Country Safety Programs

Norway: Gexcon & HiT

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10-11 November 2014

HySafe Research Priorities Workshop

Washington DC, 901 D Street SW, Energetics Offices Suite 100

Outline

- Deflagration-to-detonation-transition (DDT)
  - Knowledge gap 1: Reliable prediction of DDT in actual systems
  - Knowledge gap 2: Safe design / layout of industrial facilities
  - Knowledge gap 3: Safety gap, or “critical separation distance”
- Beyond physics – Communicating risk in organizations
  - The 3D Risk Management (3DRM) concept
  - The **Hy3DRM** project (proposal for IEA-HIA Task 37)
- Prospects
  - Finalizing implementation of integrated validation framework
  - Gexcon: Expanding large-scale experimental test site

Geometry matters!

Picture from: http://www.pdcmachines.com/fuel-cell-tech/

PDC Machines packaged a fuelling station inside a container for Air Liquide, for delivering hydrogen to it's client in Oshawa, Canada for material handling.

Safety gap

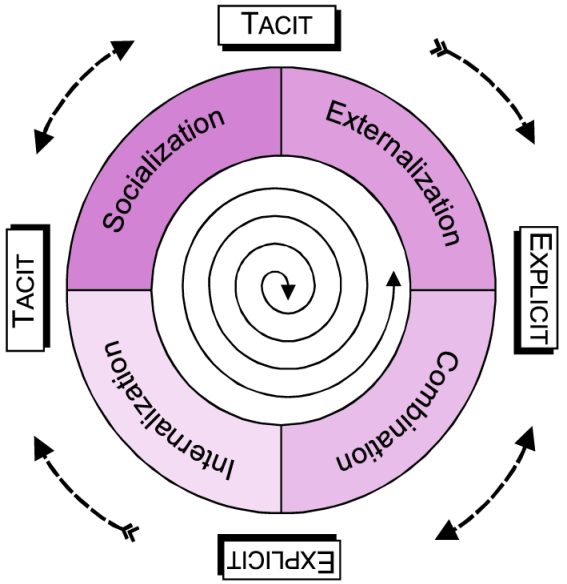
- The “Safety Gap”, or the “Critical Separation Distance” (CSD) is the minimum separation distance between two congested areas, for which a vapour cloud explosion (VCE) result in two separate blast waves (van den Berg & Mos, 2005).
- The CSD concept originates from two series of experiments performed by TNO: RIGOS & ERGOS

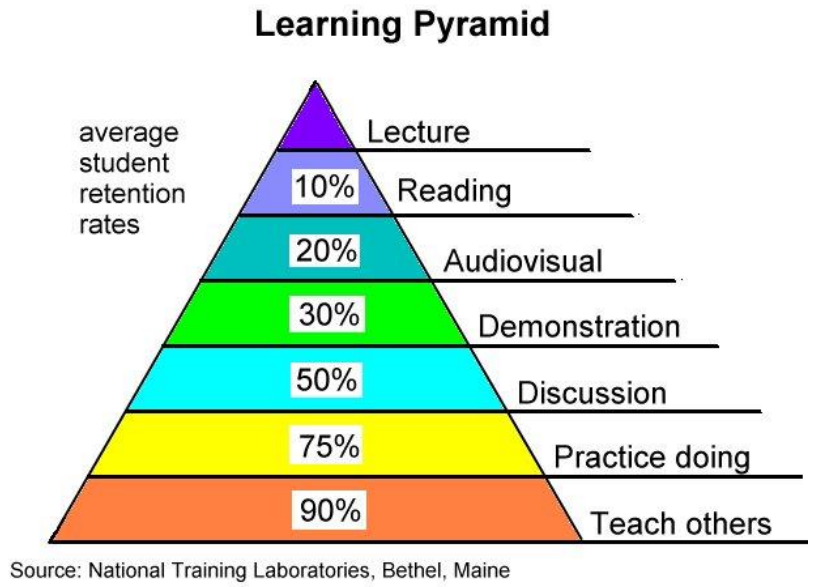
DDT or not?

Significant implications for safe layout/design of hydrogen energy applications in industry

What if …

- We could extend the use of detailed 3D models required for CDF simulations to other aspects of risk management than the ‘simple’ QRAs?
- We could create a framework for risk management that facilitates learning through discussion and practice?

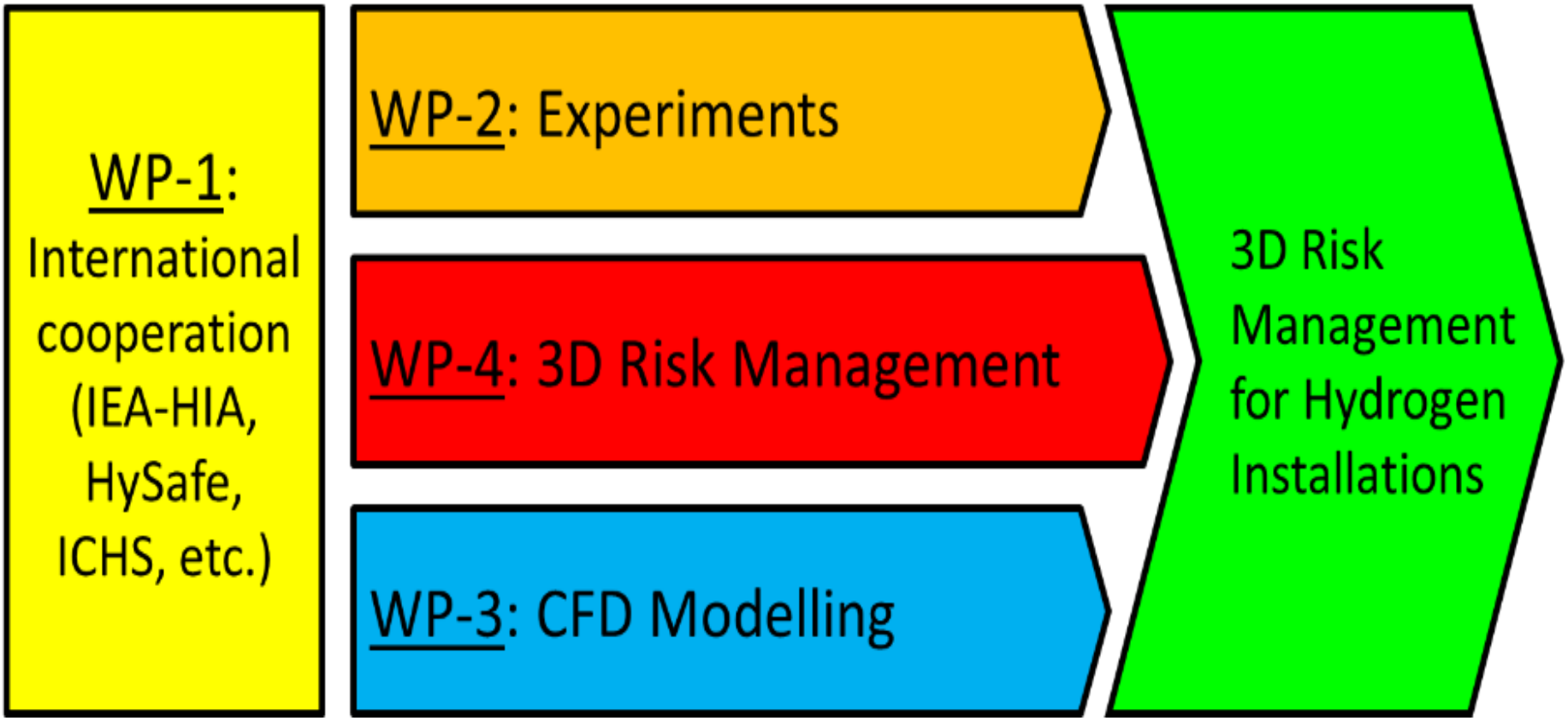




Hy3DRM: 3D Risk Management for Hydrogen Installations

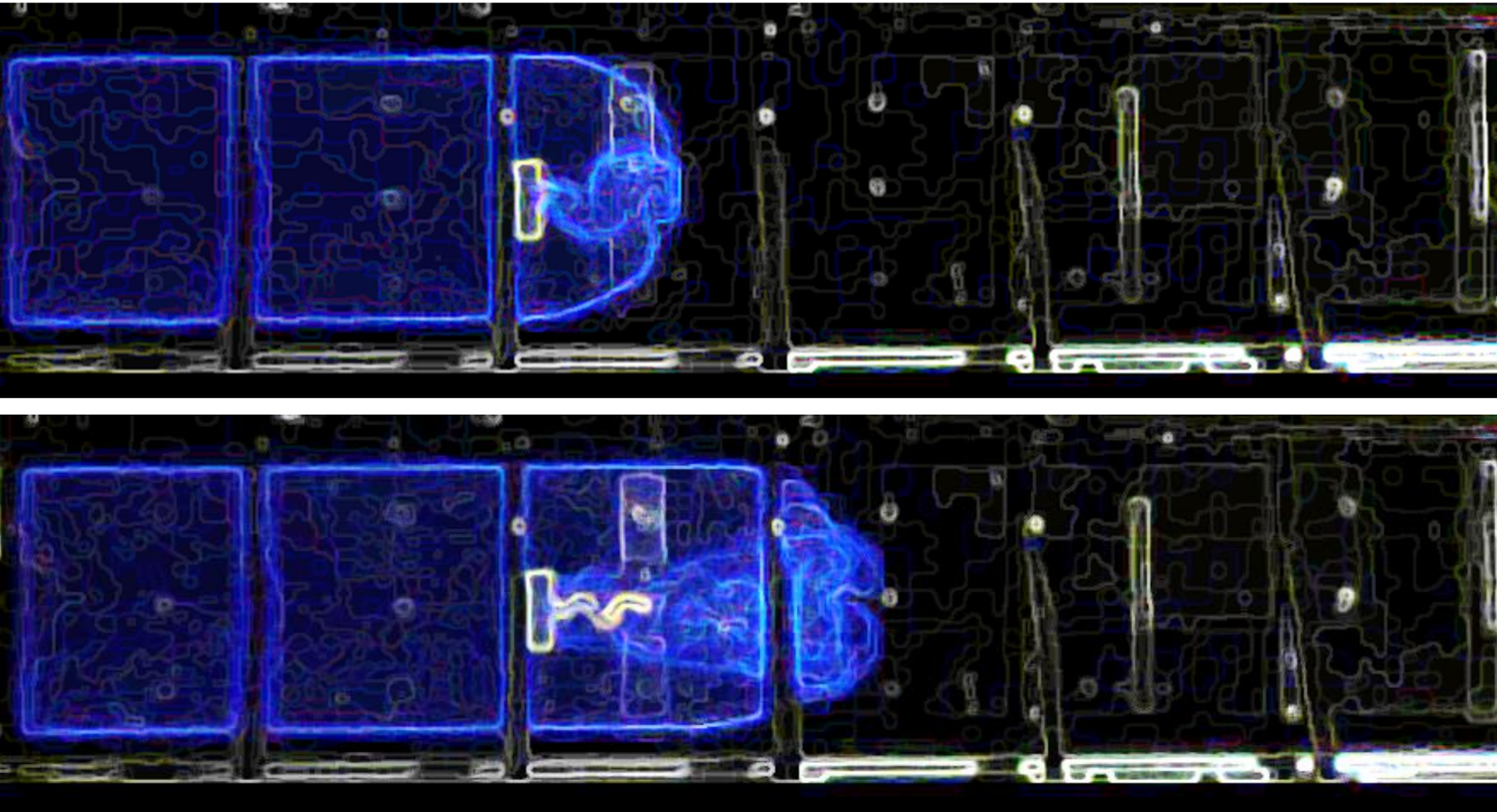
- An Innovation Project for the Industrial Sector under the ENERGIX program
- Submitted by Gexcon and Telemark University College (HiT) to the Research Council of Norway (RCN)
- For advancement of technology development in the field of Hydrogen Safety, and
- Continued Norwegian participation in international collaborative research under the International Energy Agency Hydrogen Implementation Agreement (IEA-HIA) and HySafe

Hy3DRM


WP-1: International cooperation (IEA-HIA, HySafe, ICHS, etc.)
WP-2: Experiments
WP-4: 3D Risk Management
WP-3: CFD Modelling
3D Risk Management for Hydrogen Installations

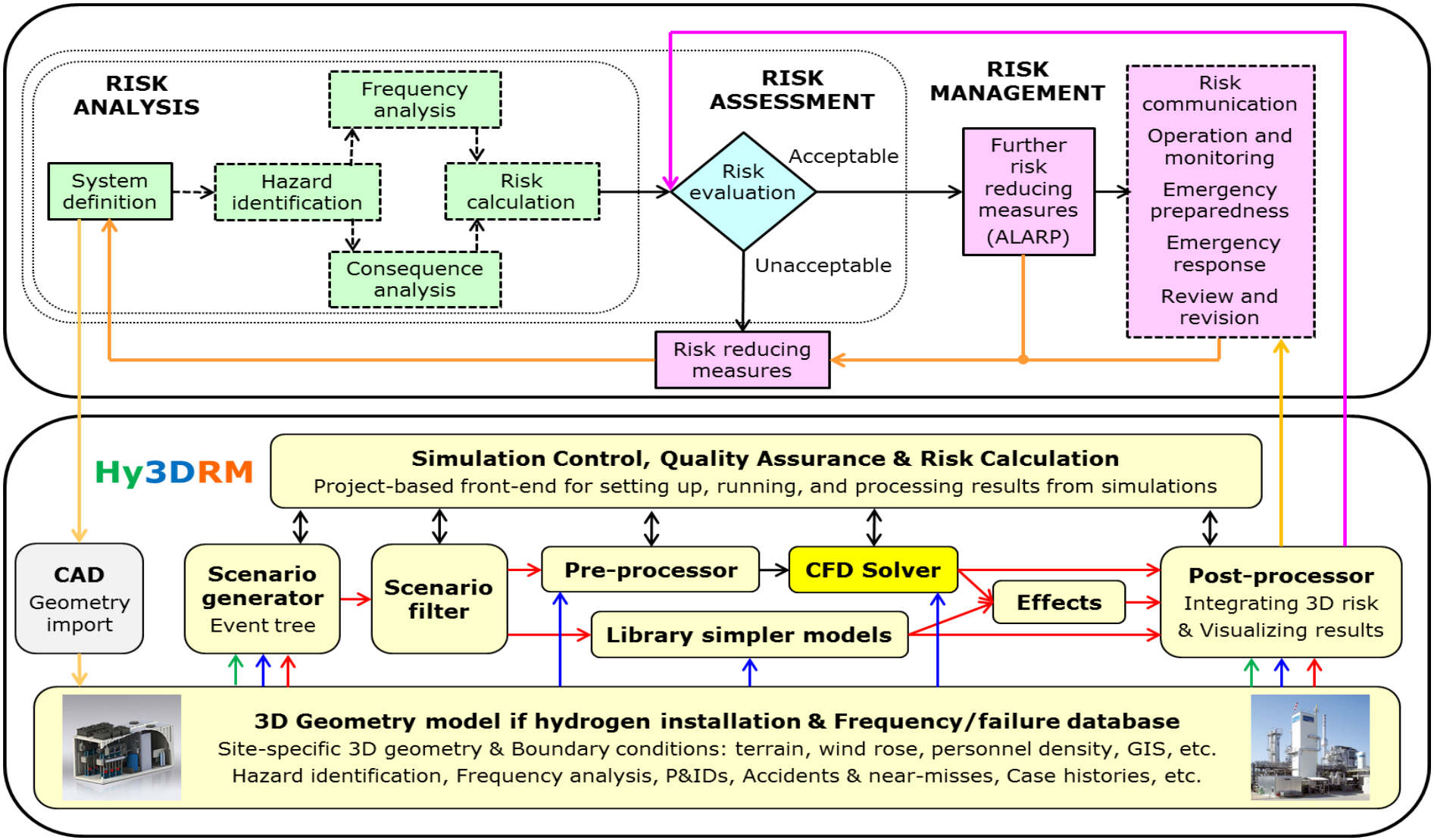
Hy3DRM: Experimental investigations

- HiT will investigate turbulence parameters and DDT in wakes behind obstacles during explosions, including sub-grid models.

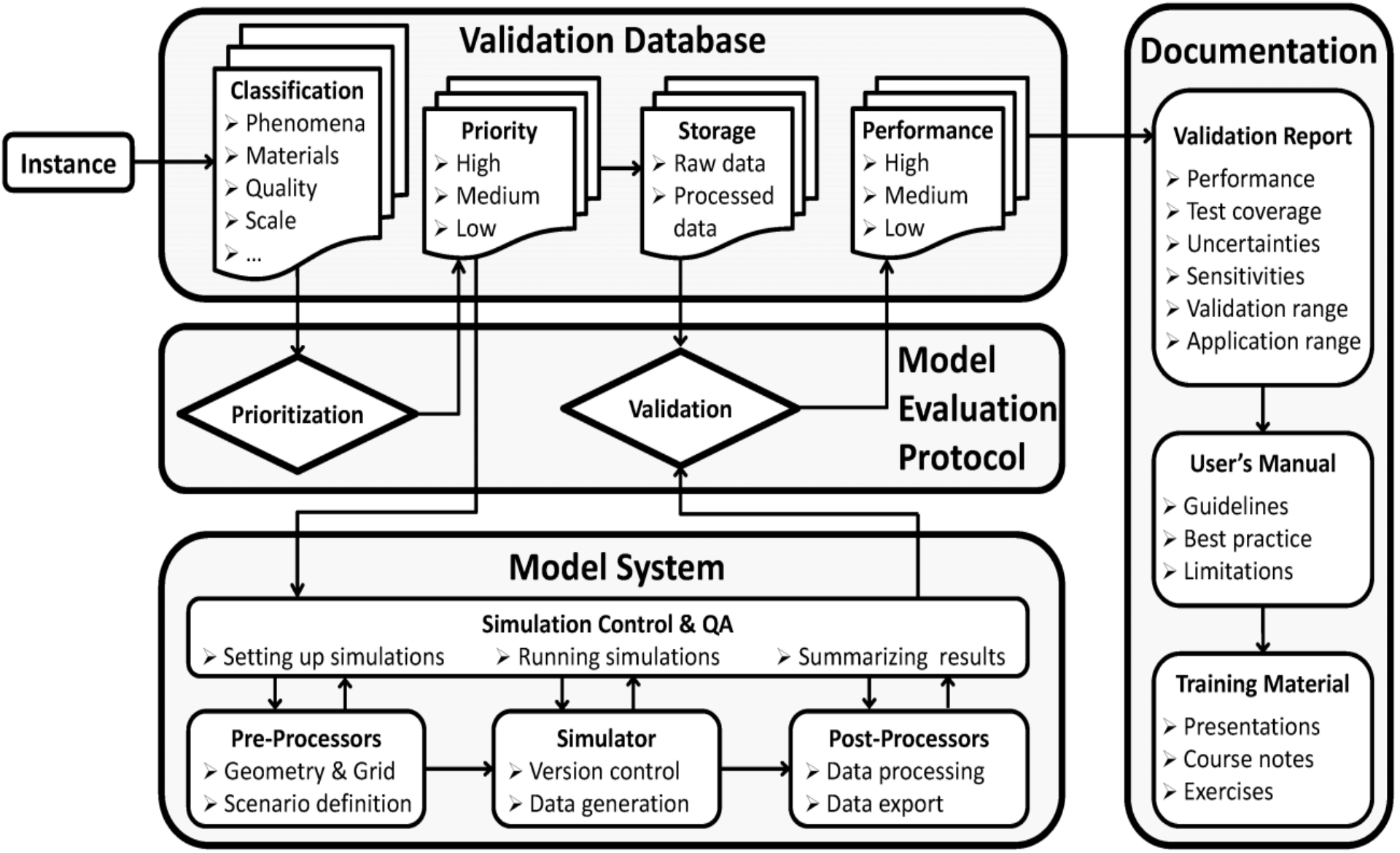


Hy3DRM: Software development

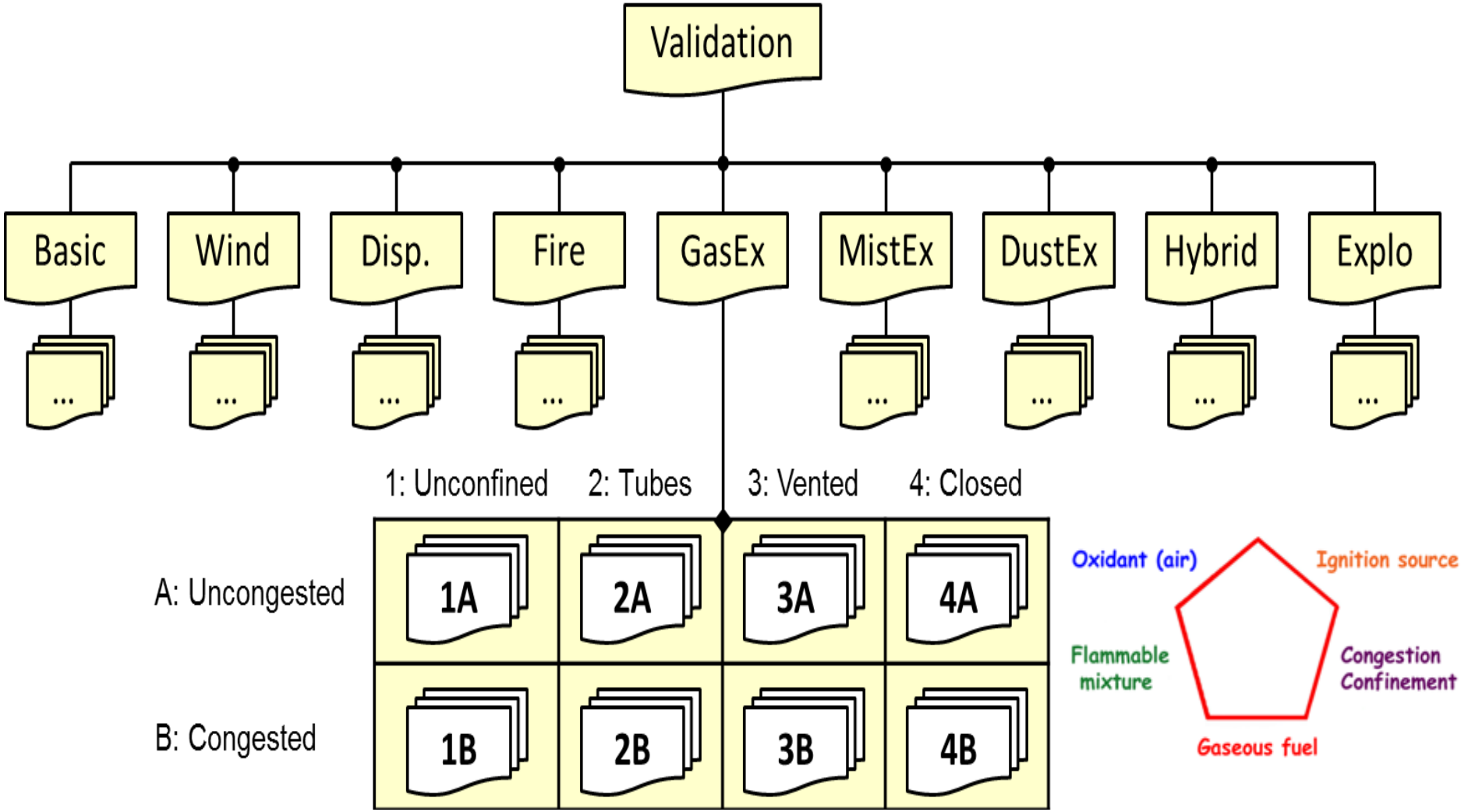
- Gexcon will implement the 3DRM concept in FLACS-Hydrogen



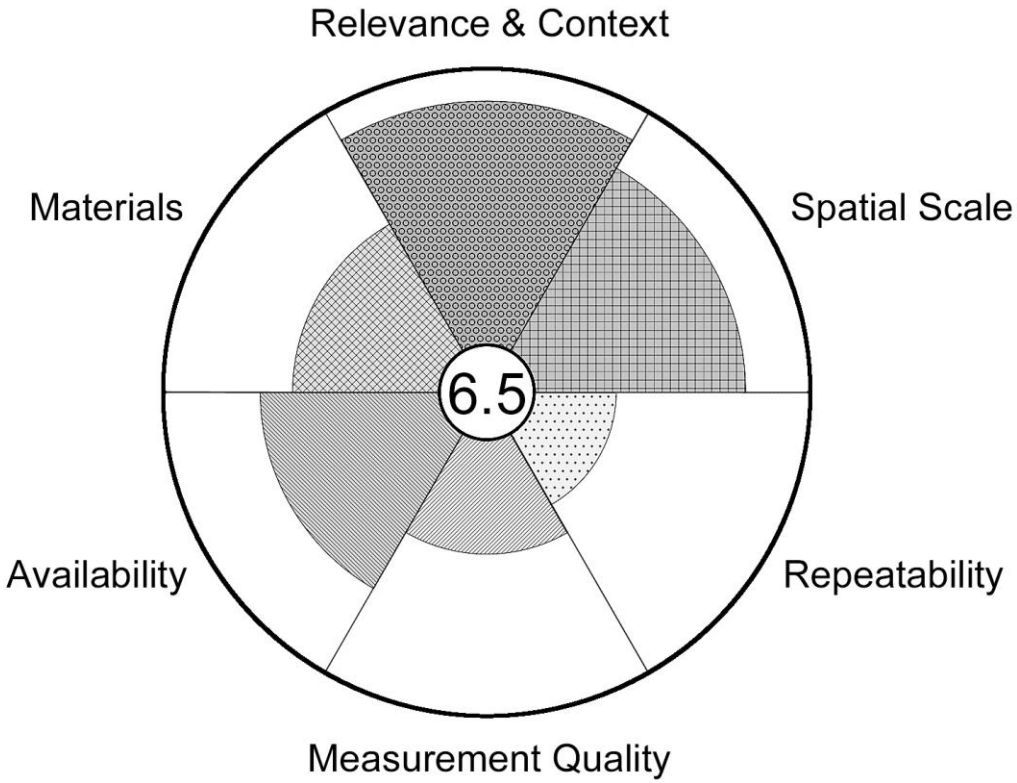
Validation framework



Validation database



Prioritizing test cases



For further details: Skjold, T., Pedersen, H.H., Bernard, L., Ichard, M., Middha, P., Narasimhamurthy, V.D., Landvik, T., Lea, T & Pesch, L. (2013). A matter of life and death: validating, qualifying and documenting models for simulating flow-related accident scenarios in the process industry. *Chemical Engineering Transactions*, **31**: 187-192.
DOI: http://dx.doi.org/10.3303/CET1331032

Large-scale experimental test site at Sotra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