WP6 – Implementation: Exploitation and Dissemination

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Online project meeting, 30th March 2020

Pre-normative REsearch for Safe use of Liquid HYdrogen

WP6 structure

- Task 6.1 Handbook of Hydrogen Safety: chapter on LH2 safety (**HySafe**; All; M1-34)
- Task 6.2 Guidelines for a safer design and operation of LH2 infrastructure (**AL**; All; M7-36)
- Task 6.3 Recommendations for RCS (**AL**; All; M19-36)
- Task 6.4 Engineering correlations and tools (**UU**; All; M7-36)
- Task 6.5 White paper on the use of LH2 (**KIT**; All; M18-36)
- Task 6.6 Dissemination conference (**UU**; All; M6-36)

Deliverables and Milestones

WP6 Implementation: Exploitation and Dissemination.

D/MS	Title	Task	Lead	Due
D6.6	Plan for the dissemination, communication and exploitation	6.6	UU	M6
MS25	ToC of Handbook of Hydrogen Safety: chapter on LH2 safety	6.1	UU	M12
MS26	ToC of Guidelines for safe design and operation of LH2 infrastructure	6.2	UU	M14
MS27	ToC of White paper	6.5	UU	M18
D6.7	Plan for the dissemination, communication and exploitation-1st update	6.6	UU	M18
MS28	Brochure and preliminary programme of the dissemination conference	6.6	UU	M22
MS29	Detailed description of novel engineering tools for LH2 Version 1	6.4	UU	M24
MS30	Discussion draft of recommendations for RCS	6.3	UU	M28
D6.1	Handbook of Hydrogen Safety: chapter on LH2 safety	6.1	HySafe	M34
D6.2	Guidelines for safe design and operation of LH2 infrastructures	6.2	AL	M35
D6.3	Recommendations for RCS	6.3	AL	M35
D6.4	White Paper	6.5	KIT	M35
D6.5	Detailed description of novel engineering tools for LH2 safety	6.4	UU	M35
D6.8	Plan for the dissemination, communication and exploitation-2nd update	6.6	UU	M36
D6.9	Report on the communication activities carried out to the general public	6.6	UU	M36

Preparation of MS28 was postponed until decision on project extension

Chapter on LH2 in Handbook…

Task: 6.1 (M1-34) Lead: HySafe Partners: All

Gathering of information on up-to-date knowledge, gaps and progress on LH2 and cryo-compressed H2 in a publishable report:

- Internal collaboration: PRESLHY partners. Alignment to the review of the state-of-the-art, strategies produced in WP2 and new knowledge generated in WP3-5.
- External collaboration: HySafe experts.

MS25 ToC of Handbook of Hydrogen Safety: chapter on LH2 safety, **M12** (HySafe, UU)

D6.1 Handbook of Hydrogen Safety: chapter on LH2 safety, M34 (HySafe)

Deliverable: ToC and plan proposal

Contributors for the sub-chapters for final delivery (1/2)

Table of contents	1st draft compilation based on current BRHS contents: Lead (delivery month)	2nd compilation to update draft with PRESLHY outcomes: Leader of the chapter in bold, contributors in italic (delivery month)	Review (month 33)
1. Properties	HySafe (M28)	HySafe (M32)	HSL
2. Applications and safety issues	HySafe (M28)	AL (M32)	
2.1 Production			
2.2 Storage			
2.3 Transportation			
2.4 Industrial and research applications			
3. Behaviour	UU (M29)	NCSRD (M32)	
3.1 Release and dispersion	UU (M28)	NCSRD (M32)	
3.1.1 Cryogenic release modes		NCSRD (M32)	
3.1.1.1 Single-phase releases		UU (M32)	
3.1.1.2 Multi-phase releases		NCSRD (M32)	
3.1.1.3 Blowdown of a storage system		UU (M32)	
3.1.2 Liquid pool spreading/vaporization		KIT/PS (M32)	
3.1.3 Dispersion of cold vapour cloud		NCSRD (M32)	
3.1.3.1 The similarity law for cryogenic jets		UU (M28)	

Deliverable: ToC and plan proposal

Contributors for the sub-chapters for final delivery (2/2)

Table of contents	1st draft compilation based on current BRHS contents: Lead (delivery month)	2nd compilation to update draft with PRESLHY outcomes: Leader of the chapter in bold, contributors in italic (delivery month)	Review (month 33)
3.2 Ignition	UU (M29)	KIT (M32)	HSL
3.2.1 Ignition of hydrogen-air cold mixtures		UU (M30), INERIS (M32)	
3.2.2 Ignition of liquid pool		KIT (M32), PS (M32)	
3.3 Combustion	HySafe (M29)	HySafe (M32)	
3.3.1 Cryogenic jet fires		UU (M32)	
3.3.1.1 Thermal loads		UU (M30), KIT (M32)	
3.3.1.2 Pressure loads from delayed ignition		UU (M32)	
3.3.2 Liquid pool burning		KIT (M32)	
3.3.3 Deflagration of cold hydrogen-air mixtures		UWAR (M32)	
3.3.4 Detonation of cold hydrogen-air mixtures		KIT (M32)	
4. Safety measures and engineering solutions	HySafe (M30)	AL (M32)	
5. Case studies and accident statistics (if available)	HySafe (M30)	HySafe (M32)	
6. Regulations, Codes and Standards	HySafe (M30)	HySafe (M32)	

Guidelines for a safe design…

Task: 6.2 (M7-36) Lead: AL Partners: All

Performed actions:

- ToC for guidelines
- Literature study on Properties GH2/LH2 and Hazard identification and risk assessment: done
- Literature study on policies and available experience, on facility design: on-going

MS26 ToC of Guidelines for safe design and operation of LH2 infrastructure, **M14** (AL, UU)

D6.2 Guidelines for safe design and operation of LH2 infrastructures, M35 (AL)

ToC Guidelines

1. Introduction
2. Description of Work
3. Terms and definitions
4. Physical properties of GH2/LH2
    a. Gaseous hydrogen
    b. Liquid hydrogen
    c. Hazards associated with GH2
    d. Hazards associated with LH2
5. General requirements - Policies and available experience
    a. Normative and regulatory references
    b. General design
    c. Site layout
        i. Hazard distances
        ii. Traffic management
        iii. Security
        iv. Coactivity management
    d. Environmental considerations
6. Facility design
    a. Storage
    b. Fuel supply
    c. Pumping
    d. Vaporizer
    e. Buffers
    f. Tubings and fittings
    g. Dispenser
    h. Evacuation routes
    i. Electrical systems
    j. Ventilation and vent design
    k. Monitoring and detection
    l. Fire management and suppression systems
    m. Emergency shutdown device systems
    n. Defuelling design
7. Commissioning, operations and maintenance:
    a. Commissioning
    b. Calibration of safety related devices
    c. Preventive maintenance plan
    d. Testing and inspection
    e. Operations
8. Hazard identification and risk assessment
    a. Hazards
    b. Risk
    c. Risk reduction measures
        i. Frequency
        ii. Consequence
9. Safety management
    a. Procedures
        i. Training for maintenance
        ii. Calibration, testing, and inspection person
    b. Job plans and safety analysis
    c. Work permitting and trainings
    d. Non-conformance and incident reporting
    e. Corrective and preventive actions based on self-audits and lessons learned
    f. Management of change procedures
    g. Personal protective equipment
    h. Integrated management system
10. Emergency response plan
    a. Procedures
    b. Contact list
    c. Crisis communication and management
    d. Personnel training
    e. Integrated management system

References

Appendices

Guidelines for a safe design…

Task: 6.2 (M7-36) Lead: AL Partners: All

Timeline:

- Integration in Guidelines: Properties (M18), Hazards and Risks (M24)
- Commissioning (M30): expected on time
- Safety management (M30): expected on time
- Emergency response plan (M30): expected on time
- Appendix 1 to 5: To be provided by partners by M30 for review and integration in the document.

Up to date: 30% done.

Guidelines for a safe design…

Appendixes (1/2)

Appendix 1. Harm criteria (UU, M30)

Appendix 2. Engineering tools for liquid and cryogenic hydrogen releases

2.1. Determination of a cryogenic gaseous release rate (PS, M32)

2.2. Determination of a multiphase release rate (NCSRD, M32)

2.3. The similarity law for concentration decay in momentum jets (UU, M30)

2.4. LH_2 vaporization and pool formation for releases at elevated height (HSL, M32)

2.5. Evaluation of LH_2 pools spreading rate (INERIS, M32)

2.6. Evaluation of LH_2 pools evaporation rate (PS, M32)

Appendix 3. Engineering tools for ignition of cold hydrogen-air mixture

3.1. Assessment of Ignition Energy for hydrogen-air mixtures (UU, INERIS, M30)

3.2. Assessment of electrostatic charge generated in cold hydrogen releases (KIT, M32)

3.3. Assessment of charge density of an LH_2 flow (HSL, M32)

Guidelines for a safe design…

Appendixes (2/2)

Appendix 4: Engineering tools for liquid and cryogenic hydrogen fires

4.1. Determination of thermal load from cryogenic jet fires (UU, KIT, M33)

4.2. Determination of pressure load from delayed ignition of turbulent jets (UU, KIT, M33)

4.3. Determination of pressure load from ignition of an LH_2 pool (KIT, M33)

Appendix 5. Engineering tools for deflagration and DDT in cold hydrogen-air mixtures

5.1. Flame acceleration and detonation transition for cryogenic hydrogen-air mixtures (KIT, M33)

5.2. Pressure load from LH_2 combustion in congested/semi-confined spaces (HSL, M33)

Recommendations for RCS

Task: 6.3 (M19-36) Lead: AL Partners: All

Performed actions:

- On-going literature study of existing RCS

MS30 Discussion draft of recommendations for RCS, M28 (UU)

- Proposed date (no project extension): April 2020
- Proposed date (yes project extension): June-July 2020

-> AL will call for a meeting with relevant participants

D6.3 Recommendations for RCS, M35 (AL)

Engineering correlations…

Task 6.4 (M7-36) Lead: UU Partners: All

Correlations developed in WP3-5 will be brought into a unified format suitable for implementation into integrated platforms for hazards and risk assessment.

- ✓ **UU:** Development of detailed unified template for description of correlations and tools developed in WP3-5.
- **ALL:** Detailed description of correlations and tools developed in WP3-5 according to the unified template (on quarterly basis as a tool is available).
- **ALL:** Inclusion of developed tools into safety engineering design, education and training platforms.

MS29 Detailed description of novel engineering tools for LH2, Version 1, M24 (UU)

D6.5 Detailed description of novel engineering tools for LH2 safety, M35 (UU)

Detailed description of novel…

Milestone 29 M24 Lead: UU Partners: All

Full title: Detailed description of novel engineering tools for LH2, Version 1.

Table of Contents

1. Introduction and scope

The objectives of the deliverable are the following:

- Present the engineering correlations and tools developed and validated within PRESLHY. Such engineering correlations will be fed into recommendations for RCS.
- Describe the engineering correlations according to a unified template for implementation into existing and/or future platforms for hazards and risks assessment, e.g. Net-Tools.

2. Phenomena

- Release and mixing.
- Ignition.
- Combustion.

3. List of engineering correlations

The list includes **21 engineering correlations and tools**. They are distributed as follow within the technical WPs:

- WP3. Release and mixing: **8** engineering tools.
- WP4. Ignition: **5** engineering tools.
- WP5. combustion: **8** engineering tools.

The current draft of deliverable 6.5 includes description of **4** engineering correlations and tools:

- The similarity law for concentration decay in momentum jets (UU)
- Two-phase steady state choked flow with pipe effects (NCSRD)
- Method for calculating the final state when mixing LH2 and moist air (HSE)
- Hazard distances for jet fires (UU)

WP3 - Release and Mixing

N.	Correlation title	Leading partner	Timeline (M): 1st-final draft
1	The similarity law for concentration decay in momentum jets	UU	18-22
2	Storage tank blowdown model	UU	26-32
3	Two-phase steady state choked flow with pipe effects	NCSRD	18-24
4	Spreading rate of cryogenic pools	INERIS	18-22
5	Release rate of small-scale jets	PS	18-24
6	Concentration decay in small-scale jets	PS	18-24
7	Evaporation rate of LH2 pools	PS	26-32
8	LH2 vaporization and pool formation for releases at elevated height	HSL	26-32

WP4 – Ignition

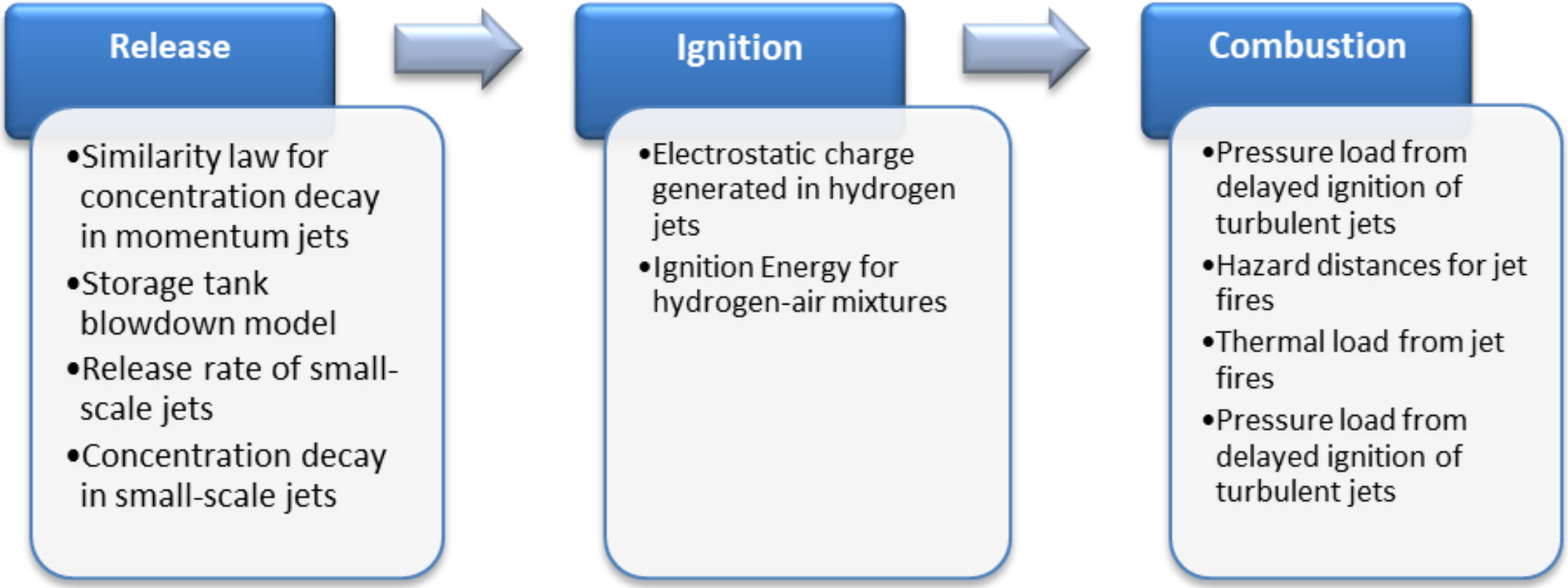
N.	Correlation title	Leading partner	Timeline (M): 1st-final draft
1	Ignition Energy for hydrogen-air mixtures	UU, INERIS	20-24
2	Laminar burning velocity and expansion ratios for hydrogen-air mixtures	INERIS	18-24
3	Electrostatic charge generated in hydrogen jets	KIT	26-32
4	Charge density of an LH2 flow	HSL	26-32
5	Pressure load from ignition of an LH2 spill	KIT	26-32

WP5 – Combustion

N.	Correlation title	Leading partner	Timeline (M): 1st-final draft
1	Pressure load from delayed ignition of turbulent jets	UU	26-32
2	Hazard distances for jet fires	UU	18-22
3	Thermal load from jet fires	UU	18-22
4	Pressure load from delayed ignition of turbulent jets	KIT	26-32
5	Thermal radiation from jet fires	KIT	26-32
6	Flame acceleration and detonation transition for cryogenic hydrogen-air mixtures	KIT	26-32
7	Pressure load from LH2 combustion in congested/semi-confined spaces	HSL	26-32
8	Fireball scale correlations for late ignition sudden hydrogen releases (including BLEVE)	KIT	26-32

3.1 Synergies and interconnections

The engineering correlations developed within work-packages 3, 4 and 5 are interconnected and they may be used in synergy to provide a full spectrum of the expected hazards and consequences from an initiating event.



3.2 Description

A unified template to describe the correlations was prepared in the early stage of the project. The unified template is available in Appendix 1 and is designed in 10 sections, which include but is not limited to:

- Brief scientific summary;
- Validity range specifying the experimental data where relevant;
- A short user's manual which describes the input/output parameters and the detailed algorithm description for implementation in a software;
- Reference and/or link to publication.

White paper

Task: 6.5 (M18-36) Lead: KIT Partners: All

The White Paper will include:

- Discussion on general economics and safety of LH2.
- Comparison of hazards and risks of LH2 systems against gaseous H2 systems.
- Contribution of external experts.

MS27 ToC of White paper, M18 (UU)

D6.4 White Paper, M35 (KIT)

White paper ToC

1. Introduction (**KIT**, M22)
2. The growing hydrogen demand (**KIT**, M24)
3. The LH_2 solution for large-scale storage of hydrogen (**KIT**, *AL, HySAFE*, M28)
    - 3.1. Production of LH_2
    - 3.2. Transport of LH_2
    - 3.3. LH_2 refuelling stations
        - 3.3.1. Layout of a refuelling station
        - 3.3.2. Safety systems
4. Safety aspects and benefits (**KIT**, *UU, NCSRD, UWAR, PS, INERIS*, M30)
5. Economical aspects and benefits (**KIT**, *HySAFE*, M31)
6. Policy and regulatory implications (**KIT**, *HSE*, M33)
7. Conclusions (**KIT**, M33)

Dissemination conference

Task: 6.6 (M6-36) Lead: UU Partners: All

Organise the dissemination conference at the end of the project to present the detailed PRESLHY outcomes to the H2 safety community:

Option	Event	Venue	Date
1	Dissemination Event with SH2IFT	Brussels, Belgium	7 December 2020
2	Dissemination Event with SH2IFT	T.B.C.	May 2020

- Budget: Euro 10k from HySafe
- Venue: JU facilities, Brussels, Belgium
- KIT and UU to contact PO and JU facilities for agreement on date, venue and cost to adapt the budget

MS28 Brochure and preliminary programme of the dissemination conference M22 (UU) → postponed until decision on project extension

Newsletter

A periodic newsletter is prepared and released by PRESLHY consortium to raise awareness of the project progress and outcomes among relevant target groups and stakeholders.

N.	Month	Leading partner	Distributed
1	18	UU	Yes
2	*20*	*UU*	*Yes*
3	24	KIT	Yes
4	30	KIT	-
5	36	UU	-

Italic: special issue

Newsletters are available at

https://preslhy.eu/resources/

PRESLHY

HSL successfully completed the experimental series on dispersion of LH2 releases

A series of 25 large scale LH2 releases from elevated positions were carried out through ¼", ½" and 1" nozzles with an indicated tanker pressure of 1 or 5 barg and release heights of 0.5 or 1.5 m.
Pipework temperature, pressure and mass flow measurements enabled a characterization of the release and downstream temperature and concentration sensors enabled the analysis of the subsequent dispersion. Near and far field video was captured so an assessment of rainout can also be made across the range of release scenarios. The data and results for the experiments are currently under analysis and will become available on the project Open Data repository.

HSL experiments on dispersion and rainout of large scale LH2 releases

Electrostatic charge in multiphase hydrogen releases

HSL completed a series of 7 experimental tests on the flow of multiphase LH2 releases in electrically isolated steel pipework. Wall current was measured in the isolated pipework and field strength was measured in the dispersing plume. The results showed the possibility of generation of a current in the isolated pipe. Occasional charge spikes were observed in the dispersing plume. It is considered they may have been caused by ice breaking off the nozzle or ejection of the air not yet purged from the pipe.
Two tests were conducted on the rapid phase transition (RPT) for LH2 pools. Sprinkler systems were not seen to lead to RPT, whereas a fire hose deluge increased rapidly the LH2 pool evaporation rate even if not leading to an energetic event.

Electrostatic plume measurements for a 1/4" and 1 bar LH2 release

Best wishes for a Happy New Year from PRESLHY consortium! 2020

Forthcoming events

⇒ CEN/CENELEC TC 6 plenary meeting, Brussels, Belgium (January 2020)
⇒ PRESLHY 5th project meeting and workshop, Athens, Greece (April 2020)

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement No 779613.

FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

To find more information about our research activities, please visit: www.preslhy.eu
Next edition newsletter: Issue 4, June 2020

Newsletter Plan

N.	Month	Date	Suggested lead	Draft of contents
4	30	June 2020	KIT	1. Project progress (contributor: KIT) 1.1. Project meetings and workshop 1.2. Progress on PNR activities (ISO TC 197, etc.) 2. Research findings (All) 2.1. Experimental campaign update 2.2. Theoretical and computational studies 3. Forthcoming events (UU) 3.1. 6th project meeting and workshop 3.2. Advertisement of dissemination conference
5	36	December 2020	UU	1. Project progress (KIT) 1.1. Project meetings: 5th project meeting and workshop 1.2. Progress on PNR activities (ISO TC 197, etc.) 2. Summary of research findings: 2.1. Experimental campaign (KIT, INERIS, HSE, PS) 2.2. Theoretical and computational studies (contributors: All) 3. Conclusions from PRESLHY dissemination conference (UU) 4. Update and advertisement of the project products (UU, AL, KIT, HySAFE)

Workshops

List of workshops for internal and external information exchange

Date (Project Month)	Meetings / Venue	Host / Organiser	Workshop Topic	Completed
4	Kick-off Meeting (1st Project Meeting) Karlsruhe, Germany	KIT	Optical Measurement and Electrostatics	✓ (~25)
9	Initial Workshop Buxton, UK	HSL	Research Priorities Workshop on LH2	✓ (~40)
10	2nd Project Meeting Paris, France	Air Liquide	Cryo-Techniques	✓ (18)
15	3rd Project Meeting Bergen, Norway	GexCon	P,T, flow measurement	✓ (21)
23	4th Project Meeting, Buxton, UK	HSL	Tools for experiments	✓
26	5th Project Meeting Athens, Greece	NCSRD	Numerical Tools, CFD and Risk Assessment	
33	Dissemination Workshop Brussels, Belgium	HYSAFE	Dissemination Workshop	
35	Final Project Meeting Belfast, UK	UU	International Standardisation	

Performed dissemination activities

List of main disseminating international conferences, meetings and events

Event	Date, Venue	Activity
IA HySafe RPW 2018	September 2018, Buxton, UK	Presentation of PRESLHY scope and PIRT activity
IEA HIA Task 37 Hydrogen Safety	18 October 2018, Paris, France	Presentation of PRESLHY project
Review Days	16-17 November 2018, Brussels, Belgium	PRESLHY was listed as a key pre-normative research project
LH2 safety workshop	6 March 2019, Bergen, Norway	Presentation of PRESLHY research activities
ISFEH 9	22-26 April 2019, St Petersburg, Russia	Paper submitted on cryogenic jet fires by UU and poster by UWAR
ICHS 2019	24-26 September 2019, Adelaide, Australia	PRESLHY project and associated papers presentation
LH2 workshop	27 September 2019, Perth, Australia	PRESLHY project presentation
FCH JU Review Days	19-20 November 2019, Brussels, Belgium	PRESLHY project presentation
H2FC Supergen Conference 2020	17-18 February, Nottingham, UK	Poster on UWAR research performed within PRESLHY
ISHPMIE	27-31 July 2020, Braunschweig, Germany	Paper submitted by INERIS on research performed in PRESLHY

Planned dissemination activities

List of main disseminating international conferences, meetings and events

Event	Date, Venue	Activity
NFPA 2 Hydrogen Storage Task Group meeting	14 April 2020 Online meeting	PRESLHY project presentation
WHEC 2020	Postponed to 2022 Istanbul, Turkey	Possibility to submit paper to IJHE
ISHPMIE	27-31 July 2020 Braunschweig, Germany	Presentation of INERIS research performed within PRESLHY
RPW2020 + LH2 Safety Workshop (t.b.c.)	22-23 October 2020 Copenhagen, Denmark	PRESLHY project outcomes presentation
EHEC 2020	4-6 November 2020 Madrid, Spain	PRESLHY project outcomes presentation
Dissemination Event with SH2IFT	7 December 2020 Brussels, Belgium	PRESLHY project outcomes presentation
Program Review & Stakeholder meeting	8-10 December 2020 Brussels, Belgium	PRESLHY project outcomes presentation

Dissemination at SDOs meetings

Event	Date, Venue	Activity	Done
ISO/TC 197 Hydrogen technologies Plenary Meeting	6 December 2018, Vancouver	Presentation of PRESLHY project and set up of new PWI	✓
ISO/TC 197 Hydrogen technologies Plenary Meeting	12 December 2019, Grenoble, France	PRESLHY project reporting	✓
CEN/CENELEC SFEM WG Hydrogen Meeting	28 January 2020, Brussels, Belgium	PRESLHY project presentation	✓
ISO/TC 197 Hydrogen technologies Plenary Meeting	10-11 December 2020, Seoul, South Korea	PRESLHY project reporting	

ISO/TC 197

- PRESLHY project meeting was presented at the plenary meeting of the ISO TC 197 in Vancouver (6-7 December 2018) by the PRESLHY coordinator Dr Thomas Jordan.
- The project presentation was associated with the proposal for a Preliminary Working Item (PWI) titled “Safe Use of Liquid Hydrogen in Non-industrial Settings”.
- The PWI proposal received unanimous support by the committee.
- Dr Thomas Jordan has been nominated as “project manager” of the PWI. PRESLHY shall regularly report on progress of the pre-normative research.
- Results and conclusions from PRESLHY project with an adequate support by industry may lead to the development of a plan for revising ISO/TR 15916:2015.

Scientific publications

- Cirrone, D., Makarov, D., Molkov, V. *Thermal radiation from cryogenic hydrogen jet fires.* International Journal of Hydrogen Energy 44.17 (2019): 8874-8885.
- Cirrone, D., Makarov, D., Molkov., V. *Thermal dose from cryogenic hydrogen jet fires*. International Seminar on Fire and Explosion Hazards, 21th-26th April 2019, Saint-Petersburg, Russia.
- Cirrone D., Makarov D., Molkov, V. *Cryogenic hydrogen jets: calculation of hazard distances.* International Conference on Hydrogen Safety, 24th-26th September 2019, Adelaide, Australia.
- Giannissi S.G., Venetsanos A.G. and Hecht E.S., *Numerical predictions of cryogenic hydrogen vertical jets*, 8th International Conference on Hydrogen Safety, Adelaide, Australia, 24-26 Sept. 2019. Submitted to the International Journal of Hydrogen Energy, under review, 2020.
- Giannissi S.G., Venetsanos A.G. and Hecht E.S., *Numerical predictions of cryogenic hydrogen vertical jets*, submitted to the International Journal of Hydrogen Energy, under review, 2020.

Scientific publications

- Jordan T., Bernard L., Jallais S., Venetsanos A., Coldrick S., Cirrone D. *Status of the pre-normative research project PRESLHY for the safe use of LH2,* 8th International Conference on Hydrogen Safety, Adelaide, Australia, 24-26 Sept. 2019.
- Proust C., *A new technique to produce well controlled electrical sparks. Application to MIE measurements*, 13th International Symposium on Hazards, Prevention and Mitigation of Industrial Explosions, Braunschweig, Germany, 27-31 July 2020.
- Venetsanos A.G., Giannissi S., Proust C*., CFD Validation against large scale liquefied helium release*, 8th International Conference on Hydrogen Safety, Adelaide, Australia, 24-26 Sept. 2019.
- Venetsanos A.G., *Choked two-phase flow with account of discharge line effects*, 8th International Conference on Hydrogen Safety, Adelaide, Australia, 24-26 Sept. 2019.
- Venetsanos, Alexandros G. *Homogeneous non-equilibrium two-phase choked flow modeling.* International Journal of Hydrogen Energy 43.50 (2018): 22715-22726.

Project extension: proposed plan

D/MS	Title	Task	Lead	Due date	Proposed date
MS28	Brochure and preliminary programme of the dissemination conference	6.6	UU	M22	M28
MS30	Discussion draft of recommendations for RCS	6.3	UU	M28	M28
D6.1	Handbook of Hydrogen Safety: chapter on LH2 safety	6.1	HySafe	M34	M39
D6.2	Guidelines for safe design and operation of LH2 infrastructures	6.2	AL	M35	M40
D6.3	Recommendations for RCS	6.3	AL	M35	M40
D6.4	White Paper	6.5	KIT	M35	M35
D6.5	Detailed description of novel engineering tools for LH2 safety	6.4	UU	M35	M40
D6.8	Plan for the dissemination, communication and exploitation-2nd update	6.6	UU	M36	M36
D6.9	Report on the communication activities carried out to the general public	6.6	UU	M36	M41

Acknowledgements

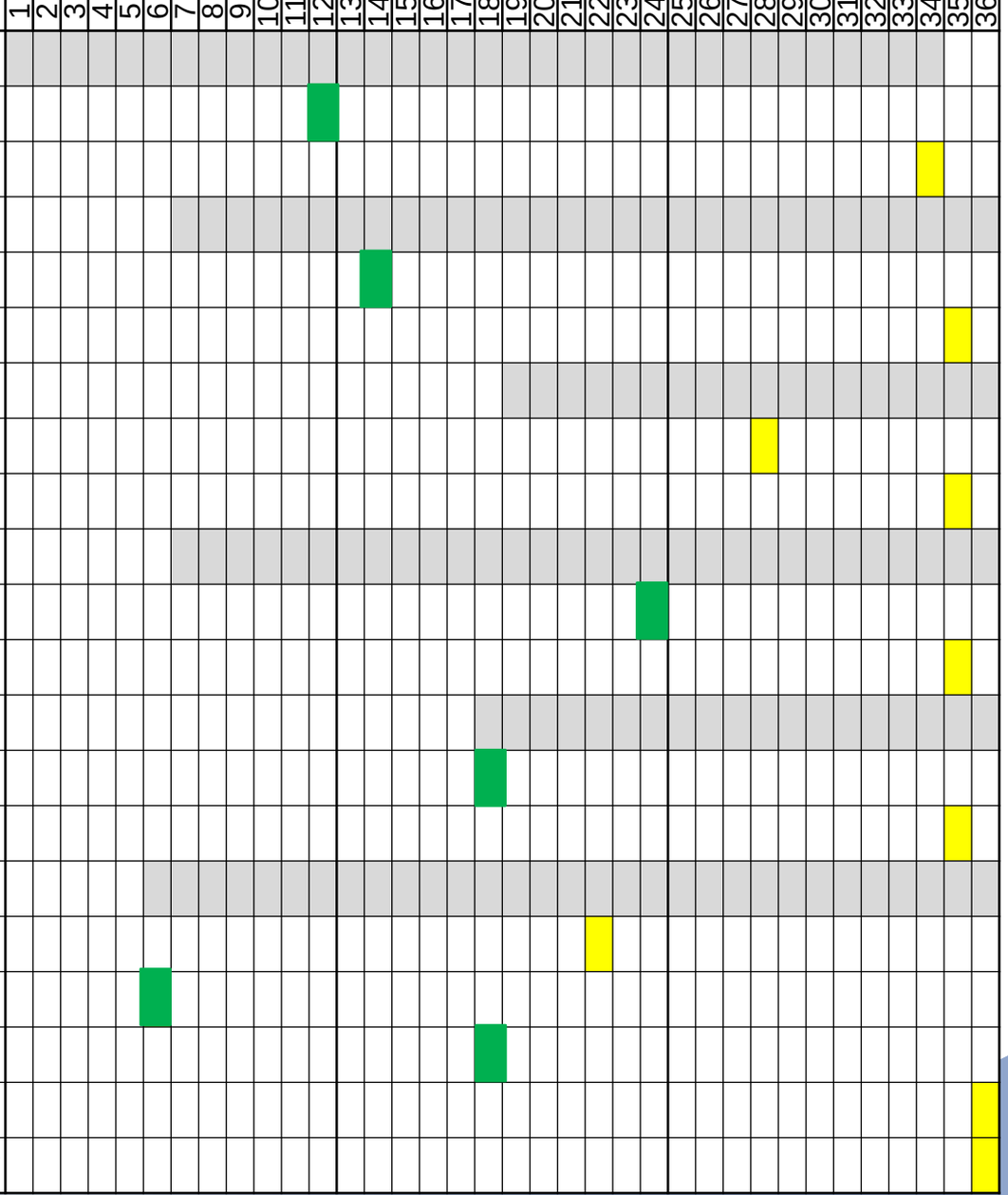
All scientific conference contributions, papers for peer-reviewed journals and documents resulting from the project must report the acknowledgement as stated in the Grant Agreement (Page 47, Article 29 Dissemination of the results):

“This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under the European Union’s Horizon 2020 research and innovation programme under grant agreement No 779613”.

Time plan and responsibility

WP6 Implementation: Exploitation and Dissemination. Leader: UU (6). KIT(3) AL (4) HSL (0.5) HYSAFE (2) INERIS (0.5) NCSRD (1) PS (0.5) UWAR (0.5)

Deliverables (D) and Milestones (MS)		Resp
Task 6.1 Handbook of Hydrogen Safety: chapter on LH2 safety		HYSAFE
MS 25	ToC of Handbook of Hydrogen Safety: chapter on LH2 safety	UU
D6.1	Handbook of Hydrogen Safety: chapter on LH2 safety	HYSAFE
Task 6.2 Guidelines for safe design and operation of LH2 infrastructure		AL
MS 26	ToC of Guidelines for safe design and operation of LH2 infrastructure	UU
D6.2	Guidelines for safe design and operation of LH2 infrastructure	AL
Task 6.3 Recommendations for RCS		AL
MS 30	Discussion draft of recommendations for RCS	UU
D6.3	Recommendations for RCS	AL
Task 6.4 Engineering correlations and tools		UU
MS 29	Detailed description of novel engineering tools for LH2 Version 1	UU
D6.5	Detailed description of novel engineering tools for LH2 safety	UU
Task 6.5 White Paper on the use of LH2		KIT
MS 27	ToC of White paper	UU
D6.4	White Paper	KIT
Task 6.6 Dissemination Conference		UU
MS 28	Brochure and preliminary programme of the dissemination conference	UU
D6.6	Plan for the dissemination, communication and exploitation	UU
D6.7	Plan for the dissemination, communication and exploitation-1st update	UU
D6.8	Plan for the dissemination, communication and exploitation-2nd update	UU
D6.9	Report on the communication activities carried out to the general public	HYSAFE



Thank you for your attention!

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