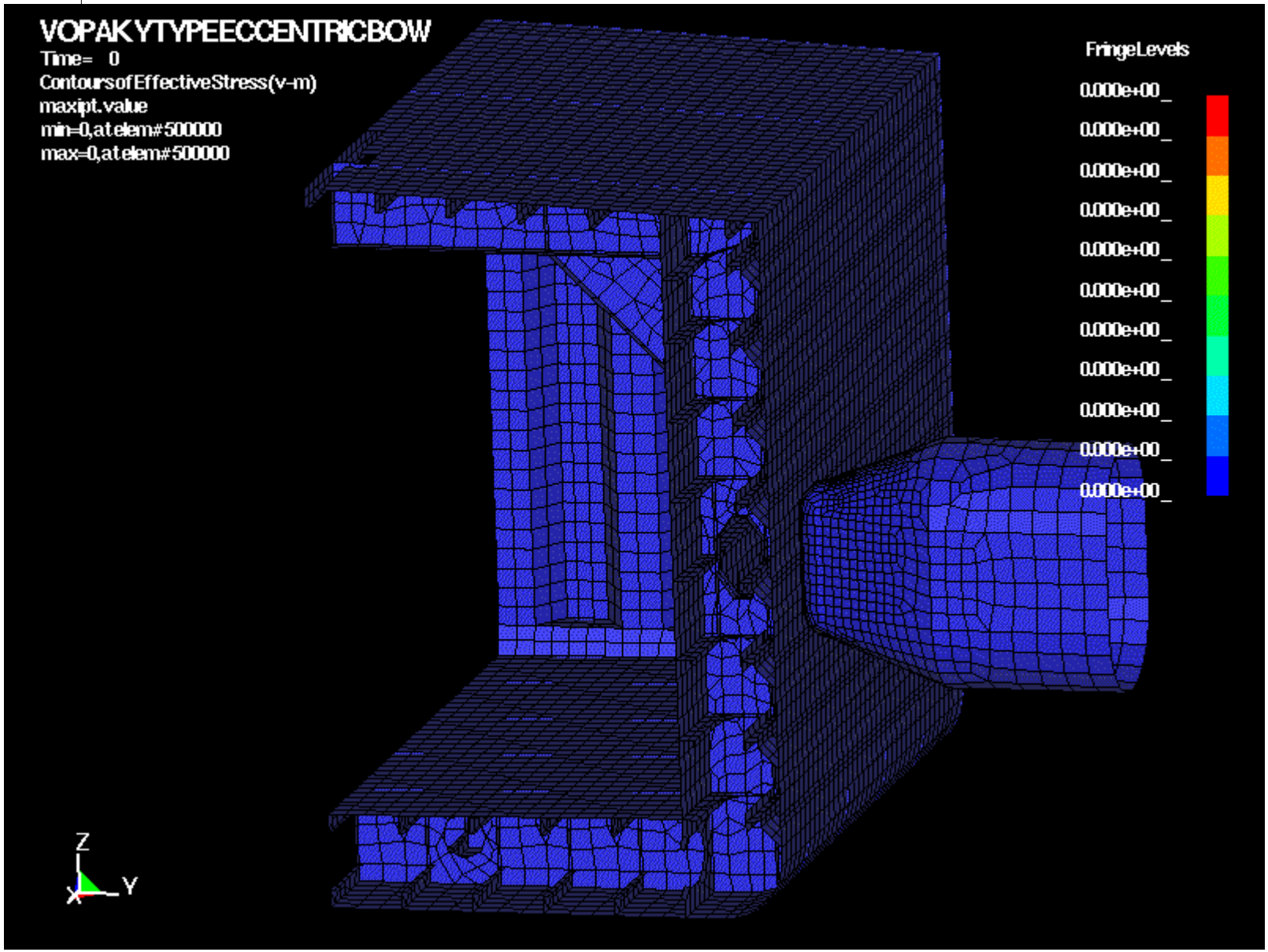
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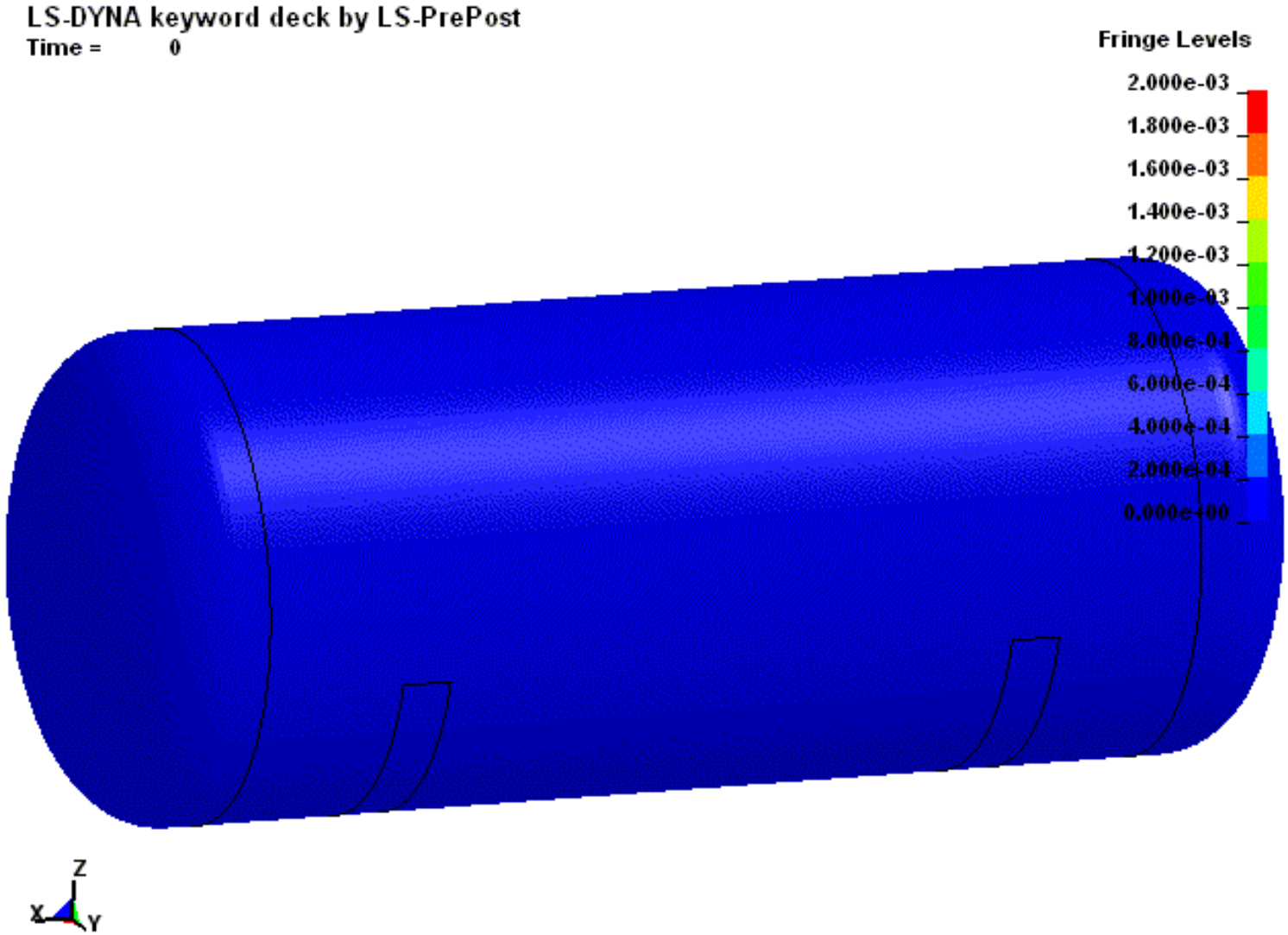
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Thank you for your attention!

Acknowledgement

Arta Armaturen

Bluewater

Exmar, Excelerate

Gutteling

SBM

Wärtsilä

Other clients of TNO

Contact

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