HySEA

Improving Hydrogen Safety for Energy Applications through pre-normative research on vented deflagrations

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PROJECT OVERVIEW

Project Information	
Call topic	FCH-04.3-2014: Pre-normative research on vented deflagrations in containers and enclosures for hydrogen energy applications
Grant agreement no.	671461
Pillar (Horizon 2020)	Cross-cutting (main pillar: Societal Challenges)
Start date	01/09/2015
End date	31/08/2018
Total budget (€)	1 511 780
FCH JU contribution (€)	1 494 780
Other contribution	17 000
Stage of implementation	39 % project months elapsed vs total project duration, at date of 1 November 2016
Partners	Gexcon AS, University of Warwick, Universita di Pisa, Fike Europe BVBA, Impetus AS and University of Science and Technology of China / Hefei University of Technology (amendment in progress)

SYNERGIES WITH OTHER PROJECTS AND PROGRAMMES

Interactions with projects funded under EU programmes	
Hyindoor	Partial overlap on the work on vented deflagrations
Interactions with national and international-level projects and initiatives	
Hy3DRM	The systems used as examples for 3D Risk Management (3DRM) include ISO containers for hydrogen applications

DISSEMINATION ACTIVITIES

Public deliverables

- 1 Publication
- 1 Newsletter
- 1 Workshop
- 1 Blind-prediction study
- 1 Presentation for HySafe
- 2 Presentations at FLUG meetings
- 2 Presentations for IEA HIA Task 37

Conferences/Workshops

- 1 workshop organised by the project
- 1 in which the project has participated (but not organised)

Social media

Publications: 1

- Hisken, H., Atanga, G., Skjold, T., Lakshmipathy, S. & Middha, P. (2016). Validating, documenting and qualifying models used for consequence assessment of hydrogen explosion scenarios. Proceedings Eleventh International Symposium on Hazards, Prevention and Mitigation of Industrial Explosions, Dalian, 24-29 July 2016: 1069-1086.

Patents: 0

Compressor in ISO container

Inside the container

FCH-04.3-2014


European Commission
RESEARCH & INNOVATION
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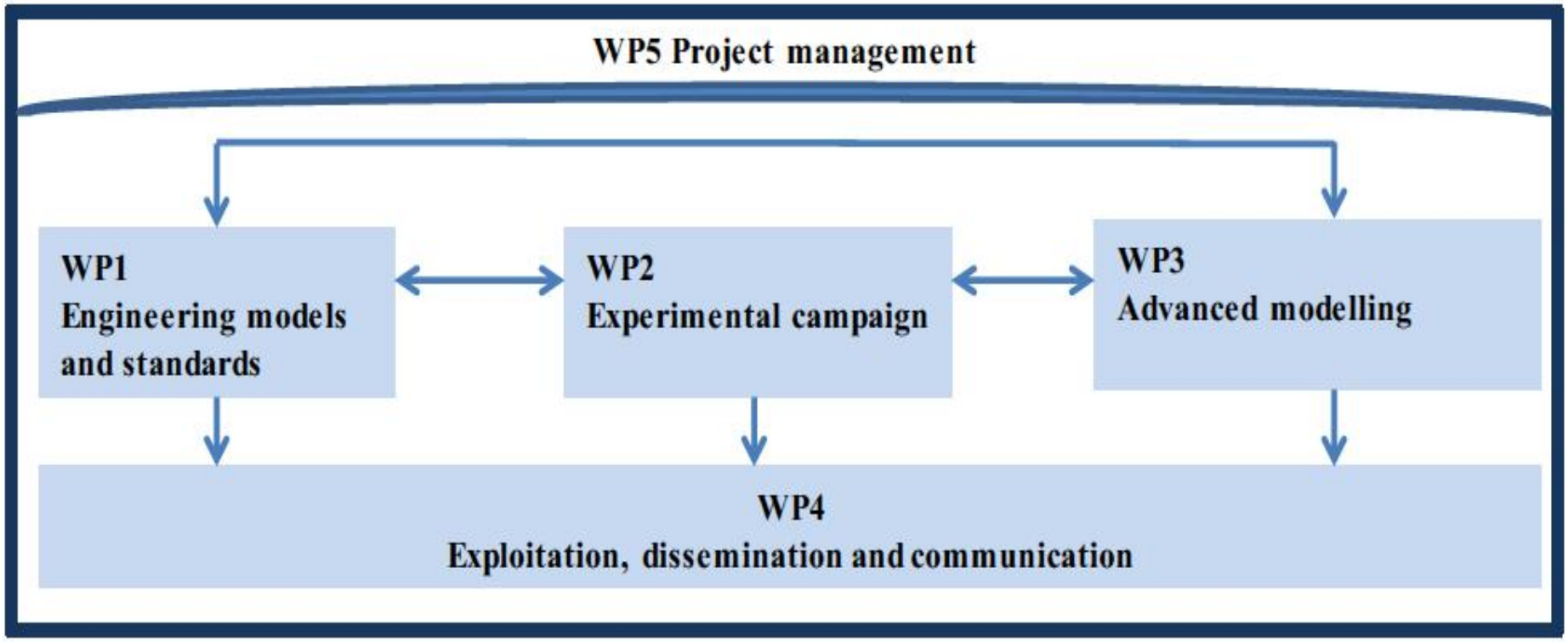
Other Funding Opportunities
FCH2 JU call for proposals 2014
H2020-JTI-FCH-2014-1
Opening Date 09-07-2014
Publication date 09-07-2014
Programme Horizon 2020
Status Closed
Deadline Date 06-11-2014 17:00:00 (Brussels local time)
Total Call Budget €93,000,000
Main Pillar Societal Challenges
OJ reference OJ C215 of 9 July 2014
Topic: Pre-normative research on vented deflagrations in containers and enclosures for hydrogen energy applications FCH-04.3-2014
Topic Description
Topic Conditions & Documents
Submission Service
Specific challenge: Many hydrogen-energy systems such as electrolysers, fuel cell backup systems, refuelling stations, etc. are commonly designed and integrated into containers and/or small enclosures. Such hydrogen products usually comprise high-pressure piping, fittings and components that, in case of failure in such confined and obstructed enclosures, may lead to the rapid formation of a turbulent flammable hydrogen-air mixture. If ignited, such cloud would trigger a deflagration or even a more devastating detonation. This event requires a specific attention where best to apply safety barriers to mitigate the risk from a hydrogen explosion in order to ensure the highest level of safety for hydrogen energy applications.
Explosion venting technique is commonly used in the industry to both mitigate explosion overpressure effects in the

Work packages



Kick-off meeting

- Gexcon, Bergen, Norway, 14-16 September 2015

First progress meeting

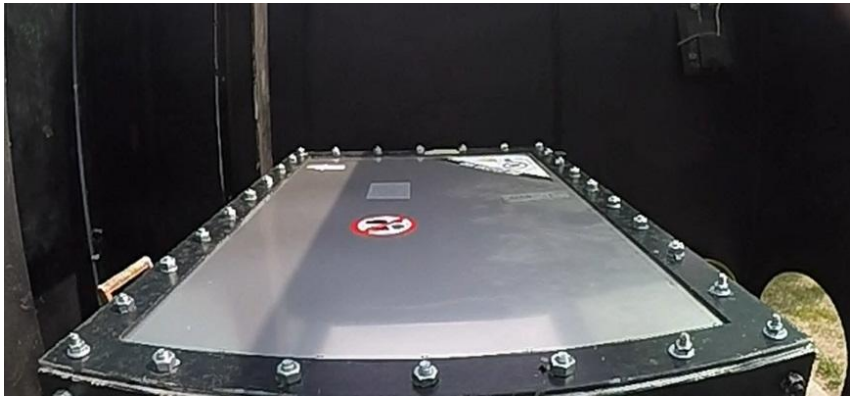
- Fike Europe, Herentals, Belgium, 3-5 February 2016

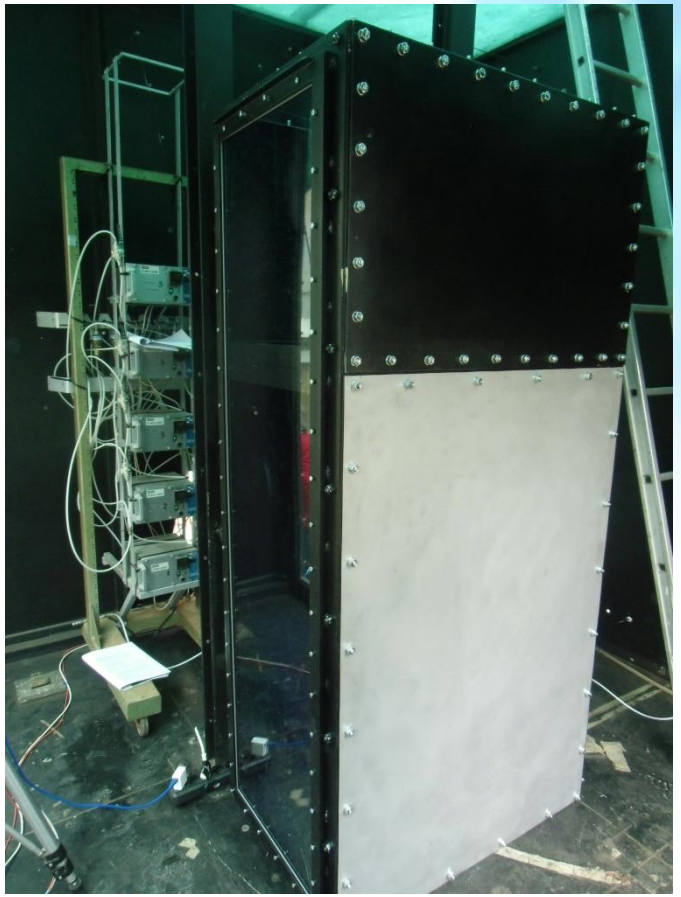
Second progress meeting

- Gexcon, Bergen, Norway, 5-7 September 2016

HySEA experiments

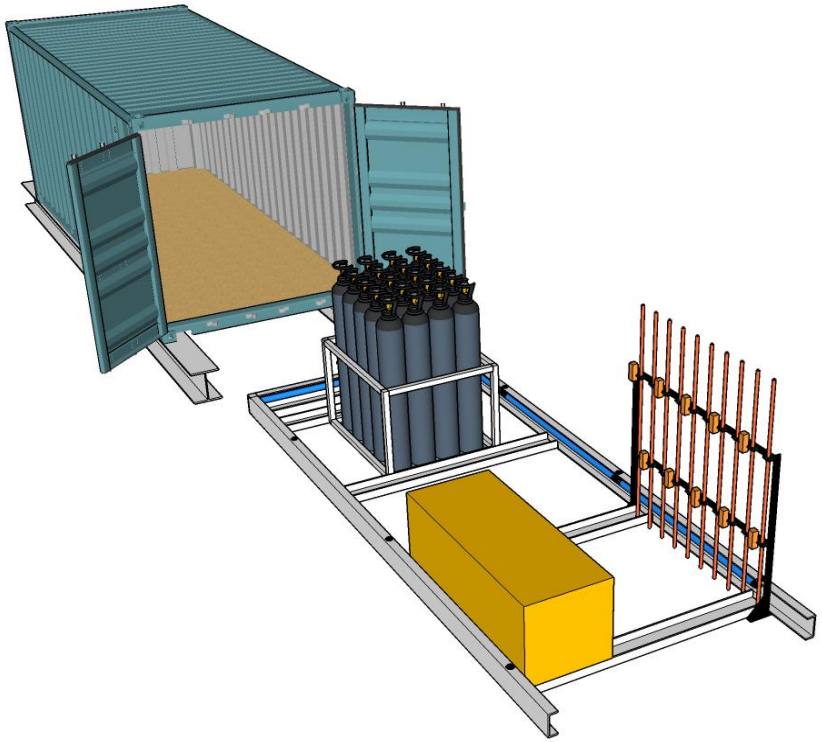
- Experiments by University of Pisa in ‘smaller enclosures’
- Phase 1 (2016): Homogeneous gas clouds (completed)
- Phase 2 (2017): Non-homogeneous clouds





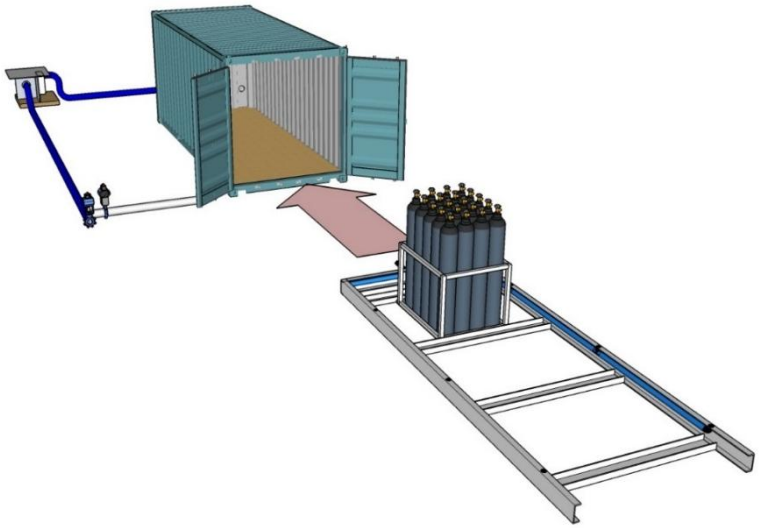
HySEA experiments

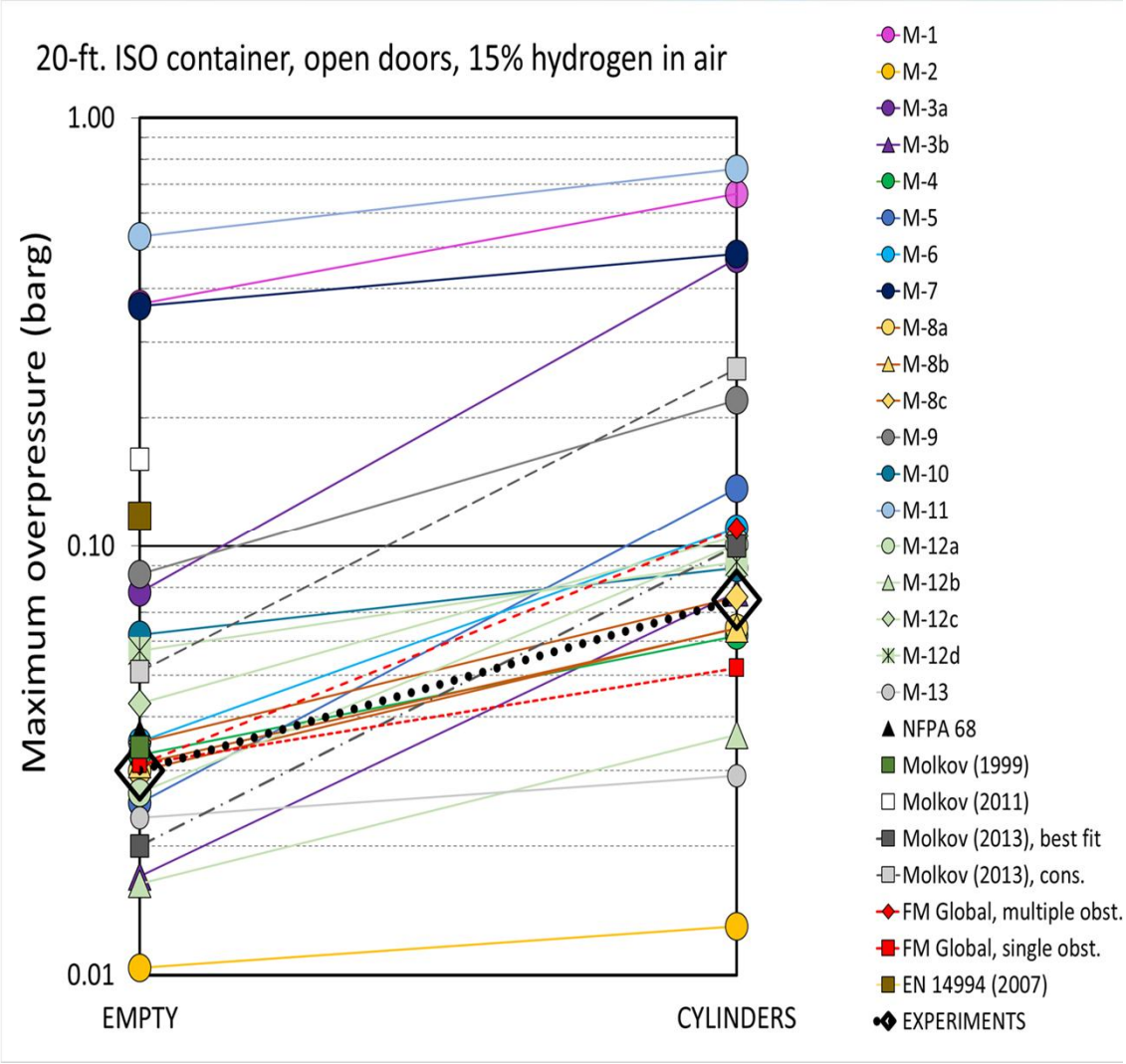
- Phase 1 (2016): experiments in 20 ft. ISO containers (Gexcon)
- Various obstacles and obstacle configurations
- Venting through door or commercial vent panels on the roof
- Phase 2 (2017): non-homogeneous gas clouds in 20 ft. containers



First blind-prediction study

- Hydrogen explosions with or without bottle basket
- 15 % hydrogen in air
- Demonstration Thursday 8 September 2016
- Workshop Friday 9 September 2016





Structural response

Doors open

vs.

Doors closed

Both test performed with 24 % H_2 in air, homogeneous mixtures, and end ignition.

www.hysea.eu

Summary

- Hydrogen can be implemented safely, HOWEVER:
- It is essential to consider safety in early design.
- Safety must be an inherent part of the design.
- Do NOT trust existing standards or guidelines!
  - Verify application range for empirical correlations!
  - Compare predictions with relevant experiments!
  - Consult updated experts on hydrogen safety!
  - Compliance is not necessarily safety!
  - Manage risk!

Acknowledgements

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Thank You!

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