

Validity of available risk-based models for hydrogen technologies

Green Hydrogen Webinars

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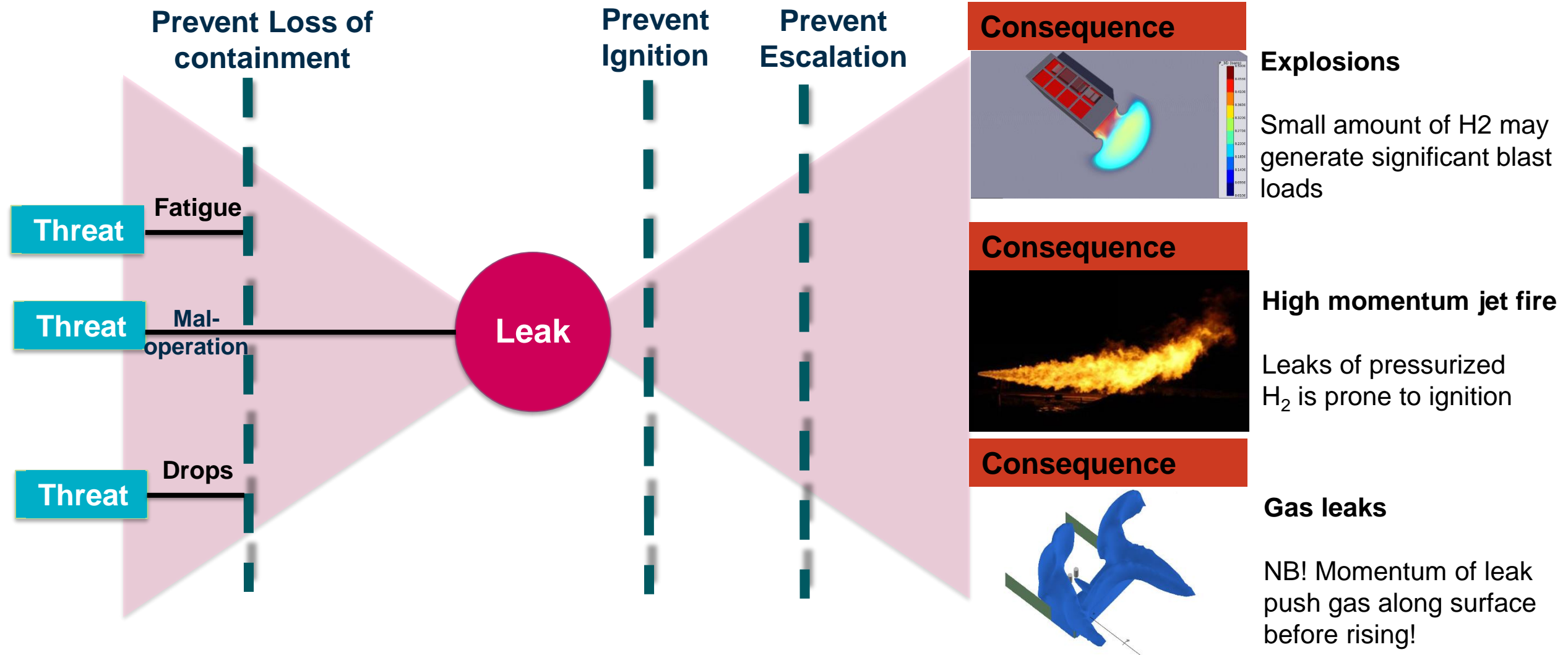
22.06.2021

A decorative background pattern consisting of overlapping, semi-transparent blue and white geometric shapes, primarily triangles and trapezoids, arranged in a staggered, grid-like fashion.

What kind of risk based models for hydrogen technologies do we have?



Are the available models valid to use for hydrogen?



...but even more important to avoid leaks due to more difficult to control ignition

ISO 19880-1:2020 prc

For standard equipment and events, safety distances can be prescribed by national regulations, and/or may be determined through quantitative risk assessment of a generic design. For any given fuelling station, one may also conduct a quantitative risk assessment, which can be used to understand the risks and the effects of station-specific mitigations; the result of the analysis may result in a recalculation of the safety distance to result in station-specific safety distances. If the safety distance is too large, additional mitigation or prevention measures should be considered and the safety distances may be recalculated using a quantitative analysis.

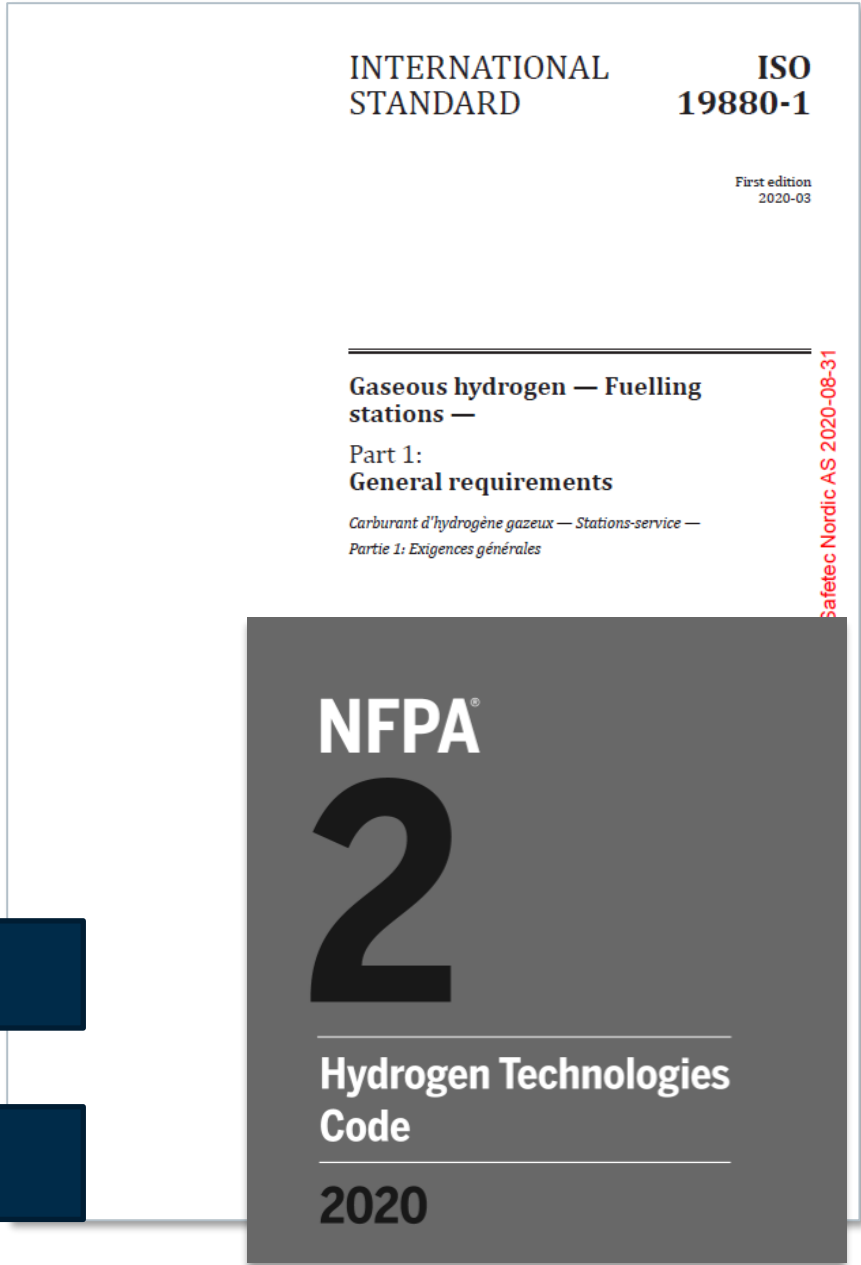
NOTE 2 The benefit of conducting quantitative analysis is that it generates safety distances that are specific to the fuelling station/site that is analysed.

NOTE 3 The quantitative analysis is used to demonstrate that the fuelling station does not pose unacceptable risk to specific targets, taking into account the design and mitigation features of the actual installation. Acceptable quantitative techniques include quantitative risk assessment (QRA) and consequence modelling (i.e., a QRA without quantification of the probability of scenarios). The analysis uses a combination of information and data regarding the fuelling station design and operation, validated physical models, and probabilistic models that meet the criteria discussed in the remainder of this clause.

Use of a common toolkit, preferably validated for hydrogen, is recommended.

Do we have this? What are the uncertainties in the current toolkit?

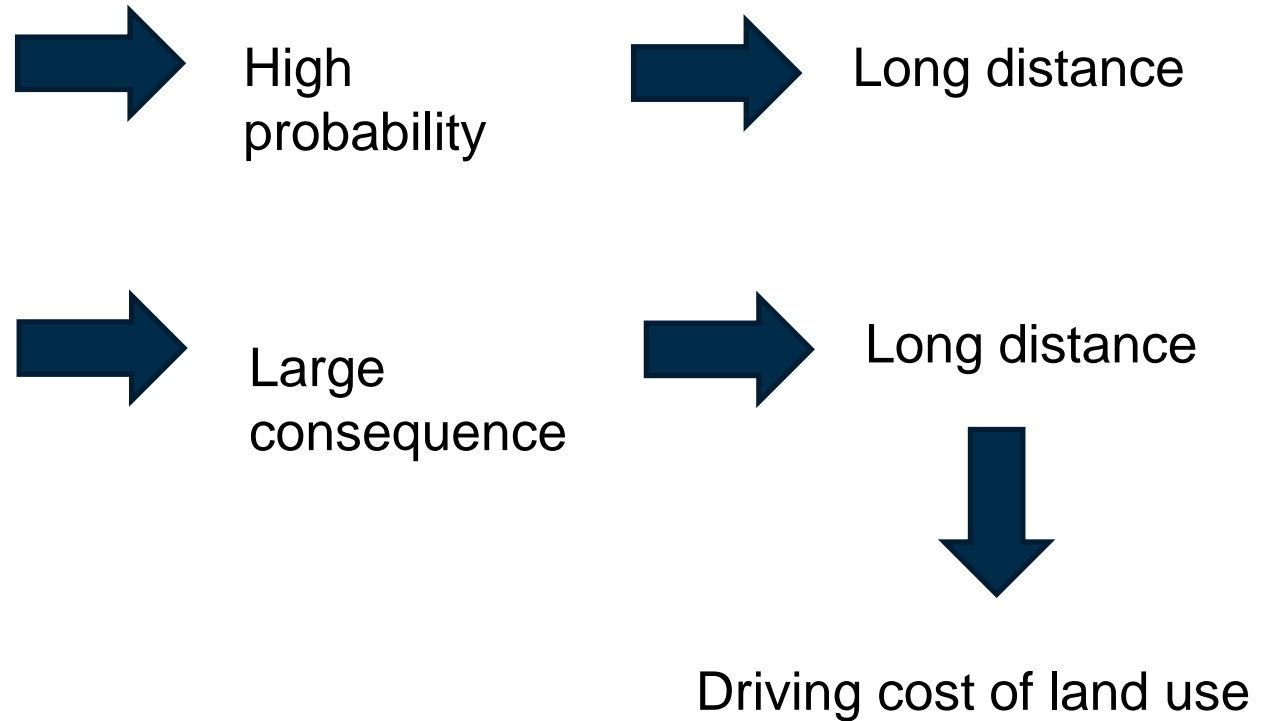
NFPA suggest risk assessment for safety zone specification



Risk-based safety zone



The trade-off between frequency and consequence based on quantitative risk analysis model



Norwegian regulations

Risk-based regime for land use



LR Lloyd's Register Working together
for a safer world

Retningslinjer for kvantitative risikovurderinger for anlegg som håndterer farlig stoff

Rapport til:
Direktoratet for samfunnssikkerhet og beredskap (DSB)



Rapportnr.: 106535/R1 Rev: Sluttrapport A
Dato: 18. oktober 2017

SANDIA REPORT
SAND2017-2998
Unlimited Release
Printed March 2017


Methodology for assessing the safety of Hydrogen Systems: HyRAM 1.1 technical reference manual

Katrina M. Groth, Ethan S. Hecht, John T. Reynolds, Myra L. Blaylock, Erin E. Carrier

Prepared by
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Albuquerque, New Mexico 87185 and Livermore, California 94550

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Approved for public release; further dissemination unlimited.



SANDIA REPORT
SAND2009-0874
Unlimited Release
Printed March 2009

Analyses to Support Development of Risk-Informed Separation Distances for Hydrogen Codes and Standards


Jeffrey LaChance¹, William Houf¹, Bobby Middleton¹, and Larry Fluer²

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Albuquerque, New Mexico 87185 and Livermore, California 94550

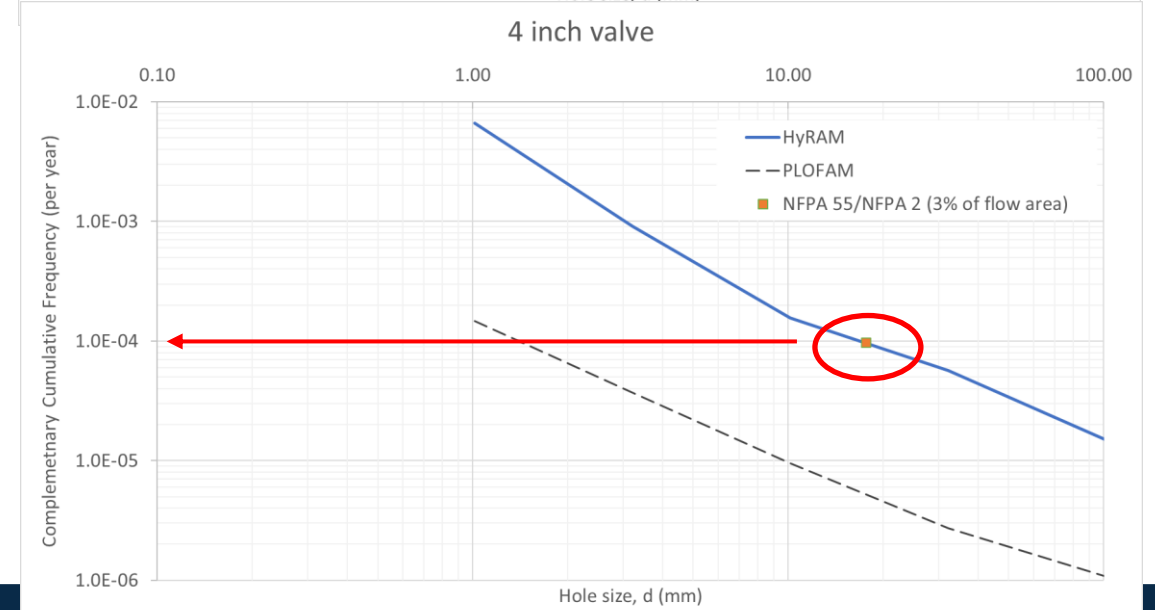
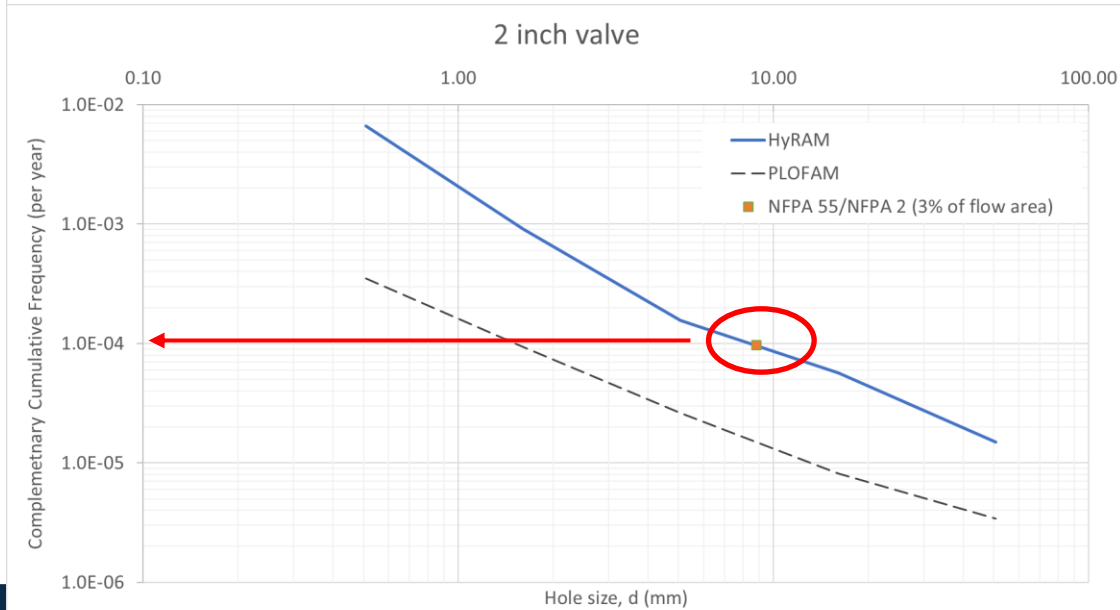
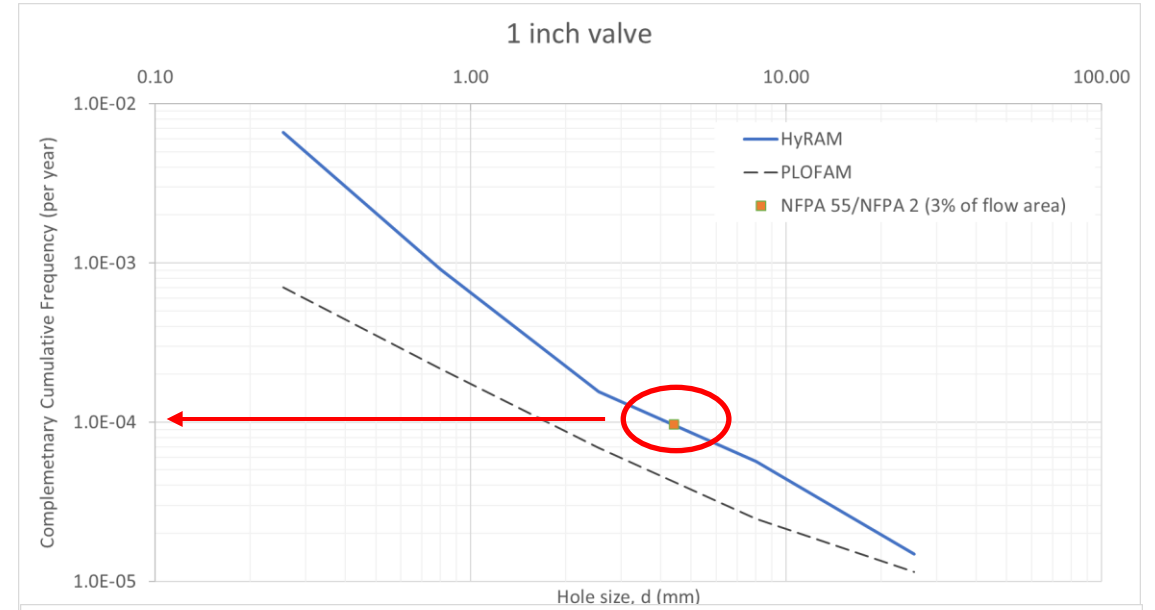
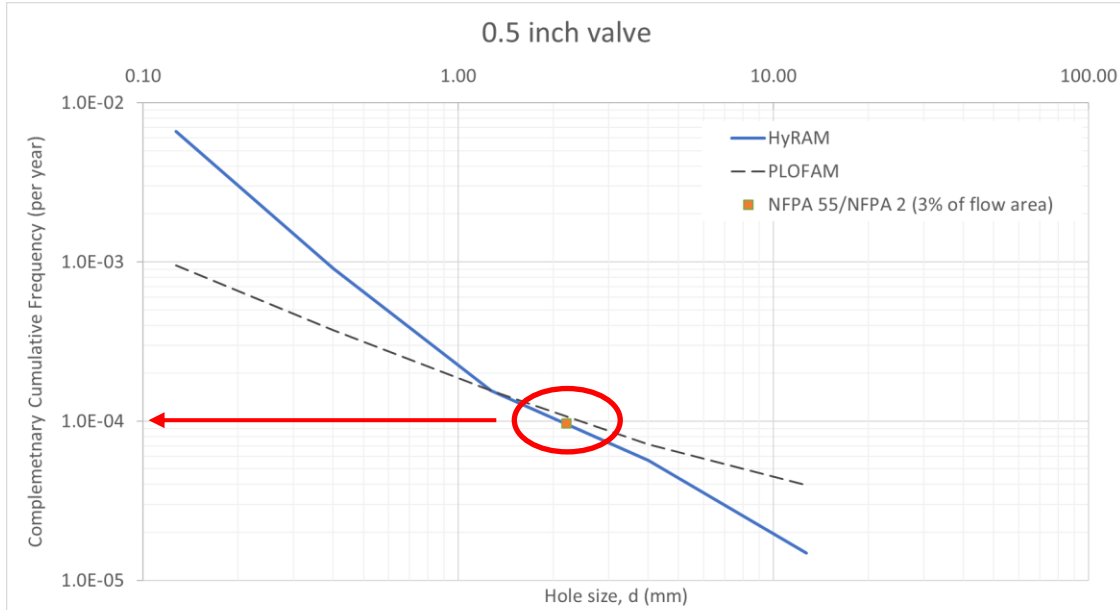
Sandia is a multi-program laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under Contract DE-AC04-04AL154000.

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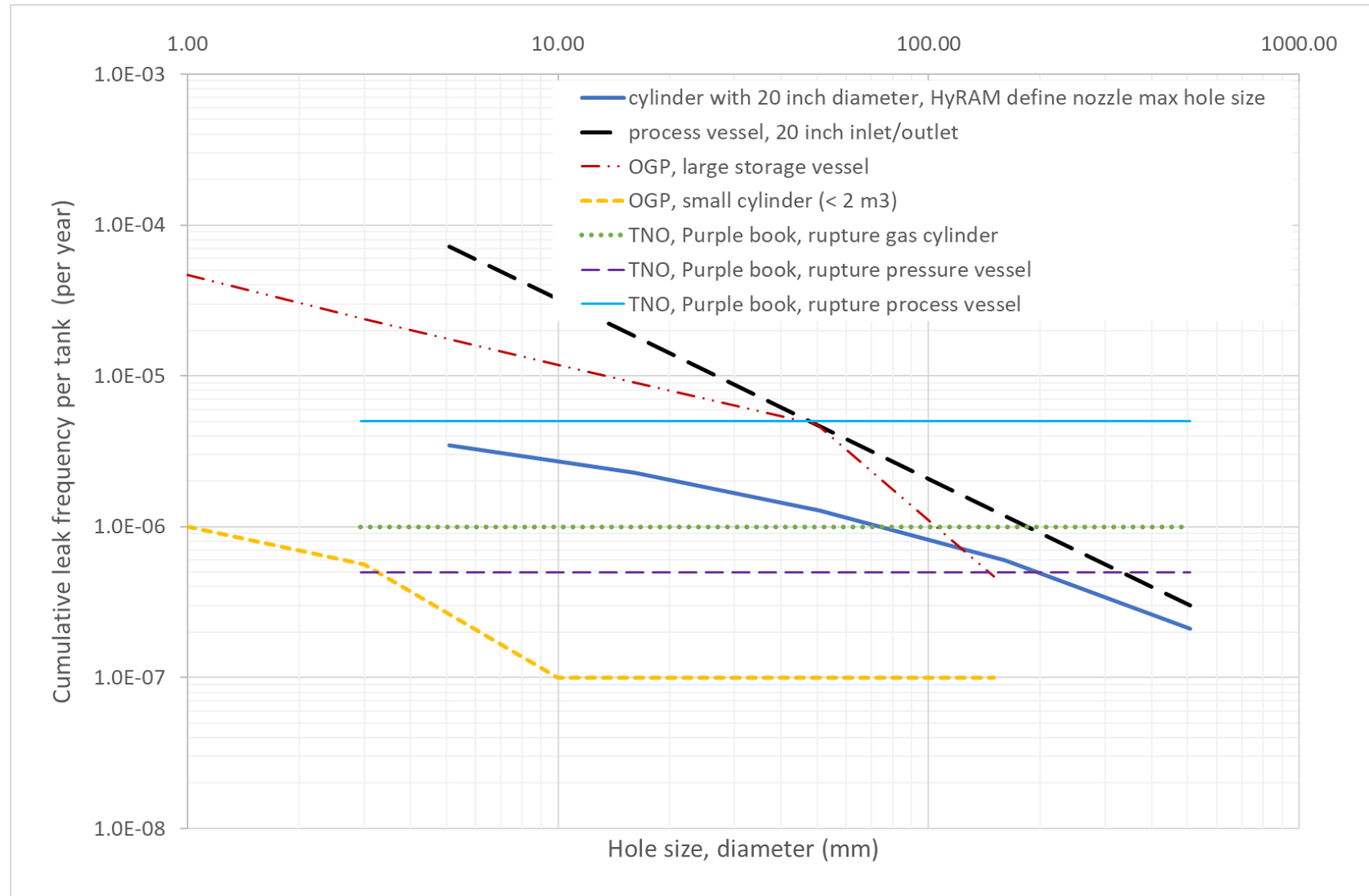
Guidelines recommend HyRAM for H₂

Equipment size dependency in HyRAM compared with offshore standard model (PLOFAM)



Risk based safety distance due to tank ruptures?

What type of model should be used?



What about ignition models?

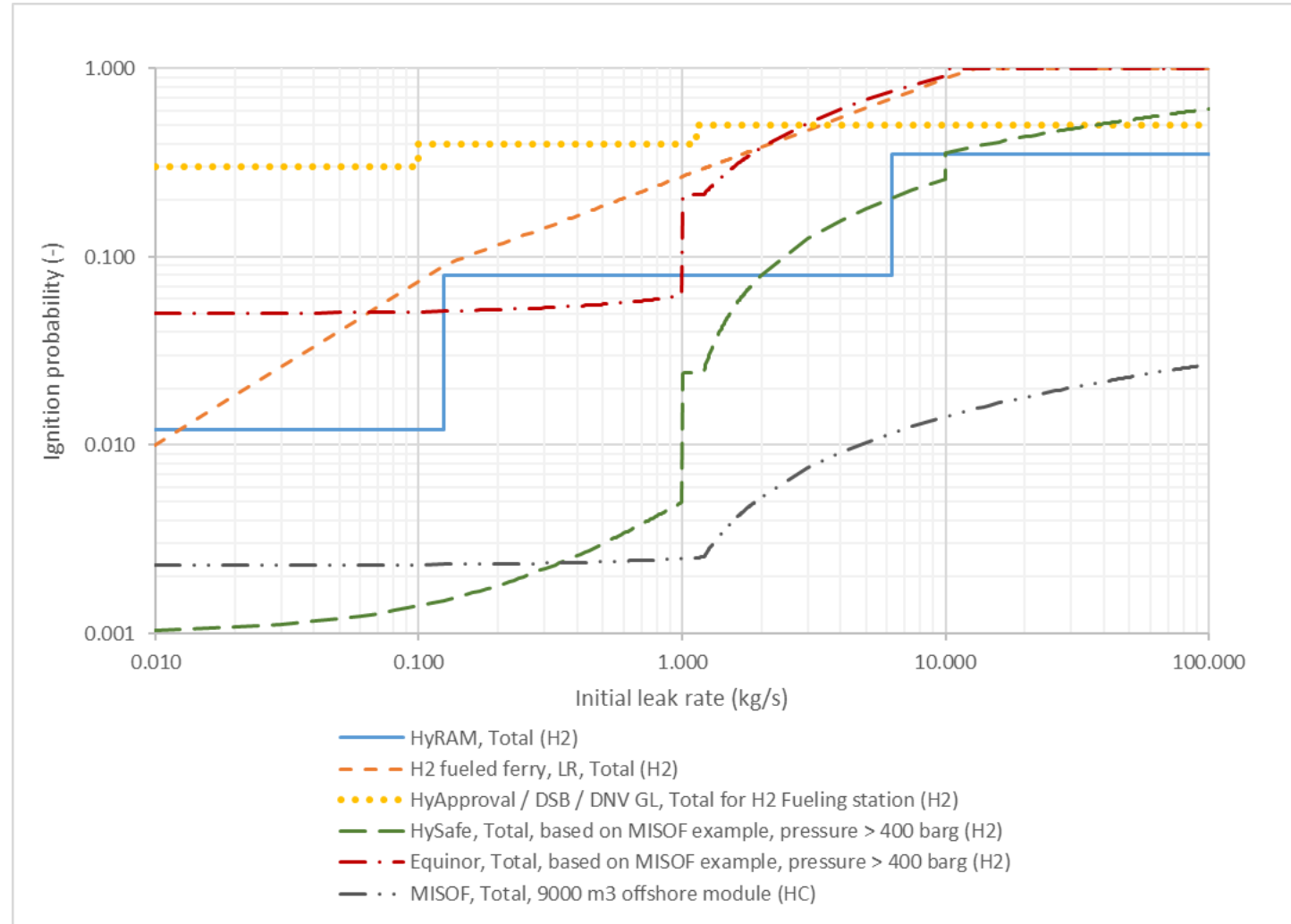
Do we have adequate knowledge about the ignition mechanisms?

Do we have statistical data to justify the ignition probability?

Will ignition control add value to H2 production units?

What about liquified hydrogen; should the ignition probability model be different?

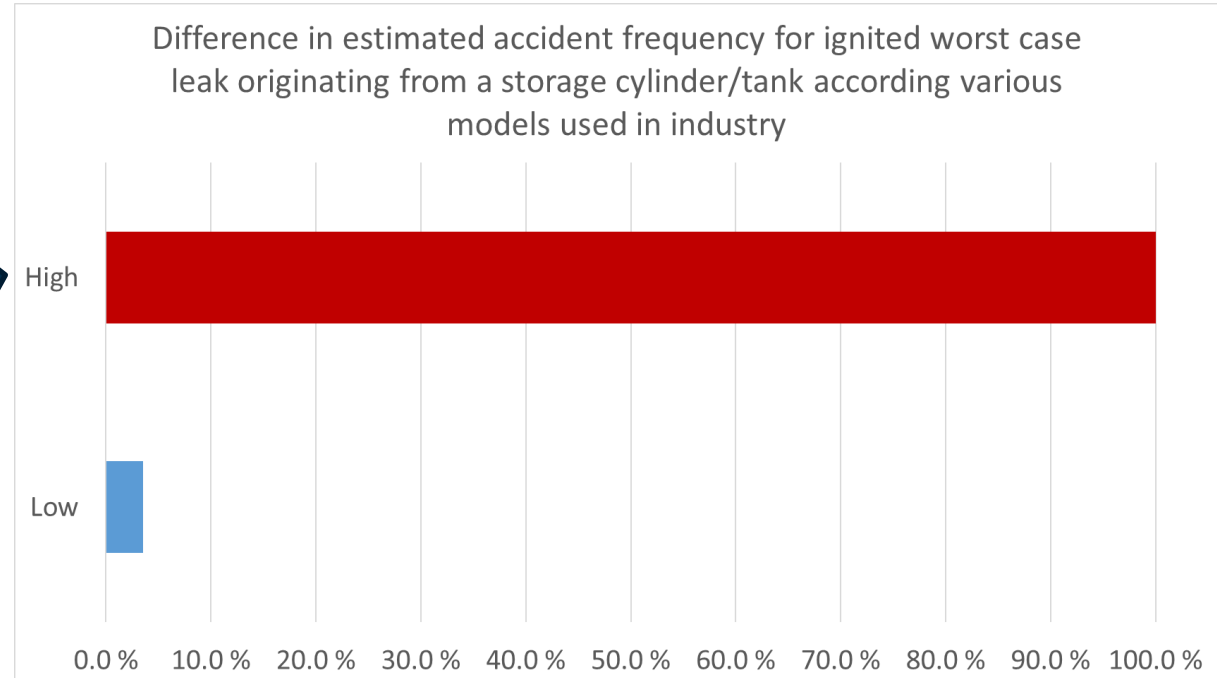
Overview ignition probability models



Risk based safety distance due to tank rupture

How to assess accident frequency for tank rupture?

What is the frequency for rupture scenarios for such a design, can we extrapolate from existing models; 129 tanks · $X \cdot 10^{-y}$ ruptures per tank/year?



What kind of risk based models for hydrogen technologies do we have?



Are the available models valid to use for hydrogen?

Summary and a way forward?

- Models are available, but there is a high variety between the different models and a lot of uncertainty regarding the validity of these models for hydrogen
- There is a need for more work related to this
- Safetec has taken an initiative together with Vysus Group, DNV Norway, Gexcon and Proactima to build a research project around this (SAFEN)
 - H₂, Ammonia and CO₂
 - Focus on loss of containment and ignition
 - Operation and human performance included in the project
- During the pre-project phase we have been encourage by Norwegian authorities and major stakeholders (such as Equinor, Linde, Air Liquide) to continue working on developing a project proposal
 - Draft ready soon
 - Application to the Norwegian Research Council (tentative early fall 2021)
- If you are interested – please contact us



SAFETEC

Thank you

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