For CEP and NOW.

3rd JOINT CEP/NOW HEAVY DUTY WORKSHOP, 21.04.2021

# *PRHYDE-Protocol for heavy-duty hydrogen refuelling*

**Call Identifier FCH-04-2-2019: Refuelling Protocols for Medium and Heavy-Duty Vehicles**

**Web: www.PRHYDE.eu**

PRHYDE

*Protocol for heavy-duty Hydrogen refuelling*

Horizon 2020
European Union Funding
for Research & Innovation

FCH
FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

# PRHYDE Main Objective

PRHYDE
Protocol for heavy-duty Hydrogen refuelling

Investigate $CH_2$ refuelling protocol requirements to help facilitate future standardisation of fuelling protocols for medium and heavy duty vehicles.

# Current protocols are not optimal.

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Current existing CH2-protocol for >10kg fuelling: SAE J2601:2020 CHSS-D

SAE INTERNATIONAL

| SURFACE VEHICLE STANDARD | J2601® | MAY2020 |
|---|---|---|
| | Issued 2010-03<br>Revised 2020-05<br>Superseding J2601 DEC2016 | |
| (R) Fueling Protocols for Light Duty Gaseous Hydrogen Surface Vehicles | | |

- Fuelling with and without communications
- Protocol not optimized based on vehicle data
- Maximal conservative assumptions lead to lower performance.
- Prescriptive (table-based) approaches or non-informative

# A new protocol approach

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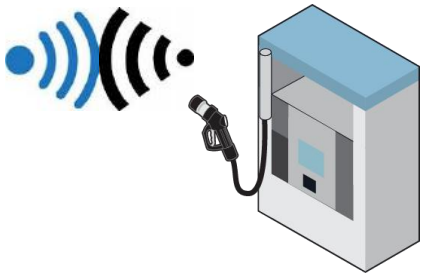
Three pressure classes **H35** **H50** **H70**

Fuelling concepts based on:

| | | | |
|---|---|---|---|
| CHSS info | **No** | **Static** | **Dynamic** |
| Control | **Station** | **Both** | **Vehicle** |
| Description | **Prescriptive** | **Performance based** | |



7 Fuelling Concepts proposed

# Current State

- 7x different Fuelling Concepts proposed + initial analysis
  - 6 of the Fuelling Concepts explore different improvements to the MC Formula framework
  - The 7th Fuelling Concept explores Vehicle-controlled fills
- Performance comparison started
  - We anticipate some Fuelling Concepts are better, but how much? And does it justify the increased requirements on reliability of advanced comms?
- Risk Assessment started
  - Some of the Fuelling Concepts can be shaped to use with current IrDA, but is primarily intended for more advanced communication technology

# Current Conclusions WP3 Protocol development

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- The proposed Fuelling Concepts are all anticipated to improve the performance in comparison to the published standard protocol SAE J2601 Category D.

- At the same time, it is a wish from the PRHYDE partners that the final Fuelling Protocol shall also be adaptable to Station / Vehicle designs that considers cost and performance (e.g. Less/no pre-cooling, Direct Compression Filling, etc.)

# Modelling of the protocol concepts

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WP2 – State-of-the-art & specification

*Iterative process*

WP3 – Protocol development

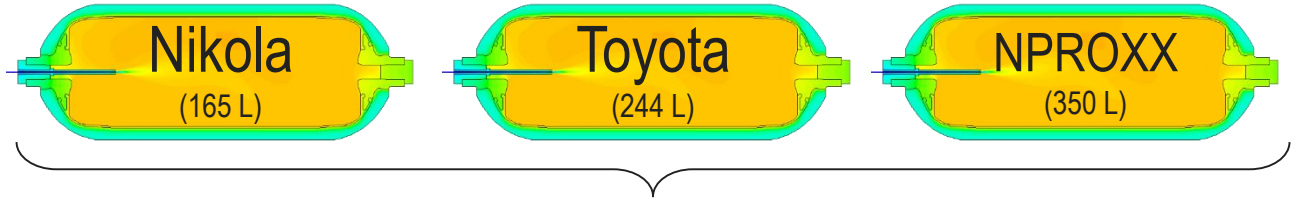
WP4 – Simulations

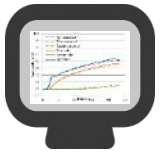
WP5 – Experimental validations

WP6 – Recommendations and dissemination

WP7 – Project coordination

Gather data (stp-files, injection system details, …)



CFD meshing started

Air Liquide

CFD Benchmark OK

ENGIE

SOFIL software protocol simulations on-going.

Article for modelling benchmark is under review.
(AL, Engie, NREL, Wenger)

# Experimental simulations of the protocol

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WP2 – State-of-the-art & specification

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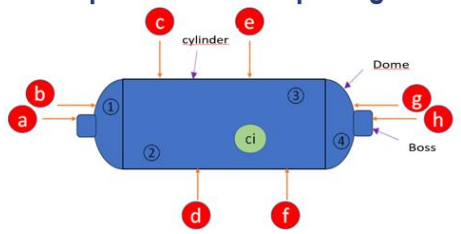
CEA Experimental Set Up: Single Tank




Tanks with instrumentation for experimental tests

ZBT test HRS

TMNA test HRS

Nikola test HRS and HSTA

(Including also NREL facilities)

First test results to be expected mid-May

# Outcome of the PRHYDE project

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- Draft fuelling protocol describing methodologies, state of work, next steps, considerations and gaps which include flow charts.
- It is a proof-of-concept that confirms the control strategy.
- Recommendations for HRS manufacturers and OEMs
  - Fuelling concepts, safety implications, communication

Target date for end of project: 31/12/2021

# Contact

Website: www.PRHYDE.eu

E-Mail: info@PRHYDE.eu

Coordinator:

Ludwig-Bölkow-Systemtechnik GmbH
Daimlerstr. 15
85521 München/Ottobrunn
Web: http://www.lbst.de

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**01 JAN 2020 - 31 DEC 2021**

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